

HARRISON CO. Roll Sk. # 8

(in flat folder)

Re: M. A. 44959 - 44960

REPORT ON REMOVAL
OF THE RED RIVER RAFT
— BY —
LT. E. A. WOODRUFF
CORPS OF ENGINEERS
— U. S. A. —

counter 45825

I hereby certify that the documents attached hereto are a true and complete copy of pages 568 thru 573, year 1872 and pages 613 thru 623, 664 thru 667 and 668 thru 671 year 1873, of the Report of Chief of Engineers, the original copy of which is on file in the library of the Corps of Engineers, New Orleans District, New Orleans, Louisiana.

J. W. Young

J. W. YOUNG
Head, Publication Section,
Office Service Branch

counter 145824

Sunday, March 30.—The barkentine Japan, bound out, at 10 a. m., in tow of tow-boat Wicaco, grounded in East channel, near East channel buoy. The Wicaco towed her to sea at 12 m.

The steamer Yazoo, drawing 18.6 feet, (Bob Wilson, pilot,) bound out, at 12 m. grounded in channel between West and outer West Mud-Lumps. She got to sea with the assistance of tow-boat Wabash at 2 p. m.

The bark Unknown, (Sherman, pilot,) bound in, at 5 p. m., in tow of tow-boat Leviathan, took a shear just below Cleopatra Buoy, and ran into the steamer Missouri, carrying away the steamer's bowsprit, and the bark's foremast. She grounded just above, and was towed in during the night.

The steamer Cortes, bound out, at 5 p. m. grounded on West Mud-Lump. She was assisted off at 5.30 by tow-boat Wabash.

Q 2.

REMOVAL OF THE RED RIVER RAFT.

In accordance with the recommendation and general project submitted in my preliminary report on the survey of the Red River Raft Region, (Report of Chief of Engineers for 1872, pp. 568 to 573,) preparations for the prosecution of this work were commenced on the 12th of August, 1872, and the work itself commenced December 1, 1872, by shore parties organized in Shreveport, and on January 27, 1873, by the steam snag-boat and crane-boats sent from New Orleans.

Since the completion of preparations the work has been conducted with but slight suspension from this office, the distance of Shreveport from New Orleans being so great that, with other duties claiming daily attention, I have not been able to even make a personal inspection of the work.

Lieut. E. A. Woodruff, Corps of Engineers, U. S. A., has directed the work in person, and to his skill and energy, aided by his excellent foreman, is due the remarkable progress so far made.

This progress is best shown by the report of Lieutenant Woodruff, following:

SHREVEPORT, LA., July 1, 1873.

SIR: In obedience to your instructions, I left New Orleans the 12th of August, 1872, to visit Louisville, Cincinnati, Pittsburgh, and Saint Louis, to find a light-draught steamboat which could be made suitable for the work of removing the Red River raft. After searching among the boats found at those cities, and making inquiries, by mail about several others on western rivers, the wrecking-boat Aid, of Saint Louis, was bought for \$19,000. The Aid was built at Pittsburgh in 1869, and was judged to be, of all the boats seen, the best adapted to the work. She has two double-end hulls 136 feet long, each 15-foot beam, and separated by a space of 14 feet. Her total breadth, therefore, is 44 feet; draught about 3 feet. The wheel is placed near the stern between the hulls so as to be entirely protected by them. She is propelled by two engines with cylinders 15 inches in diameter and 4½ feet stroke. The boilers are three in number, 24 feet in length, 36 inches in diameter, with two flues in each. At the time of her purchase they had been recently inspected and allowed to carry 136 pounds of steam pressure. They are supplied with water by an independent steam feed-pump, or donkey engine, of ample capacity. The outfit of the Aid consisted of one steam-capstan on the starboard bow, a hand-capstan on each stern, three heavy double-gear'd movable hand-crabs, two light portable hand-crabs, and the railway hoisting-carriage with four double-gear'd windlasses. The latter were the principal machinery for her business of raising wrecks, and was so built that the windlass-carriage could be used to lift over either side of the boat or between the hulls. The two railway frames supporting the carriage are 18 feet above the engine-deck, and extend across both hulls and the space between them.

The forward frame is 36 feet behind the bow, the after one 32 feet further back; and both are provided with a crane at each end by which the carriage-track can be extended over the sides of the boat.

The carriage upon which the windlasses are placed is 32 feet in length, lengthwise with the boat; and is moved sidewise across the boat by means of ratchets and levers which turn the wheels which carry it. This apparatus had been used for lifting machinery from wrecks, and is altogether similar to that of other wrecking boats on western rivers. Although I did not expect to use it in the work on the raft, I thought best to leave it in position, as it might possibly be found of service in raising snags. Being instructed to make such alterations and repairs as would fit the Aid for removing the raft, I made arrangements with the Carondelet Marine Railway and Dock Company to do the work required. This was as follows: docking, caulking, repairing bottom planks and timbers; strengthening the frame holding the two hulls together; building a longitudinal truss throughout each hull; caulking and sheathing the deck; putting an additional steam-capstan on the bow; building two large boom-cranes, one on each hull forward of the hoisting-carriage; building a sloping apron at the bow between the hulls, and making habitable quarters for officers and crew. The boom-cranes, the steam capstans, and sloping-apron were the main features of the special preparation for the work. The object of the cranes was to lift and bring within reach of saws and axes such logs as would not float, and to place their fragments on the banks. The masts and booms were made 30 feet in length; wire rigging was furnished for hoisting, and a hoisting-drum, geared at pleasure with the capstan engines, placed in each hold. The safe lifting capacity of each crane was estimated at six tons. The sloping-apron, extending down to the water's edge between the hulls forward, was designed to answer the purpose of a butting-beam similar to those used on double-hull snag-boats; and also to furnish a convenient place for working axes and saws upon logs and snags drawn upon it by the capstans or in the water in front of it. The length of the apron was made about 21 feet, and the slope about 1 on 6. The bow edge was covered with heavy sheet-iron to protect it from wearing in drawing logs and chains over it. The strength of this apron, although not comparable with that of the butting-beams of the Mississippi snag-boats, was such as to allow running it with moderate headway under a snag, and to bear the weight of any snag which might be drawn upon it by the steam-capstans.

The photographs of the Aid show its use better than a description can do. The work on the Aid was completed October 20, and after completing her outfit of provisions, lines, blocks, and furniture, in Saint Louis, and taking 2,500 pounds of blasting-powder, she started, October 25, according to instructions, for New Orleans, where she was to take in tow two crane-boats, built there under your supervision.

On her leaving Saint Louis, the Aid was placed under command of Captain Thomas Rogers, an experienced steamboat captain, whose reputation for ability and industry was well sustained in his conduct of the Aid. Small-pox was prevalent in Saint Louis in October, and one case appeared in the crew of the Aid on her way to New Orleans. This prevented her immediate departure for Red River, as it was necessary to quarantine her until free from infection, but caused no greater delay in her reaching Shreveport, for Red River was at lowest stage and passage up with the Aid before a rise was impossible. While waiting at New Orleans, the outfit of the crane-boats was completed. A steam force-pump was also placed on the Aid and a thousand pounds of dynamite, or giant-powder, received from New York. The dynamite was, like the blasting-powder, for experimental use. The steam-pump is a Blake's special fire-pump, of excellent workmanship, and capable of throwing two streams with great force through 2½-inch hose. It was placed on the Aid at your suggestion to wash the mud from the logs in the tow-heads and thus assist in opening a channel.

Four portable steam-saws and two portable boilers were also provided for the Aid and crane-boats. These saws are of peculiar construction, and although not new, merit a description, as they have been of great service in the work. They consist principally of a cylinder made of gas-pipe 3 inches in diameter and 3 feet in length, a small steam-chest and rolling-valve at the rear end of the cylinder, a cross-cut saw attached to the piston, and a light beam, 7 feet long, by the side of which the cylinder and saw are attached by a horizontal pivot at the steam-chest end of the cylinder. Half of the cylinder is prolonged to form a guide for the cross-head, and a vertical ratchet-arc and horizontal pinion give motion to the saw and cylinder, up or down, by the side of the beam, at the end of which the cylinder is pivoted. To use one of these saws the cylinder and saw are drawn up by the ratchet parallel to the beam, the forward end of the beam is laid on the log to be sawed, the other end to which the cylinder is attached resting upon the ground or deck. Steam is supplied by a flexible steam-hose. The operator seats himself upon the beam with one hand upon the throttle-lever and the other upon the pinion- crank. The steam is turned carefully on and the saw in motion lowered upon the log by the ratchet and pinion which control the feed. The saw and cylinder describe an arc, whose center is at the pivot at the rear end of the cylinder, the saw gradually cutting through the log while the beam remains by the side of the

kerf. When the cut is finished, the operator, by means of the ratchet and pinion, winds the saw up through the arc which it has described in passing through the log, until it is in position parallel to the beam.

The photographs of the Aid, crane-boat No. 2, and other saw-boats, show these saws at work, both upon the logs drawn up on the apron of the Aid and lying in the water. The crane-boats built in New Orleans are 65 feet long, 20 feet beam, 3 feet hold, scow-built, and furnished with a cabin for the shelter of the crew of twelve men.

An open deck is left for work forward, 21 feet in length, and aft 8 feet. On the forward deck was placed a boom-crane with mast and boom, each 20 feet in length. The hoisting gear of these cranes is worked by hand, and contains a winch which can be used for a pull from the water, or horizontally, as well as for hoisting on the crane.

By means of a pair of three and four part-blocks six men can lift enough by the boom to settle the bow under water.

The hulls are proof against hard usage, being built of very heavy timbers, of the full length of the boat, and securely fastened.

The small-pox infection being no longer feared, the Aid, with two months' provisions, took the two crane-boats in tow and started up the Red River November 25.

Crane-boat No. 1, in charge of Capt. D. M. Kingsbury, shipped a crew in New Orleans; crane-boat No. 2, under charge of Capt. C. H. Butts, took no crew, his instructions being to get a crew in Shreveport.

The crew of the Aid, from Saint Louis to Shreveport, consisted of a party of seventeen lumbermen from Michigan, hired by and under charge of Mr. C. E. Hollister; the plan being to ship a new crew for the Aid at Shreveport, when Mr. Hollister and his Michigan party could be detached to work independently.

The Aid did not arrive at Shreveport till January 10. In the mean time I organized (December 1) a shore party of about twenty men to begin work on the tow-heads and lower parts of the raft, the low water affording opportunity for chopping over the surface. This party began work at raft No. 3, that place being chosen because some cabins near by afforded shelter for the men, for whom I had not been able to get tents enough.

Two similar parties were organized December 9, one under Capt. J. S. Tennyson, to begin chopping on the tow-heads at the foot of the raft, and the other, under Mr. R. J. Heath, to go to Miller's Bluff and begin work on raft No. 28. This raft was selected rather than No. 27 because I feared that drift, if pulled from No. 27, would fill up Red Bayou, which is a navigable stream common to two chartered routes around the raft. The drift pulled by Captain Heath from No. 28 would stop at the head of No. 27, and when the river should be opened below would be allowed to pass by Red Bayou without obstructing it. These three shore parties continued to work under the supervision of their respective foremen, chopping surface logs and growing trees on tow-heads, girdling standing trees on the banks, and pulling such logs from the raft as would yield to the appliances at hand. For the latter work lines and blocks were furnished, and "wheel-horses," or rude hand-capstans made. Attempts were made to burn the floating raft, but without success. By cutting, splitting, and drying the logs they could be made to burn, or by piling the logs together, as in clearing land of newly felled timber, but this involved more labor than floating them away.

