REPORT OF THE SPECIAL JOINT COMMITTEE OF THE FLORIDA LEGISLATURE FOR THE YEAR 1909, ON THE DRAINAGE OF THE EVERGLADES.

To the Hon. F. M. Hudson, President of the Senate, and Hon. Ion L. Farris, Speaker of the House of Representatives, of the State of Florida:

Pursuant to the provisions of house concurrent resolution No. 1, we, your committee, beg to submit the following report:

We assembled at the Green Tree Inn, Miami, Fla., on the morning of May 11, where we were met by a delegation of the hospitable citizens of Miami with an automobile, in which we were transported to the falls or headwaters of the Miami River. They then led the way on foot to an observatory located near the Everglades. From this eminence we were enabled to examine the Glades as far as the eye could reach, as well as the precipitous incline and falls of the Miami River. From this tower we proceeded down the river below the falls to a point where the new steel dredge *Miami* had begun the initial and trial work of cutting through the vein or wall of rock which forms a dam of Lake Okeechobee, and through which the waters of the Miami River have formed the falls. The dredge *Miami* began her task of cutting the Miami Canal, as projected by the engineers, at this point.

It was a part of the contract with the builders of this dredge that she should be subjected to a trial test of 15 days under the supervision of the Trustees before final payment was made. She was at this time undergoing this test, with every prospect of success, and the Tampa Foundry & Machine Co. and the Marion Steam Shovel Co., of Marion, Ohio, are to be congratulated for the work on this dredge.

Here we witnessed two blasts in water and rock which gave evidence of competency and effectiveness, even to the killing of alligators, one of which was floating down the stream after the blast, and was secured and placed on board by the men.

After the examination of the work of this dredge we retraced our steps to the bridge across the Miami River and boarded the automobile, which rapidly conveyed us to the place of Mr. Walter Waldin, a prosperous farmer, formerly of Iowa, where we were shown a fine young grove of orange and grapefruit trees about 5 years old, in bearing. This land is situated on the edge of the Glades and is irrigated by water from the Glades, conveyed by a canal cut by Mr. Waldin, and we here quote his answers to our inquiries:

I have cropped here on this class of land five years, and my average on irrigated Glades land for the first four years has been a trifle over $800 per acre per year net. This year I have been obliged to curtail my crop, as the trees (grapefruit) are beginning to interfere, as they have a considerable spread. I have netted about $500 this year on this land per acre. I think a net of from $300 to $500 can be made per acre on drained Everglades land by intelligent culture and close application to the following crops: Tomatoes, beans, eggplants, cucumbers, Irish potatoes, mango peppers,

and squash. I am also of the opinion that one-half as much as this can be made in many farm crops, such as sugar cane, bananas, etc., and a valuable grove can be made either of oranges or grapefruit in the meantime. You will notice I have left considerable margin between what I have accomplished and what I claim can be done by the average gardener, but as it takes a little study and knowledge to do this I wished to be very conservative in this matter, so as not to mislead anyone.

As to the value of a bearing grapefruit or orange grove in this land I am not able to say conclusively, as the price of these fruits fluctuates considerably; of a few things, however, I can speak intelligently: Such a grove can be grown for practically nothing (by growing any of these crops between the rows to pay expenses); that the fruit will remain longer in juice I am able to say positively, also to state that the quality is of the very best.

As to the value of the land: Analysis gives from 2 to 4 per cent of ammonia. The fact that it can be drained cheaply and irrigated cheaply should make this land the most valuable, especially when the exceptionally favorable climatic conditions are taken into consideration. The matter of transportation will, in addition to this, be an important factor, as this can be and will be accomplished through larger drainage canals.

His hobby seemed to be bananas. Many specimens of fine varieties were shown us growing along the edge of the Everglades.

On the morning of May 12 we left Miami on the launch *Scout* and proceeded through Biscayne Bay and Arch Creek to the canal which is now being constantly used by the Coast Line Canal & Transportation Co.

When we came to New River we ascended same to Fort Lauderdale, where we disembarked and boarded one of the boats used by the Trustees to transport fuel and supplies to the dredges, and were then conveyed to the North River Canal; thence up the same to the first dam, which, owing to the fall of the water, was constructed to keep the dredge afloat while excavating the canal. Here we disembarked and examined a fine orange grove and some very large guava trees. Then we were met by Mr. Savage, one of the civil engineers employed by the Trustees on this work, and then retraced our steps to New River; thence south and up the river to where the second canal is being cut. From New River into the Glades on our way up this canal we disembarked and examined several crops of vegetables being grown on the partly reclaimed Glades lands.

A Mr. Linard, an owner of one of these farms, courteously led us over his land, telling us of his successful work even under adverse circumstances, showing us some fine specimens of Irish potatoes, and assured us that the yield of the crop on the land now about ready for harvesting on a conservative basis would not be less than 90 barrels to the acre, and supported this estimate by an actual shipment and sale over that amount from adjoining lands this year.

Farther westward into the Glades we examined a crop of tomatoes which gave evidence of a fine yield and good quality. Besides this, we saw corn and other vegetables, which left no doubt in our minds that all this land when properly drained would be exceedingly productive and invaluable owing to the fact of its situation, practically below the frost line, and cheap transportation therefrom.

We proceeded on our way to the first dam on this canal, where it became necessary to leave our boat and climb over or around the dam, where we found other boats which transported us to the dredge *Okeechobee*, which we found busily engaged in excavating this canal heading toward the Miami Canal to a point where an intersection is to be made according to plans laid out by the engineers in charge. We boarded the dredge *Okeechobee*, and with much interest we saw the

wonderful and almost intellectual work of this monster dredge, moving about 4½ cubic yards of muck and rock every 40 seconds. From the upper deck of this dredge we examined the Glades for miles in every direction, presenting one unbroken sameness as far as the eye could reach.

On our return to Fort Lauderdale we expected to examine the first canal, but owing to the lateness of the hour, and the fact that the dredge *Everglades* was temporarily stopped for some minor repairs, we did not penetrate this canal farther than the first dam.

The next morning we boarded the *Scout*, and after a few snapshots at a few Seminole Indians, we proceeded up the Coast Line Canal to West Palm Beach and passed through some very fine reclaimed lands under cultivation, where we saw thousands of crates of tomatoes in transit, on the banks, and in packing houses. One of the owners at a point where we made a temporary stop assured us that he had gathered and sold as many as 500 to 1,000 crates of tomatoes per acre, which averaged him $2 net per crate.

From Palm Beach we proceeded by rail to Dayton, for the reason that the greater portion of the water route between these points was composed of bays, rivers, and lagoons, and partly under the control and in the possession of the Federal Government, and here we learned that the Federal Government had authorized Capt. Bie and certain assistants to make a survey of this inland waterway, the particulars of which will be mentioned hereinafter.

Between Fort Lauderdale and Palm Beach we passed many fine truck farms and groves, upon which was growing in rich profusion on the lands reclaimed by the drainage afforded by the Coast Canal fruits and vegetables, which lands were absolutely worthless before this drainage.

On the morning of the 14th instant we again embarked in a launch for St. Augustine, and after passing through the Halifax River we entered the canal connecting it and the Matanzas River. Here we encountered the heaviest and most difficult work of the canal company, a portion of which was cut through solid rock, and there we passed one of the company's suction dredges cleaning out the shoals. Not far from the Matanzas River, near the Matanzas Inlet, we passed the historic Matanzas fort, now fast decaying, which should be repaired and protected as one of our oldest relics.

