

S 3.

CONSTRUCTION OF LOCK AND DAM ON MISSISSIPPI RIVER AT MEEKER'S ISLAND, MINNESOTA.

No work has been done here, no funds being available for use, as the parties holding the land-grant have not made the release to the United States required by the act of Congress approved March 3, 1873. The State of Minnesota should annul the grant to the parties holding the land-grant and release the same to the United States. If it is determined to commence the work and carry it on, not less than \$300,000 should be appropriated for the work for the fiscal year ending June 30, 1881.

Money statement.

July 1, 1878, amount available.....	\$25,000 00
July 1, 1879, amount available.....	25,000 00
Amount (estimated) required for completion of existing project.....	922,121 46
Amount that can be profitably expended in fiscal year ending June 30, 1881.	300,000 00

S 4.

IMPROVEMENT OF CHIPPEWA RIVER, WISCONSIN.

An examination of this river was made in 1874, from Chippewa Falls to its mouth, in accordance with provisions of section 2 of act of Congress approved June 23, 1874, the results of which were reported to the Chief of Engineers January 30, 1875, and printed in Part VI, House Ex. Doc. No. 75, Forty-third Congress, second session. The amount of money available was so small, that no connected survey could be made. The conclusions drawn, however, were that for the improvements of navigation, locks and dams at the Upper and Lower Dalles would be necessary, in addition to the removal of natural and artificial obstructions, to the first class of which belong bars, bowlders, &c., and to the second booms, piers, and saw-mill refuse. The closing by low dams of secondary channels and the protection of high sand-banks against abrasion were also contemplated.

The amount allotted for this examination was \$4,664.86.

The following year the survey was continued under provisions of section 2, act of Congress approved March 3, 1875. It consisted in detailed examinations of the Upper and Lower Dalles, Rumsey's Bar, Durand Bars, head of Beef Slough, and the mouth of the river. The results of these surveys are given in a report dated December 13, 1875, and printed in the Annual Report of the Chief of Engineers for year ending June 30, 1876, Part I, page 707. This report contained estimates for the construction of locks and dams at the Upper and Lower Dalles, for the protection of the Yellow Banks, the improvement of the channel at and near the head of Beef Slough, and for the construction of jetties at the confluence of the river with the Mississippi, the cost of the latter placed at \$27,300.

By act of Congress approved August 14, 1876, the sum of \$10,000 was appropriated for the improvement of the stream, and a contract entered into with Messrs. Winston, Douglass & Winston, July 2, 1877, for building brush and stone jetties at the mouth of the river. Under this con-

tract the west jetty was completed, its length being 4,013 feet, and the east jetty finished for a distance of 405 feet.

The act of Congress approved June 18, 1878, appropriated \$10,000 for the continuance of the work, as follows:

For completing and protecting wing-dams and jetties now in course of construction upon the Chippewa River in Wisconsin in and near its mouth and below the lower point of Beef Island, ten thousand dollars: *Provided*, That nothing herein shall be construed, nor shall any expenditure of this appropriation be made, so as to affect existing legal or equitable rights in or upon the said Chippewa River or its branches, whether such rights arise under the laws of the United States or the State of Wisconsin.

On the 15th of July, 1878, Major Farquhar, who had been in charge of the work, was relieved 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.

With the funds appropriated by act approved June 18, 1878, the work of extending the east and making necessary repairs to the west jetty was commenced early in August, the work done by hired labor and materials purchased in open market.

The party agreeing to furnish the brush fascines not delivering them in quantity or quality to suit, the material was cut and made into fascines by the workmen. An excellent quality of brush was obtained upon the payment of 25 cents per cord stumpage.

The total quantity of material consumed in the work during the fiscal year was—

754.9 cords of brush in place in the work, at an average cost of \$2 per cord.
3,650 cubic yards of stone in place in the work, at an average cost of \$1.58 per yard.

