

it has been used in rebuilding the superstructures, slightly extending the shore end of the east breakwater, and dredging the channel.

The improvement consists of two breakwaters which approach each other in a generally east and west direction from the opposite sides of the mouth of the harbor, from whose outer ends 2 piers run nearly north into the lake, leaving a passage between them into the harbor of about 460 or 470 feet. Their lengths are as follows:

	Feet.
West breakwater.....	2,200
West pier.....	1,400
East breakwater.....	1,590
East pier.....	940

The sand has formed a beach so far in front of the west breakwater that it is no longer necessary to keep this work up, but the superstructures of the other works exposed to the action of the waves require rebuilding as fast as they decay, in order to preserve the channel from utter destruction.

The balance now available will be applied this season to rebuilding 825 feet of the superstructure of the west pier, beginning 375 feet from the outer end. The outer 375 feet of this pier ought to be rebuilt next year, and the estimated cost of doing this is \$5,000.

The channel between the piers, though dredged several times, has never been deepened for its whole width, on account of want of funds, and in consequence the sand banks that remain under water wash down through the action of the water into the dredged channel, filling it and making it crooked.

Quite a coal trade is growing up at this port, and it is important to its interests that its channel of entrance should be deepened so as to admit the passage of such vessels as are ordinarily used in the coal trade. At least 12 feet depth should be given it for the full width between the piers, excepting a strip about 15 feet wide next each pier, whose removal might endanger the stability of the piers.

To do this would require the removal of not less than 60,000 cubic yards of material, chiefly sand, which, at 25 cents per cubic yard, would cost \$15,000, and I would recommend that this whole amount be called for in the next annual estimates, namely, \$20,000.

The east pier and the east breakwater will soon need to have their superstructures replaced, and this can best be done, perhaps, by an annual appropriation of \$5,000 until the work is finished.

Great Sodus Harbor, New York, is in the collection-district of Oswego, from which it is distant about 32 miles. It is lighted by a coast-light of the fourth order on the bluff, fixed white varied by white flashes, and by two sixth-order white beacon-lights, one at each end of the west pier.

Through the courtesy of the collector of customs at Oswego, I have been furnished from the custom-house with the following statistics of the commerce of the port of Great Sodus (Sodus Point) for the fiscal year ending June 30, 1879:

1. Revenue from customs.....	\$1,262 68
2. Value of imports.....	\$7,659 51
3. Value of exports.....	\$117,543 06
4. Number of vessels cleared.....	117
5. Their tonnage.....	15,784
6. Number of vessels entered.....	116
7. Their tonnage.....	15,692
8. Probable number of other vessels arriving and departing.....	27
9. Chief articles of commerce, coal and lumber.....	

Money statement.

July 1, 1878, amount available.....	\$7,900 86
Amount appropriated by act approved March 3, 1879.....	2,000 00
July 1, 1879, amount expended during fiscal year.....	\$9,900 86 626 15
July 1, 1879, amount available.....	9,274 71
Amount (estimated) required for dredging and repairs.....	20,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881.....	20,000 00

H H 9.

IMPROVEMENT OF LITTLE SODUS HARBOR, NEW YORK.

The scheme for the improvement of this harbor, as modified in 1871, provided, as at Great Sodus, for an east pier and breakwater, and a west pier and breakwater, and was essentially completed during the fiscal year ending June 30, 1878. Their lengths are as follows:

	Feet.
West breakwater.....	500
West pier.....	1,070
East breakwater.....	1,524
East pier.....	512

The width of the channel from pier to pier is about 250 feet.

The balance now available for this work will be applied during the present season to rebuilding 1,016 linear feet of the superstructure of the west pier, and deepening the channel between the piers and into the bay to 12 feet at low-water.

In 1866 it was proposed to extend the west pier out to the 12-foot curve, but this has never been done, and the outer end of this pier is in 9 or 10 feet water. The outer end of the east pier is 610 feet inside of the outer end of the west pier, and, in consequence, sand has washed into the channel and formed shoals that cause great annoyance to vessels going out or in.