On Saturday, the 15th instant, we left St. Augustine at 5 o'clock in the morning and proceeded by launch to the head of North River; thence through the canal to where the company was constructing a temporary dam. There we took rowboats to where the dredge *South Carolina*, one of the canal company's dredges, was at work at the head of the completed canal. From this point we proceeded in rowboats and on foot to a point where two land excavators were busily at work tearing up stumps and roots and excavating about 6 feet of soil and sand. This was in the midst of a virgin forest and was very heavy work.

From this point we proceeded by team to Pablo Creek, where we again embarked in a launch up Pablo Creek to where the canal company had another dredge at work headed for the point we left by team and where the land excavators were at work. After a short stay watching the work of this dredge we reversed our course down

the creek by launch to St. Johns River. Near the mouth of Pablo Creek we passed another of the canal company's dredges at work straightening this creek, which will materially shorten the distance to its mouth. Passing this dredge we entered the St. Johns River, and in a short time landed at Mayport, where we took a train for Jacksonville.

The canal company has only about 5 miles of incomplete solid work to do to have an open waterway for small craft from the St. Johns to Key West, and the company assured us this would be completed on or before November 1, 1910.

We secured the following information from a reliable source, which we deem of interest and importance, and which we insert:

UNITED STATES SURVEY OF INLAND WATERWAYS COMMENCED.

The United States steamer *McGuire*, in charge of Capt. O. N. Bie, assistant to Capt. Spalding of the United States Engineer Corps, arrived at St. Augustine some days ago and left the harbor the first of last week for Key West via the inland route. It is, we are told, the intention of the party under the direction of Capt. Bie to make a survey of the canals of the Florida Coast Line Canal & Transportation Co. and of the intervening natural waters with a view of ascertaining the quantity and character of the material which it would be necessary to remove in order to secure a channel which, in the opinion of the Government engineers, will be sufficiently large to accommodate the present and prospective traffic which would naturally seek water transportation.

By a recent act of Congress appropriations have been made for survey of this proposed inland waterway along the Atlantic coast from Boston to Key West, the idea being to estimate and report on the cost of a ship canal from Boston to Beaufort, N. C., and a barge canal from Beaufort to Key West. The dimensions of the canals do not seem to have been definitely fixed by act of Congress, and this question will no doubt be decided by the Corps of Engineers. From Boston the proposed inland route will follow Barnstable (or Cape Cod) Bay to the cape, thence via a canal across Cape Cod to Long Island Sound, and via the Sound and the East River into New York Harbor. From New York the waterway will probably follow the route of the Delaware & Raritan Canal to the Delaware River and via that river past Philadelphia and Wilmington to Delaware City, where it will doubtless enter the Chesapeake & Delaware Canal and follow the line of that canal to Chesapeake Bay, and on through the bay and past the city of Baltimore to Norfolk, Va.; from Norfolk either the route of the Albemarle Canal will be followed or that of the old Dismal Swamp Canal, which was enlarged about 10 years ago, but which has the disadvantage of being a locked waterway, though it could no doubt be easily enough transformed into tide-level canal. After leaving whichever of the above-mentioned canals may be selected the waterway will follow the great North Carolina sounds to Beaufort Inlet, where the survey for the ship canal will terminate, and that for the barge canal will commence. This latter survey means, we understand, the investigation of the character of all classes of material to a depth of 12 feet below mean low-water level, as well as the selection of the most feasible route, though it is left to the

Government engineers to decide the depth necessary to accommodate the traffic on each particular section of this inland waterway. From Beaufort, N. C., to a point a short distance north of Charleston there is practically no natural continuous inside passage now existing, though there are several disconnected lagoons which can be utilized by the Government by joining them by canals and deepening the natural channels where necessary. From Charleston, S. C., however, to the St. Johns River there is a continuous natural inland passage varying in depth, via Port Royal Sound and the various other sounds and creeks along the South Carolina and Georgia coasts to Cumberland Sound, past the cities of Savannah and Brunswick to Fernandina, Fla., and from that city via Nassau Sound and the Sisters Creek to the great St. Johns River near its entrance to the sea, about 25 miles east of Jacksonville.

From the St. Johns River the channel of Pablo Creek, which continues the inside waterway to the south, is now being improved by the Florida Coast Line Canal & Transportation Co. under a permit from the War Department, and a canal is being cut by the same company through a heavily timbered country from a point at the southern end of Pablo Creek to the North Matanzas River, which it enters about 20 miles north of St. Augustine. From St. Augustine south to Biscayne Bay an inside passage has been constructed by the canal company under a charter from the State, and when the above-mentioned canal, extending north toward the St. Johns River, is completed, and Pablo Creek straightened and otherwise improved, the inside waterway along the whole of the east coast of Florida will be navigable from Fernandina and Jacksonville to Key West, as there is a natural protected passage inside the Keys from Biscayne Bay to the latter city.

This great waterway means much more to the people of the east coast counties of Florida than they realize at the present time. The canals so far built have drained vast areas of swamp land, which are now producing vegetables and fruits of various kinds in large quantities, and when the work is fully completed the waterway will serve two useful purposes, as it will not only help the drainage of the territory through which it passes, but it will also provide an inexpensive transportation route and insure the establishment of reasonable freight and passenger rates to and from all points on the coast between Jacksonville and Key West. At the present time the canal company has the right to charge tolls on all vessels using its canals, said tolls to be fixed by the company and approved by the Trustees of the Internal Improvement Fund; but it is hoped that the survey now in progress under Capt. Bie's direction will result in the acquisition of the rights of the canal company by the Government (thus making it free to the public) and the enlargement of the canals and natural inside channels along the whole coast.

If this great work between Boston and Key West is seriously undertaken by the United States, if will provide a marvelous line of defense along the whole Atlantic coast, as light-draft vessels equipped with heavy guns, each vessel being practically a floating (or movable) fort, would have a strong influence in keeping hostile warships well offshore, while patrols of light-draft gunboats would undoubtedly prevent attempts being made in time of war to land large bodies of men on what, without this inside waterway, would be absolutely isolated and undefended sections of the coast line.

During the Spanish War, when the transportation companies of the country were charging the highest rates obtainable from the Government on all war supplies, the services of the Florida Coast Line Canal were called into requisition, and by using the canal the Government saved $6,500 in freight charges alone on the delivery of three mortar carriages at the fort at Key West. The canal company transported these carriages from Titusville to Key West for $2,500, whereas the lowest rate obtainable from Tampa to any other point of delivery in Florida (from rail to water) to Key West amounted to $9,000, showing a saving to the Government of $6,500.

This gives one instance of the value of an inside waterway in time of war, and its effect on the commercial interest of the country in time of peace will no doubt prove equally beneficial.

To the Hon. J. E. Ransdell, president of the National Rivers and Harbors Congress, and Hon. J. Hampton Moore, president of the Atlantic Deeper Waterways Association, is due the credit of securing the appropriations for the surveys above named.

We did not have the time or the means at hand to determine the exact depth or width of the Coast Canal, but from the draft of the launches used, the frequent soundings with poles, we feel justified in the conclusion that in so far as the canal is completed it has been done according to contract, with the exception of certain shoals, which are now being removed by the suction dredges hereinbefore mentioned. That this canal will be of incalculable value to the people of the Nation, which is evident by the saving in freight as above shown to the Government during the Cuban War, we firmly believe and affirm.

