

Lake Erie, is formed by the peninsula of Presqu'isle, a long, low, sandy peninsula, forming a magnificent bay, the entrance to which has been narrowed and deepened by breakwaters and piers.

The security of the harbor depends upon the peninsula, and this latter had been from time to time seriously injured by the heavy gales from the lake, and breaches have been made on more than one occasion, through which channels with depths of at least 6 feet have been rapidly formed; these have been promptly closed, and a great deal of work has been done for the protection of the peninsula.

The study of the currents at the entrance of the harbor develops some peculiar features.

The bay is about  $4\frac{1}{2}$  miles long by  $1\frac{1}{2}$  miles broad, and its waters have their entrance and exit through a channel only 350 feet wide; at times, when the wind is blowing strongly from the eastward, the water in the east end of the lake is lower than that in the bay, and the current runs out with great velocity; a change of wind raises the lake, and to establish its proper level the water rushes back with even greater velocity into the bay; the natural result is a bar at each end of the channel, caused by the decrease of velocity, as the current becomes less rapid after leaving the limits of the piers. Bars will continue to form from time to time, and the shore line on the north side of the north pier to advance.

I think that the north pier should be extended out to the 16-foot curve in the lake and the south pier prolonged to the same distance; this will keep a straight channel at the entrance with a depth equal to that in the Saint Clair Flats Canal, and when done Erie Harbor will need no further appropriations for many years, except for minor repairs rendered necessary from decay of piers and damage from gales, and for the removal of small annual deposits of sand.

The estimated cost of this will be as follows:

Extending north pier 800 feet, at \$50 per foot.....	\$40,000
Extending south pier 1,600 feet, at \$50 per foot.....	80,000
Total .....	120,000

Of this sum \$50,000 could be profitably expended during the fiscal year ending June 30, 1881.

A careful examination of the weather beach of the peninsula shows that the revetments built in years past are in tolerably good condition, but that the lake is eroding the shore at various points; it is proposed to run out during this season pile jetties at right angles to the shore, as it is believed that this will tend to stop the erosion and to secure the accretion of sand around them. For the present the harbor appears to me to be in no immediate danger of injury from a breach in the peninsula.

#### OPERATIONS DURING THE FISCAL YEAR.

The opening of the fiscal year found operations in progress by hired labor repairing the north pier; 389 linear feet of superstructure was rebuilt and a crib 16 feet long on the west end of this work to connect it with that done last season; in rebuilding this superstructure, &c., the following materials were used:

51,033 feet (board-measure) pine timber.
2,780 pounds drift-bolts.
700 pounds spikes.
51½ cords of stone.

In November, 1878, a heavy gale damaged considerably about 30 feet of the old part of the north pier and carried away 7 snubbing posts; this damage was promptly repaired.

Operations were commenced dredging in the channel in August, under contract, and were continued from time to time until December, when they were suspended for the season; during this period the channel was widened and deepened by removing 19,148½ cubic yards of sand.

A survey of the peninsula of Presqu'isle was made in September, 1878. In February, 1879, proposals were invited for excavating in the channel at the entrance to the harbor, and in March a contract was executed with Mr. O. J. Jennings, of Dunkirk, N. Y., for removing 130,000 cubic yards of sand at the rate of 15 cents per yard, measured in scows.

It was determined to complete the channel at the entrance so as to make it at least 350 feet wide, with a depth of 16 feet at low-water.

Operations were commenced in April and continued up to the close of the fiscal year, during which time 27,237 cubic yards of sand had been removed, and there was a good channel at the entrance to the harbor about 200 feet wide with a depth of 16 feet.

Surveys of the outer shore-line of the peninsula and of the channel at the entrance to the harbor were made during the months of May and June, 1879, and some minor repairs were made to the north pier.

During the present season it is proposed to complete dredging the channel to a width of 350 feet and a depth of 16 feet; to construct several pile jetties along the weather beach of the peninsula, and if the appropriation of March 3, 1879, becomes available in time, to prolong the south pier 600 feet.

Should an appropriation be made for the fiscal year ending June 30, 1881, it will be applied to prolonging the north pier.