These piers should be carried out equally into the lake, and both should be extended to the 12-foot curve. In order to accomplish this, the west pier would have to be lengthened 420 feet, and the east pier 1,030 feet, a total length of 1,450 feet, which, at \$40 per linear foot, would cost \$58,000, or with contingent expenses \$60,000; and I strongly recommend that this be authorized, and the necessary appropriation be asked for. Without this, dredging will constantly have to be resorted to in order to keep the channel clear for the trade, which is very rapidly increasing at this port.

For the next year I would recommend that \$25,000 be asked for, in order to carry the east pier as far out as the west pier now is.

The growing importance of this harbor is shown by the fact that more revenue from customs was collected here during the past year than was collected at Charlotte, the port of Rochester.

Little Sodus Harbor, New York (Fairhaven), is in the collection-district of Oswego, about 12 miles west of Oswego and Fort Ontario. It is lighted by a fixed white light of the fourth order, situated near the head of the west pier.

The following statement of the commerce of the port for the past fiscal



year is furnished from the records of the custom-house at Oswego, through the courtesy of the collector of customs:

1. Revenue from customs .....	\$27,019 19
2. Value of imports .....	\$171,935 00
3. Value of exports .....	\$133,000 00
4. Number of vessels cleared .....	254
5. Their tonnage .....	32,947 tons
6. Number of vessels entered .....	253
7. Their tonnage .....	32,942 tons
8. Probable number of other vessels arriving and departing .....	25
9. Chief articles of commerce, barley, coal, lumber.	

*Money statement.*

July 1, 1878, amount available .....	\$11,945 17
Amount appropriated by act approved March 3, 1879 .....	5,000 00
	\$16,945 17
July 1, 1879, amount expended during fiscal year .....	1,455 84
	15,489 33
July 1, 1879, amount available .....	
Amount (estimated) required for completion of existing project .....	60,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881 .....	25,000 00

HH 10.

IMPROVEMENT OF OSWEGO HARBOR, NEW YORK.

The operations at this harbor during the past fiscal year have consisted of the extension and repair of the new breakwater and the repair of the old breakwater by the system of hired labor.

NEW BREAKWATER.

Between July 1 and the close of navigation in 1878 eight cribs for the extension of the new breakwater had been built, and seven of them had been moved to their positions in the line of the breakwater, filled with stone, and covered with their superstructures, increasing the length of the breakwater 250 feet.

These cribs, 35 feet square each, were sunk in water about 21 feet deep, the bottom consisting of a layer of sand several feet thick, overlying a rocky substratum. They had generally settled well into this sand before the superstructure was built upon them.

In order to prevent undue settlement of the exposed end, which is always more affected by the storms of winter than any other part of the work, it was well riprapped, though the counterfort which it has been usual to place behind it at the close of each season's work was omitted, as it was thought unnecessary. When work was resumed in the following spring it was found that the extreme end had settled but from 3 to 4 feet without getting out of line, and that the riprap which had done its work was now dispersed so that it was not in the way of the next crib to be sunk.

Though the cribs are but 35 feet square, and seven of them measure 245 feet, there is always a little gain in sinking them, due to their not coming into close contact with each other, and the actual increase in

length by this season's work was 250 feet, making the total length of the breakwater at the close of operations 4,366 feet.

There was so much delay in getting timber to complete the eighth crib that it was thought inadvisable to attempt to sink it that season, and it was therefore fastened as securely as possible with our means inside the breakwater; but the chains which secured it were broken in the course of the winter and it came ashore, where several of its lower courses were broken off by contact with the rocky bottom. It was, however, secured, repaired, and sunk in place during the spring.

The work of extension was resumed in June, 1879, being somewhat delayed by the lateness of the spring and the difficulty of getting timber. By the end of the month six cribs, besides the damaged one, were well under way, being 18, 10, 10, 6, 5, and 3 courses in height, respectively, but none were sunk.