We took train at Jacksonville for Fort Myers at 9 o'clock and arrived there about noon on the 16th instant. We secured a launch, in which we were transported up the Caloosahatchee River to Fort Thompson, where we arrived about 9 o'clock at night. Here we had to change to a launch of lighter draft, and after a walk of about a half mile up the rapids or falls we proceeded up the river on the morning of the 17th to Lake Okeechobee, passing through several canals and lakes before reaching Okeechobee, which we did about 4 o'clock of the same evening. After a brief examination of this lake we retraced our course down the canal and through Lake Hicpochee to the dredge *Caloosahatchee*, which is a new steel dredge of powerful capacity and upon which we found comfortable quarters for part of the night, having arrived there between 12 and 1 o'clock at night.

On the morning of the 18th we were invited to a very good breakfast on board of the dredge, and promptly at 6 o'clock the whistle blew and the crew, like trained soldiers, every man at his post, began their work for the day, and it was a most interesting sight to see this monster steel dredge, 42 feet beam by 100 feet long, plow her way through sand, rock, and soil, often breaking in twain the hidden trees, placing them easily on either side of the river, making room for herself and for other craft headed for the Glades and Lake Okeechobee.

After spending one and a half hours watching this wonderful machine, we boarded our boat for Fort Myers and had a most interesting trip down the Caloosahatchee, passing some fine groves of orange and grapefruit trees and some nice homes, churches, and

schoolhouses, also some unique houses and outhouses framed and latticed and then neatly thatched with cabbage palmetto leaves. We spent part of one night at Fort Thompson Park Hotel, the hotel being near the falls. Here we found an enterprising man of wide experience, intelligence, and wealth. He has 8,000 acres of land, a large portion of which is Glades land, which he most positively affirmed $100 per acre would not buy, and from the appearance of his horses and cattle, which are numbered in the hundreds, many of which were high grades, this price did not seem high when compared with many lands not so good at a higher price.

Arriving at Fort Myers we were met by the mayor of the town, who very kindly furnished an automobile and gave the committee an opportunity to see the many advantages of the town and some beautiful residences, among which was the residence of the "electric wizard," Thomas A. Edison, which was surrounded by a grove of mangoes of fine size and in full bearing. After a hurried dinner we boarded the train bound for Tallahassee by way of Jacksonville, where we arrived on the evening of the 19th instant.

To give you definite and authoritative information as to the assets of the State, the work performed, the cost so far of the same, the source from which the money has been derived, the amount of money on hand belonging to this fund and due to it, we append the report rendered the trustees, which we hope will be of interest and value to you.

The following report of John W. Newman, engineer in charge, shows the cost of the drainage operations from April 1, 1907, to February 1, 1909, including the number of cubic yards of rock and earth removed, and the cost per cubic yard:

MARCH 12, 1909.

Gov. A. W. GILCHRIST: Complying with your orders wired me March 9, by Mr. W. M. McIntosh, jr., secretary of the Internal Improvement Fund, I beg to hand you herewith a tabulated statement of the work of each dredge since they began, up to March 1:

Column of "costs" includes all working expenses, repairs and supplies, and are ascertained each month for preceding month, all bills being reported to me for that purpose by the purchasing agent, Mr. R. A. Bryan.

In this statement the costs for February can not be given, as the bills for that month have not yet been reported to me.

Permit me to say that it is not practicable to separate cost of rock digging from dirt digging, both being done together and the rock being very irregular.

Work of dredge "Okeechobee" Apr. 1, 1907, to Feb. 1, 1909.

Year.	Rock.	Earth.	Total.	Cost.	Per cubic yard.	Length.
	Cu. yds.	*Cu. yds.*	*Cu. yds.*		*Cents.*	*Feet.*
Nine months, 1907	170,000	33,434	203,434	$20,398.35	10.1	10,166
All, 1908	200,000	356,431	556,431	28,382.76	5.1	24,231
January, 1909	5,000	100,884	105,884	3,935.63	3.71	5,956
Total	.....	.....	865,749	52,716.74	6.09	40,352
February, 1909	16,133	30,000	46,133	Not stated.	.....	2,259

The figures for February, 1909, are given for information, but are not included in the totals, as cost could not be stated.

Length of South Canal with branch, February 1, 7 miles and 3,392 feet. Average cost per cubic yard, 6.09 cents.

Work of dredge "Everglades" July 4, 1906, to Feb. 1, 1909.

Year.	Rock.	Earth.	Total.	Cost.	Per cubic yard.	Length.
	Cu. yds.	*Cu. yds.*	*Cu. yds.*		*Cents.*	*Feet.*
Six months, 1906	63,000	20,455	83,455	$7,702.89	9.23	3,661
All, 1907	85,829	114,962	300,791	25,599.15	8.51	9,758
All, 1908	12,200	518,780	530,980	25,962.49	4.89	21,934
January, 1909	.....	71,964	71,964	22,493.31	3.46	4,048
Total	.....	.....	987,190	61,761.83	6.25	39,401
February, 1909	.....	40,000	40,000	.....	.....	2,250

Length of North Canal with branch, February 1, 1909, 7 miles 2,441 feet. Average cost per cubic yard, 6.25 cents.

February not included, because I have not yet the costs.

Respectfully,

JOHN W. NEWMAN, *Engineer in Charge.*

The total length of the two canals dug to March 1, 1909, was 15.1 miles, each of the two canals being approximately 7½ miles long. These canals are 60 feet wide by 10 feet deep. The total cost of operating dredges (see Newman's figures) is $114,478.57. The average cost per mile is $7,591.36. The total outlay by Trustees on account of operating dredges, including cost of two new dredges, is $377,642.72. By comparing the cost per cubic yard of the work done by the *Everglades* in January, 1909, in which there was no rock excavated, cost 3.46 cents, with the cost of the work done in 1907, when it was part rock and part dirt, the cost being 8.51 cents per yard, the natural inference is that the remainder of the work will be done more cheaply. It will not, however, be done proportionately more cheaply, because as the canals increase in length the cost of transportation of materials, provisions, fuel, etc., proportionately increases. However, it is safe to say that the average cost of the work will be more cheaply done than heretofore, owing to the fact that there will not be so much rock.

It will be observed that the dredge *Everglades* commenced work July 4, 1906. It is digging a canal on the continuation of the North Fork of New River to Lake Okeechobee. To February 1, 1909, this canal had been cut nearly 7½ miles. It is working with a day force only. During the month of January, where there was no rock, it cut about four-fifths of a mile. From Fort Lauderdale to Lake Okeechobee the distance is estimated to be about 50 miles.

The dredge *Okeechobee* commenced work in April, 1907, It uses both a day and a night force. It has cut somewhat over 7½ miles. It is working in the prolongation of the South Fork of the New River. It is the intention of the Trustees to have this dredge continue its course for about 6 miles in a westward direction, at which point it will turn southwestwardly toward Miami.

Two dredges have recently been completed at Tampa, Fla. One, the *Caloosahatchee,* was towed up the Caloosahatchee River and is now at work cutting its way into Lake Okeechobee. After entering Okeechobee, it is intended to go southward for a few miles, and thence southeastwardly in continuation of the canal being cut toward Miami by the dredge *Okeechobee.*

The other dredge, *Miami,* was towed to Miami and is now at work cutting a canal from the Miami River. It will work northwestward to meet the dredge *Okeechobee* coming toward Miami.

