

## 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

the machinery having been delayed on account of making some changes in the construction of the pump.

The interior fittings of the engine-house are nearly completed, being similar to the other lock engine-houses.

At the guard and middle locks the engines have been supplied with No. 15 Hancock inspirators, to supply the boilers with water independently of the main pump.

These inspirators have worked most admirably, do not require to be fed from a tank, but draw directly from the cisterns, and feed the boiler without the necessity of running the engine.

At the middle and lower locks the machinery for operating the sluice-gates has been completed and is in use.

The six openings in the breast-wall, which permit the discharge from the canal into the sluice at each lock, are each 3 by 6 feet, = 18 square feet area. Each opening is covered by a sliding gate of cast iron, heavily ribbed. Attached to each gate is a wrought-iron stem of  $2\frac{1}{2}$  inches diameter, on the upper end of which is cut a screw-thread of  $\frac{1}{2}$  inch pitch.

A strong cast-iron tripod is bolted to and rests upon the piers of the breast-wall. The gate-stem passing through the center of this tripod engages in a bevel gear-wheel, which forms the nut for the screw. This gear-wheel rests upon the tripod, and is confined by a lock-nut under the tripod.

A small bevel pinion,  $7\frac{1}{2}$  inches diameter, engages in the 15-inch bevel gear-wheel, and is carried on a counter-shaft with a crank, hand-power being applied to the crank, is conveyed by the shaft and small pinion to the large bevel gear-wheel, which is also the nut for the screw, and this gear-wheel being so confined that it can revolve but cannot move up or down. The screw with the gate attached can be raised or lowered at will. Two men can readily handle one gate.

#### GRADING AND COMPLETING LOCK GROUNDS, ETC.

At the lower lock the lock grounds have been graded, and part covered with macadam, and part with good soil, which was sowed with grass-seed.

A macadamized road has been constructed along the lock grounds, with approaches at each end of the bridge crossing the sluice, and shade-trees set out along the road. At the middle lock the grading of the grounds has been completed. At the guard-lock the grading and macadamizing of the ground between the lock and river embankment was completed, and a slope-wall was built along the inside face of river embankment.

One hundred and eighteen and five-tenths cubic yards of wall were laid at this point.

At the middle and lower locks substantial close board fences have been built, inclosing the property on the land side. These fences are 8 feet high and each about 800 feet in length, with double gates for entrance at each end of the grounds.

At the middle and lower locks the old shops which had been used during the construction of the work were moved to convenient positions, and, with the addition of some new material, remodeled so as to present a neat appearance, and giving at each lock a storehouse, carpenter-shop, and blacksmith-shop.

At all the locks small ice-houses were built, which were filled with ice from the canal by the regular lock hands at a time when severe weather prevented repair work from going on.

At the lower lock a bridge has been constructed over the sluice, and this, together with the fences and buildings at all the locks, has been painted thoroughly in two coats.

#### LAYING RIPRAP FACE-WALL.

A force of laborers was set at work August 20 building up the riprap face-wall on the inside of the river embankment of the upper level to 10 feet above the grade of the prism of the canal. Stone for this purpose was delivered where required by Messrs. Wells, Timberman & Co.

September 14 this work was necessarily discontinued, owing to the very low water in the river, which prevented delivery of stone from the quarry, which is situated on the opposite side of the Mississippi. In October, however, the work was resumed and continued throughout portions of the months of November, February, and March. Advantage was taken of the time the canal was drained during the winter to start portions of new wall and to carry up towards completion other parts of the wall which are not accessible when the canal is flooded.

Four thousand seven hundred fifty-two seven-tenths cubic yards of new wall were laid during the year.

Several small gangs were also employed at various times repairing the wall at places where the stone had been displaced by steamers which were blown against the bank by high winds.

A mile or more of the river embankment has been dressed ready for wall laying, and portions of the bank, where from long exposure the unprotected earth at the top had been washed out in gullies, were filled out to the true section.

The bank on the shore side at a number of points having shown a disposition to cave in from the wash of passing steamers, it has been protected by loose riprap until such time as wall laying can be carried on. About  $\frac{1}{2}$  mile in all has been thus protected.

#### DREDGE.

The dredge was kept at work during the greater portion of the year, removing bars from the canal and the approaches to the canal at the guard and lower locks; in dredging the remains of coffer-dams at Montrose and Nashville and below the lower lock; in removing rock which had been chiseled in the channel between Montrose and Nashville, and in dredging out material alleged to have been deposited as a consequence of the construction of the Montrose dam in front of George Anderson's boat-yard and the steam saw-mill of Wells, Felt & Spaulding, Montrose.

From the canal about 8,700 cubic yards of sand and mud were removed, and the dredged material towed out in the river and dumped in deep holes. From the approaches to canal at both ends about 6,300 cubic yards were removed and dumped in the river. From the channel between Montrose and Nashville 3,654 cubic yards of loose chiseled rock was removed and placed in piles along the Iowa side of the channel and 50 feet from it.