At the present writing these and five others have been finished and sunk in the prolongation of the breakwater, twelve in all, which give an addition to the under-water work of 430 feet.

It is expected that before the close of the present working season six more will be sunk, giving an additional length of 215 feet, which, with the building of the superstructure, will exhaust the old appropriation.

The new appropriation of March 3, 1879, \$90,000, was not made available until July 30, and in the meanwhile it had been directed that so much of it as should be applied to the further extension of the breakwater should be expended under the contract system.

Proposals will therefore be called for this fall for work under this appropriation, by the aid of which an additional length of 700 feet ought to be given to the breakwater next season, if nothing unusual occurs to prevent it, which will nearly complete it to the length originally proposed, 5,800 feet, thus:

Now completed:	
Shore-arm .....	910 feet.
Lake-arm .....	3,456 "
Total complete .....	4,366 "
Incomplete:	
Cribs sunk: no superstructure .....	430 "
Contemplated:	
Under old appropriation .....	215 "
Under new appropriation .....	700 "
Total provided for .....	5,711 "
Total originally proposed .....	5,800 "

In view of the desire occasionally expressed that this work should be completed by the time that the enlarged Welland Canal is thrown open to trade, I some time ago addressed a letter to the Department of Public Works, Dominion of Canada, asking to be informed, if there were no objection to it, when it was expected that this would occur, and in answer received a number of public documents relating to the work, and a courteous official note stating that—

It is probable that all the works on the Welland Canal will be completed, and that the new canal will be opened to navigation, during the summer of 1881.

It appears probable, then, that the construction of the new breakwater at Oswego will be nearly, if not quite, completed many months before the enlarged Welland Canal is opened.



The estimated cost of this new breakwater—5,800 feet in length, as originally given—was \$232.89 per linear foot of structure; reduced 14 per cent. on a subsequent revision, which put the probable cost per linear foot at \$200.29, making the total estimated cost of 5,800 feet, \$1,161,682; which, in the estimates of the amount required for the completion of this work, I have called ..... \$1,162,000

Under this estimate the following appropriations have been made, viz:

July 11, 1870 .....	\$50,000
March 3, 1871 .....	100,000
June 10, 1872 .....	100,000
March 3, 1873 .....	100,000
June 23, 1874 .....	75,000
March 3, 1875 .....	90,000
August 14, 1876 .....	90,000
1877. No appropriation.	
June 18, 1878 .....	90,000
March 3, 1879 .....	90,000
Total .....	785,000
Balance of estimate .....	377,000

An error occurred in my last annual report, caused by omitting to deduct the appropriation of June 18, 1878, from the "amount (estimated) required for completion of existing project." That amount was given as \$557,000; it should have been \$467,000.

It will be observed that the amounts already appropriated for this breakwater, while nearly enough to complete it, fall between \$300,000 and \$400,000 below the amount originally estimated as necessary for its completion. This is due to the fact that nearly all the materials which enter into its composition have fallen at least one-half in price since that estimate was made, while the cost of labor itself has been reduced very greatly.

It is to be remembered also that the whole amount of these appropriations has not been applied exclusively to the construction of this breakwater, but also to the repair of both breakwaters as they became damaged by decay and storms, which repairs, applied chiefly to the old breakwater, which has been almost rebuilt, have cost not less than \$30,000 or \$40,000—more than enough in connection with the balance yet unexpended to complete the new work to its full length of 5,800 feet.

When this breakwater is completed, there will be an opening of from 600 to 700 feet in width between its eastern end and the northern end of the light-house pier, concerning which the report of the Board of Engineers of March 30 and 31, 1870, says:

The width of this opening may be reduced should it be found that the waves roll in so as to incommode shipping at the wharves.