The money to continue the drainage will be derived from the following amounts due the Trustees of the Internal Improvement Fund on account of land sold:

R. J. Bolles:	
Jan. 1, 1910	$50,000.00
Jan. 1, 1911	50,000.00
Jan. 1, 1912	50,000.00
Jan. 1, 1913	50,000.00
Jan. 1, 1914	50,000.00
Jan. 1, 1915	100,000.00
Jan. 1, 1916	100,000.00
Drainage fund under Bolles's contract, $100,000 per annum, due in quarterly payments of $25,000:	
July 1, 1909	25,000.00
Oct. 1, 1909	25,000.00
Jan. 1, 1910	25,000.00
Apr. 1, 1910	25,000.00
July 1, 1910	25,000.00
Oct. 1, 1910	25,000.00
Jan. 1, 1911	25,000.00
Apr. 1, 1911	25,000.00
July 1, 1911	25,000.00
Oct. 1, 1911	25,000.00
Drainage fund under Bolles's contract, $100,000 per annum, due in quarterly payments of $25,000—Contd.	
Jan. 1, 1912	$25,000.00
Apr. 1, 1912	25,000.00
July 1, 1912	25,000.00
Oct. 1, 1912	25,000.00
Jan. 1, 1913	25,000.00
Apr. 1, 1913	25,000.00
July 1, 1913	25,000.00
Oct. 1, 1913	25,000.00
Jan. 1, 1914	25,000.00
Apr. 1, 1914	25,000.00
Davie Realty Co.:	
On or before Nov. 1, 1909	33,333.33
On or before Nov. 1, 1910	33,333.33
R. P. Davie:	
On or before June 1, 1909	18,333.18
S. M. Tatum:	
Oct. 5, 1909	5,000.00
Jan. 5, 1910	6,200.00

In addition to this, it is expected that the drainage board will be successful in the matter of the collection of the drainage tax on the land drained or to be drained in the Everglades, and will prosecute a part of the work of drainage with the money so received.

The Trustees have withdrawn the lands in the Everglades from sale, as the value thereof is constantly being enhanced by the drainage operations, and unless something unforeseen happens the State school fund will be greatly benefited by the proceeds of these lands after the drainage is completed. Not one cent of the money paid by the taxpayers of this State has ever been used in the drainage of the Everglades, and the money so raised can never be used for that purpose unless appropriated by the legislature. No person owning land outside of the Everglades need have the slightest apprehension that any tax will ever be levied or collected on his land or on any of his property for the drainage of the Everglades.

From looking over the report made by John W. Newman, engineer in charge of drainage work, for the year 1907, we find the cost per cubic yard for materials excavated by the dredge *Okeechobee* 10 cents during that year. For the next year, 1908, we notice that the cost was 5 cents per cubic yard for the same dredge, and we observe from the records that for three months of the year 1908 this dredge was cleaning out and removing dams in canals already constructed, for which three months she was not allowed any credit for excavation; therefore the expenses for operating during the three months should be deducted, and if done would leave the amount of actual cost at about 4 cents per cubic yard. During the latter year there was a bonus paid the crew of 1 cent per cubic yard for all material excavated in excess of 20,000 yards per month. For the month of January, 1909, the dredge, under the bonus system, running day and night, excavated 105,804 cubic yards, at a cost of 3.70 cents per cubic yard. The month of February, 1909, after the system was changed, the

excavation amounted for the month to 46,143 yards, and for the next two months succeeding that the yardage amounted to about the same as that of February; and the work of the Everglades, under the same system, shows about the same relative difference in cost during the same period, which demonstrates to this committee the fact that the bonus of 1 cent per cubic yard has proved to be a great incentive to the crews to work. We also notice from the report of the work of the dredges that the work can be advanced far more rapidly when run day and night, and as these dredges are worth approximately $50,000 each, and the four dredges working day and night can be made to do the work of eight dredges run only half of each 24 hours, it is the opinion of the committee that they should be operated day and night, and we do so recommend.

We were fortunate enough to secure a copy of a valuable and pertinent report made by the United States engineers, which is hereto attached:[1]

[United States Department of Agriculture, Office of Experiment Stations.]

Drainage Investigations.

[Extract from a report on the drainage of the Everglades of Florida, by J. O. Wright, supervising drainage engineer, Feb. 25, 1909.]

INTRODUCTION.

At the earnest solicitation of Gov. N. B. Broward and others interested in the reclamation of the Everglades of Florida, the Office of Experiment Stations, United States Department of Agriculture, was authorized to make such a survey and examination as might be deemed necessary for the preparation of a report and plan of drainage. For this purpose a preliminary examination was made in November of 1906 and a field party organized and a survey commenced in December of the same year. The chief of the party was instructed:

1. To determine the topography of the country lying south of township 41, so as to locate proper channels for carrying the overflow of Lake Okeechobee to the sea along the natural and most practical routes.
2. To determine approximately the extent, area, and character of the watershed that drains into Lake Okeechobee, so as to calculate the discharge capacity of the channel or channels necessary to prevent the overflow of the lake.
3. To determine the depth of muck and to locate the rim of the stone which encircles the lake or skirts or crosses the Everglades.
4. To analyze the different kinds of soil found and determine their value for agriculture.
5. To make plans and estimates of cost of a complete system of drainage.

To acquire the above information the field work was continued under great difficulties, owing to the flooded country, until the end of April, 1907. In the following December another party of engineers was placed in the field and continued the work until the 1st of May, 1908, at which time sufficient data had been collected to make a report on the engineering features of the project. In addition to the surveys made by our engineers, all reports of other investigations and examinations made by the Army engineers and private companies and explorers were carefully examined and such

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[1] Permission to submit an abstract of a report by J. O. Wright, supervising drainage engineer, on the Everglades of Florida to the legislature of that State was granted to Gov. Albert W. Gilchrist by Secretary of Agriculture Wilson in the following letter:

Department of Agriculture,
Office of the Secretary,
Washington, March 27, 1909.

Hon. Albert W. Gilchrist,
Governor of Florida, Tallahassee, Fla.

Sir: I have the honor to acknowledge the receipt of your letter of March 11, requesting permission to use an abstract of a report upon the Everglades of Florida, transmitted to you upon March 6 and prepared by the Office of Experiment Stations of this department.

Since this report relates to the conditions which prevail in the lands tributary to Lake Okeechobee, and proposes a plan for the drainage of the Everglades, I see no reason why it should not be submitted to the legislature as a portion of the forthcoming report which will be published by this department in the near future. I take pleasure in granting you this request, trusting that, as a progress report upon the Everglades, it may be of use to the State.

Respectfully,

James Wilson, *Secretary.*

data tabulated as had a bearing upon these investigations. From the vast amount of information gathered this office is now preparing for publication a report covering the entire subject.

At the special request of the parties who are deeply interested in the matter, the following extract from the forthcoming report has been prepared. This extract deals exclusively with the drainage features and shows the plan recommended for draining Lake Okeechobee and the surrounding country, with an estimate of the cost of the work. The full report will be completed at an early date and will give additional information pertaining to this work.

Immediately north of the Everglades lies Lake Okeechobee, the largest fresh-water lake wholly within the United States except Lake Michigan. At mean level it contains an area of 468,860 acres. At high stage its surface is about 22½ feet above tide level and at low stage about 19. The lake is quite shallow, the deepest places not exceeding 22 feet at low water and the average depth being about 12 feet. In the southern portions it contains several islands, some of which are 2 or 3 miles in extent, very low and swampy, and covered with a dense growth of custard apples, scrub oak, myrtle, and in some places a few cypress, all interwoven with a network of vines. The shores of Lake Okeechobee are not well defined except on the east coast, where there is a stretch of 25 miles of sandy beach with well-defined banks. The rest of the coast line is flat and marshy and is covered with a thick growth of vegetation. As the lake rises its waters inundate this flat country and the shore line moves out in places several miles, so that the area of the lake is much larger at high than at low water. Even the bed of the lake on the south and west sides is covered with a growth of aquatic plants that impedes the progress of a boat and makes navigation impossible in some places. The bed of the lake, except in the southern part, is a fine hard sand and presents a comparatively smooth and even surface.

