31st Congress, 1st Session. [HO. OF REPS.] Miscellaneous, No. 54.

RIVERS AND HARBORS.

REPORT

FROM

THE BUREAU OF TOPOGRAPHICAL ENGINEERS,

ON

The subject of rivers and harbors.

September 19, 1850.
Laid upon the table, and ordered to be printed.

Bureau of Topographical Engineers,
Washington, September 12, 1850.

Sir: On the 27th of August, I had the honor to submit a report, in part, as a reply to a letter from the Hon. Mr. McLane of the 20th August. In that letter, Mr. McLane transmitted a copy of bill H. R. No. 348, making appropriations for the improvement of certain harbors and rivers, and he desired to be furnished with information in relation to every item in this bill, quoting from former reports in preference to merely referring to them, and referring only to very recent reports. In compliance with the request of that letter, I have now the honor to submit a report, which contains the information called for.

Respectfully, sir, your obedient servant,

J. J. ABERT,
Colonel Corps Topographical Engineers.

Hon. C. M. Conrad,
Secretary of War.

Report from the Bureau of Topographical Engineers on the subject of rivers and harbors.

Line 7 of the bill. *For a breakwater structure at the harbor of Burlington, Vermont*, $15,000.—The harbor of Burlington is an open roadstead of deep water, near the shore; but in rough weather use could not be made of the landing and wharves of the town. To remedy these defects of the harbor this breakwater was constructed, after the most elaborate investigations and the most carefully-digested plans. It was stated in the annual report from this office in 1843, that $50,000 would be required to complete the breakwater in conformity with approved plans. As $10,000 were appropriated for this work in 1844, it leaves $40,000 of the estimate as the

amount which will probably be required to complete the work. It was commenced in the year 1836.

The amount appropriated in the year 1836 was	$10,000
Do.....do.....do.... 1837 was	10,000
Do.....do.....do.... 1838 was	50,000
Do.....do.....do.... 1844 was	10,000
Total amount appropriated	80,000

Amount now estimated to complete the work, $40,000; of which the part appropriated by the present bill, namely, $15,000, will be sufficient for the present fiscal year.

Line 9. *Breakwater structure at Plattsburg, New York.*—This work is similar to that at Burlington, and made necessary by similar causes; and the remarks just made of the Burlington breakwater apply equally to this. In the report of 1843, it was stated that $50,000 were required to complete this work in conformity with the original and approved plan; $10,000 being appropriated in 1844, it left $40,000 as yet required.

The first appropriation for this work was, in 1836	$10,000
The second.....do.....do.....in 1837	10,000
The third.....do.....do.....in 1838	27,500
The fourth.....do.....do.....in 1844	10,000
Making a total appropriated of	57,500

The amount of $15,000 of the present bill will be sufficient for the present fiscal year.

Line 11. *For the improvement of the harbor of White Hall,* $10,000.—This amount will be chiefly required in dredging, which is probably the best mode of expending the amount on that harbor. The dredging of some years since was found to be of great service, and, until very lately, kept the harbor of sufficient depth for the lake trade. There have been appropriations for this harbor, in 1836, 1837, and 1838, amounting in all to $33,000; but out of this amount the dredge-boat had to be procured. The $10,000 of the present bill will be sufficient for the present fiscal year.

Line 13. *For repairs and working of the steam-dredge on Lake Champlain,* $9,000.—This dredge boat was made in 1837; and at the time the estimate was furnished (in November, 1845) upon which the foregoing item was predicated, it was supposed that amount would put the boat in order and keep her at work for one season. Since then, the deterioration of the boat has gone on; and it is feared that so much of this amount will be required to put her in order, that but little will be left to keep her at work, except at White Hall, and for the benefit of that harbor. It had at one time been contemplated, out of this item, to use the boat to deepen and widen the pass formerly dredged between the two Hero islands; but if the condition of the boat should be as it is feared to be, it will not be possible to do much at that pass. Upon the dredging at this pass I beg leave to remark, that it is a work of great value to the lake trade. It was through an ancient, not a recent deposite, and the excavation made in 1837–'38 holds its own to this day, and, when once completed, will, I have no doubt, be as enduring as it is valuable. But, until the boat is actually thoroughly overhauled, for the purpose of being repaired, it cannot be ascertained with accuracy what portion of the appropriation will be required

for repairs; yet, however, if there should not be much left for excavating between the two Heroes, there will be sufficient for working the boat at White Hall: therefore, this amount can be stated as sufficient for the present fiscal year.*

Line 15. *For the improvement of the harbor at Fort Ontario, Lake Ontario*, $15,000.—This is the same work as the one formerly known as "mouth of Salmon river," and is of great importance as a port of refuge to the trade of Lake Ontario. Appropriations have been made for this work, in 1836, '37, '38, and '44, amounting, in the whole, to $50,000.

This work, plan, and estimate were carefully revised in 1845; and the following remarks are taken from the annual report of that year:

"To complete the works which have been commenced at this place, it will be necessary to extend the southern pier to 15 feet water, and to construct at its extremity a pier-head adequate to sustain a beacon-light. It will be necessary to construct a northern pier, running from the shore into the lake, parallel to the southern pier, distant 300 to 400 feet from it, and extending into the lake to a depth of 12 feet of water, with pier-head—the total cost of which, upon the most carefully-revised estimates, will be about $70,000."

The amount of the present bill is sufficient for the present fiscal year.

Line 17. *Improvement of the harbor of Oswego, Lake Ontario.*—This is an old and an important work. It may be considered the most important harbor on that lake. Appropriations have been made in its favor, in 1827, '28, '30, '31, '32, '33, '34, '36, '37, '38, and '44, amounting, in the whole, to $230,887. The operations at this harbor are to substitute masonry for the original perishable crib-work. This crib-work, intended as foundation-work for the masonry, has been so long constructed, and so frequently injured by storms, that it is difficult now to say what amount will be required to complete the work. The able engineer, Major Turnbull, who was the superintendent in 1845, estimated $58,000 for the continuation of the work. The amount proposed in the present bill is sufficient for the present fiscal year.

Line 19. *Big Sodus bay.*—Appropriations have been made in its favor, for the years 1829, '30, '31, '32, '33, '34, '35, '36, '37, '38, and '44, amounting to $143,620. In the annual reports from this office of 1844 and 1845, the following remarks are made in reference to this harbor:

In 1844.—"This place lies about 25 miles west of Oswego, and may with great justice be considered as the best natural harbor on the southern shore of Lake Ontario. The temporary works which were erected for the protection of the entrance can be considered as having fulfilled their object. A channel of 12 feet now exists over the bar, which, before these works were erected, had not a passage over it of more than 8 feet deep, and less in low stages of water. At the time the survey was made, (August, 1844,) the lake was supposed to be 3 feet higher than its low-water condition, which shows that, in a low-water condition of the lake, the passage between the piers would not exceed about 9 feet. It ought, therefore, to be dredged out at least 3 feet deeper, to insure a depth of not less than 12 feet in all conditions of the lake. After passing this bar, there is inside the harbor sufficient depth for vessels of any size, and sufficient space for

* Recent information induces me to suppose that this boat is now not worth repairing, and that the better course will be to sell it and to make a new boat.

an immense fleet. Should it ever become necessary to maintain a large naval force on this lake, there is no place on the American shore which presents greater advantages. The ease with which the harbor may be entered; its spacious and commodious bay, in which a large fleet may be manœuvred; its protection from all winds, as well as from sudden incursions from an enemy; its position, about equidistant from either end of the lake, by which it could afford prompt assistance to any point,—all combine to characterize it as a highly favorable site for a naval depot. It can also be well defended by works upon the heights to the east and west of the entrance, to which the pier-heads, properly modified, might be made powerful auxiliaries, in affording space for small batteries of heavy guns. It wants, however, one principal requisite—an easy and secure communication with the interior, which, it is presumed, will be accomplished before many years. A few years ago, a company was incorporated to construct a canal from the bay to Clye, on the Erie canal, a distance of about 16 miles, which it was supposed would soon be completed; but, from some unforeseen circumstances, the enterprise failed. The charter, however, still exists, and its object may yet be fulfilled. Such a canal would secure a communication with all the great thoroughfares of the State, with Lake Erie, the Ohio and Hudson rivers, and with the great internal channels of communication of Pennsylvania. Such a canal, properly made, would also afford valuable and cheap water-power, which would greatly enhance the advantages of the position in a military aspect, and in developing its commercial value. From the great length of time which has elapsed since these piers were constructed, it is hardly necessary to say that they are much decayed from the water-line and above, being made of timber cribs, loaded with stone. They now need extensive repairs, and will, probably, in about a year, have to be rebuilt from the water surface. The officer in charge of the work reports that, the working season being far advanced when he arrived there, he had confined his operations to the western and most exposed pier. A portion of it, contiguous to the beach, had settled very much on the lake side. The planks, being decayed and broken, were torn off, and much of the loading of the cribs washed out; and, on further examination, it was found that many of the lower timbers were also much decayed. 318 feet of this pier has already been renewed, and no doubt is entertained, should the weather continue favorable, that the whole of this pier will be made secure by the requisite repairs during the present season. The eastern pier, being much sheltered by the one on the west, was not considered as requiring such immediate attention. Its condition is, however, very precarious, and the pier-head has been seriously injured. The planks have been swept off, as well as one of the courses of timber, and the stone in many places washed out. These parts will be repaired this season, as also a partial breach in this pier, near its connexion with the harbor pier. The only estimate submitted in reference to this harbor is for those immediate and essential repairs which will require to be made during the next season, amounting to $10,000; but it is contemplated, in time for the report of next year, to have that thorough and minute examination of the whole line of harbor and entrance piers at this place which will enable the bureau to present to the consideration of Congress a final estimate for the rebuilding of these cribs, and for the replacing of parts above water with imperishable materials."

In 1845.—"This is an extremely fine bay, of great capacity and depth, about 15 miles from the Erie canal, but as yet without any connexion with it; which deficiency alone limits its advantages for a great military and naval depot. The work for this season, at this place, was confined exclusively to the eastern-channel pier—the western pier having been thoroughly repaired last season. The zeal of the agent induced him to tear up the entire length of the pier before commencing the repairs, and the amount of money on hand was not sufficient to complete the rebuilding of it; however, 498 feet in length of the pier was entirely renewed—that is, all the decayed timbers were taken out, and replaced with new, and covered with new three-inch pine plank. For 415 feet more the decayed timbers have been taken out and renewed, but not planked. The remaining portion of the pier, 180 feet in length, although stripped of all the decayed timber, and the stone piled up along the centre of it, is not in a more precarious condition than before—the timber taken out being so very much decayed as to be incapable of resisting any great shock of the waves, and, from its position, being close in and adjoining the harbor pier, it is not exposed to any great shock."

The amount of the present bill is considered sufficient for the present fiscal year.

Line 21. *Little Sodus bay, Lake Ontario.*—This is a highly-important harbor, but a new work. The report, plan, and estimate in reference to this harbor of 1845 are hereto appended. The amount proposed in the bill is sufficient for the present fiscal year.

Line 23. *Harbor at the mouth of Genesee river.*—Appropriations for this work have been made, in 1829, '30, '31, '32, '33, '34, '35, '36, '37, '38, and '44, amounting to $158,395.

The following remarks in reference to this harbor are taken from the annual report of 1844:

"*Genesee harbor, mouth of Genesee river, 32 miles west of Big Sodus bay.*—The works at this place are in the most wretched condition. The east pier-head is entirely gone for several feet under water, and also about 250 feet in length of the crib-work. There are also two breaches in this pier, one of which is 156 feet long, the other about 30; and the remainder of the pier is very much decayed. The west pier is but little better, the pier-head much damaged by storms, and a portion of the stone loading washed out. Two hundred and ten feet of this pier has settled unequally, the top timbers on the lake side being in some places under water; but yet the good effect of these piers upon the entrance is remarkable, and continues, with all the injuries the piers have received. Previous to their erection, the entrance to the river was shallow, shifting, and dangerous: since they were put up, and even in their present dilapidated condition, the entrance is deep, fixed, and safe, affording throughout a channel of about 15 feet of water. The harbor is about six miles from Rochester, at which place the Erie canal crosses the Genesee river. Its trade was at one time of some importance, but it has gradually diminished—owing, without doubt, principally, to the want of a water-communication between the harbor or landing places and the canal. Its central position, however, its contiguity to the canal, remoteness from any position of an enemy, and the vast ability of Rochester to furnish supplies for an army, combine to render it of great importance for military and naval stores. There is a great quantity of stone belonging to government at this harbor, much of

which is dressed and ready for laying. It would seem, therefore, economy to commence at an early period with the permanent parts of the structure. But I am not disposed at present to recommend the adoption of a stone superstructure to a greater extent than for the pier-heads: these would about work up the stone now lying there. But the pier line from within these pier-heads should be thoroughly repaired."

At that time $44,000 was considered sufficient to make the repairs and to complete the work then contemplated.

Line 26. *Oak Orchard creek.*—Appropriations in favor of this harbor were made during the years 1836, '37, '38, and '44, amounting to $20,000.

The annual report of 1844 speaks of this harbor in the following words:

"*Oak Orchard creek, 37 miles west of Genesee.*—This harbor must rest its principal claim upon the patronage of the government as a place of refuge for the lake trade. Although the creek waters a fine agricultural district, yet, from the proximity of the canal, but a small portion of the produce of the vicinity will seek a market through this outlet. It, therefore, cannot be expected to attain any great eminence as a commercial place, nor can it claim importance as a military position; but, from its being intermediate between the mouth of the Genesee and Niagara, and its being the only point on this coast, between these places, at which a harbor of refuge can be made, it becomes a position of great importance in reference to the navigation of the lake. The stream affords fine water-power, which, if properly applied, would, without doubt, give to the port a respectable trade.

"The works for this harbor have never been extended according to the original plan, and are, in consequence, so incomplete that but very limited beneficial results have as yet been derived from them; and unless the piers be extended further into the lake, all that has been expended upon them may be considered as an entire loss. No doubt is entertained that the entrance would be much improved, and the object of making a harbor of refuge there be accomplished, if the piers were extended to a suitable depth in the lake, and the dredge applied to the bar between them. This bar is formed chiefly of gravel, too heavy to be acted upon by the current between the piers; and if removed, (as it ought to be,) it will have to be done by the dredge.

"The works at this place were in good preservation, requiring but little repair; and the appropriation of $5,000 will be applied principally to extending the piers; and it is expected that about 500 feet of crib-work will be completed before the season closes.

