

APPENDIX K.

ANNUAL REPORT OF MAJOR C. W. HOWELL, CORPS OF
ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30,
1879.

UNITED STATES ENGINEER OFFICE,
New Orleans, La., September 30, 1879.

GENERAL: I have the honor to forward herewith the annual report
for the fiscal year ending June 30, 1879, of the various works of river
and harbor improvements under my charge.

Very respectfully, your obedient servant,

C. W. HOWELL,
Major of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

K 1.

IMPROVEMENT OF THE HARBOR AT NEW ORLEANS, LOUISIANA.

This work, for the commencement of which an appropriation of
\$50,000 was made by act of Congress approved June 18, 1878, was not
commenced until October 1, 1878, because of high water in the river.

Detailed plans and methods for conduct of the work, as outlined in
the report made to his honor the mayor of New Orleans by the Board
of Engineers convened to consider and report upon the matter (Report
of Chief of Engineers for 1878, volume 1, Appendix J 10), had been pre-
pared and considered before date of commencement, but with the ex-
pectation that actual work would suggest many changes.

It was found impossible to frame specifications for the work such as
would warrant offering it at contract, and authority was therefore ob-
tained to conduct it during the year by hired labor and purchase in
open market.

In accordance with this authority, and pending commencement, a
steam pile-driver was built for use on the work; a barge was purchased,
and a set of ways built upon it for launching mats, and all arrange-
ments for supply of material were made.

In commencement of the work it was thought advisable to mat or
carpet a considerable portion of the bed of the river, along that portion
recommended to be first improved, before undertaking work on the bulk-
head, also recommended.

No attempt toward constructing the bulkhead was therefore made
during the year beyond driving the double row of piles for the bulk-
head for a short distance, when even this was abandoned, as a second
row was of no use in laying carpet, and could be as well driven after as
before such laying.

This course was continued during the year; and so it will be understood that the plans of the Board have at no point been fully carried out.

During the season of continuance of the work, the river front along which it was being prosecuted was crowded with vessels at the wharves, in cases as many as three abreast, either discharging or receiving cargo; and in consequence, although the city and State authorities did everything they properly could do to clear the way for the work, there was necessarily much delay resulting from this condition of affairs. There was also some delay due to non-delivery of material at stipulated times. All things considered, I think, however, that the progress made may be assumed as satisfactory.

The work was suspended on the 18th of February, in consequence of high water in the river, and not resumed until the 9th of June, 1879; from which time it was continued to the close of the fiscal year.

AMOUNT OF WORK DONE.

The work was commenced at the foot of the batture, covering the upper portion of the second section as described in the report of the Board before referred to. At the close of the year it had reached a point 886 feet lower down the river, as measured along the line of piling. It had covered a superficial area of the slope of the river-bed throughout that distance of about 170,000 square feet, an area extending from the line of piles (placed as nearly as practicable on the general line of the wharf-front) into depths of from 50 to 80 feet in the river.

The covering was not complete at all points, although allowance had been made for drift by making the carpets each 24 feet wide, and to cover a strip of only 14 feet wide for each.

The results, I think, may be considered creditable for a first attempt, and the portion of the bank protected has not caved this year.

DETAILS.

The line for the piling it was found necessary to make in offsets between wharves because of the irregular lines of the wharfage front. The piles were 65 feet in length and driven until their tops were on a level with the top of the wharves. They were driven 6 feet apart from center to center, as nearly as possible, and were of pine, 12 inches or more at butt. They were placed to serve as anchorage for the shore end of mats. The mats or carpets were made of "fish-pole cane," which is so abundant in this country. This was woven into carpets from 1 inch to 2 inches in thickness, 25 feet long and 24 feet wide. At first the weaving was done by hand, and galvanized iron wire was used as the warp, 7 strands for each carpet. Later it was woven in a loom invented for the purpose, and spun yarn substituted for the wire. These sections were then carried on board the ways-barge and 8 of them connected together to form a carpet 200 feet long, and evenly ballasted.