The following appropriations have been made from time to time for this harbor:

March 3, 1823.....	\$150 00	July 7, 1838.....	\$30,000 00
May 26, 1824.....	20,000 00	June 11, 1844.....	40,000 00
March 25, 1826.....	7,000 00	August 30, 1852.....	30,000 00
March 2, 1827.....	2,000 00	June 23, 1866.....	36,961 00
May 19, 1828.....	6,223 18	March 2, 1867.....	25,000 00
March 3, 1829.....	7,390 00	June 30, 1868.....	40,000 00
March 2, 1831.....	1,700 00	April 10, 1869.....	22,275 00
July 3, 1832.....	4,500 00	July 11, 1870.....	20,000 00
March 2, 1833.....	6,000 00	March 3, 1871.....	29,000 00
June 28, 1834.....	3,045 00	June 10, 1872.....	15,000 00
June 28, 1834.....	20,000 00	June 23, 1874.....	20,000 00
March 3, 1835.....	5,000 00	March 3, 1875.....	80,000 00
July 2, 1836.....	15,000 00	August 14, 1876.....	40,000 00
July 2, 1836.....	122 80	June 18, 1878.....	25,000 00
March 3, 1837.....	15,000 00	March 3, 1879.....	25,000 00

Total, \$591,367.23, of which amount \$538,265.48 has been expended up to the close of the present fiscal year.

Erie Harbor, Pennsylvania, is in the collection-district of Erie, Pa. It is lighted by 7 lights; a fourth-order lake coast light on the north shore of the peninsula, fixed white, varied by red flashes; a main harbor light of the third order, fixed white, and 5 range lights of the sixth order to mark the channels.

The nearest work of defense is Fort Porter, 90 miles distant.

The amount of revenue collected during the fiscal year ending June 30, 1879, was \$9,162.85.

The value of the foreign imports was \$33,238.50. The value of the foreign exports was \$30,490. The value of the domestic imports, of which no exact record is kept, is reported by the collector to have been several millions of dollars.

Eight hundred and fifty-two vessels, with an aggregate tonnage of 645,969 tons entered, and 841 vessels, with an aggregate tonnage of 637,667 tons, cleared during the year.

I respectfully invite attention to the report of Capt. M. B. Adams, Corps of Engineers, which I transmit herewith.

Abstracts of proposals and contracts and a statement of funds are submitted herewith.

Money statement.

July 1, 1878, amount available.....	\$40,789 64	
Amount appropriated by act approved March 3, 1879.....	25,000 00	\$65,789 64
July 1, 1879, amount expended during fiscal year.....	12,279 34	
July 1, 1879, outstanding liabilities.....	408 55	12,687 89
July 1, 1879, amount available.....		53,101 75
Amount (estimated) required for completion of existing project.....	90,000 00	
Amount that can be profitably expended in fiscal year ending June 30, 1881.	50,000 00	

Abstract of proposals for dredging 100,000 cubic yards, more or less, of sand, &c., at Erie Harbor, Pennsylvania, received and opened by Maj. John M. Wilson, Corps of Engineers, at United States Engineer Office, Cleveland, Ohio, at 12 o'clock m., Thursday, March 20, 1879, under advertisement of February 10, 1879.

No.	Name of bidder.	Address of bidder.	Rate per cubic yard.
1	Hosea T. Stock.....	Toledo, Ohio.....	\$0 17
2	Elias Sims and Patrick Smith.....	Cleveland, Ohio.....	19 1/2
3	Charles F. Dunbar.....	Erie, Pa.....	18
4	O. J. Jennings *.....	Dunkirk, N. Y.....	15

\* Contract awarded.

Abstract of contract for improving harbor at Erie, Pa., in force during fiscal year ending June 30, 1879.

Name and residence of contractor.	Date of contract.	Subject of contract.	Sand, &c., per cubic yard in scows.	Per hour.
O. J. Jennings, Dunkirk, N. Y.*.....	Apr. 30, 1877.....	Dredging.....		\$5 44
Do.....	Mar. 29, 1879.....	do.....	\$0 15	

\* Contract completed and closed September 30, 1878.

REPORT OF CAPT. M. B. ADAMS, CORPS OF ENGINEERS.

ERIE, PA., July 2, 1879.