The total amount of completed work is—

	Linear feet.
East jetty.....	2,110
West jetty.....	4,013

These jetties, placed 400 feet apart, parallel to each other, and their axes at right angles to the direction of the Mississippi River current, are among the most valuable works constructed by the government, their results to boat and raft navigation considered; and it is hoped that the necessary appropriations may be made by Congress, in order that the progress of the work upstream may continue.

The want of a detailed connected survey from Eau Claire to the mouth of the river is seriously felt; the cost of one would be \$6,000.

For a detailed statement of the work during the season of 1878, reference is respectfully made to report of December 28, 1878, together with map and plottings of gauge-readings and the subreport of Mr. Charles Wanzer, assistant engineer and overseer, both published in House Ex. Doc. No. 54, Forty-fifth Congress, third session.

The original estimate for carrying out the existing project, viz, the removal of obstructions, natural and artificial, between Eau Claire and the mouth, was \$139,892.50, of which amount \$64,102.50 was estimated as the cost of protecting the five high sand banks below Eau Claire. The report of my predecessor, January 30, 1875, contained an estimate of the cost (exclusive of locks and dams), about \$50,000, for improving the channel and protecting the banks between Chippewa Falls and Eau Claire.

By act of Congress approved March 3, 1879, the sum of \$8,000 was appropriated for the river, as follows:

For the protection of the high sand banks on the Chippewa River, Wisconsin, to prevent their erosion and deposition in the Mississippi River, \$8,000: *Provided*, That nothing shall be done, nor shall any improvement be made, on the said Chippewa

River, under or in pursuance of this act, or the appropriations hereby made, which shall, directly or indirectly, prevent, interfere with, or obstruct the free navigation of the said river, as heretofore, by steamboats or other water-craft, or the free use thereof, as heretofore, for the running, floating, guiding, or sheering of loose logs or rafts of lumber, or logs upon or down the same, or which shall directly or indirectly prevent, obstruct, or interfere with the use of any slough, arm, or branch of the said river, as heretofore, for the holding, assorting, or rafting of logs therein.

This act was amended by act of Congress approved June 19, 1879, as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized, in his discretion, to apply and use for the completion and protection of the wing-dams, jetties, and other improvements of the Chippewa River, in the State of Wisconsin, located at and near the mouth of said river, so much of the moneys appropriated by an act of Congress approved March 3, 1879, entitled "An act making appropriations for the construction, repair, preservation, and completion of certain works on rivers and harbors, and for other purposes," as were appropriated "for the protection of the high sand banks on the Chippewa River," and so forth, as may be required for such purpose herein provided: *Provided,* That such use or application of the moneys herein authorized shall be made under the same limitations and conditions as provided in the act hereinbefore named, and subject to the terms and conditions of the proviso attached to said appropriation for said Chippewa River in said act approved March 3, 1879.

With the funds appropriated it is proposed, during the present fiscal year, to widen and strengthen the west jetty and otherwise secure the work at the mouth, and to carry on the improvement upstream from the mouth by means of dams and jetties, protection of banks, and removal of obstructions.

ABSTRACT OF APPROPRIATIONS MADE FOR IMPROVING CHIPPEWA RIVER, WISCONSIN.

By act approved August 14, 1876.....	\$10,000 00
By act approved June 18, 1878.....	10,000 00
By act approved March 3, 1879.....	8,000 00
	<hr/>
	28,000 00
	<hr/>
Original estimate for carrying out existing project.....	139,892 50
Remaining to be appropriated.....	111,892 50

Of this amount, \$64,102.50 are estimated as the cost of protecting the five high sand banks below Eau Claire. If the work of improving this river is to continue, it is recommended that Congress be asked to appropriate the above amount for protecting the high banks, and an additional sum of \$25,000 to continue the work of building wing-dams and jetties.

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

Money statement.