"The estimate for giving to these piers their proper length, and for the requisite dredging, submitted in a report dated 13th January, 1844, is for $25,000; from which should be deducted the appropriation of $5,000 made during the last session, and there will remain, as yet required for this harbor, the sum of $20,000, of which, for the service of the ensuing fiscal year, the sum of $10,000 will be wanted."

The amount stated in the bill will be sufficient for the present fiscal year.

Line 29. *For a dredge-boat on Lake Ontario,* $20,000.—These boats are essential to all these lakes, as sources of great economy and usefulness. The following remarks in reference to the dredge-boat are taken from the report before referred to:

"In addition, however, to these estimates for the several works on

Lake Ontario, there is a necessity to have a dredge-boat; but, as such a boat is wanted for all the harbors, it cannot be introduced in the estimates for any single one, but will have to constitute a separate item. It should be a powerful steam dredge, adequate to lift not less than one hundred cubic yards per hour of a tolerably tenacious clay, or of gravel, from a depth of about twelve feet; it should also have locomotive power adequate to move it from place to place in good weather, and to tow its attending scows, in order to avoid the serious delays and great expense of having the whole towed from place to place by hired means; it should also have the requisite number of scows to receive the excavated material, carry it to places of deposite, and discharge it, with sufficient rapidity to keep the boat in activity; and it should also have attached to it a good four-oared yawl-boat. Such a dredge-boat, its scows, yawl, and equipment, will not cost less than about $20,000; which sum is, therefore, estimated for these purposes. The expense of working the dredge at each harbor is considered a proper charge upon the appropriation for that harbor, and is, therefore, not stated as a separate item."

Line 31. *Harbor of Buffalo.*—This appropriation is considered as applicable to the old and unfinished work at this place, and will probably be sufficient for the present fiscal year.

Line 34. *Harbor of Dunkirk, Lake Erie.*—Appropriations in favor of this harbor are for the years 1827, '28, '29, '30, '31, '32, '34, '35, '36, '37, 38, '44, amounting to $92,743.

The annual report of 1844 says of this harbor:

"*Dunkirk harbor.*—The position of this harbor is about fifteen miles west of Cattaraugus. It was originally an open roadstead, or small bay, exposed to every wind, except from the southward, and admitting of landing only in quiet weather with winds from any other quarter. The plan of protecting the landing was by extending a pier from its western cape in a northeastwardly direction. The pier was 1,950 feet long, 600 feet of which was an extension into the lake. Its eastern end was supplied with a pier head and a beacon-light, the end of the pier-head being in 15 feet water. In addition, there was a central breakwater 2,125 feet long, extending in a direction rather more eastwardly than the pier from the shore. The passage between the shore or beacon-light pier and the end of the central or breakwater pier was 350 feet; but, as this opening exposed the harbor to the effects of southwest winds within the entrance, and for a distance of about 700 feet from it, to protect it from the surf in that direction, a short isolated pier was constructed 300 feet long. These works were commenced in 1827, and gradually carried to the extent and according to the plan described, before the transfer of their direction to this bureau, in 1838. After the transfer, $10,000 was appropriated and expended in finishing them. Much of the work has, therefore, been built some years; and it should not be matter of surprise if parts should have decayed, and the work, in consequence, have become seriously dilapidated. Of the beacon-light pier, about 400 feet has been nearly destroyed, and much of the remainder seriously injured. Of the long central breakwater, about two-thirds of it has been knocked to pieces to the water's edge, and much of it below, and the remaining third seriously injured. The small isolated pier to shelter the entrance, being the last put up, was found to be in good order. The work was the usual crib-work of timber, loaded with stone. There was probably an error in the alignment of

the long central breakwater, which, in order to save expense, by keeping it in the shoal water, presented a concave, and consequently a weak line to the action of the surf, which may have tended to hasten its overthrow. During the last session of Congress, an appropriation of $5,000 (upon whose estimate I am not aware) was made for the repair of the work—totally inadequate to meet existing exigencies. No directions were given, except to secure the end upon which the beacon-light is placed. The repair of this work will, of necessity, from its dilapidated condition, and from its exposed situation, be very costly. $30,000 is the amount of the estimate for repairs. This is upon the supposition of rebuilding the central pier or breakwater upon the old trace. I do not believe the work would stand long if so rebuilt, and therefore do not recommend it. The trace will have to be changed into a curve, presenting its convex space to the action of the lake, with its ends probably resting against the ends of the old work. The work must be strong: it is worse than useless to build upon these lakes in any other way. As once before remarked, it is building in the sea; and, unless it be desirable to have a never ending series of disasters, and never-ending demands for costly repairs, work in such situations must be made of sufficient strength to withstand the shocks to which it is exposed. The survey of this harbor, although adequate for all commercial purposes, is defective in some details essential to a rigorous estimate. The kind of bottom over which the breakwater upon the new trace will extend is known, although its exact depth is not given. Yet, reasoning by analogy of adjacent parts, the depth assumed for the estimate, it is believed, will not be found to differ much from the reality. Acting upon these considerations, an estimate for the renewal of this breakwater has been made, amounting to $70,000.

"The final estimate for the completion of this work (See Doc. No. 115, 2d session 24th Congress) was for $253,806. The total amount appropriated (exclusive of the $5,000 of last session) is $88,446, which completed the piers to the extent described. The balance of the final estimate was to have been devoted, as granted, to the construction of the permanent superstructure for which the works were prepared when operations were suspended. But, no additional appropriations being granted, the works, being exposed in an unfinished state, have experienced the disasters which now call for such expensive repairs—in fact, it may be said, for absolute renewals of much the greater part of them.

The amount appropriated and expended being - -	$80,446
Appropriation of last session - - - -	5,000
And the estimate now submitted for renewing these works, and placing them in a condition for the permanent superstructure, being - - - - - -	70,000
Makes a total of - - -	155,446

"Deducting this amount from the final estimate before referred to, it will leave for the permanent superstructure the sum of $98,360 yet to be appropriated, in conformity with the views originally entertained of this work, after the repairs and renewals herein described have been made. This amount will be inadequate for a superstructure of masonry, although it would be sufficient for a permanent superstructure of mineralized timber; and before the question will have to be decided in reference to the

superstructure of this work, means will be taken to collect all essential facts bearing upon a comparison of these two modes, in all their properties of durability and cost.

"We are now erecting the permanent superstructure of masonry at but two of these lake harbors—namely, at Oswego and at Cleveland. The appropriation laws having adopted that plan at these two places, and the work having progressed at each to some extent, it will have to be pursued until completed. But it is believed that mineralized timber can be used at nearly all these harbors with great advantage in reference to cost, and without prejudice to durability. Should such prove to be the case, the ultimate cost of this work will yet be brought within the limit of the final estimate before stated, notwithstanding the expenses now required for renewal and repairs.

"The surface enclosed by the government works at Dunkirk is about 280 acres, of which about an extent of 80 acres is excellent anchoring-ground, with wharf room adequate to the transaction of extensive business. Its situation is nearly midway between Buffalo and Erie, and about midway between Cattaraugus and Portland. It is in consequence a valuable port of refuge, and is frequently resorted to for shelter from storms. It is also the terminating point of the New York and Erie railroad. In 1838, the arrivals and departures of vessels of various classes was 1,730, and shipping to the amount of 778 tons was owned there. Since then, no returns of its trade have been received; but, without doubt, it has experienced, in these respects, an increase proportional to the increase of the lake trade, unless the dilapidated condition of the works, by injuring the security of the harbor, has occasioned it of late to be less resorted to."

The amount proposed in the bill is sufficient for the present fiscal year.

Line 36. *Harbor of Cattaraugus, Lake Erie.*—Former appropriations in favor of this harbor are for the years 1836, '37, '38, amounting to $57,410. In the report of 1844 it is said of this harbor:

"This harbor is situated at the mouth of Cattaraugus creek, about 25 miles west of Buffalo. There was no specific appropriation in its favor, but it was included in the general appropriation of $20,000 'for the preservation and repair of harbors on the lakes, other than those enumerated, the construction of which has been authorized by law.'

"Before the works which now exist were erected, this entrance was extremely shoal, shifting, dangerous, and often impracticable for the smallest lake craft; it is now, in the unfinished condition of the work, certain, deep and safe, admitting of first-class steamers. Its commerce has gradually increased; but the settlement experienced serious impediments from the Indian reservation near the entrance. The Indian title to this reservation being now (or about to be) extinguished, no doubt is entertained that it will soon, like other places, experience the vivifying advantages which always flow from the enterprise, intelligence, and industry of civilization. It is surrounded by a rich and well-cultivated country, and towns are rapidly forming on the upper parts of the river. The stream possesses great capacities for mill privileges of all kinds, having a fall of about two hundred feet within thirteen miles of its mouth, which is already applied extensively to manufacturing purposes at the town of Irving, within about two and a half miles of the entrance. At the period of inspection, the piers were found in great need of repairs; but, as the $20,000 had to be

divided among several harbors, I directed only repairs of immediate necessity to be made—such as were essential to preserve the works from further serious injuries during the ensuing fall and winter, limiting expenses on these accounts to $3,000. At the same time, however, the officer in charge was required to furnish an estimate for thorough repairs, and for finishing the existing piers, and also for the necessary extension of the piers—the latter as a final estimate to complete the work as it had been begun, and to an extent adequate to produce the usefulness in the harbor contemplated in the original plan, and essential to justify the expenditure.

"By a careful estimate it is found that the thorough repair and finishing of the piers, as they now exist, will cost $14,194, and the extension of the work requisite to complete the plan $19,803—total, $33,997.*

"When this work was in progress, and as much as $38,073 was expended, in 1838, a final estimate was then submitted of $48,020—making a total for the work of $86,093.

"The additional amount expended after 1838 made a total of expenditure upon the works of $57,410, to which the final estimate of $33,997 being added, it will make the total amount expended and contemplated to be expended upon this harbor $91,407; exceeding the final estimate of 1838 by $5,314—an excess occasioned chiefly by the unfinished condition in which the piers were left after the appropriation of 1838 had been exhausted.

"The final views in relation to this harbor will, from the foregoing statement, require about $40,000."

The amount proposed in the bill is all that will be required during the present fiscal year.

Line 38. *Harbor of Erie, Pennsylvania.*—Appropriations for this harbor have been made, during the years 1824, '26, '27, '28, '29, '31, '32, '33, '34, '35, '36, '37, '38, and '44, amounting to $182,981.

In the report of 1844 it is stated:

"The situation of this harbor is about eighty miles west of Buffalo, and is the only harbor on the lake shore of the State of Pennsylvania. So much has been said of it, and so often, that it is not necessary now to speak of more than its general properties. It is about four miles long by one and a half wide, and of great depth, averaging in this extent more than twenty feet deep, and throughout a great proportion of its space full twenty-five feet deep, and completely land-locked. The difficulty was in the passage which formed its entrance at its eastern end, which was by a crooked and shifting channel, with a depth not exceeding five feet. Efforts to improve the entrance were commenced in 1824. They consisted in a line of crib-work from the shore at the eastern end of the bay extending out about 2,530 feet, at which point this line of crib-work is connected with the southern entrance pier. This last pier is 780 feet long, extending eastwardly into the lake. There is an angle in this pier dividing it into two parts—the part on the lake side being 260 feet long, that on the harbor side being 520 feet long. The entrance from the lake is 360 feet wide; that in the harbor is 550 feet wide: this difference being occasioned by the angle before described. The pier which forms the northern side of this entrance is without any angle, and is 1,240 feet long. Upon the eastern end of this pier a beacon-light has

*This estimate was made out before the damages of the storm in October.

been erected. At about 125 feet from the western end of this last pier (the northern-entrance pier) a crib pier-work originates, and is extended northwardly about 2,900 feet. The object of this long pier, and of that first described as extending from the shore for 2,500 feet, is to prevent the sea from breaking into the harbor, and to confine the passage of the water to the space between the entrance piers. The object has been well accomplished, and now the passage between the piers is eighteen feet deep. The pier from the shore is, however, so low, that, during moderate flows from the east, vast quantities of water pass over it into the harbor, carrying with it quantities of sand from the lake. So, in blows from the west, quantities of water pass over this pier from the harbor into the lake, but not carrying back much sand, as the wave from the harbor is less violent than from the lake, moving the sand, in consequence, only from very inconsiderable depths. More sand is therefore received into the harbor than is discharged from it over this low pier. The whole of this pier should, in my judgment, be raised about three feet above its present level, and, on approaching the southern-entrance pier, be gradually raised to the level of that pier. As might well be supposed, from piers so long constructed, they have suffered seriously from decay of materials and exposure to the surf. The timbers below water were, however, sound, and the crib-work had maintained its alignment, although great quantities of stone had been washed out. The channel piers had been occasionally repaired since their construction, and there was no breach through them, although in other respects they were much injured; but the two long piers, in addition to other injuries, had breaches through several places. The northern-entrance pier and the long pier running from it, being most exposed and most essential to the entrance, were directed to be repaired immediately. Similar directions were also given in reference to the long pier from the shore; but in reference to the southern-entrance pier, directions were given to leave it in its present condition for the present. The southern entrance pier is so much injured, and will require such serious repairs, that the amount will probably not differ much from the cost of constructing a new pier, which it may be found highly advantageous to do, in order to preserve the harbor entrance of 550 feet throughout to the lake. Although the entrance between the piers is of the depth previously stated, yet the old bar inside has not been entirely removed; and, although a passage over it of about eleven feet water has resulted from the construction of the entrance piers to the deep water of the harbor, yet this channel is rather crooked and narrow. The bottom is too tenacious to be acted upon by the current occasioned by the piers, and the dredge-boat will have to be used there. The agent was directed to put the boat in order, and to apply its action to this passage as soon as practicable.

"The island which now forms the harbor was once a peninsula, connected with the mainland by a long and narrow bank of sand at its western extremity. At the northern extremity of this sand bank, the island was long since threatened by an irruption from the sea, which it was probable would, in its consequences, seriously injure, if not destroy, the harbor. To guard against such an evil, the attention of the government was bestowed, at an early period, by the construction of a costly line of crib-work, raised and strengthened at the threatened locality, and extending southwardly over the sand bar about 1,000 feet from the barracks and other buildings erected there for the accommodation of the workmen. This extension

was a low and cheap work, intended to arrest the floating sand in that direction; which purpose it has admirably fulfilled, the sand having become raised about it, and having accumulated extensively on each side of it. The line of crib-work extending northwardly from the barracks around the point of the island also answered the purpose while it lasted, defending the island in that direction from the encroachments of the sea. But this was the dangerous locality of attack from the sea; and, although the work in this part was strong and well raised, yet, from its great exposure, and from the unfinished state in which it was left after the last appropriation, (1838,) it was found, during the inspection tour of the past season, so completely destroyed, that its repairs will be equivalent to the construction of new work. The sea had encroached to the foundation of the barracks, and threatened so seriously to break through in that direction, that orders were given immediately to renew the work, and to extend it in the direction of the original design. On my return, two months after, I found this work (as well as the repairs at the eastern entrance) had been pushed forward with much energy, so as to relieve from apprehension of further serious injury during the gales of the ensuing season.

