

without reaching 18 feet water. This is owing to the tendency of the shoals to keep pace with the advancement of the piers.

Six cribs, each 32 feet long, were put in place on the Minnesota side up to November 25, 1867, when the work stopped for the season.

The pier thus commenced was connected with the dry ground of Minnesota Point by an embankment of loose rock, which caused deposits of sand uniting the pier with the point. By the close of the season of 1868 the Minnesota pier had attained a length of 1,100 feet.

No appropriation was made for this work in 1868.

The act of Congress approved April 10, 1869 gave \$2,000,000 for the repair, extension, preservation, and completion of works for the improvement of rivers and harbors, to be expended under the direction of the Secretary of War. Of this sum \$45,000 was allotted to Superior City Harbor. The first crib of the Wisconsin pier was sunk June 15, 1869. This pier was connected with the dry ground of Wisconsin Point by a wing-dam of timber, brush, slabs, and stone 178 feet in length, designed, as in the case of the Minnesota pier, to confine the current to the channel between the piers. By the 30th of June, 1870, the Wisconsin pier had reached a length of 640 feet.

Forty thousand dollars were appropriated for this work by the act of July 11, 1870.

May 14, 1870, the control of this work was transferred to Maj. D. C. Houston, Corps of Engineers, together with the works then in progress or in contemplation for improvement of the harbor of Duluth.

The town of Duluth began to be prominent in 1869, on account of the location there of the terminus of the Lake Superior and Mississippi Railroad, and the growing probability that it was to be the eastern terminus of the Northern Pacific Railroad. A survey was made in that year, by Capt. J. W. Cuyler, Corps of Engineers, under the orders of Maj. J. B. Wheeler, with reference to providing harbor facilities for Duluth. Three plans are detailed by Captain Cuyler in his report of October 5, 1869, to Major Wheeler: 1. To make a harbor in the lake outside of Minnesota Point by the construction of a breakwater. 2. To dredge a harbor at the northwest end of the Bay of Superior, and obtain access to it by a canal cut through Minnesota Point. 3. To dredge a harbor as before, and also a channel connecting it with the channel of the Saint Louis at Conner's Point, thence to make use of the latter channel and the entry for ingress and egress. The first plan was estimated to cost \$387,000; the second \$270,000; the third \$132,000.

The third plan was recommended as less expensive, and promising all necessary harbor facilities for many years.

The conclusions of the report were adopted by Major Wheeler in his report to the department of November 30, 1869.

The question of the proper plan for the improvement of the harbor of Duluth was submitted to a Board of Engineer Officers convened at Chicago January 17, 1870, by order of the Chief of Engineers. The Board consisted of Col. J. N. Macomb, Lieut. Col. W. F. Reynolds, Maj. J. B. Wheeler, Maj. G. Weitzel, and Maj. Walter McFarland. The report of the Board, after stating the situation, concludes:

In view of these facts, and after an examination of the three plans for the improvement of this harbor presented by Colonel Wheeler, the Board is of the opinion that the present wants of the commerce of Duluth are already sufficiently provided for, and that its possible future commerce may be best and most economically provided for by the completion of the improvement of the entry to Superior Bay or mouth of the Saint Louis River, and therefore recommends the adoption of the third plan presented by Maj. J. B. Wheeler in his report to the Chief of Engineers, dated November 30, 1869, which seems to the Board to be the most desirable of the three.

The act of Congress of March 3, 1871, appropriated \$60,000 for the improvement of the harbor of Duluth. Contrary to the opinions of the above-named officers, this amount was applied to the construction of a breakwater, extending from the northwest shore nearly parallel with Minnesota Point. This breakwater had already been commenced and carried out several hundred feet by the Northern Pacific Railroad Company.