July 1, 1878, amount available.....	\$10,040 64	
Amount appropriated by act approved March 3, 1879.....	8,000 00	\$18,040 64
	<hr/>	
July 1, 1879, amount expended during fiscal year.....	9,916 76	
July 1, 1879, outstanding liabilities.....	62 07	
	<hr/>	9,978 83
July 1, 1879, amount available.....	8,061 81	
	<hr/>	
Amount (estimated) required for completion of existing project.....	111,892 50	
Amount that can be profitably expended in fiscal year ending June 30, 1881—		
For protecting high sand banks.....	\$64,102 50	
For constructing wing-dams, jetties, &c.....	25,000 00	
	<hr/>	89,102 50

COMMERCIAL STATISTICS.

	Value.
154,119,860 feet lumber, at \$11 per thousand.....	\$1,695,381 46
125,000,000 shingles, at \$2.25 per thousand.....	281,250 00
40,000,000 lath, at \$1.25 per thousand.....	50,000 00
10,000,000 pickets, at \$10 per thousand.....	100,000 00
10,000 railroad ties, at 40 cents.....	4,000 00
800,000 feet hard-wood logs, at \$8.....	6,400 00
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	2,137,031 46
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Cost of running out 154,119,860 feet manufactured lumber.....	84,765 92
Amount received for freight and passage.....	26,658 45
Number of boats plying on Chippewa River, 4.	

SPECIAL REPORT ON IMPROVEMENT OF CHIPPEWA RIVER, WISCONSIN.

ENGINEER OFFICE, UNITED STATES ARMY,
Saint Paul, December 28, 1878.

GENERAL: I have the honor to submit the following report of operations under my charge pertaining to the improvement of the Chippewa River, Wisconsin, for the season of 1878.

The operations were mostly confined to the improvement of the mouth of the river, and consisted in repairs upon the west jetty and extension of the east jetty for 1,700 feet, both of which works had been under construction before I assumed charge.

Work was begun early in August. The materials used were brush and stone. The stone was obtained by contract in open market, and a contract was also made for the brush, but the contractor for the latter not furnishing it in quantity and quality to suit, the brush was cut and made up into fascines by the workmen, and the result was a better quality of material than that offered by the contractor. The brush was made into fascines, the branches left on, the fascines bound with lath-yarn. The fascines, from 24 to 28 feet in length, were then made into mats, the latter securely staked to the bottom and loaded with stone. The stone covering was 18 feet in width, excepting towards the ends of the jetties, about 1 foot in thickness near the water edge and rising towards the middle to 2 feet in thickness. The general height of the works above low-water is 2 feet.

The total quantity of material consumed in the completion of the jetties and repairs was, up to November 1—

Rock.....	3,514.86 cubic yards;
Brush.....	442.60 cords;

of which 2,734.8 cubic yards of rock and 368 cords of brush were consumed in the extension of the east jetty.

The total amount of completed work is 6,123 linear feet, viz:

East jetty.....	2,110 linear feet.
West jetty.....	4,013 linear feet.

Both jetties widen out, at their ends, to 30 feet. The east jetty overlaps that to the west by about 75 feet, a line joining their ends being parallel with the general outline of the Minnesota shore opposite.

Before the commencement of any government work on the Chippewa, the mouth of the river was incumbered by an enormous sand bar, over which there was seldom any defined channel, and never a regular one, the depth of water at times scarcely exceeding 1 foot. The contributions

of sand from the banks of the river and its tributaries found their way to the mouth, where such as was not swept away by the Mississippi spread out over a large area at the junction of the two streams. Steamers and rafts were, at times, almost entirely precluded from crossing the bar. Temporary expedients, in the shape of training-walls and dams of brush, were frequently resorted to by the raft and steamboat men in order to confine and direct the flow of water, but, being insecurely built, they were generally flanked or undermined by the current and buried up in the sand, proving, in the end, as formidable obstructions as were those they were expected to remove.

The general features of this stream are given in the report of Major Farquhar, published on page 375 *et seq.*, part 1, of the Report of the Chief of Engineers for 1875, so that it is not necessary to do more here than to refer to that report.