From the river front of George Anderson's boat-yard and the steam saw-mill of Wells, Felt & Spaulding, Montrose, about 5,400 cubic yards were removed and dumped in the river inside the spoil bank of the Montrose dam.

## DRILLING-SCOW.

A force of ship-carpenters were employed converting a flatboat 80 feet by 16 feet into a drilling-boat, from which to operate two steam-drills for use in blasting channel in the river between Montrose and Nashville.

The boat was first hauled out on the ways and the hull thoroughly examined and repaired, new planks being inserted where required, and the whole carefully calked. At each end of the scow, just back of the rake, a solid bulkhead 6 inches thick was built across the boat, forming a solid connection between the gunwales and the center bulkhead, which runs fore and aft throughout the whole length of the boat. To these cross bulkheads the guide timbers for the spuds were bolted. The guide timbers are of 10 by 10 inch pine, and have heavy cross-timbers top and bottom connecting them, and, in addition, there are two strong diagonal braces to each set of guides, running back from the top of the guides to a second bulkhead distant from the first 8 feet, and constructed in a similar manner.

Two more bulkheads were built near the center of the boat on which engine and boiler rests, making in all 6 bulkheads, thus dividing the boat into 7 water-tight compartments, and strengthening it to withstand possible shocks when firing the blasts.

There are 4 spuds for holding the boat securely in position while the drills are at work, each spud being provided with independent hoisting-gear. Near the center of the deck is a house 32' x 8' and 8' high, covering the engine and boiler, coal-room, and small workshop.

The boiler used to furnish steam is one formerly used for pumping coffer-dams.

On one side of a boat is a rail track, 3½-foot gauge, carrying two trucks, on each of which is mounted a 5-inch Ingersoll steam-drill.

The drill-frame is attached to a cross-head, which is moved up and down, by means of a screw, in guides which are attached to the trucks. The drills can thus be adjusted for varying depths of water.

The movement of the feeding-screw on the drill-frame is 3 feet, while that of the long adjusting screw is 6 feet; so that a total movement of 9 feet can be obtained.

For any greater variation, different lengths of steel drills can be used. Suitable platforms are provided for the drill-tenders to stand upon while operating the drills. Steam connections with the boiler are made with 1-inch 5-ply steam-hose. Strong eye-bolts are fastened through the deck, spaced 4 feet apart, the distance between drill-holes, and a hook which is connected with a turn-buckle cut with right and left hand thread is fastened to the truck.

The truck being placed in position, the hook is slipped in the eye-bolt, when a turn or two suffices to tighten the connection, thus holding the truck perfectly firm and solid. The total length traveled by the trucks is 60 feet; so that 16 holes 4 feet apart can be drilled while the boat is in one position.

## TELEPHONE LINE.

During the months of August and September a telephone line was constructed, leading from the office in Keokuk to the lower lock, thence to the middle lock and guard-lock, about 8 miles in all. The line along the canal is situated on the river embankment, the three locks being crossed by submarine cables.

The object of placing the line on the river embankment was to secure it in a greater degree from interference of any kind. The instruments used are Edison's carbon transmitter and Gray's bi-polar receiver. The

line has worked very well in every way, and has proved of great utility in operating the canal, and superintending the work generally.

The passage of steamboats through the canal is greatly facilitated by its use, as lockmasters are kept informed of a steamer's progress from the time it enters until it leaves the canal.

## REPAIRS.

The canal was in operation during the winter of 1878 until December 10, when severe cold weather set in and continued for several weeks, the thermometer sometimes ranging as low as 20° below zero. This weather coming quite suddenly, very seriously interfered with the work of draining the water-pipes and hydraulic cylinders. The cylinders were, however, drained, and the joints between the pipes and cylinders broken, but not sufficiently opened. The water, in draining out of the pipes, froze on the joint flanges, and continued to increase in thickness until the opening was bridged across; thus allowing the water to run down into the cylinders. Three cylinders at the middle lock were bursted, and rendered useless as far as operating the lock was concerned. During the time the canal was closed, these broken cylinders were replaced by new ones, and all the connections made as before. At the middle lock, the pump had to be replaced, the old one having broken from a defect in the casting. General small repairs were made at both the middle and lower locks by the engineers and lock hands.

The dredge was laid up at the close of navigation in the winter near the lower lock in such a position as to be accessible when the water should be drawn from the canal.

A careful examination disclosed the fact that the bottom timber at the bow had been cut nearly through by the striking of the dipper and chafing of the backing-chain. This timber was replaced and the new one protected by a strip of ¾-inch boiler-plate securely bolted on.

Six new oak knees were fitted to the spud-guides, and cross-timbers to replace old ones which had become rotten. One spud-timber was also replaced and heavier bolts were used in all the connections.

The hull was partially calked, the engines and machinery overhauled and repaired and the hull and upper works painted.

The dump-scows and flat-boats have been thoroughly repaired, new bottom and deck-planking and gunwales inserted where required and carefully calked.