The ballast at first used consisted of worn-out boiler-tubes filled with sand; afterward canvas bags were used. No other ballast would answer the purpose because it had to be permanently fastened to the carpet and be launched with it. The carpet, 200 feet long, being ready for sinking, was attached to the piling by iron rings, and the ways-barge then moved by a tug-boat out into the stream, launching the carpet as it went.

Buoys were attached to the carpet, and after its launching these were

located to show the position in which it had settled. It took from 4,000 to 12,000 pounds ballast to sink each carpet properly, according to stage of river, although all the principal joints of the cane were opened before launching.

The cost per square yard of river-bed slope actually covered during the year is \$1.16, leaving out cost of plant yet available for future work.

This estimate is made as follows:

Amount expended to June 30.....	\$35,800 12
Deduct—	
Amount paid city of New Orleans for survey.....	\$7,241 16
Value of plant and material on hand at close of year.....	6,507 74
	<hr/>
	13,748 90
	<hr/>
	22,051 22

Area, 18,888 square yards; cost per square yard, \$1.16. The cost per running foot of front protected, 886 feet, was \$24.88.

These figures represent the work under the most unfavorable conditions, and should not be taken for purpose of estimate. They represent the work in its infancy, when methods had to be gradually developed by practical experience and along the most difficult portion of the harbor-front for advantageously conducting such a work, the front being obstructed by sunken wharves and a fleet of ships. My report for the year ending June 30, 1880, will show a material reduction of these figures. For example, the important item of cane has been reduced in cost \$7 per thousand, and the cost of weaving the carpets has, by the invention of the loom, been reduced to one-half of the cost of those woven by hand. There are other reductions that can be made when the work can be conducted on a mere extensive scale than \$50,000 or \$60,000 will warrant. For example, 1 tug-boat can handle each day 10 launching barges in place of the one now used, at a cost of \$5 per mat, and the tug not always at hand when needed.

Improvements can be made in the construction of the launching barges and in the looms, and when a large and steady supply of cane is required its price may be yet further reduced.

On an unobstructed portion of the river, like the Carrolton Bend (section No. 1 of this work), or the Gretna Bend (section No. 3), each barge should average 3 mats per day; and, with abundant means at command, skilled laborers could be kept steadily employed.

In my project of operations for the fiscal year ending June 30, 1880, I proposed to add the balance of appropriation for 1879 to that for 1880, and advertise the work for contract under the total. This being disapproved, in so far as application of balance, the work will be continued as during the past year, and in the mean time the work will be advertised for continuance by contract under the appropriation of \$60,000 made by act of Congress approved March 3, 1879. It is thought that this amount will finish the carpeting of section No. 2, for which the Board estimated \$146,025, and also one row of the two rows of piles for which further estimate was made.

If this opinion be correct, the work will have cost only about two-thirds of original estimate. Opinion is based on what now appears quite certain, that contract can be made for \$10 per running foot measured along bank, and probably for less.

Should there be a balance after this completion of carpeting the second section, it is proposed to apply it to section 1 (Carrolton Bend), leaving the bulkhead work for further consideration of a Board of Engineers.

The following statistics regarding the commerce of the port of New

Orleans for the year ending June 30, 1879, have been kindly furnished by the collector of the port, General A. S. Badger:

ENTRANCES.			CLEARANCES.		
Class.	Num-ber.	Tonnage.	Class.	Num-ber.	Tonnage.
Steam	409	590,866	Steam	406	591,351
Sail	629	346,644	Sail	680	368,227
Total number of vessels entered	1,038	937,510	Total number of vessels cleared	1,086	959,578

Total value of imports	\$7,153,610 00
Total value of exports, domestic	63,795,557 00
Total value of exports, foreign	187,157 00
Grand total of exports	63,982,714 00

Total amount of revenue collected on imports

1,428,063 88

The work is located in the collection-district of New Orleans, and the nearest light-house on the river is at the head of the passes.