In the mean time the city of Duluth had, in the autumn of 1870, commenced cutting a canal through Minnesota Point. This proceeding aroused most determined opposition on the part of Superior City, from the apprehension that the canal would divert the waters of the Saint Louis River, and thus deprive the entry of the current necessary to its maintenance. The governor, legislature, and Congressional delegation of Wisconsin became actively enlisted in behalf of Superior City in opposition to the scheme.

In the spring of 1871 an injunction was issued, at the instance of the War Department, restraining further operations in prosecution of the canal. This was subsequently dissolved, upon the execution by the city of Duluth of a bond for \$100,000 to secure the construction of a dike extending from Minnesota Point to Rice's Point, and isolating the harbor of Duluth from the rest of the Bay of Superior; said dike to be completed by December 1, 1871. Under this agreement work was resumed and the canal completed during the working season of 1871. It was 250 feet wide, and lined with crib-work piers, which extended to deep water in the lake, where the opening widens to 290 feet. The time for the completion of the dike was extended, at the request of the authorities of Duluth, to March 15, 1872, at which date it was reported complete and offered for inspection to the United States authorities. Its construction was wholly unsuited to the requirements of such a work, being made of light crib-work, ballasted with stone, and filled with sand. It proved to be utterly inadequate. The filling was washed out, and the crib-work, in parts, floated out of place, in parts was crushed by ice. Only traces of the work are now visible. No action was taken on the bond, which was pronounced worthless by eminent lawyers, the city not having legal authority to execute the same.

The appropriation of 40,000 for Superior City Harbor, made July 11, 1870, was applied to the extension of the piers. June 30, 1871, the Minnesota pier was 1,888 feet long, the Wisconsin pier 736 feet. This only included the cribs which were up to water level. The superstructure remained to be put on.

The act of March 3, 1871, granted \$60,000 for Superior City Harbor. By June 30, 1872, an addition of 768 feet of cribs had been made to the Minnesota pier; 1,184 feet of cribs to the Wisconsin pier.

The act of June 10, 1872, appropriated \$50,000 for this work. During the remainder of the working season of 1872 642 feet in length of cribs was added to the Wisconsin pier, making that pier 2,562 feet long. The Minnesota pier had a length of 2,656 feet.

The act last referred to granted \$50,000 for the improvement of Duluth Harbor. This was applied to the extension of the breakwater, which, at the close of the season of 1872, had reached a length of about 1,200 feet from the lake shore. It was composed of wooden cribs 30 feet wide and 50 feet long, reaching to the surface of the water. Each crib thus formed 50 feet of the substructure of the breakwater. The finished portion was surmounted by a continuous superstructure of timber 6 feet above water and planked over, the whole filled solid with stone. A violent storm on the 13th and 14th of November, 1872, did great damage

to this work. All the available funds were expended in repairing and rebuilding it. Since then it has been practically abandoned. It became apparent that its maintenance would be inordinately expensive, and the canal and inner harbor made it unnecessary.

A special survey of the Bay of Superior was made in 1872, at the instance of the governor of Wisconsin, to determine whether the Duluth Canal had injuriously affected the entry. A civil engineer named by the governor was associated with the officer in charge of the work for that purpose. From the results of this survey no positive shoaling of the entry was traceable to the Duluth Canal, but the fair inference was that the depth at the entry was less than would have existed if the canal had not been made.

A scraper was used for deepening the channel between the piers at the entry in the spring and summer of 1872. The original channel being crooked and the piers straight, the latter crossed and closed the former, leaving but $8\frac{1}{2}$ feet of water between the piers. This was deepened to 10 feet by a scraper.

The act of March 3, 1873, appropriated \$100,000 for the purpose of dredging out the bay of Superior from the natural entrance to the docks of Superior and Duluth and preserving both entrances from the lake thereto. The control of these works was transferred from Maj. D. C. Houston to Maj. F. U. Farquhar May 1, 1873.