Afterwards by my direction Mr. Heath built two flat-boats in Posten Bayou, each 55 feet by 16 feet, and Captain Tennyson still later built one above raft No. 9, 65 feet by 15 feet. A hand-capstan was placed on one of Mr. Heath's boats, and one of the heavy crabs from the Aid on the other, and on Captain Tennyson's Essay. The latter was also furnished with a pair of spears at the bow for hoisting snags, a small cabin, a kitchen, and store-room. Provisions, tools, and camp-supplies were hauled by teams from Shreveport to Carolina Bluffs, and Miller's Bluffs; the river being then too low for profitable navigation above Shreveport.

The rise which finally enabled the Aid to reach Shreveport, January 10, continued till the river above was also navigable for boats of her size and draught; but the channel was too narrow and too much obstructed by leaning trees to allow her to tow the two crane-boats; consequently I hired the small steamer Kalbaugh to tow crane-boat No. 1 to Carolina Bluffs.

A camp outfit was provided for the Michigan party, crews shipped for the Aid and crane-boat No. 2, and the Aid started up the river January 20th.

Finding it impracticable to tow crane-boat No. 2 with the Aid, I hired the steamer Hornet to do it. The Aid reached Carolina Bluffs the 27th; crane-boat No. 2 arrived the following day; and both crane-boats pulled up to the tow-heads at Cowhide Bayou and began making a channel. The Aid found two days' work in snag-pulling between Carolina Bluffs and the foot of the raft; and when she arrived there crane-boat No. 2 had effected a passage through a channel made just wide enough (20 feet) for her to pass.

Captain Kingsbury was placed in charge of the blasting operations, and at once began the use of powder to open a channel for the Aid. It was found difficult to get the charges placed deep enough to be effective in the tow-heads; as a shaft attempted anywhere was at once found to be obstructed by logs. By blasting in water, and working

holes around the logs as they were found in digging, to get the charges as deep as possible, tolerably good results were obtained.

The dynamite was tried, but found to be entirely worthless. Probably it had deteriorated on its passage from New York; at all events it failed to explode under any circumstances till warm summer weather, and then without any certainty, generally burning slowly when ignited by the best electric exploders. Had it been as effective as nitro-glycerine, it would have been invaluable in the first tow-head work, as it could have been exploded at the bottom of the holes bored through the logs to any desired depth. The powder-blasts were followed by washing with the steam-pump; the hose attached to a suitable pole and guided under the water by two men. Drag-hooks were also used, and by means of the steam capstans the logs were pulled out as fast as they appeared. It was found that cotton-wood logs which had certainly been under mud and water at the bottom of the river twenty-eight or twenty-nine years, would float lightly as soon as the mud was removed from them. In many cases, however, the stumps would sink when cut off from the log, and sometimes were sufficiently heavy to sink their end of the tree.

Ash, elm, and cypress, which had been sunk for a long time, generally refused to float; but the cedar was always found buoyant.

Much has been said about the wealth of cedar to be found in the raft, but its value has been greatly exaggerated.

Small cedar trees, suitable for posts, can be found almost anywhere in the raft, but trees large enough for making boards a foot wide are comparatively rare and the quality very imperfect. By the various means employed, the channel through the tow-heads was gradually opened, till after two weeks of hard work it was wide enough to allow the passage of the Aid to open water, below raft No. 1. This progress was not very encouraging, as affording probability of an early completion of the work; but as I expected, the rafts above proved less difficult.

When the Aid passed through the tow-heads, Captain Butts had got his crane-boat through raft No. 2, leaving the Aid to widen the channel; and he managed to keep ahead till raft No. 5 was reached.

To Captain Kingsbury, crane-boat No. 1, was assigned the duty of following the Aid and keeping the channel clear by sawing, chopping, and blasting the jams which frequently formed in the narrow parts of the channels through the rafts.

Captain Butts found that the portable steam-saws would work well in water across the current, which was contrary to the general belief. The deflection of the saw by the current in that position, though considerable, did not materially hinder its passage through the logs. This discovery led to placing the steam-saws at the stern of the flat-boats, on a small platform built to receive them. They were there placed across the boat, the outer end suspended from a light crane so that the saw could be lowered at will upon a log dropped down alongside the boat. The current thus constantly assisted to place and hold the logs in position; and by passing the log down past the saw it could be cut to any desired length. This method was at once adopted by the five flat-boats, which were furnished with steam-saws; and thus the greater part of the larger logs of the raft have been sawed without lifting them from the water.

On arrival at Carolina Bluffs, Mr. Hollister with his Michigan party was sent to Cuba plantation, two miles down Dooley's Bayou, with instructions to open the bayou for the passage of drift into the Dooley Lakes; after which he was to begin hand-labor at removing raft No. 20, and build a flat-boat for a steam-saw and the remaining heavy crab from the Aid. Thus, at the end of January, the raft was attacked at five different points, viz, by the Aid and crane-boats at the foot, and four "shore parties" at rafts Nos. 6, 8, 20, and 27. The "shore parties" were so called because they began without boats to work from; but all were provided with boats before the end of March.

February 1 the foreman of the party first organized was discharged, and his place filled by Mr. W. G. Kent, from the Michigan party, after which I had nothing to desire on the score of diligence, fidelity, or interest throughout the seven parties employed. The rate of progress was more encouraging as officers and crews became familiar with the work.

Early in April Mr. Kent moved from raft No. 17 to 26, immediately below Red Bayou, taking possession of the boat built for him by Captain Heath in Posten Bayou. He was, however, unable to use this boat on raft 26, the boat being above the raft; but by hand-work he succeeded in opening a tolerable channel before the middle of May, after which he began on November 27 with his boat and steam-saw. April 26, the Aid reached Dooley's Bayou, having overtaken Captain Tennyson and his shear-boat Essay a short distance below. The Essay was then placed behind the Aid with crane-boat No. 2, and the same plan was afterwards carried out with all of the saw-boats when reached by the aid. This arrangement was found to work admirably, the Aid being able, with her steam-capstans, to pull drift-logs enough in the looser rafts to keep all of them busy with the steam-saws.

Mr. Hollister's boat was overtaken at No. 23, above Elmer's Bayou, he having opened a good channel through rafts 20, 21, and 22, sending all of the drift into the Dooley Lakes.

Captain Kingsbury was then placed at the head of Dooley's Bayou, with directions to keep it open to the lakes as long as possible. The Aid, now attended by three saw-boats, worked upward toward Red Bayou. Several jams were found below at different times and broken by the steamboats, generally the Clifford, plying between Shreveport and Carolina Bluffs. One about a quarter of a mile long in the narrow river four miles by land above Shreveport detained the Clifford in her passage down from Carolina Bluffs with a load of cotton April 21. The delay promised to be a serious one, in spite of the efforts of the crew to open the jam from below. Happening to be in Shreveport at the time, I visited the jam and at once dispatched a messenger with orders detailing Captain Butts and six men with hand crab, lines, &c., to come down in skiffs to the jam. He arrived before sundown the 22d, and by hard work by torch-light opened the channel at 11 p. m.

Many small jams were formed above Carolina Bluffs, but were always removed by parties detailed for the purpose. Considerable delay was, however, thus caused, and the cost of bringing freights, provisions, and supplies considerably enhanced. The question of getting supplies at all began to look serious, and in view of greater future necessity I recommend the purchase of a light-draught steamboat, at a cost not to exceed \$5,000. This recommendation having been approved, the steamer Kalbaugh was bought for \$2,500 April 23. Although very much out of repair, she proved to be admirably adapted to our needs. Her first duty was to take a portable boiler and pile-driver engine around through Soda Lake, Red Bayou, Posten Bayou, and up Red River to Captain Heath's camp. This boiler and engine had been bought by authority in Shreveport for an additional steam-saw boiler, which purpose it still answers very well. Afterwards the Kalbaugh was employed in carrying supplies to the Aid and parties, making at least one trip a week from Shreveport to the work, and seldom failing to find some obstacle to be removed on the way.

A favorable rise in the river, beginning May 12, made our work somewhat easier; and the three saw-boats behind the Aid were pushed to the utmost to cut enough of the larger logs to keep the river from jamming below.

The 16th of May opened an era in upper Red River navigation. Mr. Kent's party had opened a narrow channel through raft No. 26, below Red Bayou, and the Aid began the work of enlarging it the 15th.

A party of gentlemen from Shreveport Chamber of Commerce, with ladies, had come up to see the work of raft-removal, and in anticipation of the event of opening navigation to Red Bayou, by which the shoal and dangerous mouth of Black Bayou would be avoided.

The steamer R. T. Bryarly, with a heavy load of freight for the upper river, came up the night of the 15th, expecting to go through Red Bayou, and thence by the Sale and Murphy route to Fulton, Ark. Only a few heavy logs remained to be pulled; and, after an hour's work on the morning of the 16th, the Aid backed out of the still narrow channel to make room for the Bryarly to pass through. She went through without stopping, and, with jubilant whistling from both boats, passed into Red Bayou, the first boat in twenty-nine years to take freight for upper Red River past Carolina Bluffs.

The Frank Morgan followed the same day, and a traffic at once began by which the remainder of the cotton crop (about 10,000 bales) was brought out from the upper river, and a proportionate amount of freight carried up in return.

The Aid, having overtaken Mr. Kent's boat at raft No. 27, had then four saw-boats behind her, Captain Heath being by this time about Alban's first canal, at raft No. 30.

Having examined Alban's canal No. 2, I decided that it should be opened for the passage of drift from the raft No. 41, immediately above it, into Posten Lake.

Mr. Hollister's party was detailed for the purpose, and his boat towed up through Posten Bayou and Lake to the lower end of the canal. A strong current was running out from the river, and although the canal was filled with a very heavy run of drift, and barred in addition by the wreck of the Cuba, sunk there in 1869 by striking a tree, I thought it worth while to spend some time in securing an additional outlet for drift.

For some time I had been making preparations for the use of nitro-glycerine, which, however, could be obtained only by manufacturing within the limits of my own transportation. Accordingly I agreed with Mr. C. D. Chase, operative chemist, from Saint Louis, to manufacture a limited quantity, guaranteed to be the tri-nitro-glycerine so successfully used by its manufacturer, Mr. G. M. Mowbray, in the Hoosac tunnel.

The price fixed was, for the experimental quantity of 100 pounds, \$1.50 per pound, which Mr. Chase estimated would be within the cost of production, owing to the quantity and high price of ice used, and the high rates of freight charged on the acids, necessarily shipped from Cincinnati.

If the quality of the product was found equal to that made by Mowbray, and its use found desirable and economical in the work, Mr. Chase would continue to manufacture it in such quantity as might be required, if not less than 500 pounds a month, for \$2 a pound, delivered at a magazine built for the purpose near raft No. 8. Owing to delay in receiving the acids, Mr. Chase was not able to furnish the experimental quan-

tity till the latter part of May, and on the 30th of May the first trial was made at Alban's second canal.

Part of the work of opening this canal consisted in the removal of growing trees in deep water. One large cypress was a complete barrier to the passage of any but the shortest drift; and on this tree our first experiment was made. The tree stood in 12 feet of water, was 30 inches in diameter at the water-surface, and perfectly sound, having been dead but one year. To allow the passage of drift required that the tree should be cut off at least 6 feet under water. The cartridges, containing in all 5 pounds of nitro-glycerine, were suspended in the water on the up-stream side of the tree, 6 inches from the bottom, the current holding them in contact with the trunk. Electric exploders and the Smith's battery were used, and the charge exploded. The tree, which stood with a hundred feet of trunk and a full top of branches above the water, was lifted about 10 feet in the air, and the bottom of the trunk thrown at the same time about that distance from the stump, away from the cartridges, causing the tree to fall in a direction opposite to that toward which it was leaning. The trunk was found to have been cut squarely off at the bottom, the upper end having a broomed and shattered appearance. Twenty pounds in all were exploded the same day, with equally satisfactory results. The logs are not thrown much in the air, unless the charge is fired near the surface; but those in the immediate vicinity are broken in two.

