

REPORT UPON CURRENT OBSERVATIONS AT NEW HAVEN HARBOR, JUNE 18, 19, 20
1879.

These observations were made with a view to determine the direction and approximate velocity of the tidal currents between Fort Hale and Light-House Point during a single movement of the ebb and flood tides in moderate weather. The following simple method was adopted and found to work sufficiently well for the object to be attained:

A series of 12 floats was used, made of pine scantling 5 feet 4 inches long, weighted at one end so as to bring the other, bearing a small flag, just to the water's surface. These were first dropped from a small boat in line across the channel from Fort Hale towards the opposite beach, at the beginning of the ebb-tide. Two observers with transits were stationed, one at Fort Hale, the other on the opposite beach.

The positions of the floats when placed were taken, and subsequently as often as the row-boat could visit them in succession. On this occasion 6 positions of each float were located. When the tide turned at the mouth of the harbor the floats were taken up. The following day, at 5 a. m., the floats were placed across the mouth of the harbor, to be followed during the flood. A brisk north wind prevailed, which seriously interfered with the progress and direction of the current. Seven positions of each float were taken, but as the water was quite rough it was considered expedient to repeat these observations on the following day, when, the weather being calm, the tide moved more rapidly, carrying some of the floats considerably above Fort Hale. The movement of the floats being very irregular, those nearer the shore having less velocity than others nearer the middle of the channel, rendered the labor of the boat party very exacting. A rapid steam-launch would have been a valuable assistance for this work. The necessary preparations for the observations were made at New London, and the observer's instruments, floats, &c., were taken to New Haven on the schooner Alice, which served during the progress of the survey as quarters for the party, enabling them to remain immediately upon the work during the whole period.

Accompanying a chart of the harbor are sent sketches for each day's observations, representing the paths of the floats, with time curves showing their relative positions at intervals of 30 minutes. That part of the harbor east of a line from the light-house to Fort Hale was obstructed at several places by fish-pounds, which, in some instances, arrested the passage of floats, making it necessary to take them up and replace them. It will be observed that at the beginning of the flood the tide sets strongly to the westward. Later on, it is attracted northward and eastward towards the upper harbor and into Morris' Cove.

C 4.

IMPROVEMENT OF MILFORD HARBOR, CONNECTICUT.

By the act of Congress of June 18, 1878, \$10,000 was appropriated for continuing the improvement of this harbor.

Proposals were invited for dredging, as follows: To widen the channel to 100 feet through the bar, below the long jetty, and to make a channel 50 feet wide from the long jetty to the town wharf, making the depth 4 feet at mean low-water.

Bids were opened August 6, 1878; the following is an abstract of proposals received:

Name.	Address.	Price per cubic yard below jetty, 10,000 cubic yards.	Price per cubic yard above jetty, 65,000 cubic yards.	At prices named the amount estimated to be removed, 75,000 cubic yards, would cost—
M. F. Brainard	Albany, N. Y.	\$0 25	\$0 28	\$20,700
P. W. Myers	New York City	21	16	12,500
J. M. Seward	Albany, N. Y.	17	17	12,750
G. C. Fobes & Co.	Baltimore, Md.	28	16	9,300
Henry D. Dennison	Syracuse, N. Y.	18	18	13,500
McDermott & Daley	Cohoes, N. Y.	28	24	18,400
H. N. & A. J. Beardsley	Bridgeport, Conn.	24	13	10,850

Total number of vessels of all classes entered and cleared during the fiscal year ending June 30, 1879 (near as I can ascertain), 473; total tonnage, 35,475 tons.

Estimated value of cargoes received, including fish \$141,900
Estimated value of cargoes exported, including fish, oil, and guano..... 200,000

Draught of vessels, 4 to 10 feet.
Number of vessels of all classes entering the harbor for refuge during the year, 1,500.

HISTORY OF THE IMPROVEMENT TO 1879.

Milford, Conn., is a small village on the Wepawaug River, at the head of tide-water. It is in New Haven County, had a population of 3,405 in 1870, is 9 miles west of New Haven, and is on the line of the New York and New Haven Railroad.