The soundings disclose no deep holes or channels and no rock is found except in the vicinity of Chancy Bay. The lake has no tide, but its surface is easily affected by the wind, and it is not uncommon to find the water at least 1 foot higher on one side than the other, due wholly to the influence of the wind pressure. The water in the lake, when not agitated, is clear and wholesome and is regarded by hunters and fishermen who frequent the lake as extremely healthful. Until within recent years this lake had no well defined outlet to the sea, but during the rainy season its waters rose to an elevation of about 21 feet, when it commenced to overflow its banks from the mouth of Fish Eating Creek on the west around the south side to a point on the east several miles north of Pelican Lake, a distance of probably 70 miles. With such a width of overflow it matters not how hard it might rain, it would be impossible for the lake to reach a higher level than 22.5 feet.

About 1884 a canal 70 feet wide and 6 feet deep was completed from the Caloosahatchee River at Fort Thompson up through Lake Flirt, Bonnet Lake, and Lake Hicpochee, making a direct and well-defined channel into the lake. During the period of high water this channel furnishes a good stage for navigation, but during the dry season, when the surface of the lake is lowered to an elevation of 20 feet or less, there is not enough water in those canals to make a boating stage for anything but small gasoline launches.

Since these canals have been cut and the current of water turned into the Caloosahatchee River, it has overflowed its banks below Fort Thompson, doing great injury to the orange and grapefruit groves that line the banks of this stream on both sides for many miles. In order to lessen or prevent this overflow a fund was raised by the interested parties and a dam constructed across the canal at the west end of Lake Hicpochee. This interfered with the navigation of the stream, and it was blown out by parties who opposed the work. If something is not done to control the flow of water in the Caloosahatchee, it is quite certain that many of the fine groves on the river will be materially damaged or destroyed.

Lying north and west of Lake Okeechobee is a watershed, as shown on the map, seven and one-half times as large as the lake. This drainage area is comparatively level, having a gentle slope from the north toward the south, and discharges all of its run-off into Lake Okeechobee. Its surface is fine sand, or sandy loam, with numerous strips of marsh and muck ponds. About 60 per cent of this watershed is covered with a scattered growth of small pines, with cypress strands or sloughs extending through it at irregular intervals. The remainder of the area is made up of open prairie, covered with wire grass or sedge, and saw palmettos. Throughout the area are numerous lakes, the largest of which are Tohopekaliga, Lake Kissimmee, and Istopoga. During the rainy season, the rainfall not removed by evaporation is poured down from Fish Eating Creek, the Kissimmee River, Taylors Creek, and the numerous sloughs and low depressions on the north into Lake Okeechobee. This lake, not having an adequate outlet, discharges its water over its southern shore into the Everglades, from

which it slowly finds its way to the sea. These, in brief, are the conditions as they exist to-day, and which constitute the drainage problem to be solved.

From an analysis of the existing conditions it is apparent that in order to reclaim the Everglades as a whole it is necessary to control the level of the water in Lake Okeechobee. A narrow strip along the east edge may be reclaimed in pieces by building a substantial embankment on the western border and cutting drainage ditches into the small streams that flow into the Atlantic Ocean, but this plan would not provide for the reclamation of that part of the Everglades adjacent to Lake Okeechobee, which is considered to be the richest and best portion. In order to reclaim this part, it must be protected from the overflow of Okeechobee. So long as this lake receives the drainage from a watershed seven and a half times its own area, it will continue to inundate the Everglades at each recurring high water, unless some plan is devised to control the discharge.

It has been claimed by some explorers that the lake is fed by subterranean streams or large springs, and that its overflow can not be controlled or regulated, but such does not seem to be the fact. A thorough examination at low water failed to disclose any such sources of supply, and if there be any, they are so small that they have no appreciable effect on the level of the lake. The height to which the lake rises depends upon the amount and intensity of the rainfall, and its low stage to the duration of the period in which there is but little or no precipitation.

The rational solution of this drainage problem resolves itself into two parts, and will be considered and discussed under two heads: First, the best means of controlling the water in Lake Okeechobee, so that it will not overflow its banks during the rainy season, and, at the same time, have sufficient water at all times to irrigate the lands if needed, and to maintain a sufficient stage for navigation in the outlet canals throughout the year; second, to provide adequate and proper drainage for the lands, when protected from overflow from the lake. The first part of this improvement is absolutely essential to the completion of the second.

Two plans have been proposed for preventing the overflow of Lake Okeechobee. One is to build a levee from the highland on the west around the south shore to the high bank on the east, and thus impound or hold back the rainfall during the wet season, and the other is to construct one or more canals from Lake Okeechobee to the Atlantic Ocean and the Gulf of Mexico, and discharge sufficient water in this manner to prevent the lake from overflowing its banks.

The first plan proposed is open to many serious objections. Owing to the depth of muck, which ranges from 8 to 14 feet along the margin of the lake on the south side, and the absence of suitable material along the line of proposed levee, with which to build it, such a plan would be very expensive. The muck might be removed by dredges and solid material hauled in from the pine woods, and a levee constructed, but this would necessitate the building of a trestle to support a track on which to bring in the material, which, together with the expensive methods of handling, would make the cost prohibitive.

The lake in its present condition does not rise to a higher stage than 22½ feet above sea level, and can not rise higher than this elevation because when this stage is reached it overflows its banks along the entire south shore. But if its waters were confined by the levee it would undoubtedly reach a much greater height, probably 25 or 26 feet.

A levee to hold back this head of water, and be strong enough to withstand the action of the wind and waves, would have to be at least 3 feet above any possible level the lake might attain. Assuming 25 feet above sea level to be the maximum height of the lake, the top of the levee should be at least 28 feet, to have a reasonable margin of safety. The elevation of the muck is approximately 22 feet above sea level, and its average depth along the line of the proposed levee, 12 feet. Under these conditions, a levee, to hold back the water of the lake, should be at least 18 feet high, with a 3 to 1 slope on the shore side and a 2 to 1 on the land side. Such a levee would contain 190,080 cubic yards per mile, and, at the current prices for such work, including the excavation of the muck channel, building trestle for track, and loading and transporting suitable material, would cost at least 35 cents per cubic yard. This estimate makes the cost of the levee $66,528 per mile, and the cost of 80 miles $5,302,240. In addition to the enormous cost, this plan has other objections. It would back the water up on the opposite side of the lake and impair the drainage of a large area of land, some of which can be reclaimed and made fit for agriculture, and it makes no provision for water transportation across the State, which is a matter of the highest importance.

Since the mean elevation of Lake Okeechobee is 20½ feet above sea level, it is evident that by digging canals of sufficient capacity to tidewater, it can be practically drained of all its water, or its surface can be lowered to any height desired.