SIR: In accordance with your instructions, I have the honor to report as follows upon Erie Harbor, Pennsylvania, for the fiscal year ending June 30, 1879, viz: I was directed to take station at Erie, Pa., and to assume charge of the works of improvement to be carried on at that harbor, under your directions, March 20, 1879; consequently, my report will be confined to the operations of the last three months. In compliance with your letter of general instructions I first gave attention, after my arrival here, to the preparation of a chart of the channel, by which the dredges could be located when dredging operations commenced. To this end the deep-water channel was first ascertained and buoyed out; the buoys were definitely located by angular measurements from a base line, and then a careful system of soundings was made and platted. The chart showing the result of this work was forwarded to you April 28, with a recommendation that the channel should be widened to the south of elbow in it which was found about two-thirds of the way in, and the rounding of which by vessels makes the system of range lights, with its imperfections, necessary. This change being possible in addition to the general widening of the channel through the inner and outer bars, with the amount of dredging then provided for the harbor under contract dated March 29, 1879, with Mr. O. J. Jennings, for dredging 130,000 cubic yards, it met with your approval April 30, and work has been progressing in accordance therewith. The advantages that will arise from this change of the channel, i. e., instead of ves-

sels having to run two-thirds of the way over the inner bar, and then make a change of direction through an angle of 27° 30' guided by lights 2,800 feet away, the smaller angle of 8° 40' will be effected immediately after passing the inner light on the north pier, only 200 feet distant, where the lights will be visible in all weather, are such as meet with general commendation from navigators.

The work of dredging was commenced under the before-mentioned contract April 26, and has progressed with reasonable regularity since; only 27,237.04 cubic yards have been dredged, however, up to date, which evidently points to the necessity of, at least, a third dredge being placed at work to insure the completion of the contract within the time it specifies, viz, on or before November 6, 1879. The contractor's attention has, therefore, been called to the rate at which he is working.

2d. In the order of your general instructions you directed soundings to be made over the site of the south-pier extension, which was done, plotted, and submitted to you accordingly.

3d. An examination of the north pier, to see what repairs were absolutely required, was ordered. The report on this, giving the estimate of the slight repairs at once needed, was made to you on May 27, which was approved, and in accordance therewith a portion of the work (excepting the driving of 5 fender piles and securing them) has been done. In these repairs 596 feet of pine lumber and 180 pounds of spikes were used, being only the renewal of a small portion of the decking. The driving of the piles has been deferred, with your approval, until the work of pile-driving which is contemplated along the north shore of the peninsula is commenced.

4th. You directed an examination of the peninsula to be made with a view to designing structures for its protection on the lake side. This was done, and the following report submitted:

REPORT.

"UNITED STATES ENGINEER OFFICE,  
"Erie, Pa., May 5, 1879.

"MAJOR: In order to carry out your instructions of the 30th ultimo, I have, first, made a reconnaissance (Saturday last) along the entire north shore of the peninsula, with a result as reported below.

"RECONNAISSANCE OF LAKE SIDE OF PRESQU' ISLE PENINSULA, MADE MAY 3, 1879.

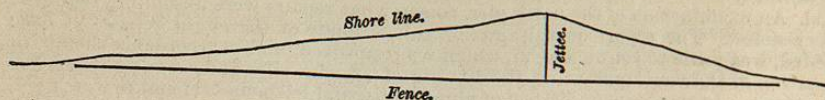
"Commencing at a point near the Range Pole Lights around the entire east and northeast faces of the peninsula, the accretion of sand and growth of the beach is very considerable; the water is so shoal that the bottom is visible for a distance of 100 feet to 250 feet out in the lake, and the bars in some places appear above the water. The beach is devoid of vegetation for a somewhat greater distance on shore, and is strewn with recent drift.