The principal business of the place is the manufacture of straw goods and carriages. The mean rise and fall of tide at Milford is 6.2 feet. By the second section of an act of Congress approved June 10, 1872, a "survey of breakwater at Milford, Conn.," was directed to be made. This survey was placed in charge of Maj. G. K. Warren, Corps of Engineers, U. S. A.; was made by Mr. J. P. Cotton, assistant engineer, in November, 1872; and December 24, 1872, a report submitting estimates for improvement was made, as follows:

For breakwater at Welsh's Point to 15-foot curve, 890 feet long and 9 feet above mean low-water—
24,290 tons granite, at \$2.50..... \$60,725
For small jetties to protect eastern shore from erosion 5,000
For dredging to 4 feet, 100 feet wide, 2,500 cubic yards, at 25 cents 6,250
For jetties at mouth of river, 550 feet long, to prevent filling of dredged channel 5,000
Superintendence and contingencies, &c 8,025

Total 85,000

By act of Congress of June 23, 1874, \$5,000 was appropriated for improvement of the harbor. In July, 1874, the charge of the work was transferred from Major Warren to Maj. J. W. Barlow, Corps of Engineers, U. S. A. During the year ending June 30, 1875, \$4,941 was expended in building 12 jetties on the east shore of the harbor, to prevent erosion of the bank. In these jetties 3,882 tons of stone were placed. The jetties are from 100 to 130 feet long, and 9 feet high above mean low-water.

By act of Congress of March 3, 1875, \$13,000 was appropriated for continuing the improvement. Under this appropriation 24,232 cubic yards of material, at a cost of 18 cents per cubic yard, were removed, making the channel 75 feet wide and 4 feet deep at mean low-water from the 4-foot curve at the mouth of the harbor to a point about 300 feet below W. Merwin's dock.

The long jetty at the mouth of the river was built under the same appropriation; 4,098 tons of rubble stone were used in its construction, at a cost of about \$1.35 per ton. In 1877 an inspection of the dredged channel showed that a bar had formed across it a short distance above the long jetty.

The following is a condensed history of the work at Milford:

Date of appropriation.	Amount.	How applied.
June 10, 1872.....	\$1,500 00	Survey.
June 23, 1874.....	5,000 00	Building jetties on east shore.
March 3, 1875.....	13,000 00	Building long jetty, widening and deepening channel to Merwin's dock.
June 18, 1878.....	10,000 00	Widening and deepening channel to Town wharf.



Money statement.

July 1, 1878, amount available	\$10,132 77
July 1, 1879, amount expended during fiscal year	\$2,736 00
July 1, 1879, outstanding liabilities	189 97
	2,925 97
July 1, 1879, amount available	7,206 80
Amount (estimated) required for completion of existing project	50,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881.	50,000 00

C 5.

IMPROVEMENT OF HOUSATONIC RIVER, CONNECTICUT.

By act of Congress of June 18, 1878, the sum of \$5,000 was appropriated for removing the shoals or bars formed during the previous season.

An examination made in April, 1879, showed material shoaling at Five Mile Island Bar, Drew's Bar, Mill Bar, and at the bend below Stratford.

Bids for dredging in such places upon the river as might be directed by the officer in charge were invited.

Following is an abstract of the proposals received:

Name.	Address.	Price per yard.		Price per hour.	To commence—	To complete—
		Deposited in sound.	Deposited on flats.			
John M. Seward	Albany, N. Y.	\$0 26	\$0 16	\$5 40	April 1, 1879	June 30, 1879
P. W. Myers	New York			6 00	April 1, 1879	June 30, 1879
E. R. Seward	do	25	25		April 1, 1879	June 30, 1879
M. F. Brainard	Albany, N. Y.			5 90	April 1, 1879	June 30, 1879
McDermott & Daley	Cohoes, N. Y.			6 95	April 1, 1879	June 30, 1879
Edgar M. Payn	Albany, N. Y.			7 50	April 1, 1879	June 30, 1879

The contract was awarded to Mr. John M. Seward, the lowest bidder, at 16 cents per cubic yard.

Work was commenced May 5, and completed June 14. For a detailed account of the operations under the contract attention is invited to the report of Mr. George H. Birnie, which follows.

I would respectfully renew my previous recommendation, that a small sum be appropriated yearly for the removal of bars upon this river, which, owing to the character of the material of its sides and bottom, are sure to appear after every considerable freshet. The sum of \$5,000 should be appropriated for this purpose at the next session of Congress, for expenditure during the next fiscal year.

With regard to the obstruction at Drew's Bar, discussed by Mr. Birnie and by him recommended to be removed, I would state that the condition of this bar is steadily improving; and though I believe it would have been more economical to have removed the rock in the beginning, or perhaps in the first or second year's following the construction of the jetty, yet at the present time, after so much material has

accumulated on either side of the jetty and a new channel become so nearly established, I think it would be better to allow the jetty and rock to remain and the new channel to form as it is now doing.