The character of the soil in the Everglades is such that it would not only be injurious, but positively ruinous to completely drain Lake Okeechobee. A large part of this muck land is of such a nature that if robbed of its moisture it would become a barren waste. During the winter and spring months the precipitation in southern Florida is not sufficient, if the ground is removed, to supply the needs of growing crops. In many places, even where there is a retentive clay subsoil, the citrus groves and vegetables suffer greatly from lack of moisture, and irrigation must be employed to get a profitable yield. Where a light muck, possessing in a high degree the power of evaporation, has the plane of soil water reduced below the reach of capillarity there can be but a scant plant growth. In order to preserve the fertility of the Everglades and make them productive, enough water must be stored in Lake Okeechobee to supply the deficiency during the dry period, and the excess must be removed in such a way as to prevent damage by overflow. This can best be accomplished by a system of outlet canals, provided at the upper end with gates to regulate the flow of water in them. The best location for these canals depends upon the cost of their construction, and the character of the land along their course to be reclaimed, and their value as a means of transportation. The proper size to make these canals will be determined by the amount of water to be discharged by them and the most economical cross section of canal to excavate.

The watershed drained by Lake Okeechobee, including the area of the lake, is approximately 4,000,000 acres. There is no authentic record of the rainfall in this area except at Kissimmee in the northern portion, so we must assume that the rainfall at this station represents fairly accurately that of the entire watershed. The average annual rainfall at Kissimmee for the past nine years is 53 inches, with a minimum of 40.22 inches in 1902 and maximum of 70.92 inches in 1887. If this amount of rainfall was uniformly distributed throughout the year, it would not be a difficult matter to take care of it, but it is excessive during the summer and fall, often exceeding 12 inches in a single month. It is this period of heavy rain that must be considered in planning the drainage of this section. In the months of July and August, 1905, there was a total rainfall of 27.95 inches recorded at Kissimmee. During the same period, there was but 20 inches at Jupiter, 24 inches at Fort Myers, and 25 at Miami. This would seem to indicate that the rain at Kissimmee was increased by some local influence that did not exist throughout the peninsula, and that probably the rainfall over the entire drainage area did not exceed 26 inches. As a fall of 26 inches in any other two consecutives months is the closest approach to this amount, it is safe to conclude that 26 inches is an extraordinary rainfall, not likely to occur except at rare intervals, and it would hardly be wise or prudent to base the carrying capacity of the drains on this amount. Since a rainfall of 18 to 22 inches in two consecutive months has occurred three times during the last decade, we may reasonably expect the same amount in the future. In order to have a fair margin of safety in the storage capacity of Lake Okeechobee, canals should be provided having sufficient discharge to remove a maximum rainfall of 24 inches from the entire watershed in two consecutive months.

The next important step is to determine how much of this rainfall is removed by evaporation and how much runs off into Lake Okeechobee. This is a difficult problem, since no observations have been made in southern Florida to determine the loss by evaporation in that latitude. Careful experiments, however, have been carried on for a number of years in some of the Northern States, in the arid West, and in Europe to determine what per cent of the rainfall is run off and what per cent is removed by evaporation. The results obtained vary with the local conditions and should be used with judgment and discretion in their application to localities where the conditions are different. Certain general laws, however, have been established by these experiments from which we may deduce fairly accurate conclusions. The most complete, as well as the best known series of observations on the evaporation from the surface of the soil are those made by Gilbert and Lawes at Rothamstead, England, 1870 to 1890, and those of the Floral Park Meteorological Station, Nassau County, N. Y., made in 1893. The English experiments show that in June, July, August, and September, 76 per cent of the total rainfall during these months was removed by evaporation. Similar experiments in other parts of England verify this result. At Floral Park, N. Y., the evaporation for July, August, and September, 1903, from a bare, sandy loam, was found to be 11.85 inches, or 62 per cent of the total rainfall. From an inspection of the table from which these figures were taken, it is quite apparent that the factors that determine the amount of evaporation of the soil surface are: First, the per cent of saturation from the soil; second, the temperature of the air; third, the wind velocity; and fourth, the degree of humidity of the atmosphere. A change in any one of these may increase or decrease the amount of evaporation. Prof. E. F. Ladd, of the Agricultural College at Fargo, N. Dak., conducted

a series of experiments in 1902 to 1905 to determine the loss by evaporation from a water surface. The average daily evaporation as shown by his report is as follows: May, 0.17; June, 0.21; July, 0.26; August, 0.24; September, 0.11 inch. The Croton River watershed in Massachusetts for a period of 32 years shows a mean annual evaporation of 25.74 inches, or 53 per cent of the rainfall, and the greater portion of this evaporation occurred during the months of June, July, August, and September. At least 70 per cent of the total rainfall is evaporated during these months. From these experiments we conclude that where the surface of the ground is very wet or covered with water, the temperature high—80° to 95°—with a gentle breeze blowing most of the time, both day and night, and the per cent of humidity less than 85, the conditions are extremely favorable for a high rate of evaporation.

During the months of July and August, 1905, when the rainfall was 22 inches at Kissimmee, the following conditions prevailed, as shown by the United States Weather Bureau, over the peninsula of Florida. (See table.) The ground was either saturated or covered with water. The mean temperature was 79°, the average wind velocity 8.5 miles per hour, and the humidity of the atmosphere 82 per cent. Under these conditions the rate of evaporation must have been greater than at any of the stations cited, and was at least 0.25 inch per day for the entire period. This amount is still further increased by the density and character of the vegetation that covers the ground. Where the vegetation is quick growth, dense and rank, a much larger amount of moisture will be collected and thrown off as evaporation than from a barren surface or from one scantily covered. The amount of water required for the growth of vegetation has been determined by many experimenters. The best known estimates are, perhaps, those of Risler, in Germany, and Prof. King, of Wisconsin. Prof. Risler states that meadow grass consumes 0.134 to 0.267 inch per day; i. e., the depth of water from the entire surface covered that is taken up by the roots of the plants and exhaled through foliage into the atmosphere as evaporation ranges from 0.13 to 0.26 inch in 24 hours. The experiments of Prof. King, at Madison, Wis., as to the amount of water required to produce a pound of dry vegetable matter show that when an abundant supply of water is furnished some crops will absorb as much as 25 inches of water in the growing season. In the forests of Germany experiments show that the amount of water transpired by the leaves of trees is equal to 33 to 36 per cent of the evaporation from a water surface of the same area as the forest. Mr. M. W. Harrington, Bulletin No. 7, United States Department of Agriculture, fixes the amount of transpiration from forests in southern Europe at about 25 per cent of the rainfall. From his own and experiments conducted by others the following table is deduced, showing the relation of the evaporation from different surfaces to the evaporation of a water surface and to the precipitation during the season May to September:

Evaporation from various kinds of vegetation.

[Harrington.]

	Proportion of—	
	Evaporation from a free water surface.	Precipitation.
	Inches.	*Inches.*
Sod	1.92	0.96
Cereals	1.73	86
Forest	1.51	.75
Mixed vegetation	1.44	.72
Bare soil	.60	.30

From examination of the data available it appears that the amount of moisture removed by a mixed growth of vegetation, such as trees, bushes, and grass, is at least 0.10 inch per day. All the Okeechobee watershed, however, is covered with a thick growth of vegetation, there being numerous lakes and ponds and extensive areas of almost barren soil, but if this vegetation were concentrated on one-half of the area it would cover it quite densely; so, instead of estimating the water removed by the plant growth at 0.10 inch for the entire watershed, we will restrict it to one-half the area, as more nearly representing the conditions in southern Florida. Assuming 0.25 inch to be removed by free evaporation and 0.05 inch by plant growth, we have 0.30 inch per day, or a total of 9 inches per month taken up by these two methods.

This is 75 per cent of the mean rainfall for July and August, which amount agrees quite closely with the results obtained in other places where careful and continued experiments have been made.