"After passing the most northerly point of the peninsula, about 1 mile east of the light-house, although there is still every indication of a great amount of comparatively recent accreted matter, it does not look to be as late as that farther east, and the face of the beach at water's edge is more abrupt, in places jumping down vertically some 2 feet or 3 feet, thus showing that such places have been slightly abraded and some sand carried away; nevertheless the beach is wide and the water is shoal as before. Some 500 feet to the west of the light-house, on the north shore of the peninsula, the first positive abrasions were seen. The beach here is gone, and for about 1,000 feet there is every indication of recent encroachment of the lake upon the shore; the trees (pine ones still green) are undermined and hanging with their tops in the water, while they are still root-bound to the bank, which keeps them from being carried away. The water is quite shoal, consequently there is more the appearance of this having resulted from a severe storm than from any regular current action of the lakes, and as the peninsula is here about the widest of any part along its entire length, no damage to the harbor in the way of a breach can possibly result in the immediate future. The abraded matter is carried around the end of the peninsula though, doubtless, and eventually finds a resting place in the harbor-entrance bars. About 1 mile west of the light-house there is a most decided encroachment of the lake upon the peninsula which must have been commenced some years ago, possibly only 4 or 5; it has, however, now extended shoreward, so that the bank rises abruptly from water's edge to a height of 15 or 20 feet. Large trees are here standing at the brink, while others have gone over, having become undermined, and are now lying with their tops out in the lake; and even their roots are some distance outside, lakeward, of the water's edge, with every indication of the encroachment having been considerable. In one instance, where the growth of trees is close together and close to water's edge, they fell with their tops shoreward, and indicate a very strong wind action from off the lake and not an undermining. There was no part of this shore, from the light-house to the first fence, where the water was deep close in, as far as I could see; and, as at

almost all the places along the shore where trees have fallen, their trunks remain interlocked, thus forming a natural revetment, it does not appear necessary to make any improvement unless the encroachment is deemed of sufficient importance upon further investigation to justify an outlay to secure the safety of the light-house.

"*First fence.*—The riprap inside and outside, along the one-half of its length, west end, is gone, and is mostly strewn along the beach for some 200 feet further west, otherwise it is in good condition, and there seems to be no encroachment of the lake, nor any other action here than the carrying away of these stones.

"*Second fence* is in good condition, the riprap in the outside being about covered with sand. A jetty 50 feet long, made of a single row of piles driven in contact and having their tops 9 feet above water level, runs off at right angles to this fence about 200 feet from its east end. The jetty works well, causing sand to form on either side of it and in front of the fences thus:



"Between fences Nos. 2 and 3 there are the remains of an old pile-dock. The piles were driven in two rows, some 10 feet apart in each row, three of these in each row being now visible above the beach-sand; and, notwithstanding the distance the piles are apart, they have acted like the pile-jetty before mentioned.

"*Fence No. 3* is in good condition throughout. Just west of fence No. 3 are the remains of a more recent timber or crib dock than the pile one. It is now razed to the water's edge almost though, and shows only about 30 feet of length above sand and water. The beach has formed around it like around the before-mentioned dock and jetty.

"*Fence No. 4.*—Fifty-six feet of its east end is now without the usual riprap inside or outside, which has evidently been carried away by the sea at this its most exposed portion. The water-line has not gained any on the shore, however, in consequence. The beach rises just back of it, as it does farther east; *i. e.*, on a slope of about  $\frac{1}{2}$  to a height of some 9 feet above water-level, and here the level bank is covered with drift, logs, trunks of trees, &c., for some distance on shore and all along the spaces between fences Nos. 3 and 4.

"The same strewed drift matter is seen back of fence No. 4, at the same distance from the water; but sand has accumulated back of the fence, more likely by wind than wave action, to a level of about 3 feet higher than the unprotected beach at a corresponding distance out; and in front of the fence the beach has formed, in some places covering the riprap, and extending out 50 feet into the lake, while at other places the riprap is entirely exposed. No doubt the formation of this sand beach in some places and its removal at others goes on at odd intervals alternately. There is, however, no indication of a breach at any place, not even where the riprap of the fences is gone, and I do not now feel justified in recommending any outlay to either extend or in any way add to these fences. The best improvement, in my judgment, in case it is desired to cause a growth of the beach, would be to construct jetties 400 feet apart and 50 feet long, at right angles to the shore, which no doubt would admit of being extended as the beach formed out and around them. These jetties could be constructed either of piles driven in a single row close together, or of piles in two rows with intervals, and brushed between and weighted with stone. I should give my preference to the single row of piles method, as affording equally good results, and, at this point, in consequence of the cost of stone, being more economical. I think all the timber required in either case could be had by the cutting from off the peninsula.

