

The lumber interests of the Chippewa River are very extensive. In good seasons about 2,000,000 feet of sawed lumber per day are manufactured and shipped, besides the 200,000,000 feet per year of loose logs. The question of the sawdust from such an amount of lumber being allowed to run into the river is one that should receive the notice of those in authority.

The Beef Slough Company, which are the parties running loose logs on the river, is a wealthy corporation, having 20 saw-mills on the Mississippi River, located at Winona, Lyons, McGregor, Dubuque, Clinton, Moline, Rock Island, Davenport, Muscatine, and Saint Louis.

The corporation is composed of the following companies: The Beef Slough Boom Company operate in the slough, store the logs, and turn them into pockets for the different owners; the Mississippi Logging Company cut and haul the logs into the Chippewa, and do the rafting at the slough; the Chippewa Improvement Company do the "driving," and have built all the dams on the river and tributaries, which are controlled by the Beef Slough Company.

The following is information obtained in reference to location and size of dams on the Chippewa and Eau Claire Rivers, for which I am under obligations to Mr. B. P. Swift, of the Beef Slough Company, and Mr. W. A. Rust, of the Eau Claire Lumber Company:

1st. Lower Elk River Dam, located in northwest of southeast quarter of section 11, township 37, range 2 west.

Height of gates above foundation..... 10 feet.  
Width of gateways..... 28 feet.  
Length of dam..... 200 feet.  
Area of flowage..... 1 square mile.

2d. Upper Elk River Dam, located in southeast of southeast quarter, section 14, township 37, range 1 west.

3d. South Fork Flambeau Dam, located in southwest of southwest quarter, section 23, township 40, range 3 east.  
Height of gateway above foundation..... 10 feet.  
Width of gateways..... 32 feet.  
Length of dam..... 140 feet.  
Area of flowage..... over 4 square miles.

4th. East Fork of Chippewa, located in southeast of southeast quarter, section 26, township 41, range 24 west.

Height of gateways above foundation..... 9 feet.  
Width of gateways..... 40 feet.  
Length of dam..... 450 feet.  
Area of flowage..... 2 square miles.

5th. West Fork Chippewa, located in southwest of southwest quarter, section 14, township 41, range 6 west.

6th. Rice Creek Dam, situated in southeast of southwest quarter, section 21, township 33, range 8 west.  
Height of gateways above foundation..... 9 feet.  
Width of gateways..... 22 feet.  
Length of dam..... 130 feet.  
Area of flowage.....  $\frac{1}{2}$  square mile.

7th. Paine Creek Dam, located 6 miles above Chippewa Falls.

8th. Chippewa Falls Dam, at Chippewa Falls.

9th. Eau Claire Dam, constructed 1877 and 1878, consists of lock and dam.

10th. North Fork of Eau Claire Dam, situated in township 29, range 4 west.

Height of piers..... 10 feet.  
Area of flowage..... 320 acres.

11th. North Fork Dam No. 2, located in township 27, range 3 west.

Height of piers..... 22 feet.  
Area of flowage..... 1,000 acres.

12th. South Fork Dam, located in township 27, range 3 west.

Height of piers..... 20 feet.  
Area of flowage..... 800 acres.

13th. Little Falls Dam, located in southeast of northwest quarter of section 28, township 32, range 6 west.

Height of gateway above foundation..... 16 feet.  
Length of dam..... 625 feet.  
Breadth of ordinary water-way..... 147 feet.  
Total breadth of gateways..... 228 feet.  
Area of flowage..... 3 square miles.  
Amount of water for flowing purposes..... 1,000,000,000 cubic feet.

This dam was completed this fall, and it is calculated by the projectors of the work that by the use of it for flooding purposes they can raise the water at the head of Beef Slough at least 3 feet.

On one trial made this fall, the following results were obtained:

Gates were shut down November 8, at 9 a. m., causing the river to fall at Eau Claire on the 10th 1 foot.

Twenty gates were opened on November 13, with a 15 feet and 10 inches head of water, and were allowed to run for twenty-four hours.

Water below dam raised..... 6 feet.  
Water at Eau Claire raised..... 4.6 feet.  
Water at Durand raised..... 3.1 feet.