I am not prepared to venture an opinion as to the permanence of the work.

In conclusion, I desire to especially commend Mr. H. Tyler, in superintendence of the work, for ingenuity in devising a launching barge; Mr. Carson Mudge, for inventing a loom, and Mr. James R. Howell, whom I left in charge during my absence from New Orleans on other duties, for many valuable suggestions and changes in the manner of conducting the work and in keeping its records.

Original estimated cost	\$476,000 00
Amount appropriated	110,000 00
Amount expended	35,068 61

Money statement.

July 1, 1878, amount available	\$50,000 00	
Amount appropriated by act approved March 3, 1879	60,000 00	\$110,000 00
July 1, 1879, amount expended during fiscal year	34,679 09	
July 1, 1879, outstanding liabilities	389 52	
		35,068 61
July 1, 1879, amount available	74,931 39	
Amount (estimated) required for completion of existing project	366,000 00	
Amount that can be profitably expended in fiscal year ending June 30, 1881.	200,000 00	

K 2.

IMPROVEMENT OF PEARL RIVER, MISSISSIPPI, FROM JACKSON TO CARTHAGE.

It is proposed to expend the \$6,000 appropriated by act of Congress approved March 3, 1879, by improving navigation at the most obstructed points of the river between Jackson and Carthage, the work to be done by contract.

It will not be possible, owing to delay in making appropriation available, advertising, &c., to commence actual work on the river much

before the 1st of November, by which time, it is feared, the water will be too high to permit effective work, and this may have to be postponed until the next low-water season.

The work is located in the collection-district of New Orleans. The nearest light-house is on the Rigolets Pass, Louisiana, opposite the mouth of the river.

The work is not considered permanent, because it appears quite certain that the channel opened will gradually fill, in places, with drift, &c., but there is no basis for estimate as to the length of time it will remain sufficiently open for navigation or as to cost of maintaining its navigability.

* Original estimated cost	\$21,000
Amount appropriated	6,000

Money statement.

Amount appropriated by act approved March 3, 1879	\$6,000 00
July 1, 1879, amount available	6,000 00
Amount (estimated) required for completion of existing project	15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881.	15,000 00

SURVEY OF PEARL RIVER, MISSISSIPPI, FROM CARTHAGE, MISSISSIPPI TO ITS MOUTH.

On December 13, 1878, the field-work of this survey was commenced at the town of Carthage, Miss., the stage of the river and low-lying character of the country adjoining it from Carthage to Edinburg preventing its beginning higher up.

The field-work was stopped on December 31, 1878, at Jackson, Miss., to await a lower stage of water for its completion to the river's mouth.

In the mean time the work above Jackson was plotted and a preliminary report submitted to the Chief of Engineers. The following is a copy:

PRELIMINARY REPORT.

UNITED STATES ENGINEER OFFICE,
New Orleans, La., February 12, 1879.

GENERAL: I have the honor to submit the following preliminary report of survey of Pearl River above the city of Jackson, in the State of Mississippi, to the town of Carthage, in that State, in advance of my report on survey of Pearl River from Edinburg, in the State of Mississippi, to the mouth of the river, as provided for by act of Congress approved June 18, 1878.

The survey of the upper portion of the river was commenced—

1. Because of information received, that seemed to warrant belief, that the improvement of this portion of the river would give a larger measure of relief to those who were most interested in cheap transportation than in improvement of the river below Jackson—the point at which the river and the railroad, if placed on equal footing, begin at compete.

2. Because the river below Jackson was at too high a stage to warrant

* Original estimated cost of improvement from Jackson to Carthage is \$21,000. Total estimated cost of improvement from Carthage to the mouth of the river is \$116,940.

attempt at survey to ascertain what obstructions to navigation (low-water) it presented.