"Before closing, I would say that the uniform plan of constructing the sand-catch or beach-protection fences on the peninsula, has been to drive two rows of piles 7 feet from each other, and from 6 to 8 feet apart in each row, the inner row projecting about a foot above the sand, the other at water's edge, and their tops extending about 7 to 9 feet above the water; the inner piles, being exactly opposite to those of the outer row, serve as anchor or tie piles for the outer row, which supports the fence. The tying back is effected by two planks spiked on both sides of the piles, in pairs, inside and outside rows, at their tops. The fence is of 12-inch planks, horizontal, and 4 to 6 courses high, and secured to the outer row with bolts. This receives a pile of stones (weighing from 30 to 150 pounds) along its inner and outer faces, the pile having a base of about 9 feet to 12 feet, and a height of 3 feet to 4 feet, and are quite solid and substantial structures. I shall expect to make a further examination of this matter, with soundings bayward and lakeward of the peninsula, especially of the portion from the light-house 2 miles west, to enable me to arrive at a more satisfactory solution of the entire question; but at the present I can say that, in my judgment, there is no improvement that is imminently required, nor any repairs of the fences at once needed;

and if there is any point at which protection is necessary, it will prove to be to the west of the light-house on the north shore of the peninsula.

"I think the neck of the peninsula could be widened by the jetty system I have here reported.

"Very respectfully, your obedient servant,

"M. B. ADAMS,  
"Captain of Engineers."

"Maj. JOHN M. WILSON,  
"Corps of Engineers, U. S. A."

As you approved the construction of jetties to the west of the light-house after your personal examination of a portion of the lake shore of the peninsula, there has been designed a system of log and pile jetties, consisting of piles in a single row, at right angles to the shore, in part, and partly of piles driven in pairs, also at right angles to the shore line, but with intervals of 12 or fifteen feet between the pairs of piles, which, with the drift logs collected from along the beach and secured between these piles with bolts, are to form the jetties at certain places.

The chart showing the location of these proposed jetties, estimates of their cost, cross-sections of the shore where each is to be constructed, and advertisement and specifications in manuscript, relating to their construction, have been forwarded for your examination.

#### GENERAL OBSERVATIONS AS TO ERIE HARBOR.

Sand is carried into the harbor in great quantity after having reached the south and east of the peninsula. Much of this sand remains as a deposit on the inner bar and in the deep-water channel through it. The water in the bay (some 6 square miles in area), in equalizing its level to that of the ever-changing water of the lake, has to fill or empty at a single opening 370 feet wide between the piers, consequently a very swift current sets through this opening at each change of level. The sand is disturbed, and in a condition ready to move on the outside and comes in with the inflow, but has had time to become comparatively quiet before the outflow takes place, hence the deposit. Much of this deposit naturally takes place along the sides of the channel through the inner bar, especially at some distance away from the piers, the swift current having there, in part, lost its velocity. The amount of this deposit could probably be advantageously diminished by lessening the current and amount of inflow and outflow between the piers, as the scouring effect there now is excessive. An opening into the bay of limited extent, provided its bottom and sides were protected against erosion and scour, would prove a benefit to the channel and harbor. If the outflow through such opening could be prevented, perhaps the excess of outflowing water over the inflowing would be sufficient to keep the channel clear of accretion. Such flooding of the bay from the lake, if it was to be undertaken, should occur at a place to be selected with these two points prominently in view:

1st. To have the least possible amount of disturbed sand on the outside.

2d. The least valuable part of the bay, as far as anchorage is concerned, on the inside, as doubtless some sand would be brought into the bay through such opening.

There is a table attached to this report, which is a condensation of gauge-readings kept at the light-house since June, 1875, showing the aggregate rise and fall, with the two greatest rates per hour of rise and fall, in each month from that date up to June, 1879. It will be seen from this table that there have occurred at certain times rises of water inside the bay amounting to 4 inches per hour; that the rise is nearly always twice as rapid as the fall of the water in the bay, and that in the month of December last alone there were not less than 74,342,400 cubic yards of water received into and discharged from the bay, the aggregate rise and fall in that month amounting to 12 feet. The amount of deposit that remains is difficult to determine; but I venture the opinion that the lower bay is shoaling each year, and consequently the banks of sand on either side of the dredged channel are gradually approaching the surface of the water.

