

rafts. Whenever a raft came into contact with the boom, the boom acted like a spring, swinging out of its position at the lower end from 6 to 20 feet and moving back ready to protect any raft from a collision with pier No. 4. It can be stated that in three distinct cases the boom saved rafts from being thrown against pier No. 4. These cases are as follows:

October 4, 1878, steamer Mollie Mohler, having in tow a 12-string raft.

October 24, 1878, steamer Silver Wave, having in tow a 12-string raft.

June 4, 1879, steamer Nellie Thomas, having in tow a 9-string raft.

As to this last case I add the following:

When the steamer towing the raft was about 200 feet below the head of the boom the machinery of the boat became disarranged and the steamer unmanageable. She dropped the raft, which struck the boom heavily about 150 feet from the end. The boom swung out 20 feet, came back to its position, and guided the raft nicely through the raft-span of the bridge, keeping it away from pier No. 4. The helpless steamer floated down stream and also struck the boom about two-thirds down from its head. Lines were thrown to the man on the sheer-boom and she was tied to it. She remained there over an hour, until the necessary repairs were made. The raft was taken care of below the bridge by the ferry-boat, which was called to assistance. The raft and steamer would certainly have struck pier No. 4, and the captain himself asserted that the boom saved raft and steamer from destruction.

2. The government bridge is admirably well constructed. It is not considered by pilots inconvenient to navigation, and therefore the sheer-boom cannot serve as much as it would at other bridges offering dangerous obstructions.

3. At a low stage of water, when the pressure of the current upon the rudders is weakened, a fresh breeze of wind will prevent the sheer-boom from lying at the desired angle to the bridge. This is objectionable. The fence, 6 feet high upon one side of the boom, although 2 rails were removed, still offers to the wind too much surface.

4. At a high stage of water, when the river carries driftwood, the sheer-boom is of no use, as it has to lie with the current; otherwise the space between the rudders will be wedged full of driftwood when the boom becomes unmanageable and liable to be broken from its moorings. This is also another objection.

All of which is most respectfully submitted.

E. F. HOFFMANN,
Assistant Engineer.

Maj. F. U. FARQUHAR,
Corps of Engineers, U. S. A.

Q 12.

IMPROVEMENT OF GALENA RIVER AND HARBOR, ILLINOIS.

The work began September 16, 1878, and closed for the winter November 17, 1878. During the whole season great difficulty was experienced in prosecuting the work, owing to extreme low water and the narrowness of the channel through which the material dredged had to be towed.

Most of the season was expended in dredging a channel from the mouth of Galena River to near the cut-off, a portion of the work which it was originally thought needed no present attention. The excavated material was partly deposited at the head of Bellevue Slough in the Mississippi River, and partly in various side sloughs and pockets found along the Galena River. The dumping-ground at low-water is, however, extremely insufficient and inconvenient, and it will be best another year to provide for putting all the material on the bank. The material varied greatly in quality, and embraced, besides clean sand, mud, muck, and stiff clay, the latter material very difficult to handle.

The citizens of Galena showed much anxiety to have the channel cleared out in the vicinity of the city, but no dredges could be sent there before the spring rise, there not being enough water to float them. An extension of time was granted the contractor, Mr. H. S. Brown, from

December 1, 1878, to July 1, 1879, and work recommenced April 3, 1879, at the point where it was stopped in November, 1878.

The troubles from low water began at the same time, and the work was carried on with great difficulty. The two towboats were constantly aground, and delayed the dredging. About the middle of May the river began rising suddenly and rapidly, and the work for a time advanced very favorably. Three dredges were sent to Galena, as soon as the water permitted, to excavate a channel of a provisional kind from the steamboat-landing downstream through the shoalest portion of the distance from Galena to the cut-off.

The high water lasted but a few days; but the worst of the bars was dug out, and a channel 35 to 50 feet wide with 3 feet water at low-water was made from the railroad bridge to a point 1,670 feet downstream, which will prove of great use to the citizens during the coming summer. The falling water finally compelled the return of the dredges to the cut-off. A further extension of time was given the contractor to September 1, 1879, by letter of Chief of Engineers, dated June 27, 1879.

I would say that Mr. Brown has shown energy in fighting against the difficulties incident to his work (due mainly to the lack of a sufficient stage of water), and a desire to do all in his power to complete his contract in season. Such low water as has prevailed during last summer and the complete failure of the early spring rise are anomalous and almost unprecedented.

To the two inspectors, Messrs. W. L. Kidder and J. C. McElherne, employed at different times on the work, my thanks are due for their careful and faithful assistance.

RESULTS ACCOMPLISHED.

I. From the mouth of Galena River to the cut-off, 2.9 miles, a channel has been made 35 to 40 feet wide and 3 to 4 feet below low-water of 1864.

II. From the cut-off upstream a channel 1,700 feet long by 100 feet wide has been dredged to a depth of 4½ feet below low-water of 1864.