Where a mass of heavy logs are found, as is frequently the case, requiring the work of a whole party for a day or more before the logs can be separated for sawing, a charge of 3 to 5 pounds exploded under them renders their removal at once easy.

Refractory snags, and stumps too large or irregular to be sawed, or those which sink beyond the reach of the saws, are easily blown to fragments by small charges placed directly under them or in auger-holes bored partly through. The latter method is most effective and economical where the log can be reached for boring.

Notwithstanding its evident advantage, its introduction in the work has been slow, partly because I had not two batteries, and partly because of distrust of its safety on the part of the men. Mr. Hollister continued its use with complete success in opening the canal and subsequent work on the large raft (No. 41) above it, sending the drift into Posten Lake, as proposed. It would have been impossible for him with other means at his disposal to have accomplished the work necessary to this end.

No accident has occurred. The usual precautions in handling it are taken, and when transported it is kept at a low temperature, although not absolutely frozen. To freeze it would require a considerable extra quantity of ice, and when wanted for use time would be required to thaw it. Captain Kingsbury has charge of the other battery, and is about to begin its use in removing snags and stumps which obstruct the river below Dooley's Bayou.

The total quantity manufactured up to June 30 is 656 pounds, of which 196 pounds remain on hand at this date. Of the 460 pounds used, about 400 pounds were expended on Alban's second canal, the remainder being used in Hervey's canal and in breaking jams below Dooley's Bayou.

The last week in May the Aid reached Alban's first canal, passing through rafts 28, 29, and 30 with comparatively little work, Captain Heath having made channels through all and partly through No. 31. The water-head continued to rise till all banks above Red Bayou were submerged.

The raft in Hervey's canal, upon which much labor had been expended in the early part of winter, was swept out by this rise, and for more than a month its current was so rapid as to take in all drift sent down from above it. The effect produced by the high water on the river between Alban's first canal and Kown's canal was unfavorable to progress. The current was entirely stopped, and the drift could not be cleared away behind the boats except by towing it. This was unprofitable work, so I sent one saw-boat into Hervey's canal to keep a passage open for the drift sent down by Captain Heath, still at work on raft 31, while two others were sent down to McWillie's ditch to cut wood in the cypress brake in McWillie's Lake.

The Aid pulled two rafts out of Alban's first canal, within a mile of the river, each about an eighth of a mile in length. These rafts were in danger of being carried whole into the river, where they would have made a troublesome jam; as it was, they were stowed in Simpson's Lake. A good side route around the raft was thus opened, avoiding the crooked channel and cross-currents of Posten Bayou, and affording easy communication, through Posten Lake, with Mr. Hollister's party at Alban's second canal.

The remainder of the month of June, up to the 25th, was spent in improving the channel from raft 24 to raft 31. After the 25th the current was sufficient above Alban's first canal to enable the Aid to begin work on raft 32, where Captain Heath's boat was overtaken. The high water had, therefore, delayed the Aid in her part of the work for a whole month; but the time was not lost.

Some changes in the superintendence of the work have occurred. On the purchase of the Kalbaugh, Captain Tennyson was placed in charge of her as captain and pilot, and his place on the Essay filled by Mr. George H. Grove, from the Michigan party.

Captain Rogers, in command of the Aid, resigned his position June 1, and Captain I. B. Hiserman, formerly mate, was appointed in his stead. The Michigan party of laborers returned home June 1, that time being the limit of their agreement for service. Captain Hollister remained, and his party was recruited in Shreveport. Mr. W. G. Kent was obliged, by ill-health, to give up his position in charge of his saw-boat, and his assistant foreman, Mr. J. D. Johnson, was appointed in his place. Constant changes have taken place among the laborers, owing to the prevalence of malarious fevers, especially since June 1. This deprives the work of experienced labor, but the numbers are readily filled by recruits hired in Shreveport.

The work accomplished so far is the opening of a navigable channel through four miles of raft, by which the navigation from Shreveport to the Upper Red River is very much improved, and the time of possible navigation increased, by avoiding the route through Black Bayou. Three and a half miles of raft remain to be removed. With the present organization of labor and appliances the remaining work will be comparatively easy, but, owing to the immense bulk of the upper rafts, and the greater breadth of the river, the time required may be longer than that of estimates based upon progress below.

The delay caused by high water in May and June, amounting to one month, must also be added to that estimate, making the time of completion at least as late as November 1 instead of October 1, as estimated in my letter of April 5, with plan of operations for the removal of Red River raft under the additional appropriation of \$80,000. At the present writing I have no material change to make in that plan of operations, and would, therefore, respectfully refer to it for the plan for the coming fiscal year.

In connection with the removal of the raft, an attempt has been made to utilize the drift in the closing of Tone's Bayou. Mr. A. L. Gervin, who had been employed as a foreman on the contract work in Tone's Bayou last season, proposed to undertake to stop the drift in its passage through Tone's Bayou at the site of the recent pile-dam, the wing revetments of which were still standing.

Having obtained permission to hire Mr. Gervin and six laborers, an outfit of lines, &c., was furnished in April, and in a short time a considerable raft had been formed in the bayou, its lower end resting on the wings of the dam. The current into Tone's Bayou was sufficient to draw in all drift coming down from Red River above; and the accumulation was quite rapid, as all raft then removed was sent down the river.

By the first week in May the length of the raft was about four hundred yards, and the difference in water level above and below it about 3 feet.

The accumulation continued till the 8th of June without increasing in length, the logs rolling under and compacting the mass as they came down. At that date the waters had risen nearly to the top of the banks, and the pressure coming more upon the upper part of the wings, they gave way, and the mass went through to Bayou Pierre. Had the raft been of uncut logs its chance of withstanding the rise would have been greater. The immediate cause of its giving way was the stopping of fourteen cribs of heavy cypress timber, which had escaped from a mill in Shreveport. Seven of those cribs were secured to the bank by the watchman before the raft gave way. These were at once taken possession of and used for making a boom, which I have had placed about one-third of a mile above the site of the dam, where both banks are protected by growing timber.

The owner of the logs relinquished his claim upon them, and authority will be asked to pay the watchman a small price for the share to which he was entitled for salvage.

The new boom is finished in a very substantial manner, and placed across the stream at an angle of 45° with the current. It is securely fastened with guys of logs and of chains from the surplus stock of the Aid.

The new raft is accumulating slowly, as the drift of late has not been sent down the river. Probably, however, enough drift will hereafter be sent down to fill the bayou up to its head, a distance of about half a mile. A nucleus will thus be formed for a complete dam to the bayou, without which it will always injure and perhaps destroy the navigation of the river above Loggy Bayou. I do not expect that a complete, or even permanent, closing in part can be effected by a raft of drift logs; for where a current can act on the banks, they will wash away, and either wash the drift with them or make a channel on one side. The current can be greatly checked for a time, however, and the dangerous logs and snags from the raft at the same time removed from the main river.

The effect of this raft on the plantations above and below Tone's Bayou was described in my letter with report of operations for June. A complete change in the opinions of the planters interested has taken place, and all are now in favor of the complete closing of the bayou, even at the risk of being obliged to protect their fronts by levees, and if the bayou is closed a great deal of back land will be reclaimed and complete protection afforded to that already under cultivation.

To accompany this I have prepared a series of photographic views showing every

portion of the raft, parties at work, &c. With the views is a photographic map of the raft region, with the location and axis of the camera for each view marked upon it and numbered to correspond with the number on the view.

This album of photographs, affording a complete and truthful panorama of the raft, will give a better idea of the nature of the work performed and of the character of the country than could be obtained from the most elaborate description.

It is proposed to continue the work during the summer and fall, the health of the working parties permitting, and it is thought that before winter a navigable channel will have been obtained through the whole length of raft. Afterward the remaining raft is to be removed, the banks cleared of overhanging trees and other obstructions, present or prospective. After this attention will be turned to the destruction of drift and timber in danger of falling into the river for a distance of about four hundred miles above the head of the raft; this to prevent the formation of future raft.

Very respectfully, your obedient servant,

E. A. WOODRUFF,
First Lieut. U. S. Engineers.

Capt. C. W. HOWELL,
Corps of Engineers U. S. A., New Orleans, La.

FINANCIAL STATEMENT.

Available June 30, 1872.....	\$150,000 00
Appropriation for 1873-'4.....	80,000 00
Total.....	230,000 00
Expended June 30, 1873.....	135,858 53
Available for the year ending June 30, 1874.....	94,141 47
Appropriation recommended for year ending June 30, 1875.....	50,000 00

Afterward for several years there will be required an appropriation each year of probably \$10,000 to prevent the formation of raft until the river regains its proper dimensions.

COMMERCIAL IMPORTANCE.

This subject is treated in the report of Lieutenant Woodruff, to be transmitted with my final report on survey of raft regions.

The work so far has furnished exit for 10,000 bales of cotton. The country opened is capable of producing many times that number. Much valuable land overflowed by the advance of the raft will be reclaimed.

The work is located in the collection-district of New Orleans, about eighty miles above Shreveport, La., is distant from any light-house, and is susceptible of permanent completion.

Q 3.

IMPROVEMENT OF CYPRESS BAYOU, TEXAS.

The work was commenced December 18, 1872, under an appropriation of \$10,000, and since continued, as shown by the following report of Lieut. E. A. Woodruff, the assistant in charge:

SIR: An appropriation of only \$10,000 having been made for the improvement of Cypress Bayou, it was decided to accept the offer made by the city of Jefferson, Tex., of the use of the dredge owned by the city.

Accordingly in November, 1872, I was directed to visit Jefferson and receive the dredge from the city authorities, hire a crew and begin work under the appropriation. Owing to delay, caused by miscarriage of telegrams, the transfer from the city authorities was not effected till December 18, at which time I assumed charge of the work, as then carried on by the city of Jefferson.

The city had a contract with Mr. A. Danahy, by the terms of which he furnished fuel and oil, and worked the dredge with a crew of nine men, for \$48 a day. By your direction a proposition was made to Mr. Danahy to continue the contract, paying

only for hours of actual dredging, at \$4.80 per hour. This proposition being declined by Mr. Danahy, I hired the crew then at work, according to your instructions, and placed Mr. Frasser, the dredge-engineer, temporarily in charge.

A few days later Mr. F. W. Gee, appointed to superintend the work, arrived and took immediate charge, living on the dredge.

The city had continued the contract with Mr. Danahy after the 1st of December at my request, as I was in daily expectation of definite instructions, and did not wish to have the crew disbanded, causing delay and expense in re-organizing for work.

The common council at the same time requested that I would recommend the assumption by the United States of all the expense of running the dredge after December 1, on the ground of low condition of the city finances. A statement of the circumstances having been forwarded, I was informed that payment to the city would be allowed for the first seventeen days of December for payment of the dredge-crew, at the rates actually paid, including an allowance for Mr. Danahy's services as foreman at \$150 per month. This payment was accordingly made to the city treasurer, the amount being \$308.89.

The plan of operations which had been adopted by the city was followed in the further prosecution of the work. This was to dredge the channel from Boone's Bend to the city wharf, making the same depth of water throughout this distance, about three miles. The contractor had reached the packery on the way up when work under the appropriation was begun.

The breadth of deep channel made was 45 feet, and the material excavated was deposited on the slope of the natural bank, narrowing the high-water channel, and leaving logs and stumps on the bank slopes, liable to slide back into the channel, and sometimes in such position as to be dangerous to boats passing at a higher stage of water. Care was taken in the continuance of the work to entirely remove all dangerous obstructions, and the contractor's work was also finished in this respect by going over it with choppers, and hauling out logs and stumps with a team of oxen. The excavation, however, was placed as before, on a slope of the bank, the reach of the dredge not being sufficient to place it on the top, entirely beyond reach of high water.