"The extension of the crib-work southwardly from the barracks had, as before remarked, occasioned the sand to accumulate in its vicinity, and, by restricting the parts on this sand bank, over which the sea passed during gales, had, as had been anticipated, facilitated the action of the sea in deepening the passage into the western end of the harbor. On the last survey, this passage was about 3,000 feet wide, and from five to six feet deep.

"The Hon. Secretary is well aware that the intention of opening a passage at this end of the harbor, capable of admitting first-class steamers, has long since formed an essential feature in the plans for the improvement of this place, and has long since been brought to the consideration of Congress, and that the estimate and appropriation of last year were intended to promote that object, and to repair the old works. The plan is to extend the crib-work from the barracks to a suitable point in the present opening for the construction of the entrance piers; then to construct two entrance piers, with a passage between them not less than 500 feet wide, extending eastwardly to sufficiently deep water in the harbor, and westwardly to sufficiently deep water in the lake; and, from a suitable point in the line of the southern-entrance pier, to extend the crib-work to the mainland, or nearly so, in order to prevent an irruption of the sea on that side of the entrance. The estimate for this work, made in 1839, and submitted with the report of that season, amounted to $326,150; but I feel satisfied, from the inspection of last season, that the greater part of the crib-work from the southern-entrance pier to the mainland can be dispensed with, and the estimate proportionally reduced. I have no doubt that the sand in that direction will accumulate rapidly, and soon form of itself an adequate and extensive barrier. But as the original estimate did not embrace the necessary pier-head and light-house on the lake extremity of the piers, and an equally-essential beacon-light on the harbor extremity, and as it may be necessary to extend the crib-work from the southern-entrance pier to the shore, I have not considered it safe to reduce the estimate because of the probable reduction of crib-work first alluded to.

"For the continuation of this work, the sum of $50,000 will be required for the fiscal year commencing on the 1st July, 1845.

"The appropriation of last year was $40,000; of this amount, for making the repairs which have been referred to, for repairing the dredge-boat, constructing essential machinery, raising the old pier from the shore in the eastern entrance, there has been and will be expended an amount of $28,514—leaving of the appropriation of last session, and applicable to the further prosecution of the work, a balance of $11,486. This balance will be required to repair the south pier of the eastern entrance, and to extend the north pier of the same entrance further into the lake. A disposition has been discovered on the part of the lake to deposite the sand swept from the island near the mouth of this entrance, which will have to be corrected by an extension of the north pier, under a proper angle."

Line 40. *Conneaut Harbor.*—Former appropriations in favor of this harbor are for the years 1829, '30, '31, '32, '36, '37, '38, '44—amounting to $48,305.

In the report of 1844 it is said:

"This harbor is about 30 miles west of Erie, near the boundary line between Pennsylvania and Ohio, and most favorably situated for the accommodation of the trade of both of these States."

As a thorough inspection was made of these harbors in 1839, and particularly of those on this lake from Conneaut west, the result of which was submitted in the report of that fall, I will avail myself of many of the remarks in that report, of a general character, as true and as applicable to these works now as then:

"At all the harbors the works are composed of timber and loose stone; and at some of them the timber is already in a state of decay, and in a few years all the work above the level of the water must necessarily fall to ruin, unless repaired and renewed. Should it be the intention to maintain the works in a sound condition, the repairs and renewals will be a constant source of expense, unless measures are taken to employ imperishable materials in replacing such as are decayed.

"The piers are frequently, and at some of the ports are constantly, used to store large quantities of the wood which the steamboats consume; and it is often of consequence that this should be piled as far out as a regard to its safety will justify, and that, in many cases, there should be space towards the extremity of the piers, not only for this purpose, but for the landing of passengers and freight carried by the numerous class of boats engaged in the general business of the lakes, running periodically between Buffalo and the extreme upper ports, and which only touch at intermediate points for the indispensable purpose of wooding, or to take and discharge way-passengers and freight, and to whom, especially in unpropitious weather and during unfavorable seasons of the year, the question of time is all-important. These considerations, among others, have influenced us in recommending the increased breadth above water we have already mentioned; and we have less hesitation in doing so, and in recommending the construction of parapets, in case of piers having beacon-lights at their extremity, as narrow piers without parapets become extremely dangerous, and sometimes impracticable to communicate with from the shore in stormy weather, when they are most needed; and we have assumed, under all the circumstances bearing upon the question in the case of these particular works, that the best form we can recommend to be given to the sides of the piers is one perpendicular to the surface of the lake, except so far as where the peculiar nature of

the bottom on which the cribs may be placed may require a sufficient quantity of loose stone to be thrown, for the purpose of protecting the foundations against the action of the waves, or to refill any void that may have accidently occurred near the bottoms of the cribs—a contingency which doubtless is possible, whatever precaution we may use in the original design and framing of cribs—a contingency, too, the extent of which we cannot well appreciate, and for which, therefore, we do not purpose to make any estimate. Having assumed a perpendicular form for the sides of the piers, and in the cases where we are not precluded from carrying out our own opinions, we consider that the additional convenience and security afforded thereby to the public would well warrant any difference of cost that may be supposed to result from its adoption.

"These works have all cost much more money than appears to have been anticipated at the time they were commenced. This is attributable to various causes, most of which, with reference to each work, will appear upon a careful perusal of the account we have given of its progress. Some of them we will now notice. The project of opening permanently the mouths of the rivers, so as to permit the passage of vessels at all times, was at the first considered to be an experiment of a very doubtful result; and it was not until some progress had been made in carrying it into effect, that the public confidence could be enlisted in it to the extent to justify the enlarged and more expensive plans which the importance of some of them would seem to have required. Moreover, the importance to which some have arisen since the commencement of the works is, in many cases, owing to the influence of the works themselves, without which, necessarily, the harbors must have remained to this day, as formerly they were, inaccessible to the commerce and shipping of the lakes, as well as measurably useless to the surrounding country. Moreover, the channels of communication which have been opened with the interior, since some of them were planned, have added vastly to their consequence. Thus they have nearly all of them, in fact, attained a degree of importance which they could not possibly have expected to possess at so early a period. Moreover, works of this character, and hydraulic works generally, were but little understood among us at that period; and the force and effect of the lake storms do not appear to have been always foreseen, since the earlier structures were not calculated to resist them, nor were they contrived, apparently, with reference to the nature of the foundation on which they were built. This, being a moveable sand, liable to be removed by a very slight force, was frequently swept away by the waves, as they washed the foot of the piers. They had rarely the strength which should have been given them: consequently, being undermined by the waves, they would yield under the weight of the stone with which they were always loaded; and hence very large and unanticipated expenditures became necessary in readjusting them, as well as for the additional protection required at their base. The formation of sand shoals near the heads of the piers, and at the entrance of the channels, and the increased draught which the rapidly-increasing commerce of the lakes demanded for the vessels employed in it, suggested additional extensions of the piers into deeper water. These causes of expense have served to swell the expenditure beyond the original estimates, and, added to these, the rapid decay of the wooden portions of the structures, and the consequent repair and renewal of

the work above water. Again: at the period of the commencement of nearly all the works, the laborers of the neighboring country being measurably without employment, and produce having no outlet to a market, labor and provision and materials for the works were extremely cheap. The impulse imparted to industry, and the facilities of conveyance for the produce of the country, provided by the works themselves, had the effect greatly to enhance their cost, by the increased prices which labor and materials could command. The extraordinarily high stage of the waters of the lake, exceeding by some feet any other on record, has indicated the necessity of a corresponding increase of the height of the piers beyond the original design; and hence an additional unanticipated expenditure.

"The original design of procuring a sufficient depth of channel for the largest class of vessels navigating the lakes is accomplished at nearly all the points within the limits of our inspection at which it has been directed to be done; and wherever that depth has not been attained, we are satisfied of the sufficiency of the measures proposed for effecting it. Whether the entrance at these places will continue unobstructed by the sand which drifts along the shore of the lake in the general direction of the prevailing winds, without any other aid than the piers which project beyond the coast line, or whether these have attained the depth of water and distance from shore the most suitable to the object for which they were designed, is a problem not to be solved with our present limited acquaintance with the forces operating upon the sands which are found immediately to windward of nearly all the works, and extending from the base of the cliffs, or the highest reach of the waves, to a depth beneath the surface of the lake which we have not been able always to ascertain with the precision we could desire. We incline, however, to the opinion that, in nearly all the cases where the plans already adopted have been carried into execution, the piers extend as far into the lake as is desirable, with reference to the purposes for which they were designed. Nevertheless, in order to be assured on that point, and to leave nothing to uncertain conjecture, and with a view to the development and collection of facts, without which, as we conceive, no enlightened view can be taken of the ultimate effect of the works already erected, or of those which may suggest themselves for the further improvement or extension of the harbors, (should the increasing trade require them,) we are of opinion that a careful and minute topographical and hydrographical survey and examination, under competent direction, should be made of the whole lake shore, so as to include all the works, and to extend from the crest of the cliffs or banks on shore to a depth in the lake at which the waves or undertow shall be found to have lost their influence upon the drifted matter at the bottom, or, if a sensible current exists in the lake, in the general direction of the discharge of the surplus water of the lake, at such a distance from the shores as to be within the limits of any work which it might be deemed expedient to erect in connexion with those already there, then to that distance. The details of such a survey would require great skill and care on the part of those who might be charged with its execution. It should be intrusted to those only who were capable of appreciating the value of its details with reference to the specific object for which it was made. Added to this, we think there ought to be instituted at each harbor a series of observations with reference to the effects produced upon the shoals, channels, and

beach by the storms and freshets occurring at them. These might be conducted by the local agents in charge of the works; and they would doubtless, in a short time, yield a body of highly useful facts, bearing upon questions which are constantly arising with respect to the proper length, direction, and position of the works, and their ultimate effects upon the navigation. The variation of the level of the lake, compared with some fixed point, ought also to be observed at all the works. We have ourselves caused a rapid survey of parts of the lake shore to be made during the period of our inspection; and although it was necessarily, from our limited means and time, of a very superficial character, the facts developed by it go to strengthen our opinion of the expediency of a more perfect examination.

"That the population, trade, and agriculture of the region of country connected with the lakes have increased with extraordinary rapidity within a few years, and especially since the commencement of these harbor improvements, is known everywhere. Prior to the formation of these harbors, there were none upon the south side of the lake which could be entered at any time by vessels drawing over seven feet, and during low stages of the lake, this depth of water was much reduced. With the exception of the harbor and exposed anchorage at Dunkirk, the harbors of Erie, Sandusky and Maumee bays, all the harbors were usually closed by sand bars. We do not here speak of the Niagara and Detroit rivers, lying at opposite ends of the lake, and under certain circumstances exposed to serious objections as places of shelter for vessels, nor of the anchorage to be found among the islands near its head. The only landing-places at the close of the war of 1812 were Black Rock, Erie, and Sandusky and Maumee bays.

"Thus, destitute of outlets for its produce, the agricultural enterprise of the country lying south and west of Lake Erie was dormant. The shipping employed upon the lake was exposed to most fearful hazard of encountering the sudden and violent gales to which this region is exposed upon a lee shore deficient of harbors. At this period, too, the country was without those lines of canals, roads, and other means of intercommunication which have since been created. Channels of communication with the lower lake, with the Atlantic, and with the valley of the Mississippi, have since then been opened or perfected; and, as indispensable adjuncts to these, harbors have been formed. Since then, and as the necessary and unquestionable consequence of these improvements, the industry and enterprise of the country have assumed a degree of activity altogether unrivalled; the tide of emigration has advanced upon it with an extreme velocity, sweeping away, at the same moment, the wandering Indian and the steadfast forest. We see in how few years all this has been achieved. Already the soil sends forth its millions of surplus grain, to receive in return the fruits of the industry of other regions. Commerce also increases with the population and productive ability of the country, and in proportion to the security afforded by these harbors."

To these general remarks may be added the following, resulting from the inspection of last year:

1st. That no crib-work should be extended into the lake less than twenty feet wide. In some cases, and as the work is extended into deep water, a greater width will be found necessary; but in no case should it be less.

2d. The method of connecting the timbers into the crib form has been generally found to be good. The most serious defects have been found in making the cribs too narrow, and in using timbers too small, resulting from erroneous considerations of the power of the surf, and from a too great anxiety to lessen the cost of the work. Strength and durability in works of this kind should be paramount ideas.

3d. Experience, so far, is in favor of the cribs without tight bottoms, with a suitable pier-head. This last, however, is essential to cribs of any mode of construction. But no modification of received and approved modes of construction should be allowed, or extensions beyond the original design, unless the plans have been previously submitted to the bureau, and have been approved.

4th. No crib-line should present angles, or an abruptly-broken line, to the action of the sea; these have been found universally to produce pernicious effects. Therefore, projections in the outside faces of the piers, rapid changes of width, and other sudden modifications of fronts exposed to the sea, having been found injurious, have been prohibited. Even the piles should be within the crib-frame, and great care taken that they do not bind so intimately with the frame as to prevent a regular sinking of the crib.

5th. The cribs added to the piers under the light house department have been in many cases erected without proper consideration of their positions and of the action of the sea, and have in consequence called for serious repairs, and have produced injurious effects upon the crib lines. In all cases there should be light-houses on the end of the piers: otherwise the pier itself becomes a dangerous obstacle in making the harbor at night and during foggy weather; but the pier-head to sustain them should be part of the pier structure, and be made to harmonize with its intention and plan.

6th. As a general observation, the most costly of these pier structures have been found to be the most durable and the best constructed. In all cases, iron bolts and straps should be used to fasten each tier of crib-work upon that below it, these bolts being sufficiently long to enter well into the second tier of logs below the one they are intended to fasten to the work. Where these bolts have been omitted, reliance being placed on treenailing, the work has proved defective.