Upon the completion of the works, early in October, their full value was realized. Where the navigation before that time was in the highest degree precarious there is now good navigation. The depth of water between the jetties is from 3½ to 4 feet, although the direction of the channel between them is not constant. It is possible that further slight contraction of the water-way will become necessary, and, if so, it can be accomplished by projecting a series of short groins from the west jetty. So far, however, the work has proven one of the most satisfactory of its kind.

Some additional widening of the west jetty, for about 2,000 linear feet, is advisable in order to meet the effect of overfall when the Chippewa is high and the Mississippi at a low stage.

Frequent soundings were taken, during the progress of the work, on the same line or cross-section, to note the movement of the material forming the bed, and towards the close of the work the entire area under improvement was resurveyed and the changes noted. The accompanying tracing is explanatory.

A gauge-rod was established at the mouth of the river, upon commencing work, and its readings recorded daily. Another was placed, afterwards, at Eau Claire, just above the mouth of the Eau Claire River.

Upon the completion of the principal part of the work, in October, I directed a rapid examination of the river from a point above the mouth of the Flambeau to the Mississippi in order to obtain data bearing upon the resumption of work in the spring; and, also, to ascertain more definitely the rate of erosion of the immense banks of sand known as the Yellow Banks. These banks are described in Major Farquhar's reports, and they have also received description from General Warren. My assistant, who made the examination, estimates, from measurements, that the most exposed of these banks contribute, together, 1,000,000 cubic yards of sand to the river annually. He suggests that, on account of the scarcity of rock, use be made of slabs and edgings for revetting these banks. My predecessor in charge has estimated the cost of brush protection of the five high sand banks below Eau Claire at \$64,102.50, a sum that may be considerably reduced by using slabs instead of brush.

The principal natural obstructions to navigation between Eau Claire, the head of steamboat navigation, and the mouth of the river, a distance of 57 miles, consist of eight bars of sand and gravel, of various sizes and degrees of tenacity. The artificial obstructions are piers, booms, and running logs. The piers, or cribs, serve as supports to lines of booms forming pockets in which to collect the logs for scaling and distribution. The principal and most formidable collection of piers and booms is at

the entrance to Beef Slough, about 20 miles above the mouth of the river. A full account of these booms is contained in the report of Mr. Charles Wanzer, accompanying.

The running of loose logs, and the practice of loggers on the tributaries of the Chippewa, and the Chippewa itself, in shutting off the supply of water, whenever they deem it necessary to do so, by means of huge dams across the streams, until enough water is collected to enable them to gather the logs above and flash them down into the reaches below, are also detrimental to the navigation below Eau Claire. The logs, flashed down thus, from reach to reach, finally enter the main stream. The dams, alternately closed and opened, very seriously affect the stages of water in the stream. The largest of these dams is at Little Falls, below the junction of the Flambeau and Chippewa. It is 625 feet long and floods an area of about three square miles. It was completed this fall.

When we consider that dams of this kind cover the Upper Chippewa and its upper and lower tributaries (it is said that there are 30 dams on the Menomonee alone), the effect of opening and closing them at random, upon the navigable portion of the river below Eau Claire, can be appreciated. And when they approach unity of action, as sometimes happens, navigation is not only seriously interfered with, but the bed of the stream is subjected to violent disturbance. The sudden "freshes" this year subjected the jetties to severe test.

The presence of a certain quantity of sand in a stream like the Chippewa is not an unmixed evil. The sand bars, at low-water, act as dams, forming pools above them, with, generally, sufficient depth of water. Raftsmen and boatmen understand this so well that, upon entering a pool of good depth, they always look for a bar at its extremity.

Contraction of the water-way by means of jetties, training-walls, &c., so as to deepen the channels over the crests of the bars, will, doubtless, aid the low-water navigation, if the degree of contraction and the consequent scour be such as not to disproportion the area to the volume of discharge and thereby injure the pools above. A single jetty, or set of jetties, in a sand-carrying river, can seldom produce much useful effect, as the sand, moving from one point under the action of the concentrated water, settles, generally, at some point below, where it must be again attacked.