My own opinion is that much the best way to protect this opening is to construct an east breakwater with the balance of the original estimate, leaving between its western end and the eastern end of the west breakwater an opening of 350 feet, which is the width of the present opening through which the river water passes out between the light-house and the old east pier. An inward arm of 100 feet or so might be made at the channel end of each breakwater.

The effect of this would be to secure a good entrance in all weathers to all parts of the harbor—western, eastern, and inner—to get rid of the dangerous sea which is now created in the very entrance of the harbor by the conflict of the river water and the waves produced by gales from the northward and eastward, as there would be no reaction from the light-house pier, and the river water would lose a good deal of its velocity by dispersion before reaching the new entrance and meeting the waves, and finally it would give to that half of the city of Oswego

which lies on the east side of the river the same harbor advantages that are now enjoyed by the west side, by securing to it additional anchorage and wharfage room as recommended in a resolution of the Oswego Board of Trade passed January 4, 1872, to be found at page 268 of the Report of the Chief of Engineers for that year.

All this can be accomplished by the expenditure of the balance of the original estimate remaining after the new west breakwater shall have been completed next year as originally designed, for the present work has not cost over \$130 per linear foot, and at this rate the balance remaining, if nothing unusual happens, would permit the construction of an eastern breakwater 2,700 feet long, which is a little less than half of the proposed length of the west breakwater. I have, therefore, to recommend that this be authorized, and make the usual requisition for next year's work.

## REPAIR OF NEW BREAKWATER.

During the winter of 1877-'78 a part of the work built in 1875 settled from 2 to 3 feet, and the superstructure over 292 linear feet of it had to be opened, leveled up, filled with stone and redecked, which was done in July and August, 1878.

A few other repairs were also made in October and December, where injury had been done by gales. The materials and labor used in these repairs cost as follows:

White pine timber and plank:		
31,859 feet, board measure, at \$15 per M .....		\$477 88
13,354 feet, board measure, at \$13.50 per M .....		180 28
		658 16
Iron:		
1,813 pounds drift-bolts, at 2½ cents .....		\$39 16
1,425 pounds spike-bolts, at 2½ cents .....		40 83
		79 99
Tug-hire .....		75 62
Labor .....		824 38
		1,638 15
Proportion of contingencies, 20 per cent .....		327 63
Total .....		1,965 78

During the past winter, 1878-'79, a good deal of the decking of the new breakwater, a few hundred feet east of the angle, was broken during the storms of winter and spring, and some stone was washed out. The same thing has occurred here several times, this part appearing, for some reason or other, to suffer more from the seas which break over it than any other part of the work.

I therefore recommended and received authority to raise this part of the breakwater 4 feet higher. It is intended to raise only the outer part of this height for a width of about 10 feet, depending upon the position of the larger deck timbers. Nothing was done to this during the past fiscal year, but it is expected that it will be finished this fall.

The only damage which this new work commonly suffers from gales and the weight of the ice which piles up on it in winter is the ripping off of deck plank, and the occasional breaking of deck joist and washing out of the stone filling. To obviate the former to some degree I have substituted oak in place of white pine deck joist, as it takes a stronger grip of the spike which holds the pine planking down.



REPAIR OF OLD BREAKWATER.

Some small repairs were made to this in September, 1878, but the work was in so dilapidated a condition that the winter storms following made a complete wreck of it, breaking down a large part of its outer and exposed half and breaching it in one or two places.

The estimated cost of its repair, which will be finished this fall, is \$15,000.

But for the protection which the outer breakwater now gives it, and which is constantly increasing, it would have been necessary to rebuild it throughout, but this may now be left for those to do into whose hands it may pass when the government is ready to give up its interest in it.