7th. And in reference to filling cribs with stone, as a general rule, it is not necessary to carry this expensive part of the work more than two feet above the water, after the crib has taken its final position: that is, stone should be thrown in as it settles, but the finishing should not contemplate more stone than to raise it to the point stated. The stone-work should always be protected from the action of the wave, either by a plank flooring over the top of the crib, or by large flat slabs of stone over the deposited stone; otherwise, the stone is extremely liable to be washed out, thereby calling for expensive repairs. If a plank flooring is used, it should be of three-inch plank, six inches wide, and the plank not nearer than a half-inch of each other; and, as a general rule, that part of the crib-work which extends into the lake should be raised about five feet above the level of the lake—the protecting pier-crib will often have to be higher. The rule which should govern the height is that which will prevent the sea, in ordinary gales, from rolling over the pier.

8th. The great improvement of all these entrances, since the several

works have been put up, is of itself an ample compensation for all the money that has been expended upon them. In no instance has there been a failure. Some have succeeded better than others, owing to local peculiarities, and to the greater patronage which some have received, and consequently greater extent of work executed, and to the bolder character of plans; but no doubt is entertained that all of them can be rendered safe and secure entrances for first-class steamers, and the efforts and estimates of the bureau will be to bring them to that condition. In the early reasoning upon these harbors, it was considered essential to plan the width between the piers in reference to the size of the streams running from them into the interior, and in reference to the water which these streams would probably discharge during periods of freshets. This reasoning occasioned the distance between the piers to be narrower than would now be adopted. Experience has brought into consideration another and a powerful element, in the somewhat regular flux and reflux of the waters of the lake. These flowing into the harbor fill the harbor or interior basin, till, raised in its level, it again returns to the lake with a force sufficient to keep open the passage once made between the piers, if the interior basin be, as it is in most instances, of adequate capacity. I do not pretend to assign a cause to this flux and reflux of the lake water; but the fact of its existence is beyond a doubt, and of its independence of winds, although much influenced by them.

9th. It is also essential to the safety of all these entrances, and particularly so where they are narrow, that one pier should be extended so as to cover the entrance and form a breakwater.

Now, if to these decidedly successful efforts in improving these harbors we join those considerations arising from the rapid and extensive settlements they have occasioned—the many towns which, it may be said, have been built up by the advantages these harbors have afforded—the rapid and extensive development of agricultural, mineral, manufacturing, and commercial resources which have followed their construction, and to which they have given life and being—the enhanced value of land, and of all the products of the soil within their vicinities,—I believe it may be said, without fear of error, that in no other case has the same amount of government expenditure done more to promote national strength and national wealth, or diffused a more extensive or more durable prosperity.

I am unwilling to close these general remarks without a tribute of respect to the memory of Major Maurice, the first United States engineer who superintended these works, and to whose excellent sense, sound judgment, and faithful execution of duty, the system and its success are so much indebted. I will now resume the more detailed reference to each place:

Conneaut harbor.—Its position upon the lake shore has been already given—namely, about 30 miles west of Erie, and near the boundary line of the States of Pennsylvania and Ohio. Prior to the construction of the works for improving the entrance, the mouth of the river was closed with a sand bar, frequently dry, and never with more than two feet of water over it; but at the conclusion of the works, which were erected in 1839, and up to this time, a depth of 11 feet can be carried into the river. Prior to the construction of these works, vessels had to occupy a dangerous anchoring-ground in the open lake, and land their cargoes at great risk and at great expense. Commerce, under such circumstances, was necessarily

very restricted, and often attended with loss of vessel and cargo. Since the works have been put up, vessels enter at all times with security, and discharge their cargoes with safety; and the commerce of the place has, in consequence, rapidly increased.

After entering the harbor, the river is sufficiently deep for lake vessels for a mile and a half. The work was commenced in 1829, and was continued, with small annual appropriations, until 1839—the last appropriation being in 1838; and the total amount appropriated for the piers was $43,805. A final estimate does not appear to have been presented, but the yearly estimates much exceed the amounts appropriated. The habit then was to estimate for an amount which could be judiciously expended in a year, and to report effects produced by extending the work as far as the appropriation would justify. In this way the good effects of each year's expenditure were known, and the best justification offered for the further progress of the work. An examination of these estimates will also show that considerable amounts were for the repairs of damage from the action of storms upon the unfinished work, and to restore the decayed timber of the first years of the work, and not for the extension of new work. The west pier is 940 feet long, the east pier 910. During the last session of Congress $5,000 were appropriated for this harbor, the whole of which will be required for the repairs of existing piers. As, for instance, the estimate and expenditure for repairs this season essential to preserve the piers from the destruction to which they were daily exposed from their dilapidated condition is $4,108—leaving a balance on hand of the appropriation of last session of $892. But the estimate for the thorough repair of these piers is $14,712; from which deduct balance on hand, $892, and it will leave $13,820 as yet necessary for repairs. The estimate for extending these piers into the lake to 15 feet water, with suitable pier-heads, is $38,184—making a total for repairs and extension of $52,004.

It is not improbable that, in the progress of the work, the extension of one pier can be so limited that the opposite pier will constitute the covering breakwater to the entrance, in which case the expense will be proportionally reduced. As effects are observed during the progress of work, and as it is a rule to extend furthest and first the pier designed to serve as a breakwater, unnecessary expense will always be saved by stopping the work in time.

The amount in the bill will be sufficient for the present fiscal year.

Line 42. *Harbor of Cunningham's creek.*—Appropriations for this harbor were made, during the years 1826, '28, '29, '32, '33 '36, '37, and '38, amounting to $19,781 12. The amount in the bill is sufficient for the present fiscal year.

The following is an extract from the report of 1844 in reference to this harbor:

"For this harbor or landing, situated 13 miles west of Ashtabula, there was no special appropriation; but as it is virtually included in the general appropriation of $20,000, it becomes my duty to name it. In a report of a board of inspection of 1839, the following opinion is expressed in reference to this place:

"'The board, not being of opinion that the wants of agriculture or of commerce, or of the business to be drawn to this place by them, can be of sufficient value for many years to justify the large expenditures necessary to carry out the plans proposed in the local agent's estimate of 1837, do

not feel warranted in recommending them to the department. Should it be deemed advisable to finish the temporary work already begun there, the sum of $1,200 or $1,500 will be required.'

"The same board also, in a previous part of their report, express a doubt of its having ever been 'the intention to form a harbor at this place.'

"Since then the increased agricultural and manufacturing products of the vicinity have much enhanced the value of the harbor, the evidence of which was placed in the hands of the committee during the present session of Congress."

Line 44. *Harbor of Ashtabula.*—In speaking of this harbor, the report of 1844 says: "The creek which forms this harbor enters into the lake about 12 miles west of Conneaut, and has a depth of water sufficient for the largest class of lake steamers for about one mile and a half from its mouth. Not more than three feet of water could be commanded at its entrance before the construction of the present works. There was also a rocky stratum underlying this bar, which opposed serious obstacles to increasing the depth; but at the suspension of the work in 1839, a channel of about nine feet deep had been obtained—not, however, throughout the whole width between the piers. The piers are 102 feet apart at the beacon-light, from which point they diverge into the lake. The west pier (including parts upon which the shore has encroached) is 1,307 feet long, and the east pier is 1,115 feet long. The construction of the piers was commenced in 1826, and was continued, with small annual appropriations, until 1838—at which period, $64,149 had been appropriated and expended upon them. The estimates and reports of the several years during which this work was in progress show that considerable amounts were required to repair damages arising from storms and the slow progress of the work."

The appropriation of the last session was $5,000, all of which will be required in the repairs of existing piers. For the extension of these piers to 15 feet water, opening the channel to 12 feet deep, and for constructing suitable pier-heads, the estimate amounts to $30,000.

The appropriation of the bill will be sufficient for the present fiscal year.

Line 46. *Grand river, or Fairport.*—Appropriations in favor of this harbor have been made, for the years 1825, '26, '28, '30, '31, '32, '34, '36, '38, and '44, amounting to $65,598 29.

The amount proposed in the bill is sufficient for the present fiscal year.

Line 48. *Harbor of Cleveland.*—This well-known and important harbor has been so frequently described, that more than the following extract from the report of 1844 is not considered necessary:

"This harbor lies in Cleveland bay, and is made by the Cuyahoga river, distant about 30 miles west of Fairport. Previous to the construction of the piers at this place, the mouth of the river was always obstructed by a sand bar, and at times entirely closed. Since their construction, a safe and deep entrance, adequate to first-class steamers, has been obtained. No further extension of these piers, for insuring a greater depth, is required; but it is highly essential, for the security of the entrance, that the western pier should be extended about 250 feet further into the lake, to protect the entrance, and to form an adequate breakwater against the more prevailing gales from the northwest. The light-house should then be placed on the end of this extension; for in the night, in snow-storms, and

in foggy weather, it is essential that the light should be upon the pier which is the furthest extended into the lake: the extension should, therefore, be finished with a suitable pier-head for such a purpose. The pier should not be less than 20 feet wide, and the pier-head 40 feet square, which would make the proposed extension cost about $10,000."

Appropriations have been made in its favor, during the years 1827, '29, '30, '31, '32, '34, '36, '37, '38, and '44, amounting to $149,413 15. The amount proposed in the bill is considered sufficient for the present fiscal year.

Line 50. *Harbor of Black river.*—The following extract is taken from the report of 1844 in reference to this harbor:

"It is situated about twenty-seven miles west of Cleveland, at the outlet of Black river. There was no specific appropriation during the last session for this harbor, and the expenses of the work directed to be done there will have to be taken out of the general appropriation of $20,000, this being one of those harbors 'the construction of which has been authorized by law.'

"Originally the entrance was obstructed by a sand bar, over which there was occasionally about three feet water, but which, like most of the rivers' mouths on the lake, was at times nearly dry. The effects of the works have been to create a depth of not less than nine feet. The entrance between the piers is 170 feet wide at their inner extremities, and 190 feet at their outer. The western pier is 1,379 feet long, and the eastern pier 1,112 feet long, including parts upon which the shore has encroached. The river is navigable for about four miles above its entrance, possessing great resources of water-power. The work was commenced in 1828, and continued, under small annual appropriations, until 1838, when, like others, and for the same cause—absence of further appropriations—it was suspended. A careful examination of the work justified the impression that about $4,000 would thoroughly repair the piers, and put them in condition to last for several years. The repairs immediately required were directed to be made without delay. The total amount expended on this work, up to and including the appropriation of 1838, is $63,204

"This harbor is incomplete. The piers require to be extended further into the lake, to insure the depth necessary for first-class steamers; and the passage between the piers requires the action of the dredge. About 100 feet should be added to the western pier, with a suitable pier-head in addition, 40 feet square. This extension and pier-head will constitute the breakwater pier, and will have to be made of adequate strength."

In the report of 1845, the estimate for the completing of this harbor is stated at $24,414. The appropriations in its favor are for the years 1828, '30, '31, '32, '33, '34, '35, '36, '37, and '38, amounting to $63,204 77.

Line 52. *Harbor of Vermilion.*—The following description of this harbor is taken from the report of 1844:

"Its position is about seven miles west of Black river, and constitutes the entrance of Vermilion river. This work was commenced in 1836. The plan contemplated the erection of two parallel piers, extending into the lake, 24 feet wide, and — feet apart, with an aggregate length of 2,850 feet, finished at the ends with suitable pier-heads, 48 feet square. The revised estimate for the total cost, exclusive of such dredging as might be found necessary, was $74,342. The total amount appropriated and

expended upon the work, up to and inclusive of the appropriation of 1838, when the work was suspended, was $53,626. Two thousand two hundred feet of crib pier have been constructed. There remain 650 feet of crib pier yet to be put down, in order to carry out the original design, and, in addition, the construction of the two pier-heads."

It will be seen by the foregoing that the amount expended upon this work has fallen short of the original estimate $20,716; but it will also, at the same time, be seen that the work has not yet been extended in conformity with the plan. The estimate was again carefully revised by a board of officers in 1839, who stated the amount yet required to finish the work to be $27,811; but in this estimate the board included $7,854 for dredging, and for kyanizing the timber for the upper works—items not embraced in the original estimate. Deducting this amount, it leaves for the finishing of the work according to the original plan, as the opinion of the board, an amount of $19,957. And the estimate for the same objects, resulting from the inspection of last year, is $19,949. We have already seen that the deficiency of appropriations in reference to the same objects, compared with the original estimates, is $20,716.

The coincidence of these three estimates, from different sources, will, I hope, establish that confidence which seems at times to have been withheld from the submitted estimates for these works.

As the cost of this work, as far as done, has been on more than one occasion the subject of unkind remark, I will take this opportunity of saying, as the result of the inspection of last season, that there is no crib-work on the lakes which more amply sustains the general remark previously made, that where, proportionally to the extent of work done, most had been expended, the works were found better constructed, more judicious in dimensions, and in better preservation.

There is therefore submitted, for completing the work according to the original plan $20,716
For dredging between the piers 6,432

Making together 27,148

Appropriations have been made in its favor, during the years 1836, '37, and '38, amounting to $53,626 57.

The amount proposed in the bill will be sufficient for the present fiscal year.

Line 54. *Harbor at Huron, Lake Erie.*—In reference to this harbor, it is said in the reports of 1844 and 1845:

In 1844.—"The entrance of this harbor, before the present piers were erected, was obstructed by a sand bar, frequently without any water over it. Since the construction of the piers, a channel not less than 10 feet deep has been obtained. The west pier is 1,587 feet long; the east pier is 1,400 feet long; and the least distance between them, 130 feet. The works were commenced in 1826, and were continued, with small annual appropriations, until the last appropriation of 1838, at which time the total amount appropriated was $40,773. I have on more than one occasion remarked, that serious amounts of these appropriations were not applied to the extension of the works, but to repair damages and injuries from storms, and from the decay of timber used at early periods. Some work

had been done at this harbor by private enterprise before it was taken in hand by the United States, in 1826; and, on looking into the history of the work, I find that, in 1831, $1,428 were required to repair this old work.

"In 1836 it is stated, 'that the appropriation of $6,700 was exclusively for repairs, and was nearly all applied this season.'

"In 1837, it was stated: 'During this season, 290 feet of pier-work, greatly decayed, had been taken down below low-water mark, and rebuilt with wood and stone, and nearly all planked over; 60 feet of the east pier was also taken up and renewed, being in process of decay.'

"In 1838: '131 feet was removed above water, and refilled with stone, during the season,' and a 'new pile engine was constructed.'

"The same history shows that, by the 31st of March, 1839, $13,256 of the amounts appropriated for this harbor had been expended 'wholly on repairs'—about one-third of the whole amount appropriated.

"These details are given to correct the erroneous impressions about the length of pier-work erected, in proportion to the total amount appropriated. The history of each work exhibits similar facts. They also serve to show how great would be the economy of substituting for the parts above water of the piers material of a more durable character than that generally used, as soon as the crib work has acquired its permanent set.