3. Because the river between Carthage and Edinburg, at the stage of the river at time of survey could not be well surveyed because of overflowed bottom lands and dense cypress brakes.

The length of that portion of the river surveyed is 105 miles, most of this averaging from 120 to 250 feet in width, but in a few places, newly-made cut-offs, it is only from 60 to 70 feet wide.

At the time of survey the water was 7 feet above extreme low, and at no place in the channel was there a less depth than 11 feet.

The bed of the stream is mostly of clay, there being, however, some sand and gravel bars and one rock bar.

The stream is very crooked, and winds through an alluvial bottom land varying in width from 1 to 7 miles, heavily timbered with cypress.

The difference between extreme low and extreme high water at Carthage is 18 feet, and 42 feet at Jackson.

The obstructions are standing cypress trees in cut-offs that have been made through cypress brakes, fallen trees, logs, and snags; also a few large overhanging trees and many miles of overhanging willows.

The opening of the river to navigation is considered a matter of great importance to the people along its valley.

The country grows a large amount of cotton, and would, it is thought, grow more if cheaper transportation than that now offered could be had.

It now costs from \$3 to \$4 a bale to get cotton to the railroad, and only two bales at a time per team can be hauled over the clay hills.

I would respectfully recommend an appropriation of \$21,000 to clear out this stream so that the products of this fertile valley may have water transportation to the railroad at Jackson.

Very respectfully, your obedient servant,

C. W. HOWELL,
Captain of Engineers.

Brig. Gen. A. A. HUMPHREYS,
Chief of Engineers, U. S. A.

On March 28, 1879, the field-work was resumed at Jackson, Mississippi, and continued to the mouth of the river, where it was completed April 26, 1879.

The following are the reports of the assistant engineer, Mr. H. C. Collins, who had charge of the party in the field.

REPORTS OF MR. H. C. COLLINS, ASSISTANT ENGINEER.

1.—ABOVE JACKSON.

NEW ORLEANS, LA., February 1, 1879.

CAPTAIN: I have the honor to submit the following report of a survey made under your direction of Pearl River, Mississippi, from Carthage to Jackson.

We started from Jackson for Carthage on the 10th of December, 1878, and arrived on the 13th. There was a 7-foot rise in the river, and the banks of the river between Carthage and Edinburg were under water to such an extent that there was no place to set up an instrument. We therefore began the survey at Carthage, which is 12 miles below Edinburg.

Carthage is near the northeast corner of township 10 north, of range 7 east, and the ferry south of Carthage at the northeast corner of section 24, in the same township, is the landing place for Carthage freights on the river and the nearest point.

The survey was made by a line run with a transit instrument set up on magnetic meridian, the telescope of which had cross-hairs adjusted to read 10 feet on a rod at 1,000 feet distance.

All distances were measured by this stadia rod, the transit being placed at a con-

venient point. Readings were taken to all prominent points in sight, and then to some point down stream from which a good view could be had down stream; then the transit was moved down below the rod to the most available point from which the rod above could be seen, and also with a good view below, setting up each time on magnetic meridian and using 2 stadia rods, each of which was carried by a man who rowed a light skiff, and also carried an ax to chop occasional brush and to blaze trees to mark the numbers of the points.

Topography was taken as fully as possible in moving from the station to the next down the river, but not hindering the survey for it. Soundings were made at intervals of about 500 feet, unless at very bad places, where many more were taken and cross-sections of the river sounded frequently. All snags and logs that were not covered by water of the rise and all overhanging trees on the bank, all towhead islands and standing cypress-trees in the river, were located; height of banks and character of timber growing upon them. High-water marks were occasionally found on trees and their height taken whenever plainly determinable. Very many logs and snags were covered by the rise, and of course escaped notice, but all overflows and bayous were more easily seen than they would have been at low-water, and the direction of their currents taken.