It is to be regretted that more information could not have been obtained in reference to this flooding, but with the exception of the above such as I have conflicts to such a degree as to make it unreliable. But certain it is that by shutting down this dam in low-water the Lower Chippewa is rendered unnavigable. The constant floodings to which this river is subjected during the year is one cause of the difficulties experienced in crossing sand bars.

Even in the low-water season, but with the dams all opened, to insure a steady stage, the river will soon wear for itself a navigable channel, only to be entirely destroyed by the first flood which causes the flattening out of the adjacent bars.

In conclusion, it only remains to report what seems to be the most urgently required improvements for the river, which are—

First. The widening of the west jetty at the mouth for a distance of 2,000 feet, and for this I would suggest a widening of 8 feet as sufficient to insure the safety of the work, which widening could be accomplished for the sum of \$3,000.

Second. The improvement of the Flower Pot Bar.

Third. The improvement of the Hog Hole Bar.

Fourth. The improvement of the Hawkins Bend Bar.

These are regarded the most important by all interested in the improvement of the river.

The stoppage of the running sand of the Yellow Banks is a matter that should be considered in connection not only with the Chippewa, but also the Mississippi River.

From inquiries, I believe that the revetting of these banks can be done with the refuse lumber from the mills above. Stone for the work would be very expensive, as there appears to be none convenient to the river.

These slab and lumber retaining walls are in common use at and around Eau Claire, and, after being constructed for twenty years, are apparently as serviceable as when first built.

Respectfully submitted.

CHARLES WANZER,  
Overseer.

Maj. CHARLES J. ALLEN,  
Corps of Engineers, U. S. A.

S 5.

IMPROVEMENT OF SAINT CROIX RIVER, WISCONSIN.

A survey of the river below Taylor's Falls was made in 1874, as required by provisions of section 2, act of Congress approved June 23, 1874, the results of which were printed in Part 6, House Ex. Doc. No. 75, Forty-third Congress, second session. The funds allotted were insufficient for as extended a survey as desirable, although enough information was obtained from which to project the general work necessary for the improvement of the stream, viz, the removal of natural obstructions, as sand-bars, by means of dams, jetties, and closing of secondary channels; snags, bowlders, and leaning trees, and artificial obstructions, as sunken cribs, piling, &c.

By act of Congress approved June 18, 1878, the sum of \$10,000 was appropriated for the improvement of the river.

Maj. F. U. Farquhar, Corps of Engineers, was in charge of the Saint

Croix until July 15, 1878, when he was relieved of the same by Capt. C. J. Allen, Corps of Engineers, in accordance with Special Orders No. 148, Adjutant-General's Office, Washington, D. C., July 10, 1878.

It having been determined to perform the work by means of hired labor and purchase of materials in open market, on account of the impossibility of predicting the several amounts of labor and materials required in the construction of dams, revetment, &c., or the amount of labor required in the removal of obstructions from the channels, the necessary flat-boats, tackle, and tools were purchased early in August, and the work commenced at Taylor's Falls, the head of navigation, the party moving down stream. The work continued throughout the winter and the following spring. The party during the winter moved on the ice, the quarter-boats and tool-house mounted on runners and drawn by teams from place to place as required.

The stream has been quite effectually cleared of obstructions between the Falls and Stillwater, a distance of 30 miles, and the difficulties of navigation greatly lessened. About 1,200 linear feet of caving bends have been protected by means of brush and stone revetment, at an average cost of \$2 per linear foot. There have also been removed—

Snags .....	number..	2,360
Stumps .....	do.....	1,832
Boulders .....	cubic yards..	5234
Leaning trees .....	number..	5,715
Cribs .....	do.....	32
Logs .....	do.....	68
Piles .....	do.....	16

Gauge-rods were established at Taylor's Falls, Osceola, and Stillwater, and their readings daily recorded; and a system of soundings upon the principal bars, taken at every trip of one of the passenger steamers by the pilot, showed the relation, during the season, between ruling depths on the bars and the stand of water at the gauges. Following the removal of the obstructions, the closing of secondary channels and chutes will be necessary in order to maintain the depths of water in the main channels, the cost of which, in the absence of any detailed low-water survey, cannot be stated with confidence. A thorough survey is, then, indispensable, preliminary to presenting a full and detailed estimate of the cost of completing the improvement.