The condition of the work is fully described in my letter of April 5, with plan of operations for improvement of Cypress Bayou under the additional appropriation of \$50,000. The frequent occurrence of stumps requiring removal has caused many serious breakages of dredge-machinery. The dredge, although a very strong one of its kind, is better adapted to work in sand and clay than among stumps. Among the repairs made, new hoisting and swinging chains have been furnished.

The 16th of June the hoisting-drum broke, and work was necessarily stopped till a new one could be procured from the makers, Atkins & Burgess, of Chicago. Mr. Gee, the foreman in immediate charge of the work, has faithfully discharged his duty in giving strict attention to the work, and making necessary repairs with all possible economy and dispatch. The work has been continued through the sickly season without serious delays from sickness of the crew.

In accordance with your letter of May 28, authorizing me to purchase from Atkins & Burgess machinery for a derrick-scow, to work as auxiliary to the dredge, as recommended in my letter of April 5, I have sent to Atkins & Burgess, and also to Cummings & Morrison, dredge-builders, for proposals to furnish the machinery required. Their replies have not yet been received.

The dredging of Cypress Bayou, from Jefferson, Tex., to Albany, La., can, however, make only a limited improvement in the navigation from Jefferson to Red River. The high water and medium stages of navigation will thus be made safer and easier for boats engaged in this commerce, but the length of the navigable season will hardly be increased.

It is only by slack-water navigation that the bayou can be depended upon to afford competition with the railroad. By means of a lock and dam at Albany, as stated in my report on the survey of Cypress Bayou, a slack-water navigation can be made which will be sufficient for light-draught boats at all but exceptionally low stages of water in Twelve-mile Bayou.

It remains to be seen how much the removal of the Red River raft will affect the lake and bayou navigation to Jefferson.

The injury will probably be gradually increasing as the channel at Red River capacitates itself to carry a larger portion of the water.

The city of Jefferson has therefore a just claim, apparently, to measures of relief from the injury unavoidably inflicted by the raft removal. The building of the locks and dam at Albany appear to me the only direct remedy for this injury.

The following table shows the amount of excavation by the dredge from December 19 to the end of the fiscal year. It does not, however, include a large amount of work in removing stumps and logs, quite as important as the excavations, but which has not been estimated, although it caused great delay in the former work, besides involving delay and expense from breakage.

Months.	Length.	Average breadth.	Average depth.	Cubic yards excavated.
	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Yards, Feet.</i>
December, from 1st	542	45	7	6,323 9
January	1,045	45	7	12,191 18
February	296	45	6+	2,883 9
March	876	45	6+	7,533 9
April	436	45	6	4,360
May	591	45	7+	7,251 13
June	284	45	6+	3,296 18
	4,670	45	6+	43,839 22

I remain, very respectfully, your obedient servant,

Capt. C. W. HOWELL,
Corps of Engineers.

E. A. WOODRUFF,
First Lieut. Engineers.

Up to the date of assuming charge the work had been carried on by the city of Jefferson, and the plan on which the city work was conducted was adopted because the size of appropriation would not admit of the purchase of machinery to inaugurate a better one.

The appropriation of March, 1873, for Cypress Bayou and Soda Lake, which is but a continuation of the bayou, makes it now possible to purchase a spoil-carrier by which the material dredged can be removed to the top of the banks. The continuation of the work this year will be in accordance with the plan submitted in the following letter to the Chief of Engineers and by him approved, viz:

UNITED STATES ENGINEER OFFICE,
New Orleans, May 15, 1873.

GENERAL: I have the honor to submit the following project for the improvement of Cypress Bayou, and construction of dam and dredging at the foot of Soda Lake, Texas, as provided for by the act of Congress approved March 3, 1873, appropriating \$50,000: 1st. It is proposed to continue the work of dredging in Cypress Bayou, below Jefferson, Tex., employing the dredge owned by the city of Jefferson, to work in connection with a boom-derrick, to be worked from the bank, on a movable tramway, for the purpose of removing the spoil to a desirable distance from the cut made by the dredge.

The importance of this will be seen from the perusal of copy of Lieutenant Woodruff's letter inclosed. It is proposed also to build a flat, with strong hoisting machinery on deck for removing stumps and projecting logs. This will absorb about \$20,000 of the appropriation.

2d. The remaining \$30,000 I propose to expend in clearing the Cut Road, above Albany Point. The obstructions to be removed are cypress stumps and sunken logs.

To do this work I propose to build a suitable crane-boat, provided with steam-power for the lifting, and to use explosives for shattering the stumps. The Cut Road is now the high-water channel through the lower end of Soda Lake. By removing the stumps and logs it will become the low-water channel; also enabling boats to avoid the present tortuous and dangerous channel between Albany Point and the Gate Post. The project for a lock and dam at Albany Point has only been considered with the light Lieutenant Woodruff's preliminary reports on survey of Red River raft region have thrown upon it. His final report will furnish data for a plan and estimate, not now available. I am not prepared to recommend or condemn the project for this lock and dam.

The amount of money appropriated is barely sufficient for other work of more immediate importance, and can be well applied as recommended, leaving the lock and dam project for more careful investigation than I have yet been able to give it. My present opinion of it is not favorable.

Should the above project be approved, I shall require in July, for purchase of machinery and for working expenses, about \$20,000. Each month thereafter from \$2,000 to \$3,000 for working expenses and repairs, as the exigencies of the service may demand.

Very respectfully, your obedient servant,

Brig. Gen. A. A. HUMPHREYS,
Chief of Engineers, U. S. A., Washington, D. C.

C. W. HOWELL,
Capt. Engineers, U. S. A.

I have grave doubts as to the value of a lock and dam at Albany Point. Lieutenant Woodruff will examine the matter more clearly and report upon it this winter.

In the meantime the money appropriated can be advantageously used as proposed in Cypress Bayou and on Albany Flats.

The work is of benefit to commerce, since for a portion of the year it will provide improved water communication between Jefferson and the Gulf of Mexico. I do not think that the results of the work can be considered as permanent because of the well-known tendency of streams flowing through an alluvial formation to make their own beds to suit the fixed laws assigned them by nature, unless hemmed in by art; and to form bars wherever nature allows them to expand laterally. Dredging only temporarily counteracts this tendency.

Excavation in a rocky bed, by diminishing the width of the stream, may make permanent increase of channel depth; but increase of depth in an alluvial stream, or on an alluvial bar, unless measures are taken to decrease the width of water-way, can only last for a few years or months; water in such case will work at the expense of the banks rather than of the bed of the stream.

FINANCIAL STATEMENT.

Available June 30, 1872	\$10,000 00
Appropriated March 3, 1873	50,000 00
Total	60,000 00
Expended to June 30, 1873	7,680 30
Available for work to June 30, 1874	52,319 70

The work is located between the cities of Jefferson, Tex., and Shreveport, La.

Q 4.

IMPROVEMENT OF TONE'S BAYOU, LOUISIANA.

By act of Congress approved June 10, 1872, an appropriation of \$20,000 was made for the "improvement of Tone's Bayou, Louisiana."

A letter from the Chief of Engineers, dated June 18, 1872, directed me to submit a project for the expenditure of this money.

I directed Lieut. E. A. Woodruff, United States engineer, to make an examination of Tone's Bayou, in connection with the survey of the Red River raft region, with a view to the expenditure of the \$20,000 to the best advantage.

The final report of this survey will be found in another portion of my report for this year.

The plan and details submitted by Lieutenant Woodruff involving greater expense than the appropriation would cover, the same plan with a cheaper construction was submitted with the following letter:

UNITED STATES ENGINEER OFFICE,
New Orleans, La., July 16, 1872.

GENERAL: I have the honor to submit herewith, with preliminary remarks, a project for the expenditure of \$20,000, appropriated by the act of Congress approved June 10, 1872, for works of improvement at Tone's Bayou, Louisiana.

The work has for its object the improvement of navigation in Red River, below Shreveport, that navigation having been seriously affected by the gradual enlargement

making a very bad place for boats. At lowest water all the water goes down Twelve-Mile Bayou, but at high water the larger portion goes down Cross Lake. At the junction of Twelve-Mile Bayou and Red River the bayou is about eight times as large as the river above the junction.

At Shreveport the Red River touches the western bluffs again, which is the first place where it does so below Digges Landing.

The bluffs on which the city is built rise to the height of 100 feet in the back part of it, and are stratified red clay, containing large quantities of fossil-wood, with soft sandstone below, and the same blue-clay shale found above near, and in the bed of the river.

I remain, very respectfully, your obedient servant,

H. C. COLLINS.

First Lieut. E. A. WOODRUFF,

United States Engineers, in charge of Red River Survey.

B.

NEW ORLEANS, LA., February 22, 1872.

DEAR SIR: I will endeavor to the best of my ability to comply with your request for information on the great raft in Red River.

I have been acquainted with this obstruction since 1844; have planted on the river largely since 1853, about one hundred and fourteen miles above the present head of the raft, producing from 600 to 1,000 bales of cotton annually, and have owned interest in steamboats plying around the raft, consequently I am well acquainted with the rates of freight and insurance charged, so burdensome to the planting interest above this obstruction. My lands are not, as yet, affected by the back-water caused by the raft, which reaches and injures the lands for some sixty-five miles above its head.

As well as I remember, in 1856, the last appropriation made by Congress was expended under the supervision of Colonel Fuller, who opened the raft from the head of Dooley's Bayou up, and improved that bayou for navigation through Shift-Tail Lake; the first rise brought down large quantities of new drift, and closed the head of this bayou, effectually cutting off access to it—no boat ever passed through it. Red Bayou above was still open, but it was evident that it would close the next season, the river having but a mile to fill below its mouth. This would have cut us off from all possibility of shipping, with a crop of some 50,000 bales on hand. Fuller's plan had entirely failed to give any relief. Much alarm was felt on the part of the shippers; a public meeting was called at Washington, Ark., and a committee appointed to go down and report on some plan for relief. I was one of that committee. We examined and reported against the practicability of any attempt to canal around the raft, as Colonel Fuller had tried, for several reasons, which I will give.

In the first place, this plan would give no relief to the overflowed lands above, and would afford uncertain and expensive navigation, as but a small class of boats could pass through. In the next place, a canal is not practicable over ten miles above the head of the raft, which must soon fill up, and necessitate the cutting of another, and so on.

On the report of this committee it was resolved to memorialize the legislature of Louisiana to grant a charter for the removal of the main raft. This was done, and the charter procured as desired, and, with the assent of Congress given, stock was readily taken by planters directly interested. I was elected president of this company, and was ready to commence operations in the spring of 1861, when the war broke out and nothing further was done.

Pending this legislation the raft had come up from Dooley's Bayou and obstructed Red Bayou. All communication was cut off that season. Boats landed their freight at Miller's Bluff, and it was wagoned above. That fall I cut what is known as Hervey's Canal, into Simpson's Lake, four miles above Red Bayou. This was used but little, as the war stopped all shipments of cotton. Several other canals have been cut and the raft closed them. I had two objects in cutting my canal where I did. First, for temporary navigation. Secondly, Simpson's Lake would make a fine reservoir for the new raft. By the construction of a boom I could have stopped it all above this point, while I was removing the obstruction below, making temporary navigation on the east side, to go in above my boom. This gives a history of my connection with charters, which, on account of the war, resulted in nothing.