III. Thirteen hundred feet farther the channel has been finished 60 feet wide and 4½ feet deep at low-water of 1864.

IV. From the Galena railroad bridge a channel 35 to 50 feet wide and 1,670 feet long has been dug 3 feet below low-water of 1864.

MATERIAL DREDGED.

	Cubic yards.
Material dredged and towed less than 4 miles.....	5,862.61
Material dredged and towed less than 3 miles.....	34,701.04
Material dredged and towed less than 2 miles.....	34,209.40
Material dredged and towed less than 1 mile.....	26,021.51
Total material dredged.....	100,794.56

Total cost of the dredging per cubic yard, including all superintendence and office expenses, \$0.238 per cubic yard.

ABSTRACT OF APPROPRIATIONS FOR IMPROVING GALENA RIVER AND HARBOR, ILLINOIS.

By act approved June 18, 1878.....	\$30,000
By act approved March 3, 1879.....	12,000
	42,000
Original estimate for existing project.....	400,000
Remaining to be appropriated.....	358,000

Cost of 100,794.56 cubic yards of dredging in Galena River.

Description.	Per cubic yard.	Total.
Cost of dredging.....	\$0 20. 2	\$20,310 38
Superintendence and office expenses.....	0 03. 6	3,708 65
Total.....	0 23. 8	24,019 03

Money statement.

July 1, 1878, amount available.....	\$30,000 00	
Amount appropriated by act approved March 3, 1879.....	12,000 00	\$42,000 00
July 1, 1879, amount expended during fiscal year.....	16,887 26	
July 1, 1879, outstanding liabilities.....	7,131 67	24,018 93
July 1, 1879, amount available.....		17,981 07
Amount (estimated) required for completion of existing project.....	358,000 00	
Amount that can be profitably expended in fiscal year ending June 30, 1881.....	30,000 00	

Abstract of proposals received and opened August 19, 1878, by Maj. F. U. Farquhar, Corps of Engineers, U. S. A., for dredging in the Galena River, Illinois.

Name.	Residence.	For dredging in Galena River and depositing, when possible, at a distance not exceeding 4 miles.	For dredging in Galena River and depositing, when possible, at a distance not exceeding 3 miles.	For dredging in Galena River and depositing, when possible, at a distance not exceeding 2 miles.	For dredging in Galena River and depositing, when possible, at a distance not exceeding 1 mile.	For dredging in Galena River and depositing on top of the river bank, not nearer than 29 feet from the edge of the bank.
		Per cub. yd.	Per cub. yd.	Per cub. yd.	Per cub. yd.	Per cub. yd.
Williams & Upham.....	Duluth, Minn.....	\$0 26	\$0 25	\$0 24	\$0 23	\$0 30
Archibald McArthur.....	Chicago, Ill.....	30	28	26	24	30
H. S. Brown.....	Hamilton, Ill.....	24	23	19	17	25
R. R. Dodge.....	Volney, N. Y.....	28	26	25	22	29
Green & Linehan.....	Chicago, Ill.....	30	28	24	23½	29

STATISTICS OF COMMERCE OF THE CITY OF GALENA, ILLINOIS.

Only very imperfect statistics of commerce for the city of Galena could be obtained, and much of this not being for the last year.

STATEMENT OF REVENUE COLLECTED AT THE PORT OF GALENA FOR THE FISCAL YEAR ENDING JUNE 30, 1877, FROM THE REPORT OF THE UNITED STATES SURVEYOR OF CUSTOMS.

Received for inspection of steam-vessels.....	\$581 22
Received for licensed pilots, engineers, masters, and mates.....	4,365 00
Received for marine-hospital dues.....	826 70
Received for fines, penalties, and forfeitures.....	100 00
Received for miscellaneous customs duties.....	7 99
Received for official fees.....	150 69
Total receipts.....	6,031 70

Statement of the number and tonnage of enrolled and licensed steam and unrigged vessels belonging to the port of Galena, on the 30th of June, 1877, as follows:

Denomination of vessels.	Number of vessels.	Tonnage.
Steam-vessels.....	28	3,795.48
Unrigged vessels.....	37	5,757.56
Vessels.....	65	9,553.04
Tons.....		

BUSINESS OF THE CITY OF GALENA FOR ONE YEAR, FROM RETURNS OF THE UNITED STATES ASSESSOR'S OFFICE.

Lead shipped by 6 dealers and manufacturers.....	\$1,601,117
Farm products shipped by 10 dealers.....	\$1,557,260
Oats, wheat, and rye shipped by 1 dealer.....	3,562,700 pounds..
Licenses granted in the city.....	435

Statement of business done during two months in the city of Galena, from report of wharf-masters to City Council of Galena.

JANUARY, 1877.