It is proposed, during the present season, with the funds (\$8,000) appropriated by act of Congress approved March 3, 1879, to make the survey required and to continue the work as commenced.

For detailed report of the work performed in 1878 reference is respectfully made to report of Captain Allen, dated December 9, 1878.

Capt. O. F. Knapp, an experienced river man, has been in local charge of the work, and is entitled to commendation for the zeal, energy, and economy with which he has conducted it.

The nearest port of entry is that of Duluth, Minn., at which port \$7,764.51 of revenue was collected for the fiscal year ending June 30, 1879.

This work is in the collection district of Minnesota.

ABSTRACT OF APPROPRIATIONS MADE FOR IMPROVING SAINT CROIX RIVER, WISCONSIN AND MINNESOTA.

By act approved June 18, 1878 .....	\$10,000
By act approved March 3, 1879 .....	8,000
	<hr/>
	18,000

Money statement.

July 1, 1878, amount available .....	\$10,000 00	
Amount appropriated by act approved March 3, 1879 .....	8,000 00	\$18,000 00
July 1, 1879, amount expended during fiscal year .....	8,272 00	
July 1, 1879, outstanding liabilities .....	614 90	
	<hr/>	8,886 90
July 1, 1879, amount available .....		9,113 10
Amount (estimated) required for completion of existing project .....		17,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881 .....		17,000 00

COMMERCIAL STATISTICS DURING SEASON OF 1878.

Logs, 160,000,000 feet, valued at .....	\$800,000
Flour, 26,200 barrels, valued at .....	131,000
Wheat, 370,000 bushels, valued at .....	370,000
Lime, 15,000 barrels, valued at .....	12,000
Merchandise, valued at .....	600,000
Sundry products, valued at .....	87,000
Passenger traffic amounts to about .....	15,000
	<hr/>
	2,015,000

Boats employed: tow boats 8, passenger boats 2.

SPECIAL REPORT ON IMPROVEMENT OF SAINT CROIX RIVER, MINNESOTA AND WISCONSIN.

ENGINEER OFFICE, UNITED STATES ARMY,  
Saint Paul, December 9, 1878.

GENERAL: I have the honor to report the following operations during the season of 1878 for the improvement of Saint Croix River, Minnesota and Wisconsin, under the appropriation of \$10,000, made by act of Congress approved June 18, 1878.

I made a personal examination of this stream early in August, from Stillwater, at the head of the lake, to the Dalles, a distance of about 30 miles. The stage of water in the river was unusually low, and the opportunity favorable, therefore, for observing the configuration of the channel and the obstructions in it.

The obstructions are, as stated in the report of my predecessor, Major Farquhar (page 372 *et seq.*, Report of the Chief of Engineers for 1875), of two kinds, natural and artificial. To the first class belong snags, stumps, and boulders; to the second, cribs, piles and booms. Many of the cribs have been abandoned for years and left in the channel, becoming obstructions to navigation. It was evident that the first need of navigation was the removal of the obstructions above the booming grounds. Under authority from the Chief of Engineers, the necessary flat-boats, tackle, and tools were purchased, the work to be done by hired labor. The immediate supervision of the working parties was intrusted to Capt. O. F. Knapp, whose long acquaintance with the stream and its navigation gave promise of intelligent adaptation of the means to the ends. He commenced work about the middle of August, moving downstream from Taylor's Falls, and has successfully prosecuted it to date, having removed, to December 1, all the principal obstructions to navigation to a point about 3 miles below Osceola, besides protecting 800 feet of bank by means of brush and stone revetment. The work is still in progress, although the boats have been laid up for the winter.