I went to Washington, D. C., last winter to urge Congress to take action in the matter. My preference, first, as it is a national improvement, is, that Congress should do the work. Secondly, to give us the privilege, under a similar charter, to relieve ourselves. We could well stand the toll, as it would be made up tenfold in cheap freights and insurance. I will show what it has cost us since the war, in excess of what it

would have done with the raft taken out. High water in the winter of 1869 closed Alban's second canal by filling the river with raft in and above it. No outlet could be made the next summer, as the river was high all the season; the result was that the crop of 1870 was got out at enormous expense, and much damaged by handling. Four small boats succeeded in getting through above the raft, light, by way of O'Rourke's Slough, and brought the cotton from above to Bargetown, whence it was carried over from the river to Moon Lake, and there put on flat-boats to be taken to steamboats, which came up as high as "Last Chance," at the mouth of Konn's Canal. Twenty-two thousand bales were freighted through to New Orleans at the following cost to planters:

Average freight per bale \$9, total	\$198,000
Damage per bale \$10, total	220,000
Insurance 4 per cent., value \$1,650,000	68,000
Return freight	50,000

Total cost of freight and insurance

536,000

If the raft were out freight would be high at \$3 per bale, making	\$66,000
Insurance, one-half above rate	34,000
Up freight, not over	25,000

Total

125,000

Or a difference of \$411,000, which came out of the pockets of the planters; enough to remove the raft paid out on half of one crop. With the raft out, instead of 22,000 bales, 40,000 would have passed out. The remainder was forced to seek other transportation. A moderate estimate would be that an excess of \$150,000 annually is lost in this way.

In six years making	\$900,000
Add the amount lost in 1870	411,000

Total loss in seven years

1,311,000

Besides this, not less than 25,000 acres of once cultivated lands of the most productive quality have been abandoned, and as much more rendered unsafe to cultivate. For some thirty miles above the head of the raft the bottom-lands are uninhabited. The effects of the back-water are perceptible for sixty miles up. The raft has extended up from Miller's Bluff, a distance of some fifteen miles, since the summer of 1858. It is not solid, as you find, but as the length of the obstruction increases the damage is more than proportionate.

The annual effects now are very disastrous. Its growth depends upon the high or low water season, some years making a mile or more of new raft, which becomes compact and shortens, sinking to the bottom of the channel.

The extreme high flood of 1866 wrought a great change in the raft. It is thought by those who live in its vicinity that if the timber had been cleared from the banks it would have disgorged itself, freeing the channel. It was rolled up in short bunches, and much changed, leaving much larger open spaces. That winter, 1866, it made nearly two miles.

The soil of the banks being alluvial, and not capable of resisting a rapid current, the increased current of the freshets causes the banks to cave and slide in, taking the heaviest forest-trees down in the stream.

No valley has a greater variety or heavier forest-growth than this for a distance of five or six hundred miles above the raft. I have seen the surface of the water covered with the heaviest timber for two or three days during a freshet, so thick that it was impossible to cross a ferry-boat.

To keep the river clear a continuous appropriation must be made. Simply to remove the raft would be a useless expenditure of money.

With this obstruction removed, at least two hundred thousand acres of the finest lands in the world will be reclaimed and benefited.

With the outlets into the lakes left open, I don't think any plantations below the raft would be more liable to inundation than they are at present.

You will see that my opinion is, that nothing short of the removal of the raft will relieve the country. I have shown the cost of its remaining unmolested, and the effects on the lands. I know of nothing more that would be of interest.

Yours, respectfully,

C. M. HERVEY.

Lieut. E. A. WOODRUFF, *United States Engineers.*

C.

Sir: In reply to your letter of inquiry of December 23, 1871, my theory in regard to the formation of the raft is, that the clog originally took place far down toward the sea, and before it ever found its present outlet into the Mississippi River. In other words, that the waters of Red River formerly reached the Gulf by some connection with the Atchafalaya, and that more recently, as these rafts pushed farther up the stream to the nearer approach of the Mississippi, the Red broke through into that river, and has ever since mingled its gypsum wealth with the "Father of Waters."

These facts are well known to the observer by certain timber found deposited where the ancient signs of the raft still exist. I refer to the red cedar. This only grows high up on the old Red.

As time rolled on, this raft, with but short spaces intervening, has continued to accumulate with every annual flood, until over nearly all this rich valley the clog has taken place, producing constantly great changes in the valley and its tributaries; so much so, that over most any portion of the valley sunken or hidden raft can be detected.

In the valleys of the tributaries, remote from the immediate current of the river, (in the region of the raft,) huge lakes are found over the dense and heavy forests of these rich bottoms. In time, this timber rots out and leaves uninterrupted sheets of water for many miles, known as shallow lakes. They, in time, disappear, as the raft marches on upward and rots out below, again allowing these old outlets to resume their ancient channels. Thus has it been passing on for centuries, ever supplied by the huge and rapid growth of timber of this valley of unprecedented richness.

Captain Shreve, in the year 1835, commenced the removal of this raft by contract with the Government of the United States. He attacked it about Boggy Bayou, one hundred and twenty miles below Shreveport. By a genius well applied, he succeeded in eradicating this formidable barrier from our river, which work was accomplished in the spring of 1839, when a fleet of boats went through, and passed to the upper Red River.

No provision being made by Government to keep open the raft, it soon closed, and was again opened by General Williamson in later years, to close again as soon as the work was abandoned, until it now reaches from Carolina Bluffs to near the Arkansas line, a distance of thirty-five or forty miles, with short intervals of clear river. The exact distance of real raft you, from your recent surveys, are better prepared to say than any one else.

Of the routes resorted to for getting around the raft, before it was removed, I know of none previous to 1830; at that time, and many years previous, the route by Loggy Bayou, on the east side of the river, a short distance above Conshatta, was the traveled route; thence through lakes and sloughs until it came into the river again at the present mouth of Mack's Bayou, two and a half miles below Shreveport.

But when the raft reached the bluffs upon the west side of the river, (near Shreveport,) stopping further progress in that way, a cut was made from one slough to another by officers of the United States Army, to open a passage to the forts above. This occurred some two miles and a half in the rear of the present mouth of Mack's Bayou, connecting a slough or bayou that runs from the foot of Bodecean Lake, and at a near approach of these bayous the cut was made. When once in Bodecean Lake, it was crossed, and the lower mouth of Willow Chute was entered, and the river again attained far above the raft. This was a short distance below the Hurricane Bluffs on the east side. As the raft was removed from Shreveport, in the winter of 1836 and 1837, an opening was made through Twelve-Mile Bayou, and up the great lakes on the west side. Lieutenant Sewall (of the United States Army) proceeded through this route up Black Bayou at McNeil's (now Irving's) Bluffs, made a cut into old Red Bayou, which leaves Red River nearly opposite what is known as the mouth of Posten's Bayou, which puts into Red River on the east side, and is to be one course of navigation around the raft unless the same is removed.

As soon as the raft reaches Blanton's Bluff, which is again on the west side, and near the Louisiana line, the same phenomena will be observed in the valley of the Sulphur, as were about the valley lands of the Bayou Pierre, Bisteneau, Bodecean, Cass, Cypress, and Black Bayous, forming immense lakes. All the swamp-lands of the Sulphur and Posten's Bayous are destined in their time to become shallow lakes, and unless this barrier is removed, the old and wealthy settlements of Long Prairie are destined to become a waste, like its rival in richness, Caddo Prairie.

It might be as well here to call attention to the fact, which is perceptible from the above statement, that from some cause in the nature of this river—for which I am unable to account—it alternately seeks the bluffs upon either side of the valley, in motion like a huge serpent, forever resting upon alternate sides of the valley, and from the quantity of sand it carries along with its alluvium, ever depositing and forming natural levees across the bottom, which makes that portion where rolls the river

the highest part of the valley, consequently forming basins between the different points where the bluffs set in. Into these basins are natural sloughs cut, which assist to carry off the surplus waters in threatened overflows.

A full answer to your fourth inquiry, asking for geological characteristics, &c., would be rather too long for this report. I will, however, say that it is a matter that have occupied much of my attention, and will merely add that this valley is rich in geological "signs," and when the time comes that the Government has concluded to make the investigation there will be found sufficient testimony, if not in the rocks, in other deposits peculiar to the valley, to read its history far back into time.

My opinion in regard to the navigation of the Red River above this place would be so inferior to that of river-men that I almost fear to venture an opinion, but will say that the route by the old channels should, in all cases, be selected when practicable, either above or below this place, and this brings in my answer to your fifth question, concerning Tone's Bayou.

Of this bayou I am well informed, having been acquainted with it since it was opened by individual enterprise, in about 1850, to the present time; it being situated near the widest part of Bayou Pierre Basin, soon made itself a formidable rival to the route selected by Captain Shreve. State aid was evoked time and again, but nothing was accomplished until the summer of 1862, when a cut-off (known as Scopini's) was made in the bend, one and a half miles above, by order of the Confederate States government, and for some time was believed would prove successful; but the bayou has gradually overcome the expected preventive, and now promises to destroy the navigation of the river, or very severely injure it.

In a report of W. H. Osborn, engineer for the third swamp-land district, printed by the State in about 1857, he speaks of it as totally impracticable, and destined to ruin the navigation of Red River if not stopped, and this is my opinion.

Col. L. G. De Russey afterward examined it closely and made a report of survey, with maps attached. This was done under a special appropriation of the legislature, and he recommended a tumbling dam, so as to use it in high water for navigation, and an escape for surplus water in overflows.

The protection of the navigation of Red River demands that Tone's Bayou be totally stopped up. Every year demonstrates more fully this opinion, and unless something is soon done, all low-water navigation will be destroyed, and what is now considered the safest and best navigation of the river will be substituted for one hundred miles of the most precarious and dangerous navigation known to river-men.

Why cannot the old river take off its surplus water as it formerly did? There always have been fewer levees and smaller ones on banks below Tone's Bayou than any other part of the river. These banks were all settled and in cultivation long before this bayou was opened; and besides, the Bayou Pierre upon the west, and Mack's and other bayous upon the east side, take off more water from that portion of the river than any other of the whole valley. The route entering Bayou Pierre, near Grand Ecore, extends as far as the landing for Mansfield, but is very difficult, although \$60,000 were expended on it before the war by the swamp-land department.

The route through Bistaneau Lake into Dorchette Bayou on the east is very good in high water and has been resorted to for many years. The chartered route, extending through old Mack's Bayou into Bodecean Lake, and thence through Bodecean Bayou into Arkansas, is completed as far as Bellevue, and by the removal of some slight obstructions will open one of the richest portions of valley-lands known to the tributaries of Red River.

My opportunities for acquiring information on the subject are those afforded by a long residence and much travel on this river; also having been swamp-land commissioner for third district of Louisiana, through which the whole course of this stream meanders.

I should like to extend these remarks, but other business at present will not permit. Should you see anything in this unfinished statement of service, it is freely at your service.

Truly, yours, &c.,

T. P. HOTCHKISS.

E. A. WOODRUFF,
First Lieut. United States Engineers.

D.

EXTRACTS FROM THE ANNUAL COMMERCIAL REVIEW OF THE SHREVEPORT SOUTH-WESTERN, OF DATE SEPTEMBER 6, 1871.

Cotton.—The receipts of cotton at this port for the commercial year ending August 31, show a total of 104,776 bales, against 111,618 bales to same date last year, being a decrease of 6,842 bales.

While the cotton-crop of the year was much larger than that of the one that preceded it, it will be observed that we received at this port, in warehouse, considerably less of the staple. This may be accounted for by the fact that the roads leading into Shreveport were not in proper condition during the winter months; that the article sought other markets to some extent in consequence, and that possibly a considerable amount of the old crop is still on hand in the interior, retained by the producers because of the low price which it commanded. This we fancy to be the case, because under other circumstances we should have received at this port an access, instead of a decrease in receipts.

From above, and reshipped at this point, have come about 25,000 bales, and other cottons taken from warehouses across the river and shipped immediately from wagons upon our levee without touching a warehouse here will amount to, say, 2,000 bales more.

The market opened in September, 1870, and ran through that month on a varying scale, averaging a fraction over 14 cents for low middling warehouse business.