When we take into consideration, however, the enormous quantity of sand in motion in the Chippewa River, and discharging from it into the Mississippi, to the great detriment of the latter, it becomes evident that the protection of the Yellow Banks against erosion must accrue to the benefit of navigation upon both streams. The Loire is, probably, one of the best examples on record of a river transporting sand, and subject to sudden floods followed by long-continued periods of low-water. No measure of success, I believed, followed the attempts at improvement of the Loire until steps were taken to protect the banks of, and arrest the discharge of sand and other material from, some of its tributaries.

No continuous survey of the Chippewa River below Chippewa Falls has been made. The stream has been examined from the falls to the mouth, and detached surveys of a number of points have been made. A thorough survey, to connect with former ones, can be made for \$6,000.

The original estimate of cost of improving the river below Eau Claire was.....	\$139,892 50
Amount appropriated by acts of Congress approved August 14, 1876, and June 18, 1878.....	20,000 00
Remaining unappropriated.....	119,892 50

Mr. Charles Wanzer has been in local charge of this work, and is entitled to my thanks for the energy and zeal with which he has conducted operations. His report of operations and of his reconnaissance of the river contains so much information of interest that I herewith forward it entire.

A plotting of synchronous gauge-readings, covering a period of several weeks, of the gauges at Eau Claire and the mouth of the Chippewa, herewith, shows the oscillations at those points due almost entirely to the working of the dams. Conceding the powerful influence of such dams upon the navigation of the river, it remains to be seen, from the results of the examination now in progress as to the feasibility of reservoirs, to what extent dams and reservoirs can be utilized in improving the navigation.

Recurring to the accompanying tracing: It represents the condition of the mouth at four different periods, viz, before any work was done by the United States Government; after the west jetty was partly built; after the completion of the west and the building of 400 feet of the east jetty; and just as the main work was closing up. The soundings are reduced to mean low-water of the surveys, the fluctuations of water surface during the periods when soundings were taken being so slight, especially during the last survey, the dams on the upper river not working, as to warrant the reductions.

Although the tracing only shows the effect to date, the work is a good example of the use of jetties in deepening the channel over a bar at the mouth of a stream when there exists a current at right angles to the axes of the jetties sufficient to sweep aside the material scoured out.

Very respectfully, your obedient servant,

CHAS. J. ALLEN,
Captain of Engineers.

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

REPORT OF MR. CHARLES WANZER, OVERSEER.

SAINT PAUL, December 28, 1878.

SIR: I have the honor to submit the following report of the works constructed by me, and the examinations made during the past season on the Chippewa River.

The works constructed were situated at the mouth of the river, and consisted of the completion of the east jetty (which was commenced early in the spring under Col. F. U. Farquhar), and the necessary repairs on the west jetty, which was constructed during the year 1877.

The channel of the river, prior to any government improvement having been made, was very tortuous, and in low-water entirely unnavigable, as the mouth extended over a width of nearly three-fourths of a mile, and the volume of water was entirely inadequate to discharge the constant supply of sand which is ever pouring from this river into the Mississippi.

This was especially the case during the year 1877, until the completion of the west jetty caused a contraction in the width of the mouth and immediately produced beneficial results.

The completion of the east jetty this year has completed the design, by contracting the mouth into a space of 400 feet in width, and the result is a present 4-foot channel, as shown on the accompanying tracing.

The contracts for the work were given out early in August, to the lowest bidder, in open market, and material was first received on the work on the 14th of the same month. The stone was furnished by Messrs. Winston Bros. and Heerman, and the brush by different parties, as required, the original contractor for brush being unable to furnish the amount needed.

The rock used in construction was a lime formation, of excellent quality, such as is obtainable on the shores of Lake Pepin, and was picked up by hand and broken with sledges to the most advantageous size for handling.

Large quantities of this same material can still be obtained from that source, and from the adjoining bluffs on the Mississippi River.