The boom grounds above referred to extend upstream from Still-water for about 8 miles. The booms cover the entire portion of this reach, excepting that occasionally a small and insufficient passage is opened for steamers. Steamers are sometimes entirely excluded, especially during the months of June and July, when the logs run in great numbers. These logs are received into the pockets formed by the lines of cribs, piles, and booms, where they are "scaled" and thence distributed. The time seems to be approaching when it will be necessary to define the limits of the booms in the interest of navigation. I cannot do better, in this connection, than to quote from the report of Major Farquhar, page 374, Report of Chief of Engineers for 1875, where he says:

As in other reports on rivers, where lumbering is the predominant interest, I respectfully suggest that if the United States is to improve this river by removing natural obstructions, some provision must be made to prevent the placing of artificial ones.

The examination of this river in 1874, upon which the report of that year was based, was necessarily incomplete, owing to lack of funds. In order to meet questions which have arisen, and others which are likely to arise, a complete low-water survey is desirable, especially of the extensive area known as Page's Slough, where the logging interests propose the excavation of a narrow artificial channel as an offset to the navigation interests for excluding them from the main river. This project does not meet with favor among the owners of steamboats.

The distance from the Dalles, the head of navigation, to the Mississippi, is 55 miles, to survey which distance thoroughly would cost \$5,000.

The original estimate for the improvement of this stream was \$21,758. From the experience of the past season, I should place the cost at \$35,000; leaving, after deducting the amount appropriated by the last Congress, \$25,000 as the amount necessary to complete the improvement.

Very respectfully, your obedient servant,

CHAS. J. ALLEN,  
Captain of Engineers, U. S. A.

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

S 6.

IMPROVEMENT OF MINNESOTA RIVER.

HISTORICAL SKETCH.

An examination of this stream was made by Maj. (now Lieut. Col.) G. K. Warren, Corps of Engineers, in 1866, under authorization of section 4 of the act of Congress approved June 23, 1866. Major Warren's first or preliminary report of this survey was rendered January 21, 1867, and printed as a part of Senate Ex. Doc. No. 58, Thirty-ninth Congress, second session.

The estimates of cost of improvement, based upon the results of this examination and survey, are given in the Report of the Chief of Engineers for the year ending June 30, 1867. Two plans were considered, viz, one to improve the navigation of the river from the Yellow Medicine to the mouth of the Minnesota by means of locks and dams, so as to secure 4 feet of water; and another, to secure 2 to 3 feet of water, by the removal

of snags and bowlders throughout this stretch of river, in addition to the construction of a lock and dam at Little Falls, and the operation of a scraper and dredge-boat.

The act of Congress approved March 2, 1867, appropriated \$37,500 for removing snags and bowlders throughout the Minnesota River, and proposals were invited, in June of this year, for their removal, and a contract entered into the month following with Samuel H. Hooper.

Major Warren was relieved of the charge of this work by Col. J. N. Macomb, Corps of Engineers, in 1870. By act of Congress approved July 11, 1870, the sum of \$10,000 was appropriated for continuing the improvement, and applied to the removal of snags and bowlders from the channel, under an agreement with Mr. Hooper upon the terms of his contract of a former year.

Congress, by act approved March 3, 1871, appropriated \$10,000 for the furtherance of this improvement, and a contract soon afterwards entered into with Mr. S. A. Hooper for the removal of obstructions, and the channel cleared of bowlders from the mouth of the Yellow Medicine River down to Fort Ridgely.

The second section act of Congress approved June 10, 1872, provided for the survey of the Minnesota River above the mouth of the Yellow Medicine, which survey was made during the same year, the report pertaining to which is printed in the Report of the Chief of Engineers for the fiscal year ending June 30, 1873.

The removal of obstructions, principally bowlders, was recommended.

The same act (approved June 10, 1872) appropriated \$10,000 for the improvement of the stream, and the work was continued, under contract, from Beaver Falls to Mankato, by the removal of bowlders and overhanging trees.

By act approved March 3, 1873, there was appropriated \$10,000.

Work was commenced in September and continued until the middle of March following, when the ice became dangerous for the men. The work consisted in the removal of rocky ledges crossing the stream between Minnesota Falls and the mouth of the Yellow Medicine, and bowlders, snags, and overhanging trees; in addition, the river was cleared of snags and overhanging trees from the mouth of the Yellow Medicine to center of section 1, township 114, range 38; work was, also, commenced where the contractor had left off the year previous, near Golden Gate, and continued downstream to Judson, with the exception of some 3 miles of river between center of section 25, township 109, range 29, and east line of section 29, township 109, range 28.