The following is a summary of receipts by the warehouses of merchandise from boats, and forwarded into the interior by rail and wagons:

General merchandise, not enumerated below, in packages	201,510
Barrels flour	43,358
Sacks corn and oats	6,891
Bundles iron ties	18,710
Cases boots and shoes	25,104
Barrels and half-barrels molasses	8,111
Sacks coffee	5,125
Barrels and half-barrels whisky	3,116
Bales bagging	1,376
Rolls bagging	2,780
Barrels and half-barrels sugar	2,560
Boxes tobacco	3,100
Wagons, buggies, carriages	671
Casks bacon	2,825
Barrels pork	1,500
Bales hay	250
Hogsheads sugar	351
Coils rope	711
Pianos	45
Total number packages	328,094

Miscellaneous.

Total value of exports from this port	\$7,263,000 00
Merchandise sales for current year	6,639,960 00
Bank deposits	
Value of real estate	\$4,607,326 00
Value of personal property	\$1,718,947 00
Number feet lumber	4,295,000
Number feet gas consumed	1,404,000
Shipments of hides, pounds	2,000,000
Shipment of wool, pounds	76,907

The falling off from last year's warehouse receipts and shipments to the interior is to be accounted for by the action of the Southern Pacific Railroad.

On the 12th of November they began receiving freight consigned to their agents direct from the boats.

CYPRESS BAYOU.

As stated in my report of work of improvement now in progress in Cypress Bayou, I am not prepared to indorse a plan for lock and dam navigation, between Jefferson and Shreveport, but have directed further investigation of the project.

With this remark the final report of Lieutenant Woodruff, on survey of Cypress Bayou, is submitted:

Sir: Cypress Bayou properly includes the whole navigable route from Shreveport, La., to Jefferson, Tex., and an appropriation for the general improvement of Cypress Bayou would be applicable to any part of this route, unless its expenditure was re-

stricted by some clause of the act of appropriation. The route, however, consists of four divisions, caused by the lakes, which have nearly obliterated the old bayou channel for a considerable part of its course. These divisions are—

1. Twelve-mile Bayou, from Shreveport, to the foot of Soda Lake.
2. Soda Lake to the head of Willow Pass, at foot of Fairy Lake.
3. Fairy Lake to Bois d'Arc Pass, or mouth of Cypress Bayou.
4. Bois d'Arc Pass to Jefferson.

Considered as levels for slack-water navigation, the division would differ slightly from that given above.

Twelve-mile Bayou is a rapid stream, but deep and crooked, nearly always affording tolerable navigation from Shreveport to Albany, at the foot of Soda Lake.

Soda Lake may be considered a level for slack-water navigation from Albany to the head of Willow Pass, the fall in that distance being, at the time of the survey, (when there was 4 feet navigation to Jefferson,) only 1.63 feet.

From the head of Willow Pass the level of Fairy Lake extends throughout the whole lake, and up Cypress Bayou on to Smithland. From Smithland to Jefferson, a distance of six miles, the water is shoal, and above the back-water of a low navigable stage of Fairy Lake. The total fall, however, from Jefferson to head of Willow Pass, at the time of the survey, was but 1.5 feet.

In my preliminary report on the survey, dated April 29, 1872, I recommended, in the event of the removal of the Red River Raft, building a dam on the lines A, B, C, and D, shown on a sketch accompanying that report, at the lower end of Soda Lake. The object of this dam, as proposed, was to give a chute navigation to Soda Lake, and the recommendation was based on the supposition that if all the water flowing into Soda Lake was confined to the narrow passage at the Albany Bluff, the lake would be kept at a navigable stage. This supposition was, as I have since learned, by actual observation, entirely incorrect. In extremely low water all the water flowing into Soda Lake from Red River bayous, Black Bayou, and the three Cyresses, is confined at Albany Bluff to a narrow channel about 100 feet wide, having a maximum depth of 8½ feet, with a regular basin-like cross-section, and a velocity not exceeding three miles an hour. The dams recommended would evidently be useless at such a stage of water, and only a lock, with the dams, would afford the navigation desired. The dams built on the lines indicated, and a lock with a lift of 10 feet above low water, so as to maintain the Lakes Soda and Fairy at the height of ordinary low-water navigation, would give navigation to Jefferson at all times when Twelve-mile Bayou is navigable to Albany, which would be nearly at all times when Red River is navigable to Shreveport. Without such a lock and dam the navigation to Jefferson must gradually deteriorate after the removal of the Red River Raft. The three Cypress bayous, Big, Little, and Black, and Black Bayou, would doubtless supply water enough for the lock-navigation proposed, without assistance from the Red River overflow. In high water, the lock-gates being left open, a chute-navigation would be obtained without the trouble of locking. The lakes would then be more effective reservoirs than at present, holding back a moderate freshet, instead of pouring it directly into Cross Lake, through the Gilmer ditches, as they now do. The great length of the dams would afford ample discharge for the highest water, without danger of backing the lakes over any Red River lands now in cultivation.

Soda and Fairy Lakes are bordered, except on the east side of Soda Lake, by poor lands, not under cultivation, nor worth cultivating.

In 1867 a lock and dam company was organized in Jefferson, and a preliminary survey made of the vicinity of Albany by Mr. F. P. Leavenworth, civil engineer. The following extracts from his report to the directors of the company show that the project is feasible. His survey was made at a lower stage than that of this survey, but the water was 10 feet higher than the lowest water, at which there is no navigation. His section line across the valley from Albany Bluff to Red River, at Gold Point, is marked on the map of this survey:

[Extract.]

“JEFFERSON, TEXAS, October 31, 1867.

“To the Directors of the Lake Lock and Dam Company.

“GENTLEMEN: I have the honor to lay before you the results of a preliminary survey of the outlets of Soda Lake, made in accordance with instructions from your committee. The waters of Soda Lake, about a mile above Albany, are spread out over a broad shallow bay, giving only 2 or 2½ feet of water at the present stage. These are the only shoals of any difficulty between Shreveport and the Jefferson packery; and the object of the survey was to ascertain whether the waters of the lake could not be backed up, so as to render the navigation good at all seasons.

“Reference to the accompanying map will show that the lake now discharges its water, about one mile below the flats, through two passes; the main channel, which

has an average width of 370 feet, and a section of 2,400 superficial feet; and the south slope measuring 400 feet in width, with a section of 902 feet. The greatest depth of the main channel is 18 feet, with a current of nearly 100 linear feet per minute.

"The current of the south slough is hardly perceptible, and its greatest depth is 3 feet. The north slough does not, at this stage, discharge any water from Soda Lake. In order to satisfy ourselves, beyond question, that these three passes, namely, the main channel, north and south sloughs, were the only outlets through which water can escape when at a stage not exceeding 3 feet higher than at present, I projected a line from the north bank of the north slough to the nearest point on Red River, distant nearly 3 miles. This line crossed no channel or bayou, through which the water might escape and reach the arable lands of Red River, at a maximum elevation of 18.15 feet above the highest flood level of 1866, upon Soda Lake. This flood-mark was 2.38 feet higher on Red River than on the open lake, and the surface of Red River was 3.80 feet above the present level of the lake at Albany. Returning to Albany, careful measurements and soundings were made of the main channel and both sloughs, with a view to ascertain the probable cost of a dam of the maximum height of 3 feet above the present lake level, with a lock in the channel.

"The proposed obstructions will, doubtless, raise the level of the lake, even in the lowest stage, to the top of the dam. Time was not afforded to find how far this would back the water up the lake, but the inference, from a survey of the lake shore from Albany to George's plantation, was, that the level would be effected above the mouth of Willow Pass, giving about 5 feet water on the flats.

"The dam would reduce the cross section of the outlets during the low stage from 3,302 to 1,080 superficial feet; nor would this materially affect the discharge of water during a flood, since the ridge of the proposed dam is 14.13 feet below the flood-level of 1866, 6.37 below the level of 1867, and 6.51 below the lowest arable lands on Red River.

"In the event that the proposed obstructions were deemed too expensive, the plan could be modified so as to contain a series of flood-gates between substantial abutments, the opening of which would give nearly the same passage to the descending waters as at the present time. We propose to avail ourselves of the highest portions of North and South Islands, which are four feet in height, and work them into the line of obstructions. We require a dam fifteen hundred feet long and six feet high between the north island and the north slough; one four hundred and ten feet long and six feet high between the two islands, and wing-walls from each end of the lock to the shore of the main channel. The southwest shore of the lake is well supplied with stone of an excellent character for ballasting the dam, but not in sufficient quantity for construction. The best location for the lock is on the line designated B D on the map, adapting the center of the lock chambers to the course of the natural channel, which, at that point, occupies a gap forty feet in width, with an average depth of eighteen feet. The wing-walls from the fore and tail bays would return to either shore with the ordinary dam, and the cavity thus inclosed on either side of the lock would be filled in with clay and edge pared with rock.

"The probable cost of a dam of 2,348 feet in length, with timber foot, top face, and slope of 4 to 1, is about \$40,000; and a lock 200 feet in length, 60 feet wide, with a draught of 18 feet and lift of 3 feet, will require an expenditure of not less than \$120,000.

"P. P. LEAVENWORTH."

The present survey supplements that of Captain Leavenworth in one important particular, viz, the fall of the water surface, at a navigable stage, from Jefferson to Albany, which is seen to be but about 3 feet. The company for which Captain Leavenworth's survey was made appears to have failed to prosecute the work for want of capital. At all events, no further work was done toward building a lock and dam. The estimates of \$40,000 for the dam and (not less than) \$120,000 for the lock would not be a safe guide for the present time. My estimate of \$70,000 for the dam alone, as given in the preliminary report, is probably small enough. No estimate was made for a lock, and my duties on the work to which I am at present assigned do not leave me time or afford facilities for making an elaborate plan and estimate. The general plan described by Captain Leavenworth would necessarily be adopted. The detailed plans for construction of the dam would be subject to variation. The difficulty to be overcome would be in guarding against washing of the bottoms near the dam and lock. The current, in high water, is very rapid, but the soil is a tenacious clay. The work ought to be done in the very lowest stages of water, and might be delayed or interrupted by the freshets, which seem to come without any particular recurrence. Elaborate preparations, and therefore ample capital, are required to insure the safety of the work during its progress.

The dam could not safely be built till after the completion of the lock, as its presence would endanger the latter in case of a freshet. Only a lock and dam can supply the

deficiencies of the lake navigation to Jefferson and make amends for the diminution of the water supply caused by the removal of the raft.

The cost of the complete work ought to be within \$300,000.

I would especially recommend that if any appropriation be made for this purpose authority be granted by special act, if necessary, to the officer or agent in charge of the work to cut timber from the most accessible public lands in Louisiana and Texas. The timber on these lands (principally swamp lands) is cut at pleasure by raftsmen who supply the Shreveport market.

The tender of the use of the Jefferson dredge, promised in the preliminary report, was duly made and accepted. For the work of deepening the shoal channel between Jefferson and Boon's Bend it has answered very well, but has required many repairs. Much useful work can be done by removing stumps and trees, and in making the channel through the lakes, particularly in Fairy Lake.

The deepest water from Oxbow or Bois d'Arc Pass down to Bird Island is found in the old channel of the bayou. If no lock and dam are to be built, this channel should be improved by pulling stumps and dredging across the points. With a lock and dam sufficient depth of water could be found by a direct route, passing around near Potter's Point, and thence directly to Rocky Point. In either case a small boat, such as recommended in my letter of March 29, 1873, concerning the Cypress Bayou improvement, would be the most economical means of doing the work. To that letter I would respectfully refer you for my views on the subject.