"Huron river has about six miles of good navigation from its mouth. Formerly it was entered only by lighters: now, first-class steamers can pass in."

1845.—"Since the last annual report, the repairs of the west pier at this place have been completed. At two places the work was so far decayed that it was found necessary to take it up from two to four feet below the water-line, and to entirely rebuild it. The pier was then raised one course of timber throughout its whole length, (1,350 feet,) new snubbing-posts put in, and new planked throughout. This pier is now in a perfectly good condition.

"The timber of the east pier is so far decayed that it requires a thorough repairing. An estimate for that purpose is herewith submitted; and also an estimate for dredging the channel between the piers to the depth of twelve feet.

"In the last annual report, an estimate was submitted for extending the piers at this harbor to fifteen feet water. This was thought necessary to get rid of the shoal lying just within the mouth of the entrance, on which there is but nine feet water.

"'As there is no perceptible change in this shoal since last year, I have come,' says the engineer, 'to the conclusion that the shoal was formed two years ago, when there was a breach in the east pier, and that it was a consequence of that breach, and that an extension would not cause the current to remove it, and, therefore, that there is no necessity for a further extension of these piers.'

"The inner end of the east pier is so far decayed that the sand from behind it is constantly washing through and filling up the channel. This is a serious evil, and the difficulty will be constantly increasing until the pier is repaired."

Appropriations were made for this work, in the years 1826, '28, '29, '30, '31, '32, '34, '36, '37, '38, and '44, amounting to $45,773 71.

The amount proposed in the bill will be sufficient for the present fiscal year.

Line 56. *Harbor of Sandusky, Lake Erie.*—In reference to this harbor it is said in the report of 1844:

"The entrance to Sandusky bay or harbor is about 10 miles west of Huron. The bay is very large, with a prevailing depth of 12 feet; but not more than 10 feet (low water) can be counted upon to enter the bay, by reason of a shoal inside. The channel to pass this shoal is not intricate, but is rather dangerous at night, during snow storms, or in foggy weather, because of its distance from landmarks. It should be carefully marked out with slender piles on one side of it, not exceeding six inches in diameter, and not more than about 50 feet apart, so that a vessel would always obtain sight of one by the time the sight of the other was lost. I do not at present think that dredging would be of any great advantage here, and therefore do not recommend it. The most dangerous parts of the entrance are on the bars outside, over which not more than 10 feet water (low water) can be counted upon. The best passage out is nearly in a direct line northeast from the deep water off Cedar Point. Also, after leaving this point astern about 400 feet, there is another passage due east, which, after going about 1,300 feet, leads into 13 feet water, from whence there is no impediment to the lake. These channels, however, require to be marked out; but, from the shoalness of the passages, it is evident they cannot be attempted in bad weather, the breakers being very violent over the bars. The dredging of a passage over these bars has been suggested; but, doubting the durability of any useful result from such a process, or of an utility in any just proportion to the cost of such work in so exposed a position, the plan is not recommended.

"The entrance to the bay is formed by Cedar Point on the east and Peninsula Point on the west, distant about 1,000 feet from each other; but the deep water of the entrance is immediately adjacent to Cedar Point. From some cause, the force of the current is thrown against this latter point, in passing which the force is such that the depth of the channel abreast the point is 36 feet, and is 14 feet deep to a distance of 900 feet into the lake, and 12 feet to a distance of 1,100 feet into the bay. For 100 feet further in the same direction, it is nine feet deep; from whence to 11 feet water into the harbor there is a sand bar, 600 feet wide in that direction, with no more than four feet water over it. Vessels entering the harbor have to take a circuitous direction, in order to avoid this bar, and to insure a depth of 10 feet. The best place to dredge inside would probably be in the direction just indicated, of 600 feet across this bar. But dredging at this place is not recommended, because it is believed the effects of dredging would be rather temporary, unless the passage outside were previously modified and improved; and, moreover, the dredging inside should be consequent upon this modification, as the latter might change the line proper to be dredged, or even render any dredging unnecessary.

"That the entrance outside can be improved, and a safe, wide, and convenient passage to the deep water of the lake be obtained, I have not the least doubt. And when the vast importance of this bay is considered, in its commercial, military, and naval bearings, it is also a point well deserving of the expense which a judicious improvement of the entrance would occasion.

"I am not now prepared to submit a plan and estimate, because the survey lately made has not yet been sent in.

"The facts in reference to this entrance just stated are taken from a very minute and excellent survey made by Captain C. Graham, in 1826. Those of the survey of last summer will show if any serious changes have occurred—matter essential to know before any judicious plan or sound estimate can be made.

"Peninsula Point is the extremity of a long, narrow bank of sand, extending from the land forming the western boundary of the bay to the east. It is not a high bank anywhere; but, being deprived of its timber and undergrowth near the land, the sand, thus exposed, drying, and blowing away, ceased to be an adequate barrier to the sea, which broke through it a few years since, gradually widening and deepening a passage in that direction. During the inspection tour of last season, it was found to be about 1,300 feet wide, seven feet deep in the deepest parts, and was gradually wearing away the peninsula, now an island, and endangering the existence of the entrance heretofore described. The island is low in several places—the sea passing over at these parts during heavy gales. It is essential to the preservation of this entrance that the breach should be closed, and the island be protected at the low places just alluded to; and, in reference to the island, it is essential that the general or State government should have a control over it, so as to prevent the removal of the timber and brush-wood now growing there."

In the report of 1845 it is stated: "The appropriation for this harbor was intended to close a breach which had been made by the sea through the long, narrow neck of sand called 'Peninsula Point,' which, for a distance of a mile and a half, forms the outer shore of the harbor, and separates it from the lake. This breach has a mean depth of $6\frac{1}{2}$ feet, and is 1,354 feet wide, through which the water flows freely back and forth between the lake and the bay—the direction and force of the current depending on the wind. Unless this breach is closed, and the peninsula protected, there seems no reason to doubt that the whole will be washed away, and leave the harbor entirely unprotected against the north and northeast winds.

"As a preliminary step, it was found necessary to protect the sides of the breach, to prevent its widening, and also to put down a narrow crib-work at two places (one 200 feet long, and one 100 feet long) on the peninsula, where it was so low that there was danger of new breaches being made. The length of crib work put in during the last season for these purposes is, on the west side of the breach, 736 feet, and on the east side, 612 feet. 986 feet of this crib-work is only six feet wide, and placed on dry land, on each side of the breach and on the peninsula, to prevent the breach from widening, or new breaches from being formed. Besides the crib-work, the shanties, carpenters' shop, scows, boats, machinery, and tools have been built and purchased, at a cost of $4,516 10.

"In addition to the work done, a quantity of timber has been purchased, sufficient to construct the crib-work entirely across the breach. These operations have so nearly exhausted the funds on hand, that nothing further can be done until another appropriation is made.

"We have no exact account of the commerce of this place; but it is very considerable, and constantly and rapidly increasing. Two important railroads diverge from Sandusky city into the interior of the State—one

connecting it with Cincinnati, all of which is now under contract, and will be completed during the coming year."

And in a special report from this office dated 20th of May, 1846, the survey, plan, and estimate for the improvement of the harbor are given. The estimate amounts to $296,352 65. The amount proposed in the bill will be sufficient for the present fiscal year.

Line 58. *Harbor of Monroe, Lake Erie.*—The report of 1844, in speaking of this harbor, says:

"This harbor is situated at the western extremity of Lake Erie, about forty miles northwestwardly from Sandusky, and thirty miles southwestwardly from the mouth of Detroit river.

"The object of the works was to connect the deep water of river Raisin by a direct communication with the lake, its natural outlet being over a shallow and extensive sand bar 6,290 feet wide. It was a substitute for the imperfect entrance from Pleasant bay, and resorted to as a more economical plan, and one more certain of success, than that of improving the pass into that bay. Before the construction of the work, the passage into the river was about three feet deep; since then, the passage between the piers has been ten feet deep. This harbor is the outlet of an important river, possessing great hydraulic power, and running about 130 miles through the State, (Michigan,) watering an extremely fertile country, with many important towns upon its banks—such as Monroe, Dundee, Petersburg, Blissfield, Palmyra, Adrian, Tecumseh, Clinton, and Manchester. The southern railroad (a State work) terminates at Monroe—a work intended to connect with New Buffalo, on Lake Michigan. Some idea may be derived of the vast advantages of these harbor improvements by the following extract from the agent's report:

"'Up to the last-named date, (1835,) the river Raisin being, in consequence of the bar mentioned, inaccessible, the harbor within it was useless, and a substitute for present convenience used in La Plaisance bay. The commerce was limited to the difficult importation of a few tons of merchandise, with no exports worth mentioning. The country from the lake back, embracing the whole southern district of Michigan, was a wilderness, owned by the government of the United States, and the site of the present city of Monroe, occupied by a population of about 500. An office for the sale of government lands had just been located here, and a few sales made.

"'But the prospects opened by the first appropriation, in 1835, appear to have commenced a new era in the affairs of this district, and in its commercial advantages. Sales of the public lands instantly commenced, and were made with a rapidity theretofore unexampled; and, up to the year 1838, no less than 3,000,000 acres had been entered by individuals, for which the sum of $3,750,000 had been added to the public revenue for those three years.'

"'The State of Michigan, relying, it would seem, on the completion of the work, has, by a law, directed the construction of their southern railroad, which is completed from the harbor of the river Raisin to the county-seat of Hillsdale county, about seventy miles, at a cost of about $1,000,000, and will probably be carried to Lake Michigan. In 1834, the population of the whole southern tier of counties depending on this harbor may be stated at 4,500 souls; in 1844, they cannot amount to less than 75,000. The newly and but partially-opened port of the river Raisin

is now the point of a very active business, in the importation of merchandise necessary to supply the fine country brought into cultivation and occupation by the fostering care of the government, and the exportation of its large products. The southern State railroad, as appears from official statement, is becoming lucrative to the State, and has, within the last four years, nearly quadrupled its business. Monroe, a flourishing town, situated at the harbor of the river Raisin, has rapidly increased in population and commerce, and several steamboats and schooners are now owned at this point. Accompanying is a statement of the shipments since the 1st of May, 1844, to the 1st of September, 1844.'

"The papers referred to in this extract from the collector of the port give, for the entries of the seven months of 1844, 7,600 tons; and of exports, 57,000 barrels of flour, 137,000 bushels of wheat, 3,000 casks of potash, 1,000 barrels of pork, and 600 barrels of seed.

"The work has been costly, in comparison with many others, as, in addition to the piers extended into the lake, it has been really the construction of a ship-canal through a sand beach and a difficult marsh. Its cost, not including the appropriation of last year, is $90,000. Appropriations for this were made, during the years 1835, '36, '37, '38, and '44, amounting to $110,000."

The amount proposed in the bill, it is believed, will complete the works at this place.

Line 60. *Dredge-boat for Lake Erie.*—In reference to this measure, I beg leave to refer to the remarks of this report of line 29 of the bill.

Line 62. *Harbor at Michigan City.*—The following description of this harbor is taken from the report of 1844:

"This harbor is situated at the lower end of the lake, on its south-eastern coast, and is about thirty-five miles south of St. Joseph. It is essential to the commerce of the lakes. Vessels driven by north and northwest gales, failing to find shelter there, inevitably go ashore, as is attested by yearly and melancholy instances of loss of life and property, so frequent as to have obtained for this part of the lake coast the appellation of the 'coast of bones.'

"The stream at this place is small, and before the works were erected had rarely a passage into the lake of more than two feet deep, and was frequently completely closed. Since the piers have been put up, and limited as is their extent, there have been always about five feet of water between them. No doubt is entertained that the extension of these piers, and dredging, would insure an adequate depth; but the narrowness of the entrance would still deprive it of its important consideration as a port of refuge—a consideration too essential to the general commerce of the lakes to be lost sight of. On this account a different plan will have to be adopted than that of merely extending the piers. The plan now alluded to was brought by the bureau to the attention of the department when the project for improving this harbor was first agitated, but it was not then adopted. It was to protect the mouth of the entrance, and to afford a shelter for vessels in storms, by a suitable crib-work breakwater placed in the offing. The only modification which, after careful inspection of that place during the last season, is now proposed, is to connect one of the piers of the present entrance with that breakwater by a suitable open-bridge pier. This last is a cheap kind of structure frequently adopted for quiet-weather landings on the lake, but will be very efficient and of great use under the protection of, and connected with, the proposed breakwater.

The breakwater should not be less than 2,000 feet long; should be placed in not less than eighteen feet water; should be one connected line, curved, however, and presenting its convex face to the lake; and should have substantial pier-heads. It must be built strong: otherwise it will soon be knocked to pieces, and its whole expense be lost. This lake is not only boisterous in its character, but Michigan City is on the lee shore of prevailing winds, where the surf is extremely violent.

"The present work consists of two parallel piers, 100 feet apart, the western 650 feet and the eastern 800 feet long. Of the former, 109 feet require levelling timbers, and 147 feet to be planked; of the latter, 212 feet require levelling timbers, and nearly the whole of it to be planked. These piers have withstood the action of the lake without serious damage. The water at the end of the west pier is 8 feet deep, and at the end of the east 10½ feet; between the piers the depth is 5 feet into the creek harbor. Outside of the piers there are two sand bars: one with 6 feet over it; the other, the furthest out, about 500 feet in advance of the work, has about 9 feet over it. The bottom between the piers is a blue clay, covered in places with a foot or two of sand. This sand removed, a channel can be dredged through the clay, which will in all probability be durable.

"The space between the piers being rather limited, and the interior river basin small, a large column of water cannot be thrown in from the lake, and, the stream being small, the water which it throws into the lake is insufficient to scour between the piers. A remedy could be had by the enlargement of the interior basin, when the flux and reflux of the lake water would act effectually upon the passage between the piers. Such a basin would also much increase the commercial facilities of the harbor."

Appropriations were made in its favor, during the years 1836, '37, '38, and '44, amounting to $135,733 59. The amount now proposed in the bill is sufficient for the present fiscal year.

Line 65. *Harbor at Chicago, Lake Michigan.*—This notorious and important harbor has been so frequently and so fully described, that additional remarks in relation to it would probably now be considered superfluous.

Appropriations have been made in its favor, for the years 1833, '34, '35, '36, '37, '38, '43, and '44, amounting to $247,601. The amount proposed in the bill is sufficient for the present fiscal year.

Line 66. *Harbor of Waukegan, on Lake Michigan.*—This is the work previously known under the name of Little Fort, and for which no appropriations have been heretofore made. A special report was made in reference to it from this office on the 6th March last.