By act of Congress approved June 23, 1874, a further appropriation of \$10,000 was made "for the survey or improvement of the Minnesota River."

The survey proceeded, from the mouth to South Bend, a distance of 116.4 miles, to determine the practicability of improving the navigation by means of canals, locks, and dams.

The results of this survey proved the feasibility of lock and dam navigation for the distance passed over, the estimated cost of which was:

1. Lock and dam at Little Rapids .....	\$115,875 50
2. Lock and dam No. 2 .....	136,427 00
3. Lock and dam No. 3 .....	139,418 70
4. Lock and dam No. 4 .....	126,338 30
5. Lock and dam No. 5 .....	117,652 80
And for removal of snags, trees, and drift piles .....	31,441 00
	<hr/>
	667,153 30
10 per cent. for contingencies .....	66,715 33
	<hr/>
	733,868 63

The report dated February 11, 1875, of results of the above survey is printed in the annual report of the Chief of Engineers for the fiscal year ending June 30, 1875.

The question of location and construction of a canal was, through lack of time for thorough study of it, only partially reported upon.

Congress by act approved March 3, 1875, appropriated further the sum of \$10,000. A contract was entered into September 7 of the same year with Fendall G. Winston for removing snags, bowlders, and overhanging trees. Under this contract all the snags and bowlders in the low-water channel and the overhanging trees on the banks were removed between Mankato and a point 20 miles below. The contractor made use of dynamite in loosening and destroying snags whenever they were too firmly imbedded to be removed by his machinery alone.

By act approved August 14, 1876, \$10,000 was appropriated, but no work was done during this season, the funds not being available.

A contract was made July 3, 1877, with Messrs. Douglass & Winston Brothers for removing snags, &c. Under this contract work was commenced in July at a point  $2\frac{1}{2}$  miles below Saint Peter, and continued downstream until about the middle of October following,  $29\frac{1}{2}$  miles of river having been passed over.

In his report for the fiscal year ending June 30, 1877, Major Farquhar reports:

There has been spent \$77,879.16 in removing snags, &c., and there are plenty more in the river.

Act of Congress approved June 18, 1878, appropriated \$10,000 for the further improvement of the stream.

For a full description of the physical features of the Minnesota, reference is respectfully made to the extended report of General G. K. Warren, page 380 *et seq.*, Part I, Report of the Chief of Engineers for 1875.

Major Farquhar relieved Colonel Macomb of the charge of the work on the Minnesota River April 25, 1873, and Capt. C. J. Allen relieved Major Farquhar of the charge of the work July 15, 1878.

#### OPERATIONS DURING THE FISCAL YEAR.

By act of Congress, June 18, 1878, the sum of \$10,000 was appropriated for the improvement of the river, which amount it was decided to use in carrying out the plan of improvement which had been adopted for small appropriations, viz, the removal of snags, bowlders, leaning trees, and other obstructions to navigation.

After due advertisement, a contract was entered into with Messrs. Warren & Perkins for the removal of obstructions (see abstract of proposals and contract herewith).

Work commenced at a point  $3\frac{1}{2}$  miles above Henderson September 16, and continued until February 28, 1879; 35 miles of river were passed over; 2,637 snags, 3,067 leaning trees, 9 cubic yards of bowlders, and 1 sunken flatboat were removed.

The removal of snags and leaning trees affords temporary relief to the at present small amount of commerce on the river. The banks are continually caving, resulting in trees being launched into the river to become snags. At low-water stage boats cannot ascend the stream from the mouth further than Little Rapids. If a system of locks and dams be ordered by Congress, the lock and dam recommended for Little Rapids should be constructed first, and at least \$75,000 appropriated for its commencement.

The project for the improvement of the river from its mouth to South

Bend (see report of Major Farquhar, page 364, Part I, Annual Report of Chief of Engineers for 1875) contemplated the construction of five locks and dams, and the removal of snags, trees, and drift-piles, at an estimated cost of \$733,868.63, which is the existing project.

Mr. John Cullen, inspector of the work during the past season, is entitled to credit for faithful performance of duty. His report is hereto appended.