Very respectfully, your obedient servant,

M. B. ADAMS,  
Captain of Engineers.

Maj. JOHN M. WILSON,  
Corps of Engineers, U. S. A.

Condensed table of gauge-readings kept at the light-house, Erie Harbor, Pennsylvania, from June, 1875, to June, 1879.

Year and month.	Aggregate rise or fall.	Greatest rate per hour.		Year and month.	Aggregate rise or fall.	Greatest rate per hour.	
		Rise.	Fall.			Rise.	Fall.
1875.	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	1877.	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>
June .....	8.65	0.14	0.18	June .....	5.00	0.05	0.07
July .....	5.70	.08	.09	July .....	5.45	.09	.08
August .....	7.50	.12	.06	August .....	6.45	.15	.10
September .....	8.30	.10	.06	September .....	7.20	.10	.08
October .....	8.70	.15	.08	October .....	10.75	.17	.10
November .....	11.45	.31	.10	November .....	9.15	.16	.08
December .....	7.30	.12	.10	December .....	8.85	.16	.10
1876.				1878.			
January .....	9.35	.07	.06	January .....	7.00	.06	.13
February .....	11.75	.33	.18	February .....	5.30	.13	.10
March .....	10.35	.11	.08	March .....	7.62	.08	.08
April .....	10.85	.26	.16	April .....	5.00	.08	.06
May .....	13.90	.32	.29	May .....	5.45	.05	.05
June .....	10.45	.19	.19	June .....	4.20	.09	.06
July .....	8.45	.27	.17	July .....	4.75	.09	.05
August .....	5.92	.09	0.45	August .....	6.45	.08	.05
September .....	9.52	.16	.15	September .....	6.50	.13	.12
October .....	13.78	.22	.18	October .....	8.10	.16	.08
November .....	9.15	.09	.21	November .....	8.85	.09	.08
December .....	8.47	.09	.09	December .....	12.06	.18	.10
1877.				1879.			
January .....	3.20	.03	.02	January .....	7.53	.09	.09
February .....	3.80	.06	.04	February .....	5.87	.08	.08
March .....	7.27	.13	.05	March .....	6.33	.13	.05
April .....	7.22	.11	.11	April .....	5.45	.12	.08
May .....	5.25	.04	.08	May .....	5.37	.11	.05

APPENDIX H H.

ANNUAL REPORT OF MAJOR WALTER MCFARLAND, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1879.

UNITED STATES ENGINEER OFFICE,  
Oscego, N. Y., September 5, 1879.

GENERAL: I have the honor to transmit herewith my annual reports for the fiscal year ending June 30, 1879, upon the river and harbor works in my charge.

Very respectfully, your obedient servant,

WALTER MCFARLAND,  
Major of Engineers.

Brig. Gen. H. G. WRIGHT,  
Chief of Engineers, U. S. A.

H H I.

IMPROVEMENT OF DUNKIRK HARBOR, NEW YORK.

Under the contract with O. J. Jennings for extending the breakwater, entered into July 5, 1877, work upon it was to have closed June 30, 1878. At that date, however, the work, though nearly through, was not quite finished, and upon Mr. Jennings's application and my recommendation, the time for its completion was extended to the 15th of July, 1878, at which date the work was finished.

After the closing of this contract and the payment of all claims arising under it, there remained a balance of \$2,500.56, which I recommended should be applied to the repair of the west pier, which was in a dilapidated condition, and this recommendation was approved by letter from the Chief of Engineers dated August 7, 1878. This work, which was begun at once and completed October 5, consisted in taking up the old plank and deck-joists, replacing them with new material, and leveling the superstructure for a distance of 993 feet shoreward from the beacon, which is at its outer and eastern extremity.

In this operation the following material was used:

Pine timber and plank .....	feet, b. m. . . . .	52, 125
Stone .....	..... cords . . . . .	34
Drift bolts .....	..... pounds . . . . .	334
Spike .....	..... do. . . . .	7, 626

The pier and breakwater are now in good condition.

No money has been appropriated for the improvement of this harbor