Line 68. *Harbor of St. Joseph, on Lake Michigan.*—The report of 1844, in speaking of this harbor, states:

"The St. Joseph's river is an important stream, having about sixty miles of navigation for small steamboats from its mouth, and extending far into the interior, with many clever towns upon its borders. The State of Michigan is now constructing a railroad from Detroit to the mouth of this river, which is completed to the town of Marshall, one hundred and ten miles from Detroit, and is being rapidly made the rest of the distance, over which there is a regular daily line of stages connecting with a steamboat line which crosses the lake daily to Chicago.

"There are ten counties of Michigan and Indiana, with hardly an acre

of unproductive land, the produce of which has to find its outlet at the mouth of this river; and I have already stated that the central railroad from Detroit is to terminate there. A few years since, its exports and imports were comparatively nothing; now, the exports of flour alone exceed 100,000 barrels yearly, with a fair proportion of other products. It cannot fail to become an important place—probably second only to Chicago on this lake.

"The works here were commenced in 1836, and continued to 1838, under annual appropriations, when an amount of $86,113 had been appropriated. The work was then suspended, with other works, but was recommenced in 1843, with an appropriation of $25,000, and continued by another, in 1844, of $20,000—making the total amount appropriated up to this day equal to $131,113.

"The construction of the piers at this place has been attended with great difficulties—lying on the eastern coast of the lake, exposed to severe and frequent storms from the northwest, and a heavy surf, which at such times beats upon this coast with great violence, obstructing the placing of cribs, and knocking them to pieces before they can be sufficiently secured. The piers are 250 feet apart, and they have already added much to the security of what was before a difficult, and, at times, an impracticable entrance.

"Since the report of last year, and during last fall, but one additional crib was put down, the whole force being employed in building up the work of 530 feet of pier which had been put down that season. It was raised four feet above the water, and completed to that height, by the 6th of December; after which time, and until the ensuing spring, a part of the hands were retained, and employed in repairing the machinery, scows, &c., preparatory to future operations. During October, 1843, the heavy blow upon the coast heaped up the sand at the entrance, reducing the depth there at one time to about seven and a half feet—which, however, shortly afterwards deepened of itself to nine feet, at which depth it continued during the winter. The entrance kept open throughout the winter, vessels being able to enter and depart occasionally during every month.

"The spring (1844) was unusually rainy, and the rivers, in consequence, unusually swollen. The St. Joseph's, among the rest, discharging a vast quantity of water, scoured out the passage between the piers, and created a depth nowhere less than eleven feet over the bar outside. The depth between the piers was thirteen feet, and in places much deeper. The south pier sunk, by the effects of this freshet, on its inner front, about four feet. Originally the depth along this pier was eleven feet; it is now about nineteen feet.

"The further extension of the north pier was commenced on the first of June; but, owing to the continued succession of boisterous weather until September, the work did not progress as rapidly as was anticipated, although by that time 472 feet of crib-work had been put down. A gale in this month, catching the work before secured, carried away the outside crib, and several rounds of timber off of three others. Others of the cribs of this pier sunk considerably—one as many as four feet below the surface of the water. All have since been built up and secured, and have since stood a severe gale.

"The end of this north pier is now upon the place of the old bar, and

within 350 feet of 15 feet water of the lake. Its extension has already proved of great security to vessels entering during gales from the north and northwest.

"The work to be done this season is further to secure this pier, and to build up parts of it at least four feet above the water-surface, as it will probably settle to that extent during the coming winter. The south pier will also have to be built up. The old work (that is, the parts constructed under former appropriations) is in a good state of preservation.

"The channel of the entrance makes south after leaving the south pier; and, as it has received a direction nearly west in passing between the piers, it is apparent that this turn to the south can be occasioned only by some power coercing the river water in that direction after it is free of the piers. Now, this force can be only in the prevailing and violent north and northwest winds. It would seem highly probable, then, that if the river current were protected from the force in that direction until after passing the bar outside, all danger from this change of direction in the river channel would be removed. This protection can be obtained only by a further extension westwardly of the north pier. Such a course, under similar circumstances, has succeeded admirably elsewhere; and I can see no sound reason why it should not succeed here. The north pier will, therefore, be extended as proposed, and as indicated in the original plan; and eventually, should it become necessary, some additional length can be added to the south pier.

"The total length of additional pier-work contemplated, under any view to complete the entrance, is about 1,500 feet. It may and probably will be less, if the extension of the north pier, in the first instance, should produce the effects anticipated. My own impression is, that 850 feet of crib will be all that will be required at this place, and, therefore, it is all for which at present any estimate will be made.

"To make this work as strong as it should be—add the pier-heads, and raise the work to its proper heights, load it adequately with stone, finish and floor it—will not cost less than $35,000. But there is about 902 feet of crib-work put down in 1843 and 1844 which has to be built up to the proper height, and much of it to be readjusted. It has also to be supplied with more stone, and to be planked. The planking and some repairs of the piers made before the renewal of 1842 have also to be done; and these piers likewise require additional stone: which different items will about absorb the balance of previous appropriations."

And in the report of 1845 it is stated: "After the last annual report from the superintending engineers, operations at the harbor of St. Joseph were continued until the beginning of the stormy season, when the work was suspended for the winter. The whole work done during the season consisted in sinking 10 cribs, altogether, 436 feet long. These cribs were carried up four courses of timber above water, the upper work being connected throughout the whole length of the pier. In consequence, however, of the constant succession of gales during the summer, and especially toward the close of the working season, it was found impossible to close up this work as securely as was necessary to resist the storms of the winter. The consequence was, that the work was considerably damaged—a breach of 90 feet long having been made through it, extending several feet below the water. When the work was resumed in May of this year, (1845,) the breach was well and securely closed; and, during

the summer, the pier has been carried up to its full height, and finished in the best and strongest possible manner. The south pier has settled on the channel side so much that the upper timbers were only from one to two feet above the water. This pier has been built up vertically on the channel side, and so filled with stone that no further settling is anticipated; in fact, it has not settled at all during the last twelve months. In addition to this, a crib, 30 feet long, has been sunk at the end of the south pier. This has been carried up two feet above the water, and filled with stone. It will not be connected with the old work until it has stood through the winter and had time to settle.

"In conformity with the principles and plan laid down in your last annual report, I have estimated for an additional pier-work, 850 feet long. This addition, after your personal inpection, was the least you deemed sufficient to complete the harbor.

"You will perceive, by the map herewith submitted, that an extension of 450 feet on the north pier will reach 15 feet water, and that there is no bar inside of this point. I suppose, therefore, that this will be as far as you will deem it necessary to carry out this pier. I am of opinion that, if the remaining 400 feet of pier-work of the estimate were added to the south pier, the effect would be very beneficial; and, probably, by giving to the river a full and decided set in the direction of the piers, the current would sweep away the shoal which lies near the end of the north pier, in front of the entrance."

The importance of this harbor is every year increasing. Locks have been constructed on the St. Joseph river, at Michawaka and at Bristol, which have opened the navigation to three rivers, a distance of 130 miles from the lake. The export of wheat alone this year is estimated at 750,000 bushels—equal, at least, to half a million of dollars. Three steamboats are running on the river.

The present condition of the piers is described by the agent in the following extract from his report:

"The south pier is in good condition, and nothing will be required for repairing it during the ensuing year, except what may be required for levelling and finishing the 30-feet crib recently put in, and for connecting the old work with it. It has not settled or changed its position since its completion; and an accumulation of sand upon the river side of it, which has already been formed, indicates that the current of the river washes it with less force than formerly, and that no fears need be entertained of its undermining and settling.

"The two upper sections of the north pier (the first being a single wall of timber, with ties, and the second consisting of piles, caps, sheet-piling, and ties) have an accumulation of sand upon the river side of them to the warter-surface, are not exposed, and will need no repairs the ensuing year.

"The third section of this pier, extending from the second to the third and last angle, (150 feet,) and the fourth section, extending from the third angle to the end of the old work, (596 feet,) have suffered great injury from the action of the water, and, unless effectually repaired, must soon become a wreck.

"530 feet of this pier have been undermined, and a considerable portion of its stone carried into the river, to the great prejudice of the navigation; and there is now an opening under the river side of this part of the

pier of from one to four feet wide, through which the water rushes with great violence into and out of the pier, whenever we have a strong wind from any direction, and thus frequently carrying away timbers from the lower edge of the river side of the pier.

"In the upper course of both piers, the cross-ties are dressed on four sides, and put in five feet apart. This gives the pier a handsome appearance, and strength to sustain any load of ice that may be thrown upon it by the sea. The posts have all been cut off at the top of the upper or square cross-ties, except one at every 40 feet, which has been cut off three feet above the top of the pier, and finished as a snubbing-post. The tenth or outer crib has been planked over with pine plank three inches thick and six inches wide. The outer end of the pier has been covered with 3-inch oak plank, put on vertically, reaching from the top of the pier to four feet below water. This planking extends round the corners four feet on each side. The piers are not covered; but a plank walk has been made, four feet wide, extending the whole length of the piers, for the purpose of towing vessels, getting out the beacon-light," &c.

Appropriations have been made for this harbor, in the years 1836, '37, '38, '43, and '44, amounting to $131,113. The amount proposed in the bill is sufficient for the present fiscal year.

Line 70. *Harbor at the mouth of Kalamazoo.*—A special report has been made of this harbor to the Senate, under a resolution of the 19th February, 1836. In my opinion, it would be advantageous to double the amount proposed in the bill for the present fiscal year.

Line 73. *Harbor at Grand river, Lake Michigan.*—The same remarks which have been made of Kalamazoo apply to this improvement. They are both harbors of importance to the lake trade.

Line 75. *For the improvement of the harbor of Milwaukie.*—The report of 1844 says of this harbor:

"This harbor is also on the western shore of Lake Michigan, twenty miles north of Racine. At the close of last year's operations, 960 feet of the north pier had been put down, and raised three feet above the water. This season, 150 feet more have been added to that pier, extending it to water 14 feet deep; and 600 feet of the south pier have been put down, filled with stone, and raised to the surface of the water; and a part of a sand bar near the inner end of the north pier has been removed.

"Before this work was commenced, there was not more than four feet of water over the bar that obstructed the entrance; there is now a passage of adequate width 9½ feet deep.

"This work was commenced in 1843, and the amount appropriated, including that of the last session, is	$50,000
"The estimate for completing the work is	46,793
"Making a total of	96,793

"The original estimate was for $92,183; but there is a small balance in the hands of a former agent, now in suit, which, deducted from the former expenditures, will make the present amount actually expended and the amount now required for completing the work agree very well with the first estimate. Of the estimate now submitted to complete this work, ($46,793,) the sum of $30,000 will be wanted for the next fiscal year."

And in the report of 1845 it is said:

"Since the last annual report, seventy feet have been added to the length of the south pier, the whole pier raised to a height of three feet above the surface of the water, and filled with stone; 15,739 cubic yards of earth have been removed from the space between the piers and the bar at the west end of the north pier, which secures a channel of sufficient width and depth for vessels of the largest class on the lake.

"The appropriation for this work having been nearly expended last season, but little has been done on it this year. With the balance on hand on the 10th of April, 160 feet of the east end of the north pier has been raised to the level of the rest of the pier, five feet above the surface of the water; and to render the harbor accessible to vessels at night, a beacon-light has been erected on the end of it.

"From the soundings taken in August last, it is found that the channel retains its depth, and that the water has increased in depth near the end of the south pier. No indications of the formation of an outer bar were discovered; and, from the protection given to the entrance against the northeast and southeast winds by projecting points north and south of it, it is probably secured from the formation of such bars."

Amounts heretofore appropriated for this harbor were for the years 1843 and '44, amounting to $50,000. The amount of the present bill is sufficient for the present fiscal year.

Line 77. *Harbor of Racine, Lake Michigan.*—The report of 1844 says of this work:

"The town of Racine is at the mouth of Root river, about ten miles north of Southport.

"Private enterprise had already been at work there, and had put down an aggregate of 626 feet of crib pier-work, which had greatly improved the entrance, having insured a constant and safe channel, with adequate depth, in the place of one which previously was dangerous, always shoal, and often nearly shut up.

"The appropriation of last year was intended to complete this work, giving to existing piers the requisite additional extension. About 311 feet of crib pier will have to be added to this work, with a suitable pier-head."

The report of 1845 says:

"Active operations on this work, under the bureau, did not commence until in the course of the month of September, 1844; since that time there have been added to the length of the north pier 176 feet, and to the south pier 155 feet—the former terminating in 12½ feet water, the latter in 9½ feet. Three hundred and thirteen feet of the north pier, which was incomplete when it became a government work, has been levelled up, filled with stone to the surface of the water, and decked.

"After the failure of the appropriation bill for this year, the citizens of Racine at once raised a sum of $5,500, to be expended on the work in conjunction with the balance of the former appropriation; and, in addition to the work done as stated above, 115 feet of the south pier has been completed. Ninety feet has been levelled up to the requisite height; 5,000 cubic yards of earth have been removed from between the piers, which gives a channel of sufficient width and depth for vessels to pass into the harbor; and the rock which obstructed the entrance between the piers has been removed, and a scoop-dredge constructed on the pile-driver.

"The bar which had formed at the end of the north pier, last year, has

entirely disappeared; and, from the large and rapid accumulation of sand between the piers, it is more than probable it found its way into the channel during the heavy northeast storms of October and November last. The increased length of the north pier and the removal of the rock will, probably, prevent similar deposites for the future."

The estimate to complete the work by this last report is $34,189.

Former appropriation in its favor was for the year 1844, amounting to $12,500.

The amount proposed will do for the present fiscal year, but the estimate from this office for that period was for $15,000.

Line 79. *Southport harbor, Lake Michigan.*—The report of 1844 says of this harbor:

"Southport is on the western shore of Lake Michigan, about five miles north of Chicago. The work at this place is new, the appropriation of the last session of Congress being the first in its favor.

"The law in reference to it states that the appropriation is 'for the construction of a harbor at the town of Southport, in the Territory of Wisconsin.' And the second section of the same law further states 'that the corps of topographical engineers shall select, from actual examination and survey, the point of location of said harbor.'

"The examination and survey were made and the results duly prepared at the time of inspecting the harbors on this lake, and the selection of the locality for the piers was also made. The following is a brief exposition of the reasons which governed in the selection.

"By the quotations from the law just given, it was clear to my judgment that the piers must be located 'at the town of Southport,' and therefore the discretion of the engineer in making the location was necessarily confined to the corporate limits of that town. Governed, then, by these limits, there are but two positions at which an entrance to the harbor can be made—one immediately adjacent to the inhabited and settled part of the town; the other about half a mile to the north, where no one resides.