The total number of linear feet of dam built during this season was 1,710, and this length makes the lower or east jetty to extend into the Mississippi River 75 feet farther than the upper. But this greater length causes no further contraction of the water of the Mississippi, as the bluffs on the shore of that river are not on an exact right angle with the jetties.

The brush used in the work was obtained from the adjoining bottom lands, and was of the best material to be found in that section, being mostly a small growth yellow birch and maple, making straight and symmetrical fascines.

These fascines were easily handled, and when laid in the work made an almost perfect flooring of solid brush, free from interstices, even at the butts, and with the small limbs and tops remaining on, produced at the tips a perfect network of matted brush, and made the fascines from butts to tips not less than 24 feet in length, and of good solid brush not less than 20 feet.

The contract specifications demanded only 18 feet in length of fascines, and the difference accrued entirely to the benefit of the government, and was of no extra expense to the contractors. These fascines were of an average diameter of 15 inches, and were estimated to contain 22 cubic feet of brush.

The dam built this year consumed the following amount of material, viz:

Rock	2,734.8 cubic yards.
Brush	368.0 cords.

Repairs of the west jetty consumed the following:

Rock	780.0 cubic yards.
Brush	62.6 cords.

Total amount for construction and repairs is—

Rock	3,514.8 cubic yards.
Brush	442.6 cords.

The brush in all cases was placed in position and staked by government labor, and there is no doubt of the fact that even the short time that has elapsed since the construction of the east jetty has proven the utility and sound judgment in having them so placed, as in no instance as yet has the work constructed this year shown any of the naturally expected settling and washing.

The jetty, as constructed, is composed entirely of brush and stone, the stone being placed on the brush so as to form a wall of 18 feet in width, 1 foot high, or deep, over the fascines at either end, and 2 feet high in the center, containing as top load 1 cubic yard per linear foot of dam.

This width of jetty is continued until the Mississippi River is reached, where the wall is then gradually widened to an extreme width of 30 feet; the brush, in all cases, extending with their tips at least 6 feet beyond the stone.

In construction, the fascines, where the water was shallow, were laid singly and closely together, each bundle being firmly staked to the ground with stakes at least 4 inches in diameter and 5 feet in length.

Where deeper water was encountered, the fascines were made into mats of convenient size, floated into the proper position, and the corners firmly staked.

The stones necessary to sink the mat were then loaded on it, and the second tier of fascines was placed in position and sunk in the same manner until the surface of the water was reached, then stone of the required amount was placed on the whole.

The mats in all cases were made as long as possible, generally from 14 to 20 feet, so as to avoid the danger of interstices between them. In no case did any accident happen to the work during its construction, and everything progressed rapidly to a satisfactory completion.

The weather was propitious for the contractors to procure stone from Lake Pepin, only 3 days being lost during the season on account of winds, while early in the spring, during the space of 32 days, only 12 were found practicable for working, the high winds driving the steamboats and barges out of the lake during the balance of the time.

The contract price paid for stone for this work would appear on first sight to have been extravagant, but when it is considered that every load of rock had to be wind-lashed from the mouth to the place of unloading, and that on the most successful days, with two steamboats and full crews, only five loads could be delivered, the price paid per yard would not appear in disproportion to the amount of work required to deliver the stone, and I am satisfied that the interests of the work were served by giving the contract to the before-mentioned firm.

The repairs to the completed west jetty were necessary on account of its settling in places, which settling I believe to be almost entirely due to the fact that the fascines were laid on bars largely composed of sawdust from the mills on the upper river.

These bars are very easily washed when once any seepage or percolation has taken place. The work of repairs consisted of raising the sunken places by means of rock and brush, and of widening the dam where the most likelihood of a break appeared.

The west jetty, from the island to the mainland (with the exception of that repaired this year), should be widened and strengthened at the earliest opportunity. It is now so narrow (in some places only 8 feet wide), that any great amount of water running over it in the spring floods of the Chippewa, with a possible low stage in the Mississippi River, would endanger one of the most important portions of the work.