A Board of Engineer Officers, consisting of Col. J. N. Macomb, Lieut. Col. Z. B. Tower, Maj. G. Weitzel, Maj. D. C. Houston, and Maj. F. U. Farquhar, was convened at Chicago April 16, 1873, to consider and report upon the best mode of applying the above appropriation.

In accordance with the recommendation of this Board, the work done under this appropriation consisted in extending, repairing, and completing the piers at both entrances and dredging between them; in dredging a channel 200 feet wide and 13 feet deep from the entry channel to the wharves at Superior City; in making an opening through the dike and lining it with piers. It will be noticed that the government had at this time assumed control of the works undertaken by the city of Duluth. In 1874 the piers at the entry were completed, including the superstructure, the Minnesota pier having a length of 2,856 feet, the Wisconsin 2,656, with not less than 12 feet in depth of water between them.*

The act of Congress approved June 23, 1874, granted \$10,000 for continuing the improvement of the entrance to the inner harbor of Duluth. This amount was expended mainly in dredging in the harbor. In 1875 the current through the canal had increased the depth to 20 feet in places, and caused a considerable length of the north pier to tilt sharply toward the canal, threatening to fall in.

An appropriation of \$35,000 was made by the act of March 3, 1875, for dredging the inside harbor of Duluth, which was expended accordingly.

No appropriation was made for the entry at Superior City in 1875. The sum of \$5,433 was allotted from the appropriation for repairs of harbors on northern lakes to construct a shore protection of brush and crib-work to close a breach which had been made through Minnesota Point.

The act of August 14, 1876, granted \$3,000 for the improvement of the natural entrance, and \$15,000 for the improvement of the harbor of

*Major Farquhar's report of 1874. Report of 1875 says 5,439 linear feet of piers. See Report of Chief of Engineers 1874-'75.

Duluth. During 1877 operations at Superior were confined to repairs of piers and protection of Minnesota Point, which consisting toward the southerly extremity mainly of sand is liable to be breached by the combined action of wind and waves.

At Duluth some 300 cords of rock were deposited along the channel side of the north pier to prevent undermining. Some dredging was done, viz, a channel through bar north of dike.

The act of June 18, 1878, appropriated \$3,000 for improving the natural entrance to Superior Bay, Wisconsin, and \$30,000 for continuing the improvement of the harbor of Duluth.

In the working season of 1878 slight repairs were made to the piers at the natural entrance, consisting mainly in replacing stone filling which had disappeared. Some 200 feet of shore protection, made of fascines and loaded with stone, was put in near the origin of the Minnesota pier.

The work at Duluth this season consisted mainly of dredging to extend the area of deep water in the harbor and to remove deposits which had taken place on some parts of the area already dredged; 108,359 cubic yards is the quantity reported as removed this season; 3 dredges and 2 tugs were employed by the contractors, Messrs. Williams & Upham. Some 250 feet of the superstructure of the north pier of the canal was renewed.

The act of March 3, 1879, granted \$25,000 for Duluth Harbor and \$5,000 for Superior. Dredging in Duluth Harbor was resumed in the spring of 1879 by the same contractors, Williams & Upham, and 49,819 cubic yards removed to June 30. To aid in maintaining the southerly part of Minnesota Point, some 3,000 willows, sand cherries, and other cuttings were inserted in the sand. They have taken vigorous root, and promise to render valuable service in averting the movement of the sand.

The total appropriations for these harbors amount to \$599,433, of which amount there had been expended to June 30, 1879, the sum of \$559,376.66. Some \$334,000 of this amount is chargeable to Superior, the balance to Duluth.

The total amount of dredging done in Duluth Harbor to June 30, 1879, is 457,000 cubic yards.

Y 3.

IMPROVEMENT OF HARBOR AT GRAND MARAIS, MINNESOTA.