This work is in the collection-district of Minnesota. The nearest port of entry is Duluth, Minn., at which place the revenues collected during the fiscal year ending June 30, 1879, amounted to \$7,764.51.

There are no commercial statistics to report.

#### ABSTRACT OF APPROPRIATIONS MADE FOR THE IMPROVEMENT OF THE MINNESOTA RIVER.

By act approved March 2, 1867.....	\$37,500
By act approved July 11, 1870.....	10,000
By act approved March 3, 1871.....	10,000
By act approved June 10, 1872.....	10,000
By act approved March 3, 1873.....	10,000
By act approved June 23, 1874.....	*10,000
By act approved March 3, 1875.....	10,000
By act approved August 14, 1876.....	10,000
By act approved June 18, 1878.....	10,000
	<hr/>
	117,500

\* Used in making survey of river.

Amount (estimated) required for completion of existing project (see page 364, Part I, Annual Report of Chief of Engineers for 1875), \$733,868.63.

#### Money statement.

July 1, 1878, amount available.....	\$10,013 41
July 1, 1879, amount expended during fiscal year.....	\$9,648 41
July 1, 1879, outstanding liabilities.....	150 00
	<hr/>
	9,798 41
	<hr/>
July 1, 1879, amount available.....	215 00
	<hr/>
Amount (estimated) required for completion of existing project.....	733,868 63
Amount that can be profitably expended in fiscal year ending June 30, 1881, for commencement of lock and dam at Little Rapids.....	75,000 00

Abstract of proposals for improvement of Minnesota River, opened August 31, 1878.

Number.	Name and residence of bidders.	For remov- ing bowl- ders.	For removing overhanging trees.				For removing snags, &c.				Aggregate.		
			36 inches diam- eter and upwards.	20 to 36 inches diameter.	20 to 30 inches diameter.	6 to 20 inches diameter.	4 to 6 inches diameter.	36 inches diam- eter and upwards.	30 to 36 inches diameter.	20 to 30 inches diameter.		6 to 20 inches diameter.	4 to 6 inches diameter.
1	George H. Warren and James P. Perkins, Minneapolis, Minn.	10c. per cu. yard. \$5 00	10c. ea. \$1 60	10c. ea. \$2 00	10c. ea. \$6 60	60c. ea. \$546 00	40c. ea. \$138 00	80c. ea. 24 00	\$2 ea. 84 00	\$4 ea. 680 00	\$2.20 ea. 2,200 00	\$2 ea. 570 00	\$4,257 20
2	John S. Dewolf, Minneapolis, Minn.	20c. 10 00	\$2 32 00	\$1 50 30 00	\$1 66 00	70c. 637 00	45c. 155 25	\$8 240 00	\$7 294 00	\$5 850 00	\$4 4,000 00	\$2 30 655 50	6,969 75
3	Rollins M. Douglass, Minneapolis, Minn.	5c. 2 50	\$2 54 56 64	\$2 70 54 00	\$1 80 118 80	80c. 728 00	35c. 120 75	\$18 50 555 00	\$16 50 693 00	\$12 30 2,091 00	\$2 70 2,700 00	90c. 256 50	7,376 19
4	Edgar Folsom, Minneapolis, Minn.	\$2 100 00	\$1 16 00	95c. 19 00	80c. 52 80	\$1 50 1,365 00	30c. 103 50	\$2 50 75 00	\$1 75 73 50	\$2 45 416 50	\$5 50 5,500 00	\$2 570 00	8,291 30
5	Douglass, and Winston Bros., Minneapolis, Minn.	5c. 2 50	\$1 16 00	\$1 20 00	\$1 66 00	\$1 910 50	10c. 34 00	\$4 50 155 00	\$4 50 189 00	\$4 50 765 00	\$4 50 4,500 00	20c. 57 00	6,695 00
6	Abraham D. Rockey, Minneapolis, Minn.	\$2 100 00	\$2 32 00	\$2 40 00	\$1 75 115 50	\$1 50 1,365 00	\$1 50 517 50	\$8 300 00	\$8 336 00	\$3 510 00	\$3 1,500 00	\$1 50 427 50	5,243 50

REPORT OF MR. JOHN CULLEN, INSPECTOR.