The valley of Pearl River is several miles wide at Carthage, and at low river the water all flows in one channel at the ferry. This is near the north side of the valley, and the north side of the river at the ferry landing is covered but 1 or 2 feet at high floods.

Old channel bayous enter the river from each side just above the ferry.

On the south side of the river are Mr. McFadden's fields, about 100 acres in extent, of high bottom, covered but 1 or 2 feet at high floods, but south of his fields is a mile of low bottom-land on which the high-water mark is 6 or 7 feet above the surface, and in great floods a large portion of the water runs down over this low bottom-land.

South of this are the bluff lands, which are very rough, being cut by numerous small streams which run into Pearl River, all of which are cut down nearly to the level of the river, forming steep clay hills which roads, in any direction except towards the river itself, must cross.

The slope of the valley is very steep, but the river runs from side to side of the bottom-land. Bends are very frequent, and at places where the river reaches the bluff the wash of the bluff formation appears to be far more rapid than that of the alluvial soil of the bottoms under similar circumstances.

The bends of the river are so frequent that the channel, after wide sweeps, frequently returns to within a few hundred feet of the same place. The current with a 7-foot rise is but 1 to 1½ miles per hour in most places, seldom reaching 2 miles in its most rapid place.

During highest floods the whole river valley is covered, the highest bottoms from 1 to 2 feet, and the low cypress brakes 12 to 16 feet deep. The water then runs directly down the valley, crossing the channel and but little affected by its curves, far the larger portion finding its way through the cypress brakes.

Nearly all the valley except the river channel and the lakes, which are old river channels, is covered by a dense growth of trees and bushes interlaced by vines, and cane grows almost everywhere. This undergrowth prevents all washing of the surface, and so obstructs the current at high floods that the swamps are covered for many months, keeping a half stage of the river for more than half the year—acting as a reservoir. At the high floods, whatever drift is floating finds its way into the cypress brakes at the bends of the channel, and usually at just the places where any wash would make a cut-off. In this way natural cut-offs are almost entirely prevented, as the large rafts of drift make an additional protection to the bank, but though preventing natural cut-offs they afford means to make cut-offs with very little work in those places where cut-offs can shorten the river most, and so increase the slope of the surface in the channel. If at times of low river, when from a drought the whole drift timber is very dry, a fire is set in these piles of drift, they burn and kill the trees among which they have lodged, destroying also the coating of cane, bushes, and vines, and leaving a soft, unprotected surface in just the condition to be most easily washed at the next rise of the river.

Usually the drift being drawn by the increased current fills up the new cut-off at its head once or twice, but a repetition of the burning next year leaves it worse and worse until the new channel is formed, any material shortening or straightening of the channel being followed by caving of the bends near or even of straight reaches, so that the original length is regained, but at the expense of washing away a large tract of land in each case, and sending down all its timber as snags or drift trees.

Pearl River is said to have been named from its clear water, and old inhabitants told me that many years ago it was so clear that the bottom could be seen distinctly where the water was 5 to 10 feet deep. It is now about as muddy as the Mississippi.

Farms are found on the bluff lands and the bottoms washed out by the small streams running into Pearl River, but very few farms are found on Pearl River bottom-lands.

Cotton is the principal crop exported, but all corn and most of the bacon is raised on farms. But for the cost of hauling cotton over the bad roads far more would be raised, and the country would be far more thickly settled.

The timber on the bluffs is white oak and pine mostly, and it is a high rolling, well watered, healthy country, offering good opportunities for settlement, if navigation is so improved as to make it practicable to run boats on the river.

A detailed description of the river for the first mile will give a good idea of it for the first 60 miles of the survey.

Beginning at McFadden's Ferry, the river-channel is 170 feet wide with a cross-section depth of 20, 18, 16, 15, 12, and 8 feet, soundings being taken at about equal intervals at a 7-foot rise. High-water is 11 feet higher, but would cover the whole valley. Two hundred feet below the ferry landing a bayou leaves the river on the right bank, running out into a cypress brake (or swamp) on the north side of the river. Below this the land is low, and for 300 feet a growth of willow trees hang over the water—few of them project enough to obstruct the passage of boats, but they catch drift at high water; long logs project out into the channel, and the entire bank requires to be cleared.