Since the maximum rainfall that is likely to occur in July and August is 24 inches, the mean daily precipitation for these two months equals 24 divided by 62 equals 0.387 inch. The difference between this amount and 0.30 inch, the amount removed by evaporation, is 0.087 inch, which is the mean daily run-off from the entire watershed. This amount of run-off, although not obtained by actual measurements, is supported by the results of the most careful experiments that have been carried on in this country, Europe, and India.

The land surface that drains into the lake is seven and a half times the area of the lake; so a run-off of 0.087 inch in 24 hours causes a rise in the lake of seven and a half times this amount, or 0.6525 inch per day. Should this continue throughout the months of July and August, a period of 62 days, it would cause the lake to rise 40.455 inches, to which must be added the rainfall on the lake, not removed by evaporation, during this period. The daily rainfall being 0.387 inch and the free evaporation 0.25 inch, there is an excess of 0.137 inch not removed by evaporation, which raises the lake this amount, exclusive of the run-off from the land surface. In 62 days this would raise the lake 8.494 inches, which added to the run-off, 40.455 inches, gives a total of 48.949 inches, the amount the lake would be raised, should there be no discharge during the months of July and August. If the lake should be full when the period of intense rainfall occurs, and no water should be allowed to escape, this run-off would raise the surface of the lake to an elevation of 25 feet, but as it begins to overflow its banks at a stage of 21 feet, this level has never been reached.

From a study of the above facts it appears that the most feasible way to control the level of Lake Okeechobee is to dig sufficient canals from the lake to tidewater to reduce its level just before the rainy season sets in to an elevation of 16 feet, and provide a storage capacity for 36 inches of the run-off. There will then remain to be removed by drainage through the canals 12.95 inches during the 62 days, or 0.2088 inch in 24 hours. To remove this depth from the entire surface of the lake in 24 hours will require canals having an aggregate discharge of 3,938 cubic feet per second.

In determining the number of and proper location for these canals, the cost of their construction, and character of the land to be reclaimed through which they pass, and their use for transportation must be considered. A canal 40 to 80 feet wide and 5 to 10 feet deep can be cut by a modern dredge and the material placed on the bank without rehandling. This size is more economically constructed than a larger canal. If one large channel, having the necessary discharge capacity, was constructed, there would not be as much land benefited as would be if the same capacity was secured by cutting two or more canals extending in different directions from the lake. The advantages are, therefore, decidedly in favor of cutting a number of small canals having the necessary carrying capacity rather than one large one.

The proper location for these canals must be determined largely by their length and the character of the land through which they pass. Deep cutting and stone must be avoided as far as is practicable.

Since transportation across the State is a matter of great importance, it is desirable that the drainage be so planned as to form an all-water route from the Atlantic Ocean to the Gulf of Mexico. With these ends in view the plan here recommended provides for a series of canals of ample capacity to regulate the stage of water in Lake Okeechobee, and provides adequate drainage for the lands through which they pass. (See Plate IV facing page 168.)

The first of these canals, marked "A–A" on the map, passes down the Caloosahatchee Valley, following the course of the present drainage. This has the advantage of being the shortest route and will have the greatest fall per mile, but there will be a larger per cent of rock to excavate than on some of the other lines. This is a disadvantage, as it will materially increase the cost, but for the purpose of navigation it is very necessary that this route be selected.

In addition to taking off part of the excess from Lake Okeechobee, this canal will furnish adequate drainage for the entire Caloosahatchee Valley, and reclaim and make fit for agricultural purposes a large body of extremely fertile land.

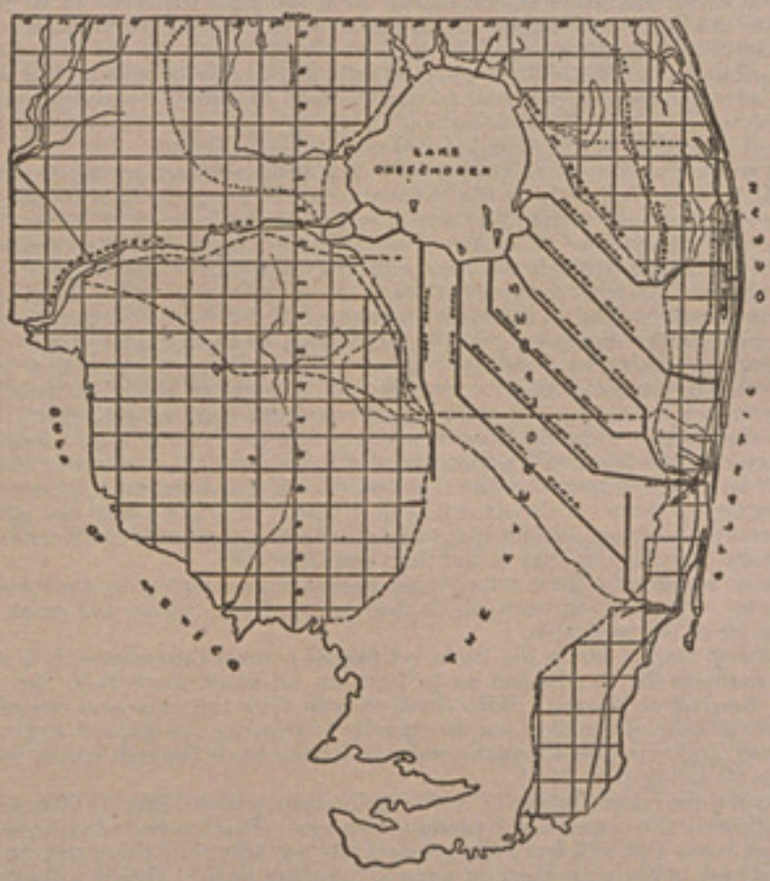
There is a grave apprehension that any enlargement of the upper portion of the Caloosahatchee will cause it to overflow its banks along its lower course and damage the citrus groves. Such will not be the case when Okeechobee is lowered and the discharge brought under control. There will not be as much water brought down this channel as is now carried by it in time of high water. The flow is to be regulated by locks at the upper end and only as much water allowed to enter the canal as the stream can carry without damage to the property along its course. One object of the improvement is to make the flow more uniform and maintain a good boating stage during the period of low water.

The canal second in importance, marked "B-B" on the map, is the Hillsboro route, which leaves Okeechobee at Pelican Bay and extends in a southeasterly direction to the head of Hillsboro River. This route is not as short as one directly east from Lake Okeechobee to the Loxahatchee River, but the cutting is not so deep, and it affords drainage for a much larger area of good agricultural lands.

These two canals, "A-A" and "B-B," are intended chiefly as a relief to Lake Okeechobee, and for transportation across the State. They are made deeper than the other canals shown on the plan and with proper locks a depth of 5 feet may be maintained throughout the year. This will furnish a good boating stage and be of great value to the agricultural and commercial interests of the State.

The other canals shown on the map are primarily drainage canals, although they would be navigable for light draft boats and barges and would be very useful in bringing in fertilizer and other supplies desired, and transporting to the market the crops produced.

Map showing the lines of canal recommended by J. O. Wright, supervising drainage engineer, U. S. Department of Agriculture, February 25, 1909.



In determining the size of the several canals it must be borne in mind that in addition to discharging 3,938 cubic feet per second from Lake Okeechobee, they must take the run-off from the territory through which they pass. Computing this run-off at the same depth that was determined for the watershed of Lake Okeechobee, there must be removed 90 cubic feet per second from each township, below Lake Okeechobee, discharging into these canals. This requires that the several canals be increased from the lake toward their outlets to carry this additional quantity without overflowing their lands during the period of heavy rains.