A plan of improving the entrance to this river by means of a low jetty at the east side has been considered. Such a structure could be so placed as to result in great benefit, and can be built for about \$12,000. It would be simply a wall of riprap extending about 6,000 feet in length from near the end of Milford Point, running in a southerly direction about parallel to the present channel. Its height should average about 3 feet, and it would reach the low-water plane. It would act principally as a training-wall for the ebb current, and would not materially obstruct the passage of the flood. The ebb current thus directed and strengthened would maintain a depth due to the width of the confined waterway and the velocity of the current, points which should be carefully determined by observations previous to deciding upon the exact location of the jetty.

Following are the several appropriations which have been made for the improvement of this river:

March 3, 1871	\$15,000
June 10, 1872	15,000
March 3, 1873	10,000
June 23, 1874	10,000
March 3, 1875	5,000
June 18, 1878	5,000

Housatonic River is the dividing line between New Haven and Fairfield collection districts.

There is a light-house on Stratford Point at the mouth of the river, and on Stratford Shoal, Long Island Sound.

The nearest defensive work is Fort Hale, New Haven Harbor, 13 miles distant.

No commercial statistics of the past year have been received. Following is the business of this river for the year ending June 30, 1878:

Total number of vessels of all classes entered and cleared during the fiscal year ending June 30, 1878, 126; total tonnage, 25,200; estimated value of cargoes received, \$110,000; estimated value of cargoes exported, \$5,000; draught of water, 7 feet.

Number of vessels of all classes entering the harbor for refuge during the year, 50.

HISTORY OF THE IMPROVEMENT TO 1879.

In December, 1869, pursuant to a resolution of the House of Representatives, "authorizing and directing a survey of the Housatonic River, Connecticut, below Derby," the Chief of Engineers requested Col. D. C. Houston, Corps of Engineers, "to make such investigation or examination as was necessary to report upon the character of the stream, its depth, &c., and should a detailed survey be required to determine upon a plan of improvement, to state the probable cost of such survey."

Under date of January 8, 1870, Colonel Houston estimated the cost of the complete survey at \$5,000.

By act of Congress of July 11, 1870, an examination or survey was directed to be made of the Housatonic River, below Derby, Conn., and the sum of \$2,000 was afterwards allotted for a survey "sufficient to determine the prominent obstructions to navigation."

By direction of General G. K. Warren, United States Engineers, in charge of the work, Capt. W. S. Edwards, assistant engineer, of Bridgeport, made detailed surveys at Sow and Pigs Reef, Two Mile Island, Crofut's Bar, Drew's Rock and Bar, and Mill Bar and Rock, during the months of October and November, 1870. It being desirable that a survey of the bar at the mouth of the river should be made, a further sum of \$700 was allotted in December. A few soundings and measurements

were taken in January, sufficient to show the changes since the coast survey of 1837. In a report to the Chief of Engineers, under date of January 23, 1871, General Warren submitted plans and estimates for improving the river, as follows:

For jetty at Sow and Pigs Reef.....	\$4,000
For dredging 16,000 cubic yards at Two Mile Island Bar.....	4,000
For dredging 6,000 cubic yards at Crofut's Bar.....	1,500
Removing 357 cubic yards at Drew's Rock.....	2,000
Dredging Drew's Bar, 29,944 cubic yards.....	7,486
Dredging Mill Bar, 22,000 cubic yards.....	5,500
Total.....	24,486
For improving the mouth of the river by breakwater and dredging.....	380,475
	404,961

By act of Congress of March 3, 1871, \$15,000 was appropriated for the improvement of the Housatonic River. Proposals were invited for dredging at Two Mile Island Bar, Crofut's Bar, Drew's Bar, and Mill Bar; and for an embankment at Sow and Pigs Reef and Drew's Rock. Bids were opened June 7, 1871, and a contract awarded to P. W. Myers, of Stamford, Conn., for dredging, at 18 cents per cubic yard, and for embankment, \$1.90 per cubic yard.

Work was commenced on July 12; and during the season 28,922 cubic yards of material were removed from Drew's Bar, and 778 $\frac{1}{2}$ cubic yards of embankment built at Sow and Pigs Rock.

By act of Congress of June 10, 1872, \$15,000 was appropriated for continuing the improvement. Proposals were invited for dredging between Derby and Huntington Landing; at two Mile Island Bar, at Crofut's Bar, and at the mouth of the river; and for building an embankment at Drew's Rock. Bids were opened June 28, 1872; the contract for dredging was awarded to Francis H. Smith, of New York, at 23.95 cents per cubic yard; and for building embankment, to A. A. Bouker, of New York, at \$1.70 per cubic yard.