Fifteen hundred feet below the ferry the high bottom ends on the left or south bank and a bayou runs off to the southwest.

The south bank is very low for 1,000 feet farther. At 2,000 feet from the landing is a cluster of live cypress trees standing in the channel. These must be cut at extreme low river. Three hundred feet farther is another cluster of cypress trees in the channel to be cut. On the left bank for 600 feet below this is a large cypress brake. It is at a sharp bend of the river and on the outside of the bend. The water runs in among the cypress trees, taking large quantities of drift, which is lodged against the trees. It is but 1,000 feet through the cypress brake to the river $1\frac{1}{4}$ miles below, and with a 7-foot rise fully half the water of the river finds its way across through the swamp. There is also, at the lower edge of the cypress brake, as the river reaches the higher land, a great mass of drift collected on a nucleus of two large trees which have fallen in from the bank. Removing this partial dam would give a freer current down the channel, and if the willow growth on the bank above and the cypress which must be cut are also run into the cypress brake on the bend, so as to still more obstruct the flow of water, that way the channel will be improved.

At 3,000 feet are a few small overhanging trees, and the cross-section was 120 feet wide, depths 16, 22, and 19 feet.

At 4,400 feet is a cypress brake on both sides of the river with banks covered by a 3-foot rise.

There are many snags and logs entirely under water, of which some break in the current gives an indication, but they will all appear at low-water and must be removed. The number of these is unknown, but they are easily sawn up at low river and hauled out on the bank to dry, so that at a rise they may drift into some bayou or overflow. Drift seldom reaches the river after once running out into a bayou. This ends the first mile from the ferry. Below this only bad places or peculiarities of the valley will be noticed, referring to the chart for a minute description of the river.

Fifteen hundred feet below is a cluster of five very large cypress, and some small ones in the river with a passage between them of but 40 feet. All of them should be removed, leaving a clear channel, as a long log in coming down is at any time liable to lodge in such places and form an obstruction, and a raft now collects which throws the current out into side bayous. With a clear channel the effect would probably be to give increased width and depth each year, while every obstruction tends to make other obstructions.

Seven other large cypress are found in the river on the second mile, and about the middle of this mile is a bayou cut-off, formed by burning a pile of drift, which can be easily closed by floating in drift. At the beginning of the third mile the river runs through a cypress brake. A large quantity of drift is lodged against the trees. Nine very large cypress and some small ones must be taken out, and I counted nine drift trees in the mass of drift lodged here; more may be found under water, probably.

On the fourth mile are six single large cypress trees standing in the river, each of which forms the basis for a raft of drift-logs.

At the beginning of the 5th mile is an old river channel, leaving the river and returning again 1,200 feet below. This cut-off shortened the river more than a mile.

Eight hundred feet below where it returns another old river channel leaves the river, which, though partly choked by drift, yet takes nearly half the water of the river; its entire closure by running in the drift and overhanging trees from above will help the channel of the cut-off, which is now very much better than the old channel.

The only available means of closing the bayous leading out of the river, when it is advisable to do so, is cutting such trees as can be easily fallen in and floated down into them.

Were the channel used once cleared of obstructions, and boats run upon the river so as to keep it clear, the side bayous, which would gradually catch and retain the drift, would close with little other care than that of not burning their rafts at low-river times.

Bayous, whenever needed to float cypress logs out of the breaks, only need to have the ends running into the river opened; the rafts, which prevent their becoming cut-offs, and which prevent loss of water from the channel at low stage of water when it is needed for navigation, are all at the immediate head where it leaves the river.