The cost of the materials and labor expended upon the repairs first mentioned—the latter, which are estimated to cost \$15,000, not being begun until after June 30—is as follows:

White pine timber and lumber, 12,788 feet, board-measure, at \$15 per M.....	\$191 70
Hemlock, 6,888 feet, board-measure, at \$13.50 per M.....	92 99
Drift-bolts, 2,483 pounds, at 2½ cents.....	57 93
Spike, 745 pounds, at 2½ cents.....	20 48
Stone, 15½ cords, at \$4 per cord.....	62 00
Labor.....	463 10
Proportion of contingencies, 20 per cent.....	177 64
Total.....	1,065 84

In addition to the extension of the new breakwater, and the repair of it and of the old breakwater, a large amount of incidental work has been done, costing \$4,133.89, as follows:

Four scows were calked, repaired, and launched. The largest, which was very old, was almost rebuilt. A new mast was made for the movable derrick.

A skiff was rebuilt.

The stone house near the shore end of the new breakwater was moved upon the United States reservation, and a bank of gravel near the ways was taken out of the way of the workmen.

The beach was leveled to facilitate the launching of the scows and hauling of timber.

The United States wharf near Fort Ontario, where the cribs are framed, was repaired by removing the old decayed timbers down to the water-line for a distance of 167 feet along the north and west faces and replacing them with new material.

The old ways for launching cribs were taken up and the foundations under them were leveled and planked and new supports put in.

A new mast was made for the stationary derrick.

A storm-shelter for the workmen engaged on the new breakwater was built on one of the scows.

All tools and plant on the work were thoroughly overhauled and repaired.

Oswego Harbor, New York, is in the collection-district of Oswego, at the mouth of the Oswego River, through which the waters of the great chain of lakes in Central New York empty themselves into Lake Ontario.

The harbor is lighted by a fixed white light of the third order at the eastern or channel end of the old breakwater, and by a red beacon-light at the outer end of the light-house pier. Fort Ontario lies at the mouth of the river, on the east side.

Oswego is the only American city on Lake Ontario, the Canadian cities of Kingston and Toronto, on the other shore of the lake, being distant from Oswego about 50 and 150 miles respectively, the former nearly due north, and the latter nearly due west. It is at the only outlet of the Erie Canal on Lake Ontario, having by means of it direct water communication with New York. Before the construction of railroads and canals the only mode by which freight or passengers reached Lake Ontario from New York

of this money; and it appearing that the interests of the village would be best subserved by further improving the channel below the dam, I recommended October 25 that the new appropriation be applied to this purpose, but that to make the improvement of value it would be necessary to secure an additional appropriation of \$10,000, by means of which a channel, 675 feet long, 100 feet wide, and 8 feet deep, could be made from below up to the mills.

This recommendation becoming known, objection was made to it on the part of those interested in the canal scheme, who wished to have the money applied above the dam, and some correspondence and discussion ensued, which produced delay in the settlement of the question, and it was not until the 3d of July that I was authorized to carry out my recommendation.

No work excepting the survey has been done therefore during the year. It is expected that it will be begun this fall, and that the funds available will be exhausted before the close of the next fiscal year.

Vaddington Harbor, New York, is in the collection-district of Oswegatchie, on the Lawrence River, about 20 miles below Ogdensburg, where the nearest American house is situated, and about 90 miles west in a straight line from Fort Montoye, at Rouse's Point, on the outlet from Lake Champlain.

The following statistics of its commerce for the past fiscal year are furnished from the records of the custom-house at Ogdensburg through the courtesy of the collector of customs:

1. Revenue from customs .....	\$4,706 07
2. Value of imports.....	\$35,615 00
3. Value of exports.....	\$15,820 00
4. Number of vessels cleared.....	9
5. Their tonnage..... tons..	477
6. Number of vessels entered.....	9
7. Their tonnage..... tons..	477
Number of arrivals and departures, independent of those which enter and clear.....	2,500
Chief articles of commerce, live stock and agricultural products.	

Money statement.

July 1, 1878, amount available.....	\$5,000 00
July 1, 1879, amount expended during fiscal year.....	130 52
July 1, 1879, amount available.....	4,869 48
Amount (estimated) required for completion of existing project.....	10,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881..	10,000 00