"After a personal examination of these two positions, and after consulting the survey which had been made, it did not appear to me that any one could hesitate which to select. With me there was no hesitation; and, making selection of the most southern of these two positions—the one immediately adjacent to the inhabited part of the town, usually denominated and known as the southern outlet of Pike creek—the engineer in charge was directed to make his arrangements for constructing the piers at that place.

"After this decision had been made, it was suggested that the words of the law, 'at the town of Southport,' were intended to mean 'within the township of Southport,' and therefore the range of selection could be extended throughout the limits of that township, embracing about 12 miles of lake coast. Although such an interpretation of the law struck me as unwarranted by its phraseology, and as erroneous, yet, as that interpretation may be adopted by others, I deem it proper to lay before the depart the considerations which it will involve.

"It will bring into view another point, usually denominated the outlet of Pike river. This outlet is about one mile and a half north of the one chosen, and within the limits of the town of Kenosha. The survey of this outlet had also been made, and it had also received a personal examination during my inspection tour of that quarter.

"At the time the survey was made, the opening at this outlet was about 50 feet wide, and 2 feet deep; that of the place selected, the same width and depth. When the personal inspection of these outlets was made, the opening at the former was about 15 feet wide, and 3 inches deep; the opening at the latter place was shut up by a bar of sand: a severe storm from the east had prevailed a day or two before, throwing the sand of the lake against that shore.

"Pike river has a longer extent of water-way, after entering, which can be used as a harbor. The extent of water-way in Pike creek, after entering it, which can be so used, although not so long as that of Pike river, is, however, adequate for all harbor purposes. The widths and depths of each, after entering, are about the same.

"The reasoning which involves an artificial enlargement of the harbor space, by excavating the soft marsh within each entrance, can be applied equally to both places, and may probably, for either, be considered as belonging exclusively to individual enterprise in the improvement of water-lots.

"Upon Pike river there are no settlements, (that is, nothing in the character of concentrated settlement or town,) the survey exhibiting merely the residence of the owner of the land at the outlet. At the mouth of Pike creek, on the contrary, is the town of Southport, containing already upwards of 2,000 inhabitants, with many large and valuable buildings and extensive stores; and it is already in the enjoyment of an active and increasing commerce. All the commercial business of the vicinity is now done there, and the principal roads leading into the interior concentrate there. The grounds, also, at Southport are better adapted for the location of a town than at either of the other points.

"To locate the piers at Pike river would be destructive of the town of Southport, its property, buildings, and trade. To place these piers at Southport, or, in other words, at the mouth of Pike creek, would be no injury to the property at Pike river; on the contrary, it must increase the value of that property, by the good effects of having a harbor so near it. The construction of the piers at Southport will be less costly than at Pike river, from the advantages to be derived from the concentrated population of the town—its laborers, workshops, and mechanics—and by the advantages derivable from the temporary bridge-piers already erected there in landing supplies from the lake.

"From these considerations, therefore, even if the mouth of Pike river were considered as included within the phraseology of the law, believing that an equally good harbor can be made at either place, I should yet have decided in favor of the south mouth of Pike creek.

"The estimate for the construction of this harbor, on the supposition that it will require an aggregate of 1,460 feet of crib pier-work, including a suitable pier-head to sustain a beacon, is $50,592; from which should be deducted $12,500, the amount of the appropriation of last winter, leaving a balance required for the work of $38,092."

And in that of 1845 it is said:

"Operations were commenced on this work in September, 1844, and during the fall the machinery required for the work was constructed. The first crib was sunk on the 20th of October; and between that time and the 1st of December 103 feet of the north pier and 163 feet of the south pier were put down and filled with stone to the surface of the water, and 2,500

cubic yards of surface sand removed from the bar between the piers. During the winter, the facing, 175 feet, to the south side of the entrance through the bar, was put down, and materials for the next season's operations received and prepared.

"Early in the month of March, 1845, the work was recommenced; and during the present season 404 feet in length have been added to the north pier, making its length 507 feet, and terminating in about 9½ feet water. 130 feet have been raised 3½ feet high, 250 feet 2½ feet high, and 127 feet 1½ foot high, and the whole filled with stone, level with the surface of the water.

"It was deemed advisable during the spring to construct a scoop-dredge, moveable by horse-power, for the purpose of removing the sand which had accumulated between the piers. As there was not sufficient channel for the egress and ingress of the machinery, it was also deemed advisable to suspend the work on the north pier until a passage for the pile-driver could be obtained, and piles driven into it, without which the pier-work, in so great a depth of water, could not be considered safe in heavy storms. Preparations were consequently made to place one on the hull of the pile-driver, so that the same power might answer for both. It was expected that the machinery for the dredge would be in readiness by the 15th of June, and that the machine would be ready for use in the course of that month; but unavoidable delay, however, occurred in its preparation, and it did not reach Southport until the 31st of July. It is now ready for use, and will be kept constantly at work until the whole of the sand is removed from between the piers to a depth sufficient for the passage of the machinery.

"During the time that the sinking of cribs has been suspended, a large portion of the timber required for the extension of the piers has been framed, and 395 cords of stone received and deposited near the work. If the weather should prove favorable during the coming fall, 200 feet in length will be added to the north pier, and 300 feet to the south pier; which would leave the termination of the north pier in 14½ feet water, and that of the south pier in 9¼ feet water."

The expenses incurred in constructing the machinery required for dredging will cause the estimate of this year to overrun that of 1844 by a small amount.

Appropriations in favor of this harbor were made, during the years 1844 and '45, amounting to $27,500. The amount now proposed in the bill is sufficient for the present fiscal year.

Line 81. *Dredge-boat on Lake Michigan.*—Upon this item allow me to refer to the remark in this report on line 29 of the bill.

Line 83. *Survey of the lakes.*—The many demands made for surveys of harbors not falling within the line of operations contemplated by this appropriation during the ensuing year make it proper on my part to suggest an increase of this item to $35,000.

Line. 85. *For the harbor of Dubuque, on the Mississippi.*—The report of 1844 says of this harbor: "In a law of June 15, 1844, there were certain appropriations for improvements in the Territory of Iowa. These were, first, at the town of Dubuque: $7,500 were appropriated to improve the harbor at this place, 'provided, upon due examination and survey, under the direction of the Secretary of War, it shall appear that a permanent improvement can be accomplished and completed for this amount, so

as to admit the landing of steamers of the largest class navigating the river at the town of Dubuque at all seasons of the year.'

"Dubuque is situated on the Mississippi river, and the landing in question is a landing on the shore of that river. In a report from the agent to whom this duty was assigned, dated September 1, 1844, he states that the water is unusually high for this season, and it would be extremely difficult, if at all practicable, to make a correct estimate or plan for the improvement. The obstructions are all hidden by the water, and there is no certainty of ascertaining what they are until the water shall fall. Conflicting interests render it impossible to get representations which can be relied upon. On these accounts, the examinations directed had to be delayed, and it was probable, at the date of the last report, (September 1,) that some weeks would elapse before the water would be sufficiently low. Since then no report has been received. It is presumed that the condition of the river had not yet admitted of the necessary examination."

And the report of 1845 says: "Final views and estimates in reference to Dubuque harbor and the roads of Iowa cannot at this time be presented, as the annual report of the agent has not been received. After a careful examination of the plans proposed for the improvement of this harbor, one has been approved which appears best suited to the case, and well adapted to render the earliest relief. The plan consists in making a short opening from the 'basin,' or harbor, through a narrow island, to the 'outer slough,' which connects immediately with the main river; 2d, in forming a partial dam at the 'outer slough,' below the mouth of the outlet, and by that means to throw more water into the channel by the outlet; 3d, to dredge a deeper channel than now exists at low water within the outer slough and in the outlet itself. The operation now in progress is the making of the short cut from the basin to the outer slough. When the water is at its lowest condition, the dredging and the formation of the dam will be undertaken."

The appropriation now proposed, it is considered, will be sufficient to complete this harbor on the latest received and approved plan.

Line 87. *Harbor of St. Louis.*—In the report of 1844 it was said of this harbor: "For this purpose, a special appropriation of $25,000 was made during the last session. This harbor is threatened by two serious dangers: one, that the Mississippi, which is gradually encroaching upon the east bank, will eventually pass nearly the whole of its waters between Bloody island and the Illinois shore, and, as a consequence, destroy the harbor of St. Louis; the other, more distant in locality, but not less to be dreaded, is, that the Missouri, bursting through the small impediment which now resists its action, will carry its waters, and those of the Upper Mississippi, through what is called the 'American bottom of the State of Illinois,' again entering the old bed of the Mississippi about —— miles below St. Louis. The consequences of such a disaster are beyond calculation: the loss of life and property by it would probably be unparalleled."

In the report of 1845 it is said: "In the report of last fall it was remarked of this harbor, that several plans for its improvement had been submitted by the engineer in charge of the work: but, although the bureau was willing to award to him all imaginable credit for his acquirements and his ingenuity, yet it could not agree with him in any of the plans proposed; and, therefore, a board of officers, consisting of Lieutenant Colonel Kearny and Lieutenant Colonel Long, had been organized, and ordered to

meet at St. Louis, to examine the locality of the work, to revise all plans and estimates, and to report its own views and plans. It was clear to my judgment that the actual cause of alarm had not been sufficiently considered nor adequately and directly attacked, but that the engineer had permitted himself to dwell too much upon collateral and probable considerations. Every notion which might present itself to an ingenious mind was carefully exhibited in his reports, forming thereby valuable matter for the consideration of the bureau—all of which was duly submitted to the examination and revision of the board.

"The immediate danger to St. Louis harbor arises from the tendency of the waters of the Mississippi to avoid the Missouri shore at the city of St. Louis, and to pass between Bloody island and the Illinois shore. The consequences of this tendency are, to fill up and make shoal the harbor or landing at the city of St. Louis, and to open and deepen the passage between Bloody island and the Illinois shore. We have, therefore, in this simple statement of the case, the evil to be remedied; and the evil of itself suggests the remedy, viz: the tendency of the waters of the Mississippi to pass between Bloody island and the Illinois shore must be counteracted. It was clear to my mind that all works above and below the city, not having a direct influence upon the views just stated, could with propriety be postponed, because, if the views stated could not be accomplished, all works above and below were comparatively useless.

"The idea of intercepting the passage of the water between Bloody island and the Illinois shore, and thereby to coerce a passing of it on the Missouri side of the island, is of old date. It will be found to prevail in some of the earliest reports on this subject, and was, I believe, first presented to the consideration of the department, in the form of a plan, upon a survey of that harbor made in October, 1837, by Captain Robert E. Lee,* of the United States engineers, then in the superintendence of the work. This plan was, to construct a dam or dike directly across the upper end of Bloody island to the Illinois shore, with other accessory works of revetments of shores, &c. This plan was afterwards adopted by a subsequent superintendent of the work, but never authorized. The idea of turning the waters of the Mississippi into the Missouri channel was here evidently exposed; but the plan of accomplishing that idea was not considered the best and most practicable. Such a dam offered too direct a resistance to the course of the stream, thereby producing consequences which could not be readily forseen, and, reasoning from analogous cases elsewhere, would probably create other evils, and entail serious consequent expenses. The water would be obstructed and deflected by such a dam or dike, but the deflection would be too violent, and in a wrong direction. It should be as gentle as practicable, coinciding as much as practicable with the course of the stream.

"The plan recommended by the president of the board, exhibited upon the drawing annexed to this report, after enumerating other accessory works above, was to revet the lower and western side of Kerr's island; then to construct a dike from the lower end of Kerr's island to the upper end of Bloody island; then to revet the western face of the upper end of that island.

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* See the report, plan, and drawings of Captain Lee, printed as Doc. No. 139, 2d session 25th Congress.

"The objections on the part of the bureau to this plan were, to the extent of dike-work and of revetment-work; to the admission of whatever water should pass on the slough east of Kerr's island, in the rear of the work, and between it and the Illinois shore; and to the consequent hazard to the work, and obstruction of access from the river to the Illinois shore between Bloody island and Kerr's island. These objections to the plan being discussed between myself and Lieutenant Colonel Kearny, the president of the board, after his return to Washington with its proceedings, the conclusion on my part was to recommend the following plan, viz: to construct a dike or dam from the point 12 or 13, on the Illinois shore, to the upper end of Bloody island, and to revet part of the western face of Bloody island, as essential measures, to which attention in the first instance should be directed, and which would probably render other accessory measures above and at Kerr's island unnecessary. It is, to my judgment, a matter of secondary importance what direction the channel of the river takes immediately above and below St. Louis—the great object in view being to maintain the deep water on the St. Louis side at all landings of that city; and the plan now proposed, it is believed, will accomplish that object. At least, I am decidedly of the opinion that the measures now indicated should be the first adopted, and that those spoken of in the various reports which have been before Congress for the head of Cascarot island may be postponed until future experience shall indicate their necessity. The operations at the head of Cascarot island have this consideration in view: that, by erecting an obstruction from the rocks on the Missouri shore, called the Chain of Rocks, sufficient to turn the principal low water channel, and to make it pass on the eastern side of Cascarot island, it would, in passing out at the lower end of this island, acquire a direction towards the St. Louis shore, and thereby aid the effects of the works before spoken of at Bloody island, and render them less liable to accident. It would, therefore, be advisable to contemplate work at this point; but I think the construction may with safety be delayed until the works at and near Bloody island have begun to exhibit their effects, and their need of assistance by means of any deflection of the channel to be made at the Chain of Rocks.

"Two considerations seriously affect this or any other plan of a dike: 1st, the height which it would be proper to raise the dike; and, 2d, the depth which the work would probably sink in the bed of the river. It is evident that, if the dike were raised too high, it would deflect such a mass of water into the St. Louis channel, and create thereby so violent a current, as to produce serious and dangerous consequences; and equally evident, that, if it be too low, it would not produce sufficient action in low stages of water to prevent deposites. Applying to these considerations all the facts and reasoning at command, it was decided to limit the height of the dike to 3 feet above the low water of the river.