ST. PAUL, MINN., March 10, 1879.

MAJOR: I have the honor to submit the following report of operations for the removal of snags, bowlders, &c., from the channel, and cutting down and removing overhanging trees from the banks of the Minnesota River from a point 3 1/2 miles north of Henderson to Carver, by Warren & Perkins, contractors, from September 16, 1878, to February 28, 1879.

From the point of commencing to Carver the river is confined between well-defined banks from 12 to 25 feet high and from 250 to 350 feet apart, and, except in a very few places, covered with a continuous belt of timber.

The river in places is very crooked, and the current setting against the bend washes the banks, which are a mixture of clay and sand, undermining the trees, which fall into the channel, which invariably is close to the caving banks, blocking the river and forming obstructions to navigation.

The cutting banks change sides of the river at every bend, and when one bank is cutting the bank opposite is making.

The contract for removing these obstructions and cutting overhanging trees from the banks was awarded Warren & Perkins, and September 16 they began preparations for work at Henderson by launching their boats and placing their machinery on them, which consisted of a crane, the power furnished by a 7 horse-power engine. September 24 they began cutting trees from a caving bend 3 1/2 miles north of Henderson, where work stopped the year previous. They commenced taking snags out of the same bend on the 26th. October 1 they began using oxen with block-purchases, and October 12 the crane was abandoned. Their power from that time until work was finished consisted of from 5 to 8 yoke of cattle, with a lifting-force of from 18 to 26 tons, with from 14 to 19 men.

They used dynamite very effectively in loosening snags that were so firmly imbedded as to be beyond their lifting-power.

The first 12 miles of river cleared was a continuous line of caving bends. The banks were thickly timbered, and snags, consisting principally of trees with their roots imbedded in the bottom, were numerous in this section of the river. In some bends the tree-tops covered almost all the surface of the water. There were 1,641 snags taken out of the channel, and 1,948 trees cut from the banks in this part of the river, which work was not finished until December 27, taking over three months; costing \$4,800.20, an average of \$400.02 per mile.

There were 114 snags taken out of the channel, and 265 trees cut from the banks in the 4 miles of river between these cutting banks and Belle Plaine. This section of the river, with but two exceptions, has sloping banks, where snags are not as numerous, and was finished January 6, 1879; costing \$404.30, an average of \$101.07 per mile.

At Belle Plaine there are four caving bends 3 1/2 miles long. The river is so crooked here that the distance by land from the upper end to the lower end of the lower caving bend is not more than half a mile. There were 339 snags, 9 cubic yards of bowlders, and 1 ferry-boat taken from the channel here, and 216 trees cut from the banks; costing \$1,001.70, an average of \$286.20 per mile. This piece was finished January 27.

The river for 6 miles below these bends has, with one exception, sloping banks. There were 110 snags taken out and 191 trees cut from the banks, finishing February 3; costing \$366, an average of \$61 per mile.

The 5 1/2 miles of river intervening between these sloping banks and Little Rapids has, with one exception, caving banks; and snags were numerous. There were 339 snags removed, and 305 trees cut from this part of the river; costing \$987.20, an average of \$179.50 per mile. This was finished February 21.

From Little Rapids to Carver, the distance by river is over 4 miles. The first 2 miles the banks are sloping, but with a number of badly-leaning trees, which were cut and removed. The lower 2 miles have caving banks, with very little timber on them. There were 94 snags taken out and 142 trees cut from the banks of this section of the river; costing \$297.90, an average per mile of \$74.47. This was finished to Carver February 28, when work was suspended.

From the time work began until it was finished there were 2,637 snags, 9 cubic yards of bowlders, and 1 ferry-boat taken out of the channel, and 3,067 trees cut from the banks, clearing over 35 miles of river; costing \$7,857.30, an average per mile of \$224.50.

All snags in the channel and near the cutting banks were removed. There were 51 snags the contractors were unable to remove, roots and all. They were destroyed with dynamite 5 feet and more below the surface of the water; 58 snags out of the channel near the making shores and 28 snags lying close to the shores of the sloping banks were passed.