The functions and dimensions of the several canals located on the map, together with the approximate amount of excavation required in their construction, are given in tabulated form in Table 1. (See p. 169 for this table of estimated excavations in proposed canals.)

* * * * * * *

It is not possible to determine the exact amount of excavation without a survey and profile of each separate line of canal, but this estimate is sufficiently accurate to serve as a basis for computing the probable cost of the work. It was not deemed expedient to make this detail survey until it was determined that the work would be undertaken according to the proposed plans. Another element entering into the cost of the work is the proportion of rock and muck to be removed. This can only be known after the lines of canal are definitely located and soundings made to determine the depth of the muck.

From the investigations made by this office the results indicate that about 20 per cent of the excavation required will be a mixture of sand and porous rock, similar to that found at New River, and the remainder will be pure muck or muck underlaid with fine sand. On this basis of classification there will be 7,745,844 cubic yards of muck excavation and 30,983,760 of muck and sand.

From the work at Fort Lauderdale, it has been demonstrated that with a good dipper dredge the rock can be handled at a cost not exceeding 8 cents per cubic yard. With a suitable equipment there is no doubt that the muck can be removed at a cost of less than 4 cents per cubic yard. At these prices the total cost of the excavation would be:

7,745,844 yards, at 8 cents	$619,667.52
30,983,376 yards, at 4 cents	1,239,335.04
Total	1,859,002.56

This is approximately $1 per acre on the lands designated on the map as the upper glades.

In order to control the water in these canals and regulate the flow, they should be provided with gates or locks at both the upper and lower ends, and in some cases at intermediate points. Because of the slight head these will be comparatively inexpensive structures.

The canals represented on the map are for the purpose of regulating the height of the water in the lake and providing an outlet for the lands through which they pass. In addition to these, lateral feeders and small field ditches will depend largely upon the use to which the land is to be put. It will not require as much drainage for growing rice and grass as for cultivated crops. These field ditches will be small and not deep. Their cost will probably range from $2 to $4 per acre, according to the crop to be grown and the method of cultivation adopted.

J. O. WRIGHT,
Supervising Drainage Engineer.

We fully indorse this report, and it is our opinion, after a personal examination of the Everglades from the east and west approaches thereto, and the careful reading of this report, we feel perfectly justified in saying that the drainage of the Glades is absolutely feasible and practicable and its success depends alone upon the number and size of the canals that are cut through them to Lake Okeechobee. We had the advantage of low water, as the season there was a dry one.

Owing to the fact that the Everglades are very inaccessible, personal financial interests prompt the circulation of false reports or statements, which, in a large measure, accounts for the misinformation and prejudice now existing with reference to the Everglades, and believing that the importance of this matter justifies your committee in its effort to give you full and accurate information, as far as possible, considering the time devoted to the work, we feel justified in presenting you with the information above set out, though it be a little long and possibly tedious. However, we think it is correct and reliable in detail, and it is our opinion that it is a matter of so much interest and importance to the State of Florida that every means should be exerted to inform our people as to the facts pertaining thereto and so enlist the cooperation of every citizen of the State in preserving and retaining what is left to them of this vast and invaluable domain.

It is our opinion that if after reasonable development of these Glades the Federal Government is made acquainted with the facts in this case and the advantages to be derived from making a canal from Jupiter or Hillsborough Inlets on the east coast, thence to Lake Okeechobee and down the Caloosahatchee River to its mouth on the west coast, its cooperation can be easily obtained, thus furnishing a public highway from ocean to gulf which will be the pride of every Floridian and the wonder and admiration of the world.

If the Government lands were sold at the prices now prevailing, which we do not advise, a vast sum of money could be obtained, aggregating millions for the State of Florida, and besides this, if a good system of irrigation be established, based upon sound business principles, and this right be reserved in all sales of lands, an annual income of from $2,000,000 to $4,000,000 may be obtained from irrigation alone and then furnish landowners water for irrigation cheaper by far than any has ever been furnished up to this time.

We suggest that the remaining State lands be sold only in small parcels and then sold only to settlers and cultivators, and that none be sold now or in the near future unless for drainage purposes, for two reasons: First, you do not desire to bring the State lands in competition with lands sold in bulk; and, second, you want, when sold, to get much better prices because of the enhanced value by reason of the completion of drainage.

We recommend to the Trustees that they push with all possible dispatch the work on the Glades, and if possible let several of these canals on contract to reliable responsible bidders, who should be required under heavy bond to do the work under the supervision and in exact accordance with the contract, besides a deposit of a good bonus as an evidence of good faith.

Also that they secure at once a good suction dredge furnished with dipper for light work, which must be used to clear out the dams and shoals, thus opening up the canals for the transportation of supplies which is becoming daily more expensive as the work advances, the cost of which suction dredge would soon be saved by eliminating the transferring of everything at each dam, and besides this giving very much better drainage than is now possible.

We advise that the contract made with Mr. Bolles that an additional dredge be constructed by the Trustees and put to work excavating canals connecting with other canals and other outlets leading to the sea from Lake Okeechobee as soon as is possible and practicable.

THEOP. WEST, *Chairman.*
J. R. MILLER, *Secretary.*
J. W. HATCHER.
J. H. B. MILLER.
A. J. PEADEN.

RESOLUTIONS OF THE FLORIDA HOUSE OF REPRESENTATIVES.

The following resolution (H. R. No. 131) was adopted by the Florida House of Representatives, May 31, 1909:

Resolved by the house of representatives, That in view of the magnitude of the operations involved in the drainage of the swamp and overflowed lands of the State, and of the vast importance thereof, and of the great benefit to be derived therefrom, it is of vital interest to the people of the State that the drainage operations now being conducted by the Trustees of the Internal Improvement Fund should be prosecuted with vigor and economy, to the end that large areas of immensely valuable lands may be placed upon the market by the State, to secure desirable immigrants and to encourage the development and use of the almost limitless natural resources of the State, thereby increasing the wealth of the State and leading to a corresponding reduction in tax burdens. It is earnestly recommended that the Trustees use every proper means in their power to facilitate the work of drainage and reclamation at the lowest possible cost, and that some one of the Trustees do make personal visits to and careful inspection of said drainage operations, and all the details thereof, at frequent intervals, in order that the Trustees and the public may be kept fully advised of the progress of the work.

The following resolution (H. R. No. 138) was adopted in the Florida House of Representatives:

Whereas on the thirty-first day of May the House of Representatives of the State of Florida adopted House Resolution Numbered One hundred and thirty-one, expressing the wish of this house concerning the drainage of our swamp lands by the Trustees of the Internal Improvement Fund:

Therefore be it resolved, That the secretary of the house of representatives is hereby instructed to deliver a copy of the said resolution to the secretary of the Trustees of the Internal Improvement Fund of the State of Florida.

The following resolution (H. R. No. 141) was adopted in the Florida House of Representatives, June 4, 1909:

Resolved by the house of representatives, That it is the sense of the house that the Board of Drainage Commissioners of the State of Florida are to be congratulated upon the successful outcome of the litigation against the railroad land-grant claimants that have refused to share in the burden of draining and reclaiming their own lands within the drainage district created in the wisdom of the Legislature of Florida, and that the board should continue vigorously their efforts to enforce the law.

And further, That the chief clerk transmit a certified copy of this resolution to the honorable Board of Drainage Commissioners of the State of Florida.