The following table of statistics was compiled by order of the city council of Jefferson, to accompany a memorial to the Senate and House of Representatives asking for an appropriation of \$250,000 for the improvement of the navigation of the lakes:

"RECORDER'S OFFICE, JEFFERSON, TEX.,

"March 12, 1872.

"By order of the city council the following statistics are furnished, as shown by the books in my office:

Population of the city, (just taken)	7,297
Steamboat arrivals in the year 1871	226
Capacity in tons, (from 125 to 700)	67,822

EXPORTS.

Cotton shipped from this port from September 1, 1870, to September 1, 1871, (bales).....	76,328
Dry hides.....	84,762
Green hides.....	18,471
Wool, pounds.....	87,623
Peltries.....	48,210
Bois d'Arc seed, bushels.....	9,721
Cattle.....	5,381
Lumber, feet.....	121,000
Pig-iron—amount not ascertained.	

"J. K. LAURANCE, Recorder."

The city of Jefferson has shown much energy and public spirit in building a large dredge at an expense of about \$50,000. The machinery was built by Atkins & Burgess, Chicago, and the hull in Jefferson. It is an excellent machine for dredging sand and clay, and has done good service in pulling stumps—a kind of work for which a dredge is not specially adapted.

The iron products of Jefferson, amount not specified, promise to become of considerable importance. The pig-iron product, from native ore, is used in the manufacture of stoves, plows, agricultural implements, &c.

E. A. WOODRUFF,
First Lieut., U. S. Engineers.

Capt. C. W. HOWELL,
Corps of Engineers, U. S. A., New Orleans, La.

STONE'S BAYOU.

The report of Lieutenant Woodruff is transmitted without remark. Such as I have to make will be found in my report on improvement of Stone's Bayou:

SIR: This is the most important obstruction to navigation in Red River below Shreveport. To it my attention had been particularly called by steamboat-men and merchants of Shreveport.

It is an outlet of Red River, about twenty-eight miles below Shreveport, through

N 2.

NEW ORLEANS, June 12, 1872.

DEAR SIR: Your letter addressed to Messrs. Price, Hine, and Tupper, requiring their statement concerning *benefits to Bayou Teche* derived from works done under the special supervision of your office, was handed to me by these gentlemen for answer.

It is a pleasant duty to acknowledge that the work done, under your instructions, by Captain Kingsbury is complete in every respect, and restored once more that important stream, Bayou Teche, to navigation.

Captain Kingsbury, with commendable energy, removed every obstruction from the mouth of Bayou Teche to Fausse Pointe, a distance of 70 miles, consisting of some 20 steamboats' hulls, 3 gun-boats, not less than 50 logs or sawyers, and managed his work so economically as not to absorb the whole of the appropriation made by Congress, (\$17,500.)

I certify that the job of removing these obstructions is perfect and well done; that public interest of that section of country has received therefrom immense advantages, and the navigation company which I represent hereby tender you and Captain Kingsbury their sincere thanks for the thorough manner in which this heavy task was performed.

In conclusion, I will further add that if the State appropriation of \$30,000 had been as judiciously expended as the congressional, under your charge, the trees, overhanging live oaks, &c., would all have been removed, leaving a handsome balance, (unexpended,) but personal greed absorbed all of the State appropriation and left many trees standing.

With renewed assurance of high esteem and consideration for yourself and Captain Kingsbury, I remain yours, respectfully,

E. B. TRINIDAD,

Captain United States Mail-Boat and Superintendent A. M. T. Co.

Major C. W. HOWELL,

Captain of Engineers, New Orleans, Louisiana.

I take great pleasure in testifying to the facts stated by Captain Trinidad. From personal observation, during the work of clearing the Teche and since, it is not too much to say that the accomplishment of the work was more thorough and at less cost than any similar job I have ever examined.

Yours, very respectfully,

T. TUPPER,

President A. M. T. Company.

N 3.

IMPROVEMENT OF NAVIGATION IN RED RIVER ABOVE SHREVEPORT LOUISIANA.

UNITED STATES ENGINEER OFFICE,
New Orleans, Louisiana, April 29, 1872.

GENERAL: I have the honor to transmit herewith a preliminary report, submitted by Lieutenant E. A. Woodruff, giving a general plan, with estimates, for the improvement of navigation in Red River above Shreveport, Louisiana, and in the route from Shreveport to Jefferson, Texas, via Sodo and Ferry Lakes and Cypress Bayou. A sketch of that portion of Red River now obstructed by raft and of a portion of the route to Jefferson accompanies the report.

The recommendations made by Lieutenant Woodruff can only be discussed when his final report is submitted.

The facts elicited by his survey of the Red River "raft-region" show that its character has been thoroughly misapprehended by engineers, and that it has been a comparatively unknown country, even to the oldest settlers on its borders. The "great raft" itself dwindles down to a pigmy in comparison with the popular notion of its extent and constitution.

Lieutenant Woodruff's careful personal examination of the whole country covered by his survey eminently qualifies him for deciding the relative value of the several plans heretofore submitted both for removing and for evading the raft. He recommends the removal. The plan of operations sketched is the best that can be devised. It is necessarily crude, but will be elaborated in the final report.

The estimates are as good approximates as can be made at this time.

Very respectfully, your obedient servant,

C. W. HOWELL,

Captain of Engineers, United States Army.

Brigadier General A. A. HUMPHREYS,

*Chief of Engineers, U. S. A., Washington, D. C.*UNITED STATES ENGINEER OFFICE,
New Orleans, Louisiana, April 25, 1872.

SIR: I have the honor to submit the following preliminary report on the surveys of Red River and Cypress Bayou, in compliance with your order accompanying a telegram from the Chief of Engineers, dated April 18, 1872. The object of this report being to supply such information as has been obtained by the survey, especially with regard to the improvement of the navigation of Red River from Shreveport to the river above the raft, and of the lakes and Cypress Bayou to Jefferson, Texas, the general results only of the survey are herein given, with a statement of the plans and estimates for such improvements as are recommended. A sketch of the raft-region of Red River is transmitted herewith; also, a sketch of the lower end of Sodo Lake, pertaining to the improvement of Cypress Bayou navigation. A general map of the whole region from Shreveport, Louisiana, to Jefferson, Texas, and to the head of the raft, is in preparation, but cannot be completed for this preliminary report. The sketch of the raft shows accurately the portion of Red River obstructed by floating raft and "tow-heads," with characteristic soundings made at the time of the survey. The total length of raft covering the whole breadth of the river is seven miles, but throughout almost all of the distance between the head and foot of the raft the channel is partially obstructed. The whole area of floating raft is computed at 290 acres. The whole area of "tow-heads," or raft resting on the bottom and above water at the time of the survey, is computed at 103 acres. According to your letter of instructions, dated October 17, 1871, the object of the survey of the raft-region is to determine which of two general methods of improvements is more feasible: the removal of the raft obstructions from the main channel or the opening of some route around them. The latter plan was recommended, and work upon it done by Mr. Charles Fuller, United States agent, under Colonel J. E. Johnston, Topographical Engineers, in 1854-'55. The route selected was through Dooley's Bayou, Shift-tail Lake, Sodo Lake, and Twelve-mile Bayou. A survey and careful examination of this route have been made, as well as of all other possible routes on the west side of the river. The details will be fully given in the report to accompany the completed maps, but the results only are here stated. All of such routes are rejected as impracticable, for the following general reasons:

1. The route to be opened should not only afford passage for boats at moderate stages of water, but should have sufficient capacity (depth being the more important) to carry the drift which will continue to come from the upper river till the sources of its supply are destroyed. To give such capacity would require extensive excavations in the clay formations through which any such route would pass, involving great expense for digging or dredging.

2. Such a route would necessarily be much shorter than the main river, giving a greater fall per mile from its head at the river to the lakes. At several points it would have difficult rapids, and the freshets of the upper river would be brought down so quickly that the time of high water in it and the river would be greatly decreased. It is probable that any such channel would, on this account, require as high water for navigation as do the present routes, opened under charters from the State of Louisiana.

3. The channel of the main river affords a greater and more uniform depth than can be given to any other route for the cost of removing the raft, and can therefore be most easily adapted to the carrying of new formations of raft. It would afford incomparably better navigation than any other route and for a much longer time after each rise.

That the removal of the raft and the prevention of its re-formation is desirable, hardly admits of discussion. The need of a cheap mode of transportation of the products of the upper river, the relief of valuable plantations made worthless by overflow,

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and the prevention of the ruin of more valuable plantations above, are sufficient reasons to warrant extensive appropriations for these ends, provided it be shown that the work is practicable within reasonable limits of expenditure. The only objection likely to be raised, except that of expense, is the anticipated injury to the lake and bayou navigation to Jefferson, Texas.

The people of that city are naturally anxious to secure their present facilities and to improve them. Even if their apprehensions were well grounded, they would form an insufficient reason for allowing the ruin caused by the backing up of the water above the raft to spread over the productive valley below Fulton; but it is susceptible of demonstration that the decrease of the water in the lakes, caused by opening the main channel of the river, must be very gradual, and that the injury to navigation may be entirely counteracted by means not too expensive to admit of practical application. Such a demonstration will be attempted in the completed report, but here the means only for carrying out desired improvements are indicated, with such estimates as the time and the unfinished state of the maps have enabled me to prepare. To make intelligible the methods recommended for the removal of the raft, it is necessary to explain the nature of the obstructions found in it. Beginning at Carolina Bluffs, the foot of the raft, we find, at low water, an almost complete dam, consisting of a row of tow-heads, extending across the river, between which the water flows rapidly. These tow-heads are formed during freshets by an accumulation of the logs and drift-wood, of which the raft is formed, around some snag, which checks their progress down the river. As the water falls the pile rests on the bottom, and a rapid deposition of mud takes place around it. The surface left above water produces willows, which grow rapidly and bind the mass more firmly together by their roots, which also protect the deposit from the washing of subsequent freshets. The willows found on the tow-heads of this oldest part of the raft are none of them larger than 10 inches in diameter. As shown by the map, the tow-heads are found principally below Dooley's Bayou, in which part of the river they form the principal feature of the raft obstructions. Generally they are islands, but frequently project into the channel from one side, greatly narrowing the water-way.

Above Dooley's Bayou floating raft is more common, and above Red Bayou the tow-heads entirely disappear and the greater areas of floating raft are found. But throughout all the raft much of the material of which it is composed is water-logged and sunken, so that one end rests on the bottom. If cut into short pieces, the heavier ends, usually the stumps, would sink, while the lighter parts would float. In removing the raft, therefore, all water-logged trees and stumps must be removed from the channel and deposited where they will not be liable to obstruct navigation. Only a small proportion of the tow-heads will float, and as they are made up of piles of drift-logs and red mud, their removal presents the greater difficulty. The river below Carolina Bluffs is much narrower than formerly, and its sides fringed with willows which would impede the passage of large bodies of floating drift. If the raft were removed and a new run of drift brought down by a freshet, it would doubtless jam in some part of the narrow river below Dooley's Bayou, or in the vicinity of Carolina Bluffs. Therefore the banks of the narrow part of the river should be cleared of trees, in order that the caving of banks and enlargement of channel may go on as rapidly as possible. The river above the raft supplies material for new formations. This supply should be stopped, or at least diminished. This would require the cutting of all snags, and dead trees, lying on sand-bars or on the banks, which are likely to fall into the river. Cotton-wood trees, when deadened, decay so rapidly that if their falling into the river be delayed two or three years, they will not be likely to form raft. The work to be done is, therefore, of three kinds:

1. Clearing of banks and bars above and below the raft.
2. Removal of tow-heads, or sunken raft.
3. Cutting up and removing floating raft.

For the first work a party of axmen will be needed below the raft, and a larger party, or two parties, above the raft. The work below the raft need not extend below Shreveport. From what I can learn by inquiry, the work above should extend two or three hundred miles above the head of the raft.