Under these contracts, 7,739 cubic yards of material were removed from between Derby and Huntington Landing, making a channel 40 feet wide and 6 feet deep; 20,761 cubic yards from the bar at Two Mile Island, making the channel 60 feet wide and 7 feet deep at mean low-water; and 426 cubic yards of stone deposited in the embankment from shore to Drew's Rock. During the summer and fall of 1872, a survey was made at the mouth of the river and from Derby to Huntington bridge, under direction of Gen. G. K. Warren, by Mr. Henry Harding, assistant engineer.

By act of Congress of March 3, 1873, \$10,000 was appropriated for continuing the improvement of the river.

Proposals were invited for dredging at Two Mile Island, Mill Bar, and the Ballast; and bids were opened May 6, 1873. The contract was awarded to Mr. G. H. Ferris, of Brooklyn, N. Y., at the rate of 34 $\frac{1}{2}$ cents per cubic yard for all the work.

During the summer and fall of 1873, 5,052 cubic yards were removed from Drew's Bar, making the available channel 165 feet wide and 7 feet deep; 17,019 cubic yards from Mill Bar, making the channel 200 feet wide and 7 feet deep; 10,197 cubic yards from Crofut's Bar, making the channel 42 feet wide and 7 feet deep, and 2,246 cubic yards from the Ballast at the mouth of the river, a total of 34,514 cubic yards. During the fall of 1873, by direction of General Warren, a survey was made by Mr. H. N. Babcock, assistant engineer, of the river from Derby to Drew's Rock and Bar and from Mill Bar to the New York and New Haven Railroad bridge.

By act of Congress of June 23, 1874, \$10,000 was appropriated for continuing the improvement of the river.

In July, 1874, this work was transferred to the care of Maj. J. W. Barlow, Corps of Engineers. Under this appropriation a dredge, tug, and scows were hired at the rate of \$70 per day. During the fall of 1874 and spring of 1875 the channel was widened and deepened as follows: At Two Mile Island 7,883 cubic yards of material were removed, making the channel 66 feet wide and 7 feet deep at mean low-water. Drew's Bar (a new bar formed since previous season's work), 1,795 cubic yards removed, 80 feet wide and 7 feet deep at mean low-water. Derby and Huntington Landing, 10,691 cubic yards, making the channel 160 feet wide and 6 feet deep at mean low-water. Crofut Bar, 7,186 cubic yards, 60 feet wide and 7 feet deep at mean low-water. During the month of November, 1874, a survey was made from Mill Bar to Drew's Rock.

By act of Congress of March 3, 1875, \$5,000 was appropriated for continuing the improvement.

During the fall of 1875 a map of the river from Huntington to the mouth was prepared. A dredge, tug, and scows were hired at the rate of \$6 per hour to do such work as might be necessary on the river.

An examination of Drew's Bar, early in 1876, showed that a shoal had again formed below the rock, and in the summer of 1876 the dredge was employed at this place in removing 2,168 cubic yards of sand, making the channel 60 to 80 feet wide and 7 feet deep at mean low-water.

Money statement.

July 1, 1878, amount available.....	\$5,017 73
July 1, 1879, amount expended during fiscal year.....	4,839 55
	178 18
July 1, 1879, amount available.....	5,000 00
Yearly amount (estimated) required for continuing existing project.....	5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881..	5,000 00

REPORT OF MR. GEORGE H. BIRNIE.

ENGINEER'S OFFICE, U. S. A.,
New London, Conn., July 1, 1879.

COLONEL: I submit herewith the following report of work done in improving the channel of the Housatonic River during the season of 1879.

On Wednesday, April 16, Mr. W. W. Starr, jr., Mr. Henry Harding, and myself began to take soundings in the river between Derby and the sound, in order to determine at what points dredging was most needed. The soundings were located in the usual manner, with two transits; none were taken at the mouth of the river, owing to the stormy weather, and also to the fact that the appropriation was insufficient to be applied to the river at this point. On Wednesday, April 23, we finished taking the soundings, and from that time till May 5, I was at Derby awaiting the arrival of the contractor, my time being occupied with the study of the previous reports and maps of the river, and of the river itself.

May 5, the contractor, Mr. John M. Seward, arrived and began work with two dredges just above Two Mile Island. Here the "cross-over" channel was excavated to a depth of 7 feet at mean low tide, and a width of 60 feet.

The lower end of the channel is close to the east bank of the river and makes quite an angle with the shore. It was therefore necessary to dredge a wedge-shaped piece at the southwest corner about 75 feet long in order to ease off the bend. From this bar 6,930 cubic yards of material were excavated. It is composed of loose sand and was easy to dredge.

Another bar had formed just below this at the mouth of Turkey Hill Brook, which empties into the river opposite Two Mile Island.

The material in the bar consisted partly of sand and partly of coarse gravel and