The benefit to the river, caused by these improvements, can hardly be estimated. Lumbermen and stevedores all cheerfully bear witness to the advantage therefrom, and all are anxious that the works should be so strengthened as to insure their stability.

On October 2, 1878, I left Saint Paul, under your instructions, and proceeded to gauge the tributaries and main Chippewa, from the mouth of Yellow River to the Mississippi, and to make an examination of the "Yellow Banks," said to be situated between Chippewa Falls and the mouth of the stream.

The first bank encountered is situated at Chippewa Falls dam, has a total length of 2,700 feet and an average height of 85 feet, but, being located above the dam in quiet water, no sand of any amount is washing from it.

The river from Eagle Rapids to this place is free of sand, and has a hard gravel bottom and a 5-foot channel. Before the various dams were built on this portion of the river there were many rapids, which are now entirely flooded out.

The second "yellow bank" is located at Eau Claire, also immediately above the dam, and therefore in quiet water, and doing no damage.

There is a small "bank" located about 1 mile below the mouth of the Eau Claire River, nearly three-eighths of a mile in length and 20 feet high, estimated to have thrown into the river about 14,500 cubic yards of sand within the last 15 years.

The first large "yellow bank" in descending the river is known as the "Twelve-mile Bank," and is situated in section 31, township 27 north, range 10, and is 6,300 feet long. The upstream 3,100 feet of the above length is covered at the upper part of the slope with vegetation and soil, but the bottom of the bank has commenced sliding out.

The balance of this "bank" (3,200 feet) is free from trees, and is one continuous range of sand 175 feet high, and constantly washing into the river.

The amount estimated to have washed from this bank within the last 15 years is 2,077,777 cubic yards. Below this place appears the first sand-bar of any account, the river-bottom to this point being coarse gravel and the channel generally good.

The Mary Dean "Banks" are next in order in descending the river, and are located in township 26, range 11, sections 5 and 6, and in sections 31 and 32, township 27, range 11.

I here obtained what I deem authentic information in regard to the wash of these banks from Mr. Garland, one of the owners of the mills at this place, and a 20 years' resident.

These "banks" are 6,900 feet long, with an average height of 145 feet, and the slope runs directly into the river. They are composed entirely of fine sand, and from information gained it is estimated that during the last 15 years at least 4,632,000 cubic yards of this material have washed into the stream.

Rumsey's Landing "Yellow Banks" are the third (after leaving Eau Claire) of any size. They are located in sections 1 and 2, township 26, range 12, are of same material as last "bank" mentioned, and are estimated to have thrown 4,264,813 cubic yards of sand into the river during the last 15 years. These "banks" are 4,700 feet long, with an average height of 140 feet above the river. From a 22 years' resident at this place I obtained data upon which to base my calculations, he having on his first arrival at the locality built a certain fence of a given length, from a known point, to the then edge of the river bank. The portion of the fence not washed away is still standing, and the old channel-marks corroborate the calculations made from this source of information.

"Waubeek Yellow Banks" are situated at the mouth of the Waubeek Slough, in section 4, township 25, range 13, and are 3,800 feet long, with an average height of 135 feet. The central portion of this bank is as yet throwing no sand into the river, but the upper 2,000 feet and the lower 700 feet are in present need of improvement, and are estimated to have discharged during 15 years the sum of 871,760 cubic yards of sand.

The above include all the "banks" of any size which now contribute to the sand in the Chippewa River, and the aggregate discharge, as per above estimates, reaches the sum of 11,846,352 cubic yards for a space of 15 years. This estimate I know to be a low one, and I have no doubt that a more careful examination would establish the fact that 1,000,000 cubic yards of sand are annually moving from these banks into the river, causing shifting bars and tortuous channels in the Chippewa, and eventually reaching the Mississippi River, there to cause obstructions to navigation and a never-ceasing expense to the national government. There is no doubt but that one of the ultimately best improvements that could be made for the Chippewa River would be

the stoppage of the running sands in these banks. The damage caused by this discharge of sand into the Mississippi is apparent anywhere below the junction of the two rivers. It being impossible for any quantity of sand to come through Lake Pepin, the bars below the lake must be attributed almost solely to the discharge from the Chippewa.