A survey of this harbor was made in 1874, by Maj. F. U. Farquhar, Corps of Engineers, the results of which were printed in Part I, House Ex. Doc. No. 75, Forty-third Congress, second session. The plan of improvement recommended was to dredge within the harbor so as to give the necessary depth for vessels seeking refuge in the harbor, and to partly close the entrance by crib-work so as to further increase the area of shelter. The total cost of making the improvement recommended was placed at \$139,669.40.

Congress, by act approved March 3, 1879, appropriated \$10,000 for the improvement of the harbor.

A project for the expenditure of the appropriation, based upon reports on file in the office, was submitted to the Chief of Engineers under date of April 11, 1879, and by him approved. It contemplated dredging and the construction, so far as the funds would allow, of a line of crib-work to narrow the entrance, the dredging to be done by contract, after due

advertisement, the crib-work to be built by hired labor and purchase of material in open market.

The locality is remote, it being on the north shore of Lake Superior, and the season for working short. Nevertheless, it is thought that the appropriation can be profitably expended during the season of 1879. The sum appropriated is very small with which to inaugurate a harbor improvement.

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

Money statement.

Amount appropriated by act approved March 3, 1879.....	\$10,000 00
July 1, 1879, amount available.....	10,000 00
Amount (estimated) required for completion of existing project.....	129,669 40
Amount that can be profitably expended in fiscal year ending June 30, 1881, to be used in dredging and construction of piers.....	40,000 00

Exhibit of business done in the year 1878 at Grand Marais, Cook County, Minnesota, furnished by Mr. H. Mayhew.

Name of vessel.	Home port.	Tonnage.	Times arrived at Grand Marais.
Tug Nellie Cotton.....	Duluth.....	50	14
Tug Sisquet.....	do.....	50	1
Tug.....	Prince Arthur's Landing.....	30	1
Tug Amethyst.....	Duluth.....	40	1
Schooner Charlie.....	Beaver Bay.....	50	1
Schooner Mary Ann.....	Bayfield.....	40	4
Schooner Northern Belle.....	do.....	40	1
Schooner.....	La Point.....	30	1
Schooner Marco Polo.....	Bayfield.....	30	1

Tons freight received, 40; character, general merchandise; value, \$4,000.

Tons freight shipped, —; character, fur; value, \$2,000.

Grand Marais is the terminus of the United States mail-route, and in the winter months the point of distribution of the Canada mail.

APPENDIX Z.

ANNUAL REPORT OF MAJOR HENRY M. ROBERT, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1879.

UNITED STATES ENGINEER OFFICE,
Milwaukee, Wis., July 13, 1879.

SIR: Herewith I have the honor to transmit my annual report of operations at the several works in my charge during the fiscal year ending June 30, 1879.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

Z I.

IMPROVEMENT OF ONTONAGON HARBOR, MICHIGAN.

The estimated cost of completing the improvement (consisting of two piers, each about 2,500 feet long, and dredging between them) was..... \$363,770
Appropriated since..... 202,600

Leaving to be appropriated..... 161,170

Amount that can be profitably expended in fiscal year 1880-'81..... 60,000

The work already done consists of about 750 linear feet of pile pier and revetment and 2,430 feet of crib-work.

The operations during the past fiscal year consisted of refilling with brush and stone 112 linear feet of pile revetment and riprapping on shore side 200 linear feet; refilling and replanking cribs Nos. 1, 2, 36, 37, 39, and 41 east pier, and riprapping along inside of 116 linear feet of east pier. These repairs were done by hired labor. Six cribs were built and sunk in continuation of east pier under contract with C. P. Macdougall. After the necessary repairs had been made, and the 6 cribs for the extension of the east pier paid for, there remained funds available for building 3 more cribs, and the contract with Mr. Macdougall was extended for their construction.

The operations of the present season will consist in placing of 3 additional crib structures, under present contract; and under new contracts, the building of superstructures over 9 cribs, together with the sinking of 4 additional cribs (more or less), and dredging to the extent of about 10,000 cubic yards.

Continuation of the pier extension is the work contemplated during 1880-'81.