The operating of the canal has been without accidents or delays, and the increase of business over that of last year shows that the public are rapidly learning to appreciate and take advantage of its facilities. A new line of steamers has been placed on this part of the river during the year and the large class of boats which before the opening of the canal had to withdraw at the approach of the low-water season now continue without interruption. The benefit to the lumber interests is as great as to the steamboat lines.

The canal was closed from December 10, 1878, to March 17, 1879, on account of the cessation of navigation, and during a part of this time it was drained.

Immediately after refilling the canal and placing it in readiness for navigation, it was frozen over, the weather having suddenly turned cold, and nothing passed through till March 22.

Considerable difficulty has been experienced at times by the large steamers and tows in entering the guard-lock from the river when the lock was used as a lift-lock, owing to the current which sweeps around the lock and tends to draw a boat out into the river while she is attempt-

ing to enter under slow headway. As the river rises, the current becomes stronger and the difficulty increases. This could be remedied by placing a heavy boom or timber fenders along the outside line of the channel and resting them against crib piers filled with stone. The structure should extend about 300 feet up-stream and permit the water to flow freely under it so as to prevent as much as possible the deposit of sediment at the entrance to the lock. The cost would be about \$6,000.

At the middle and lower locks experience has shown that the walls should be built about 3 feet higher on the up-stream half of the length of the lock.

The walls are now 2 feet above the high-water level of the canal. During the spring months when the water is high, strong northerly winds prevail, and boats entering the locks from the upper levels are sometimes unavoidably blown against the walls, and if light their guards ride over the walls, striking the snubbing-posts and the suspension-rods of the gates, which might sometimes cause a serious accident. The cost of building up the walls at the two locks would be about \$16,000.

Considering these improvements of importance, I have included them in my estimates.

To my assistants, Messrs. R. R. Jones and O. S. Willey, and Messrs. C. P. Comegys and B. Railey in my office, I am under obligations for faithful and energetic work during the year.

The following shows the business of the canal during the year:

*Statement of steamboats, barges, rafts, &c., passed through the Des Moines Rapids Canal from July 1, 1878, to June 30, 1879.*

Month.	Steamboats.		Barges and flats.		Cargo.		Rafts.					Lockages at one lock.
	No.	No.	No.	No.	General merchandise.	Grain.	Number.	Lumber.	Logs.	Shingles.	Lath.	
July	123	37			7,184	169,957	3	150,000	1,000,000	225,000	70,000	333
August	119	45			6,756	165,328	3	2,280,000		300,000	4,702,146	163
September	81	37			4,191	78,790	16	15,940,785	2,485,000	5,396,000	622,000	239
October	93	46			5,092	194,290	5	3,425,178	300,000	710,000		156
November	78	62			5,705	170,441	2		1,400,000	1,183,000		114
December	4	4			100	12,205						18
March	19	12			2,083	33,188	1		750,000			30
April	60	61	424		8,840	348,069	2	1,594,000	550,000	700,000		105
May	103	82	954		11,538	441,230	9	9,957,649	1,574,000	3,205,500	3,327,650	205
June	122	68	3,630		13,169	579,144	1		27,000	30,000		201
Total	802	454	5,008		64,658	2,192,642	42	33,347,612	8,086,000	11,749,500	8,721,796	1,564

The canal was closed from December 10 to March 17, on account of cessation of river navigation. The record of passengers was not kept until April 1, 1879. The boats and barges at work in the canal are not included in this statement, except in the number of lockages.

This work is located in the collection-district of New Orleans. Saint Louis, Mo., is the nearest port of entry.

The following is a statement of the collections at the port of Saint Louis, Mo., during the fiscal year ending June 30, 1879:

Duties on imports	\$1,109,708 51
Marine hospital dues	9,752 45
Inspection of steam-vessels	5,410 10
Licenses of officers of steam-vessels	7,690 00
Official fees	2,327 65
Storage	1,079 19
Fines, penalties, and forfeitures	449 95
Total	1,136,417 85

The estimated complete cost of this work as now being carried on as given in my annual report ending June 30, 1878, was 4,388,000 00  
For additional work recommended 22,000 00

Total cost of construction 4,410,000 00  
Cost of operating and maintenance of canal from August 22, 1877, to June 30, 1880 127,565 00  
Estimated cost of operating and maintenance for fiscal year ending June 30, 1881 40,000 00

Total amount appropriated up to June 30, 1879 4,448,500 00

Amount required yet to be appropriated for finishing improvement and operating canal 129,065 00

#### Money statement.

July 1, 1878, amount available \$99,960 50  
Amount appropriated by act approved March 3, 1879 65,000 00  
\$164,960 50

July 1, 1879, amount expended during fiscal year 75,168 08  
July 1, 1879, outstanding liabilities 3,917 36  
79,085 44

July 1, 1879, amount available 85,875 06

Amount (estimated) required for completion of existing project and operating canal for fiscal year ending June 30, 1881 129,065 00  
Amount that can be profitably expended in fiscal year ending June 30, 1881. 129,065 00