For the second work I submit the following plan: Build a strong double-hull scow, 100 feet in length, each hull having 20-foot beam and 36-inch hold; space between hulls, 10 feet, each hull to have a steam-capstan, worked by a nigger-engine, which can also be used for sawing snags when raised; the pair to be provided with strong shears and all convenient appliances for lifting sunken raft and sawing it up; this boat to be towed by a light-draught steamboat, furnished with a steam-crane on the bow, to be used in discharging on the bank such water-logged raft as may have been cut upon the double boat; apparatus for blasting the tow-heads and batures to be provided; but whether the use of any explosive compound for this purpose will be economical or not can be determined only by experiment. From their structure and situation, I think it probable that blasting will facilitate their removal. This work should begin at the foot of the raft. The plan here recommended was suggested to me by the apparent

necessities of the work, which can be done to best advantage in low water, when light-draught boats will be required. I have since learned that a similar plan has been recommended for the removal of snags in the Arkansas River, in a report of Captain David Hiner, transmitted by Colonel Macomb to the Chief of Engineers with his report for 1868. (See report of Chief of Engineers, 1868, p. 596.) To Captain Hiner's report I am indebted for estimates of cost of working.

For the third class of work different appliances are required for greatest economy.

I submit the following description of a saw-boat, devised for cutting up floating raft, with auxiliary boats for removing the water-logged parts of the trees cut. One stern-wheel boat, of 175 feet in length, 40 feet beam, and 5 feet hold, furnished with sloping sides or aprons for a distance of 100 feet from the bow, the bow also to be furnished with an apron; these aprons to have a slope of 45° to the water, and to be furnished with cross-cut saws at intervals of 20 feet, connecting at pleasure with shafts under the deck, run by a small engine for that purpose, one shaft parallel to each side and one across the bow; the bow to be furnished with two steam-capstans, and the deck with a steam-crane, all worked by one large nigger-engine in the bow, and each connecting at pleasure with the engine. Movable shears, for lifting at bow or sides, also to be provided. The manner of working this boat would be as follows: Beginning at the lower end of a field of floating raft, some of the larger logs would be drawn by the steam capstan or crane to the sides and bow, where they would be cut up by the adjustable cross-cut saws, and the pieces allowed to float down stream. The power of the boat would also be used at times to break loose and scatter the raft. Large trees will frequently be found, the roots of which rest on the bottom, while the top is out of water. The part long under water will not float, and, if allowed to sink where cut up, may prove dangerous to boats in low water. To dispose of such logs, it is proposed to have a strong scow, managed by a small stern-wheel steamboat, in readiness to receive the heavy cut logs, which can be lifted by the steam-crane of the saw-boat, the small tow-boat to be also provided with a steam-crane for unloading the scow at the bank, when no suitable place for dumping the load can be found near at hand. In the last work of removing the raft, undertaken by Mr. Thomas T. Williamson, in 1841, the side-wheel boat Eradicator (which had been used by Shreve) was used. This boat had an apron at the bow, up which the logs were drawn by a steam-windlass. When conveniently upon the apron, they were sawed by hand into lengths of about 20 feet. The stumps, which were too heavy to float, were disposed of with much loss of time, by being taken on the boat to some bayou or lake where they could be dropped out of the channel. In the boat proposed, the sawing could be done by steam-power, without lifting the logs entirely from water until sawed, when those parts likely to sink could be removed on the scow provided for the purpose, without interrupting the progress of the saw-boat. Mr. Williamson also employed men to go upon the surface of the raft, by means of long planks, and saw all logs within reach into short lengths.

He says that a saw working down into the water will cut fully twice as fast as when entirely out of water. I am led to recommend stern-wheel boats because of their entire economy in running and less exposure to injury in the raft, as well as on account of the greater deck and side room which they afford. Supposing the plan here submitted to be adopted, it remains to consider the amount of running expenses and the rate at which the work can be done. Estimates of probable cost of boats and machinery and running expenses for one year are appended. Only trial can determine the rate at which any machinery or work can remove the obstructions, and to specify the time in which the method recommended can complete the work would be mere guess-work, or, at best, an estimate based upon uncertain data.

Assuming such data as the survey affords, and supposing that the work be carried on under competent and faithful supervision, the estimates which I have made lead me to think it possible to open a navigable channel in one year of work. Work done in clearing the channel from the foot of the raft up would not be lost, even if the whole were not at once completed. If the main river were opened to Red Bayou, a choice would be given between the two side routes now in use at lower stages of water than now required for boats to pass up Black Bayou. The channel would gradually improve its capacity for carrying raft, and, when the whole of the present raft is disposed of, need not again be allowed to choke up. Suppose the channel entirely open and the supply of drift above not stopped. In the event of any great run of drift appearing in the upper river, it might be boomed at some place above Red Bayou, probably above Alvan's first canal, or just below Hervey's Canal, where it could be destroyed at leisure and stowed in Simpson's Lake. In the mean time, navigation would not be suspended, as there would be a good route from Red Bayou through Posten Bayou, or, better, through Stump-Dam Bayou, Kelly Bayou, Scott's Slough, and Koun's Canal. The estimate of work required after the first opening of the channel is still more difficult, and can be based only on judgment as to time that the boats would be kept at work, which would vary with the runs of drift caused by freshets. Ample work for the large boats (double scow and saw-boat) could be found for some years in removing snags throughout the whole length of the navigable river. The saw-boat would be

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efficient as a snag-boat when not at work on floating raft. The following are estimates of cost of boats, machinery, and work, based on the plans submitted above:

Estimates for machinery and work for removing the Red River raft.

1. One stern-wheel saw-boat, fitted with ten saws on sloping sides and bow, two steam-capstans, with equipage complete	\$57,950
2. Stern-wheel tender to saw-boat, with steam-capstan and steam-crane, for removing water-logged snags from saw-boat	1,000
3. Double-hull scow, with lifting and sawing apparatus, and small engine for working same	15,000
4. Stern-wheel tow-boat for same, with one steam-capstan and steam-crane, for unloading water-logged snags	15,000
Total machinery and boats	<u>98,950</u>

Estimate for work for one year.

No. 1 saw-boat, at \$5,000 per month	\$60,000
No. 3, with No. 2, at \$1,000 per month	12,000
Nos. 4 and 5	20,000
Ax and saw party above raft	12,000
Ax and saw party below raft	3,000
Repairs of machinery, 10 per cent. on cost	9,895
Total work and repairs for one year	<u>116,895</u>

Summary for one year.

Boats and machinery	\$98,950
Work and repairs	116,895
Contingencies, 20 per cent	43,169
Total	<u>259,014</u>

Subsequent expense of keeping river clear of raft and improving channel may be estimated, for first year after opening of channel, \$50,000. Afterward the expense will decrease rapidly, but for several years the work of destroying raft-material and guarding against jams must continue, at an annual expense of from \$10,000 to \$25,000.

CYPRESS BAYOU.

The survey for improvement of Cypress Bayou includes properly the whole route from Shreveport, Louisiana, to Jefferson, Texas. From Shreveport to the head of Willow Pass, (the upper end of Sodo Lake,) the route is identical with that of boats for the upper river. At this point boats for Jefferson turn to the west into Fairy Lake, and, by a tolerably direct course, in high water, reach the present mouth of Cypress Bayou, west of the Texas line. From the mouth of Cypress Bayou (Bois d'Arc Pass, or the Ox-bows) to Jefferson, a distance of twenty-seven miles, the channel is well defined, and nearly all of the way has banks above water, except in freshets from the valley of this stream or high water of the lakes from Red River overflow. A survey of this bayou, with transit and level lines, has been made and extended across Fairy Lake to the south side, along which it is continued, to connect with the west line of the Red River survey at the head of Willow Pass. The map, as before stated, cannot be furnished with this preliminary report.

The route consists of four distinct divisions, viz:

1. Twelve-mile Bayou, from Shreveport to the foot of Sodo Lake.
2. Sodo Lake to the head of Willow Pass.
3. Fairy Lake to Bois d'Arc Pass, or mouth of Cypress Bayou.
4. Cypress Bayou to Jefferson.

Considered as levels in some of which slackwater navigation may be desirable, the division is slightly different. Twelve-mile Bayou is a rapid stream, but deep and crooked, always affording tolerable navigation to Albany, at the foot of Sodo Lake. Sodo Lake may be considered a level for slackwater navigation from Albany to the head of Willow Pass, having a fall in that distance of 1.63 feet at the time of the survey. From Willow Pass the level of Fairy Lake extends throughout the whole lake and up Cypress Bayou to Smithland. From Smithland to Jefferson, a distance of six miles, the water is shoal, and its depth more dependent upon the stage of Cypress Bayou

above this point than upon the lakes below. The improvements of which the route is susceptible consist of removing stumps and snags, dredging, (which is required near Jefferson,) and giving slackwater navigation in Sodo Lake and Fairy Lake by dams, alone or with locks. In the event of the removal of the raft, I would respectfully recommend building a dam on the lines A B and C D, shown on sketch of the lower end of Sodo Lake, accompanying the sketch of the raft-region. It may afterwards be found desirable to narrow the water-way at the bluff by extending the dam from the island and main shore. Should these means fail, a lock can be constructed at this point, but if the chute be found to answer it will be cheaper and better. Other possible improvements, in controlling the flow of water into the lakes, will be indicated in the report accompanying the completed map, but as their need will depend upon the ascertained results of a successful removal of the raft, it is not necessary to consider them at present. If the raft be removed, the closing of Dooley's or any western canal or bayou above it should be prohibited, both as a measure of safety for the plantations on Red River below the raft and for the benefit of the lake and bayou navigation to Jefferson.

While at Jefferson, I was assured by the mayor that the city dredge would be placed at the disposal of the Government, if any appropriation were made to run it. The dredge is a very powerful one, by Atkins and Burgess, Chicago, and in good order. It could be employed to advantage on the shoal and narrow channel of Cypress Bayou, between Jefferson and Smithland. From the mouth of Cypress Bayou, in Fairy Lake, the deepest water is not found in the steamboat route, but through a cypress brake near Potter's Point, on a nearly direct line to Rocky Point. This route could be opened at a cost of about \$3,000, and would greatly improve navigation at this end of the lake. Many stumps are found in Cypress Bayou, which could be removed, with advantage to navigation, at small expense. For the dam at the foot of Sodo Lake, pile-work will be cheapest, and in the clay bottom at that place can be built securely. In case any pile-work is needed in this region, I would recommend that permission be obtained for the officer or agent in charge of the work to cut timber from the public lands above. In this way only is it probable that the Government will derive any benefit from its timber in this vicinity, which is cut as fast the market at Shreveport demands. The following estimates for work on the Cypress Bayou route are respectfully submitted:

Estimates.

For work in removing stumps in Cypress Bayou and opening route from Bois d'Arc Pass, through cypress brake, near Potter's Point, it is recommended to build a flat-boat 80 feet long, 20-foot beam, 3-foot hold, and provide it with a small steam-engine suitable for running a saw for cutting off snags or stumps under water. Movable shears and lifting-apparatus also to be furnished.

Total cost estimated at	\$5,000
Cost of running same, with superintendent and eight men living on boat, one year	12,000
Extra cost of opening new route in lake	3,000
	<u>20,000</u>

If the city of Jefferson will furnish dredge, running expenses of same six months, \$12,000.

If it be decided to remove the Red River raft: For building dam at foot of Sodo Lake, to contract water-way at low stages, \$70,000.

Commercial reports pertaining to Shreveport and Jefferson will be furnished in the completed report.

I remain, very respectfully, your obedient servant,

E. A. WOODRUFF,
First Lieutenant of Engineers, U. S. A.

Captain C. W. HOWELL,
Corps of Engineers, U. S. A., New Orleans, Louisiana.

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