Articles.	Quantity.	Number of cars.	Number of pounds.
Dressed hogs.....	2,940 head..	24	489,210
Mess pork.....	2,765 barrels..	46	884,800
Lard.....	907 tierces..	18	334,610
Bacon.....	294 packages..	11	206,500
Lead.....	3,071 pigs..	12	224,100
Green hides.....	13,693 sacks..	110	2,269,800
Butter.....	679 packages..	2	37,900
Cattle.....	178 do.....	1	15,140
Pigs' feet.....	36 head..	2	36,000
Zinc ore.....		1	14,750
Sundries.....		21	420,000
		2	29,960

JANUARY, 1878.

Dressed hogs.....	3,360 head..	33	658,075
Mess pork.....	1,440 barrels..	24	460,800
Lard.....	457 tierces..	9	153,970
Bacon.....	130 packages..	6	106,110
Lead.....	4,618 pigs..	18	331,720
Green hides.....	25½ thousand feet..	5	100,000
Butter.....	641 bundles..	2	37,060
Cattle.....	574 sacks..	4	83,100
Pigs' feet.....	495 do.....	4	66,280
Zinc ore.....	138 do.....	1	19,000
Sundries.....	148 packages..	1	12,070
	184 head..	10	180,000
Merchandise.....			120,922

Two hundred and fifty cars, with 4,959,770 pounds of produce, were forwarded in January. A large portion of this would go by river if it were made navigable at low-water.

There is at Galena a great production of zinc and lead ores, much of which would go by water if the navigation were good.

It is said that a bushel of oats costs for transportation by rail to Cairo 30 cents; by river the bushel can be shipped to New Orleans for 18 cents. Oats by rail to Saint Louis pays 23 cents per bushel. Oats by river, when navigable, pays 10½ cents per bushel.

Q 13.

SURVEY OF THE MISSISSIPPI RIVER AT AND ABOVE THE CITY OF
ALEXANDRIA, MISSOURI.UNITED STATES ENGINEER OFFICE,
Rock Island, January 7, 1879.

GENERAL: I have the honor to make the following report of the results of a survey, made under my direction, of the Mississippi River at and above Alexandria, Mo., in pursuance of instructions from your office contained in letter dated July 8, 1878.

The difficulties to navigation in this part of the river are caused by a bar, which extends from the left bank of the river just above Warsaw, Ill., diagonally across the river to just above Alexandria, Mo. (See tracing forwarded this day by express.)

During the low water of 1878 the water was only 3 feet deep on the crest of the bar.

This bar is a permanent one, and is due in a large degree to the materials brought down by the Des Moines River, whose present mouth is just above the bar. The estimated low-water flow of the river is 24,000 cubic feet per second, and the slope is $\frac{1}{100000}$. This would give a width of channel with a uniform depth of 6 feet of about 1,800 feet. As the left bank of the river at Warsaw is rocky, there is no danger in contracting the channel-way by means of spur-dams from the right bank. By examining the tracing it will be seen that the existing water-way opposite Warsaw is only about 1,400 feet wide.

The proposed works to confine the channel consist of three spurs from the right bank and one from the left bank, as shown on the tracing. The estimated cost is as follows:

10,434 cubic yards brush, at \$1.25.....	\$13,042 50
12,072 cubic yards stone, at \$1.25.....	15,090 00

	28,132 50
Add for contingencies 10 per cent.....	2,813 25

	30,945 75

This work should all be done in one season.

The amount of commerce that would be affected by this improvement is the total commerce for which the Des Moines Rapids Canal was built. Hoping that this may meet your approval,

I am, very respectfully, your obedient servant,

F. U. FARQUHAR,
Major of Engineers.

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

APPENDIX R.

ANNUAL REPORT OF CAPTAIN AMOS STICKNEY, CORPS
OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE
30, 1879.UNITED STATES ENGINEER OFFICE,
Keokuk, Iowa, July 25, 1879.

GENERAL: I have the honor to submit herewith annual report of the work on the improvement of the Des Moines Rapids of the Mississippi River and for operating the canal under my charge during the fiscal year ending June 30, 1879.

Very respectfully, your obedient servant,

AMOS STICKNEY,
Captain of Engineers.

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

IMPROVEMENT OF DES MOINES RAPIDS, MISSISSIPPI RIVER, AND
OPERATING THE CANAL.

The work performed was as follows, viz:

Completing the construction, and placing of the machinery for operating the guard-lock.

Constructing and placing the machinery for operating the sluice-gates at middle and lower locks.

Grading and completing lock grounds at middle and lower locks, and inclosing them.

Laying riprap face wall.

Dredging chiseled rock from channel between Montrose and Nashville.

Dredging, in front of city of Montrose, deposit caused by coffer-dam.

Dredging sediment from canal and approaches.

Arranging and equipping scow for operating steam-drills in channel.

Constructing telephone line along canal.

Making repairs to machinery, dredge-scows, &c.

Operating the canal for navigation.

All work on this improvement during the year has been done by hiring the labor and purchasing the necessary material in open market, a system which has given most satisfactory results as compared with that of contracts.

The work in detail is as follows:

MACHINERY.

The machinery for operating the guard-lock by hydraulic pressure is now completed and has been in use during the past few days.

This lock has heretofore been operated by hand, the completion of