In my examinations I also noted the sand bars which were causing the most trouble in navigating the river, and would note as follows, viz:

Sebastopol Bar, located below Twelve-Mile Yellow Bank.

Hoghole Bar, located below Rumsey Landing Yellow Bank.

Hawkins Bend, located 1½ miles below Rumsey Landing Yellow Bank.

Bear Creek Bar, located short distance above Durand.

Plum Island Bar, located at head of Plum Island.

Ed. Ray Bar, located 6 miles above mouth of river.

Fred. Young Bar, located 4 miles above mouth of river.

Flower-Pot Bar, located 2½ miles above mouth of river.

The above are in order named as you are coming down the river, and are designated as known to river men.

The first three are gravel bars; the balance are composed almost entirely of sand. But I found no bars below Eau Claire on which the gravel exceeded 1 foot in depth, and once this crust is removed, the action of the water would, without difficulty, wash them away. For the removal of the sand bars a contraction of the river is needed, either by means of wing-dams or jetties. The Flower-Pot Bar will require a dam across the entrance into the Little Missouri, and a training dam of 1,400 feet in length from the shore above to the upper end of Flower-Pot Island.

If practicable, there is no doubt but that the simplest and most effectual method of improving the river below the head of "Big Beef Slough" would be to either dam the head of that slough entirely, or at least construct a dam which at low-water would retain its present discharge in the main river, allowing only the surplus in high stages to find an outlet through the slough. (See gauging of Beef Slough.)

The artificial obstructions in the river below Eau Claire consist of sheer-booms and piers.

The first sheer-boom is located 1 mile below Eau Claire, is a swing, and when in position completely closes the channel. The piers at or near the same location are built of timbers and loaded with stone, and being near the middle of the river, are of course a detriment to navigation.

The second large boom is 2 miles above the Mary Dean Mills, and is also a swing. There is also a range of boom piers from this locality, extending to the mills, having the same objections as the first piers mentioned, only they are more detrimental.

Round Hill boom, 1½ miles above the head of Beef Slough, is the largest on the river, stretching as it does from Round Hill to the head of the old channel leading into the slough, a distance of 3,000 feet.

Complaints are made against the location of this boom and the neglect of opening it when passing boats require it. The swing or open end of the boom is directly under a high perpendicular rock, known as "Seeping Rock," and during the nights it is very difficult for boats to find the opening at the end of the boom, on account of the dark shadow from the rocks overhead. The object of this boom is to turn loose logs into the head of Beef Slough, and also to divert as much of the Chippewa River as possible into the same channel. No protection is afforded against the logs jamming the boats against the rocks when the boom is suddenly opened. The above constitute the principal artificial obstructions to navigation in the river, but the fact of loose logs being allowed to be run below Eau Claire is, in reality, the most serious danger to boats and rafts, and it would seem absurd to an observer for the people of the Chippewa Valley to ask the government for appropriations to improve navigation while they themselves are every year allowed to fill the river with the most dangerous of obstructions; and this leads me to speak of the status of affairs between the different lumbering interests of this river. One interest, logs, on the Upper Chippewa and Flambeau Rivers, run their logs to Eau Claire, and there manufacture them into lumber, then raft and run the lumber to the Lower Mississippi markets. Another interest run their loose logs the whole length of the Chippewa to the head of Beef Slough, and down the slough to the Mississippi River, where they are rafted for down-river mills.

This running of loose logs and diversion of the waters of the river to Beef Slough has given rise to a series of suits, the culmination of which is expected to take place this winter in a United States court, and the legality of loose-log navigation will probably be definitely settled. The loose logs calculated to be run by this interest amount annually to 200,000,000 feet, and one can readily imagine the danger in running steam craft through their high-water "drives."

All interests are united in desiring improvement to the river below the head of Beef Slough, and above where there will be no danger of Beef Slough operations causing them to conflict with government authority.