The next bad place is on the 9th mile, where the river runs through a cypress-brake, the trees of which are so near together that there is no passage greater than 25 feet between the trunks. The depth of water is enough, and all that is necessary is to remove the trees standing in the river, 15 in number, and the drift which has accumulated.

Near the lower end of the 9th mile is a bayou cut-off, which has started by the burning of a drift-pile within a year. It now runs through a cypress-brake. It would shorten the river 2 miles, and it now has a very strong current. It will take a large quantity of drift to fill it, so as to prevent its reducing the current in the main channel too much. Man's Landing is on the bend which would be left out by this cut-off, and all around the bend is willow bank on one or the other side of the river. At the lower end of the bend on the 11th mile are two bayous running to the river below through the cypress-brake, both of which need closing, and the willows of the Man's Landing Bend will suffice for their closure.

Nearly every man we met on the survey was ready to point out some place where by a short cut in the bank a cut-off could be made, and very many of them had at times done more or less toward making new cut-offs, with the expectation that such cut-offs would improve navigation. How it has effected it is seen in the fact that formerly steamboats ran quite regularly to Carthage, and now only one little boat remaining, with but a capacity of 31 bales of cotton, is laid up at Grant's Ferry, the change being the direct effect of the great accumulation of logs, snags, &c., washed in from caving banks which were only made caving banks by the increased currents due to cut-offs.

On the 12th mile is the first place where the river reaches the bluffs on the south or left bank. Here a stratum of sand reaching 2 feet above water of the rise is washed out by the river, and the high yellow-clay bluff above it goes in great land-slides, and the clay being broken by the slide is soon washed away, leaving a new surface of sand exposed to the current. The wash here appears to be more rapid than in any of the alluvial land.

On the 14th mile the river again touches the south bluffs.

About the year 1872 a cut-off was made here, and the cut-off at first ran 3,200 feet nearly straight across a great bend, shortening it 2 or 3 miles.

The bottom-land at the place was easily washed by the strong current, and by caving banks bends were formed. There are now 10 bends in this distance, and the channel of the cut-off is now 6,700 feet, having increased its length 3,500.

The sum of all the angles which the channel has acquired by means of its caving banks in this cut-off is $17\frac{1}{2}$ right angle. These bends so reduce the current that the banks are now caving but little. A very slight rise overflows the banks, but they are so covered by undergrowth and drift that there is no present danger of any cut-offs.

At the end of the 16th mile the Tas-ka-la-meta River joins the Pearl from the south. It is a stream nearly as large as the Pearl above the junction. Sixteen and one-half miles from McFadden's Ferry is Grigsby's Ferry, where a point of bluff land comes to the river on the north side.

There is very little work needed from Grigsby's Ferry to the middle of the 21st mile. A cut-off has been made in the usual way through a little cypress swamp. Most of the cypress trees remain standing.

The water is 20 feet deep among the trees of the cut-off, and nearly all the water goes that way, the old river-bed being dry on the bar at its head in low-water. An old cut-off had been made near the same place and two just below. Every bend of the 21st and 22d mile is now caving, and many trees have fallen into the river.

Large bushy-topped oak trees usually remain where they slide in, collecting drift, but trees with few branches appear to float until they reach some obstruction, and collect in large numbers in the cypress-brake cut-offs.

At the 26th mile the bluffs on opposite sides of the valley approach within 2,200 feet. The river is but 200 feet wide, but is 25 feet deep, and with a 7-foot rise fully as much water runs down through the swamp bayous as follows the channel.

On the 28th mile, at Hoover's Bluff, the river is confined to one channel 240 feet wide, and soundings of the cross-section were 23, 27, 25, 23, 20, 19, and 14 feet. There is a place at the lake just above the bluff where the river is 650 feet wide and runs over a gravel bar. The least depth in channel over this bar was 13 feet, but as the river falls the gravel is washed to the top of the bar, and not over until at lowest water. Some years there is as little as $3\frac{1}{2}$ feet on the shoalest place in the channel, but Mr.