"Should experience demonstrate that a greater height ought to be given to the dam, the addition could be easily made at any future day. In reference to the sinking of the work in the mud of the river, it was decided, after careful investigation, that we must assume for the sinking a depth of 9 feet. The sinking may, and probably will, in places, be greater, which will involve a greater depth of dam-work. The height of the dam will, therefore, involve the settling in the mud, the depth of water at low water, and a height of 3 feet above low water. As the work is brought in

contact with the two shores—the Bloody island and Illinois shores—the structure will have to be raised, forming an abutment at each end. Bloody island must be preserved, or the dike would be comparatively useless. It became, therefore, necessary to anticipate the abrasion of part of the western shore of the island, and to provide against such a contingency by a suitable revetment of part of the western shore of the island. It is possible that this revetment may not be necessary, as the mass of the current will be thrown off from the island by the dikes; but, as it is highly probable, it is proper to provide for it, and to be ready to apply the remedy when and where required.*

"The material of the work to be obtained by contract, but the work to be put together and put in place by hired labor, under vigilant superintendents.

"These were the general views sent to the officer (Captain Cram) in charge of the work, with directions to prepare an estimate accordingly."

During the years 1836, '37, and '44, there was appropriated in favor of this work $75,000. The amount in the bill is sufficient for the present fiscal year. Recent information induces the belief that the work will, in the end, be less costly than was at one time anticipated.

Line 89. *Havre de Grace, Maryland.*—This is a new work, but of great importance to the trade of the Susquehannah. The amount is sufficient for the present fiscal year.

Line 91. *Breakwater structure at Great Point, Nantucket, Massachusetts.*—I am not informed on this subject. The plan and estimate, whatever they may be, are not the result of operations of this office.

Line 93. *Harbor of New Bedford, Massachusetts.*—Presuming this to be in continuation of former work at this place, the amount is sufficient for the present fiscal year.

Line 95. *Provincetown harbor, Massachusetts.*—This is for the continuation of old efforts to prevent the drifting of the beach sand, and is considered a valuable work. The amount in the bill is sufficient for the present fiscal year.

Line 97. *Wilmington, North Carolina.*—The amount of the bill is adequate for the surveys, but will not do much to the improvements which will probably be required. The surveys are, however, an essential preliminary measure.

Line 102. *Harbor of Bridgeport, Connecticut.*—The amount proposed in this case is adequate for the present fiscal year.

Line 104. *Harbor of Savannah, Georgia.*—A valuable improvement, and an old work. A recent survey and estimate have been made, and have been submitted to Congress during the present session, and are printed.

Line 107. *Breakwater at Stamford Ledge, Portland, Maine.*—An old and highly-valuable improvement, which has been the object of frequent appropriations.

Line 110. *Harbor of Falmouth, Massachusetts.*—The appropriation in this case will probably accomplish the work—one of much value to the coasting trade.

Line 113. *Harbor of Providence, Rhode Island.*—The amount in this

*A revetment to protect the shore of this is and preferred to any system of jettees; the latter, for such a purpose, are considered seriously objectionable.

case will, I presume, be adequate to the removal of the rock in Saukonnet river.

Line 116. *Harbor at New Castle, Delaware.*—The United States is under an obligation to keep the piers at this place in repair. The amount is sufficient for the present fiscal year.

Line 118. *Harbor at Newark, New Jersey.*—If the work at this place is the same as formerly contemplated, it would be chiefly by dredging; for which purpose, the amount in the bill is inadequate. The best that can be done will, however, be done with this amount, by instituting the most careful preliminary examinations before any other work be commenced.

Line 122. *Harbor at Port Penn, &c., Delaware.*—The appropriation in this case will enable the piers at Port Penn to be so repaired as to cease to be an injury, as they now are, or to be removed. But it will be of little or no aid to the contemplated work at Reedy island. It is contemplated to be able, at the ensuing session of Congress, to present a more connected system and a regularly-digested plan of the works, constituting ice-harbors for the Delaware, so essential to the safety of the trade of that river and bay.

Line 125. *Sand shoal in Pamlico river.*—I doubt if the appropriation in this case will do more than enable the bureau to make the required survey, and present the necessary plan and estimate for the work.

Line 128. *Delaware breakwater, Delaware bay.*—A very important work, of interest to the whole coasting trade. The amount is sufficient for the present fiscal year.

Line 130. *Harbor of Baltimore, Maryland.*—An important work, and the continuation of an old work. The amount is sufficient for the present fiscal year.

Line 134. *Repair and preservation of harbors on the coast of the Atlantic ocean.*—A very important appropriation, enabling the bureau to give that general attention and timely aid to these works which they so much and so frequently require.

Line 136. *Improvement of Hudson river.*—An old and very important improvement, which has been a frequent object of the United States appropriations.

Line 139. *St. Clair flats.*—This is one of the most important improvements on the lakes, highly general in its character, affecting the whole lake trade from Lake Erie to the lakes above. It has been regularly surveyed, and has been the subject of frequent reports to Congress. The amount in the bill is sufficient for the present fiscal year.

Lines 142, 144, 148, 150.—Old and well-known subjects, and of extensive national interest. The amounts in the bill are sufficient for the present fiscal year.

Line 152. *Harbor at Stamford, Connecticut.*—The survey and estimate in this case were made in 1830. The estimate varies, according to depth of dredging, from $11,025 to $13,250 The appropriation proposed may do for the present fiscal year, if the dredging can be done by contract.

Line 154. *Improvement of Hog Island channel, South Carolina.*—My impression is that this work is a link in the military defences of that harbor. As a question of harbor improvement, independent of that consideration, I have no knowledge of it.

Line 157. *Harbor at Manitowoc, Wisconsin.*

Line 159. *Harbor at Sheboygan, Wisconsin.*—Both of these are important harbors, and would justify, in the commencement, the appropriation of a greater amount for each. Regular surveys and estimates have been made for each of these works, and will be found printed as Senate Document No. 179, 2d session 25th Congress.

Line 161. *Upper and lower rapids of the Mississippi.*—A work of great importance to the trade of that river, and to the development of its resources. The amount in the bill is sufficient for the present fiscal year.

Line 163. *Hurlgate channel, harbor of New York.*—I am not aware of the plan in this case, or of the authority upon which the estimate for this work has been made. But the amount in the bill is adequate to the accomplishment of much work, and to do it well.

Line 165. *Rocks in Cobscook bay.*—A survey of this bay, exhibiting the rocks at Falls island, was made in 1836, and is printed as Senate Document No. 73, 2d session 25th Congress. A reference to this report will probably prove that the amount in the bill will be rather inadequate to accomplish the object contemplated.

Line 168. *Harbor at Saginaw bay.*—The amount proposed in the bill will probably make a reasonable beginning.

Line 171. *Bayou La Fourche.**—The precise plan and object in this case being rather unknown to me, I can only say that the amount in the bill is probably adequate for the present fiscal year.

Line 173. *Harbor at the mouth of Clinton river.*—The appropriation proposed in this case will certainly accomplish the survey, and make a beginning in reference to the improvement.

Line 176. *Harbor at Pultneyville, New York.*—The amount proposed is sufficient for a beginning.

Line 179. *Harbor at the mouth of Black river, Michigan.*—A very important improvement. The survey and estimate were communicated to the Senate this session, and are printed as Senate Document No. 20. It might well justify a commencing appropriation of double the amount stated in the bill.

Line 182. *Survey of the harbor at Beaufort, North Carolina, &c.*—The amount in this case will probably accomplish the survey directed to be made.

Line 186. *Survey of the Sauk and Pike rapids.*—The amount is presumed to be sufficient.

Line 191. *Survey of the Delta of the Mississippi.*—The object is of great importance. The amount in the bill is sufficient.

Line 195. *Survey of the harbor of Mobile.*—This is very necessary, in order to ascertain the effects of former work, and the propriety of pursuing former plans for the improvement of this harbor, or of changing them.

Line 199. *Improvement and further survey of the harbor at Richmond city, Virginia, and the James river.*—An important and interesting improvement, for which survey and plan were once made. The resurveys directed in the bill are very essential.

Line 203. *Snag boats, &c., for waters of Texas.*—Very essential. At

* The bill says "Bayou La Fource, in the Mississippi river." This is an error. It should read "Bayou La Fourche, in the State of Louisiana."

present, without any means of doing anything for that extensive coast and its many interesting harbors.

Line 206. *Removal of Middle rock, in the harbor of New Haven, Connecticut.*—The amount proposed in the bill is presumed to be sufficient for the purpose.

Respectfully submitted.

J. J. ABERT,
Colonel Corps Topographical Engineers.

HON. C. M. CONRAD,
Secretary of War.

APPENDIX.

The Hon. Mr. McLane, chairman of the Committee on Commerce of the House of Representatives, having expressed to me the opinion that there were some points in the foregoing report which required more full explanations and descriptions, and desiring that the same should be made in time for the printing of the report, the following is added as a supplement to the report:

Line 89 of the bill. *Havre de Grace, Maryland.* – The report and chart of the survey for this improvement were submitted to Congress in February, 1837, and will be found printed as House of Representatives Document No. 195, 2d session 25th Congress. The following extracts are taken from that report—a report of Captain Hughes, of the corps:

"Congress, at its last session, appropriated the sum of five hundred dollars 'for a survey of the head-waters of Chesapeake bay, pursuant to a resolution of the State of Maryland.'

"It is proper to remark that the appropriation was not sufficient to defray the expenses of a careful and minute examination of the whole expanse of waters included between the extreme points designated in the resolutions of the Maryland legislature. We were therefore compelled to confine our observations mainly to the locality of the obstructions, and to point out their relation to the shores, channels, shoals, &c., but without attempting to seek for the remote causes of those obstructions, which may possibly exist much higher up the river than we were authorized to survey."

After some interesting general remarks, and a description of the locality, the report goes on to say:

"The only plan which I feel authorized to submit, under present circumstances, is, to dredge out the bars in the main channel to the depth of at least ten feet at extreme low water, and a width of two hundred feet, under the belief that, when the channel is once open, the increased quantity of water which will flow through it, with a greatly increased velocity, will be sufficient to keep it in good navigable condition for many years to come. As it regards the depth of water, I was guided by the draught of vessels that would most likely be engaged in the trade which the completion of the Susquehannah canal is so well calculated to increase, and in a measure to create. At spring tides, vessels drawing over fourteen feet of water will be able to enter the port of Havre de Grace with great facility. The resolutions of the Maryland legislature, asking an appropriation from Congress for this object, set forth that, at low water, vessels drawing more than eight feet water cannot enter the port of Havre de Grace, but do not suggest what would be considered the most desirable depth. I have given estimates for ten feet water, and also for twelve, leaving it to the wisdom of Congress to decide which shall be adopted. Perhaps the latter is best calculated to advance the interests of commerce, and develop the internal trade of the country. To attain the assumed width and depth of the channel at extreme low water, it will be necessary to remove at least two

hundred and twenty-three thousand six hundred and eleven cubic yards of sand and mud.

"It is suggested that, instead of letting this work by contract, in the ordinary way, the government should build a steam-dredge, and then either appoint superintendents, hire workmen, &c., and execute the work at its actual cost, or let it by contract, lending the machine to the contractors, who should be bound to keep it in repair, and give security to return it in good order to the United States when the work is done. In this way there would be more competition than in the usual lettings; and the dredge might afterwards be used for any other similar purpose in the waters of the Chesapeake bay. I have included an item in the estimates for a steam dredging machine, which, although necessary for this special service, is, properly speaking, chargeable to general expenses.

"A steam dredge (including six scows, each carrying twenty-eight cubic yards) of sixteen horse-power will cost, when complete - $13,000 00

[This machine will raise five hundred cubic yards of mud or sand per diem of twelve hours, and the daily expenditure, including everything, viz: one captain, one engineer, one fireman, one cook and assistant, and sixteen hands, two and one-half cords of pine wood, oil for machinery, &c., will be forty dollars. This machine would, if kept in constant use, require four hundred and forty-eight days to remove the obstructions, and this would consume two seasons. The cost per cubic yard, from the foregoing data, would be eight cents; but when we take into account bad days when no work can be done, the breaking of machinery, and that two seasons will be required for its execution, double that sum will not be too much.]

Removal of 223,611 cubic yards of sand and mud, at 16 cents per yard - - - - - -	35,777 00
Channel marks - - - - - -	1,223 00
Superintendence, contingencies, and surveys - -	8,000 00
Total - - - - - -	58,000 00

"Before the work is commenced, the channel should be carefully marked out with piles driven on each side, and numerous soundings taken between them, in order that the quantity of excavation may be carefully ascertained; and also, for the purpose of preventing any unnecessary expense in removing dirt not directly in the channel.

"If it should be deemed advisable, (as perhaps it will,) in consideration of the great trade which will probably concentrate at Havre de Grace, to increase the depth at low water to twelve feet, it will be necessary in that case to remove, in addition to our above estimate, about seventy-five thousand cubic yards; I say *about* seventy-five thousand cubic yards, because our estimates of work must be considered as approximations to the truth, near enough, it is believed, for the purpose; and could not have been made more correct, owing to the deficiency of the appropriation, which was not sufficient to warrant as minute a survey as will be necessary before the improvement is actually commenced. On the supposition, then, that twelve feet water should be given to the channel instead

of ten feet, we must add twelve thousand dollars to the foregoing estimates; and, in consideration of the extra depth, add two thousand dollars for contingencies—making the whole estimate of cost $72,000.

"These estimates of cost are predicated on the supposition that it will not be requisite to remove the dirt over five hundred yards. If it should be found necessary to transport it a greater distance, the price will be increased in proportion.

"The trade of the Susquehannah is even now of great importance, notwithstanding the unfavorable and discouraging circumstances under which it is prosecuted, and well deserves the protecting care of the federal government. Mr. George Clinton Veasy, of Port Deposite, an officer of the old Susquehannah canal around the rapids in the river, has kindly furnished the following information, viz: 'I find that we have passed through our canal, up to the first day of November, seven hundred arks, supposed to contain produce to the amount of twenty five hundred dollars each. The average number of rafts about eight hundred and fifty, supposed to contain fifty thousand feet of lumber each, worth about twelve dollars per thousand feet. Independent of this, we suppose to have run on the river four hundred arks, and five hundred and fifty rafts, which you will average as above.' According to the above statement, which is in part official, we shall have—

1,100 arks, at $2,500 - - - - -	$2,750,000
1,400 rafts, at $600 - - - - -	1,080,000
Total - - - - - -	3,830,000

"The value of the stone trade I have been unable to ascertain, but presume it to be considerable, when we reflect that it is carried to the public works at Point Comfort, to the Delaware breakwater, and is also used in Baltimore and other places to some extent. It is a granite of good quality, and for some purposes is preferred to any other. When the navigation is so improved as to enable vessels of larger size to be employed, it is probable that this trade will greatly increase. The fisheries also furnish valuable articles of trade; but I could obtain no other information on this subject than that they were productive and of considerable importance.

"When the canal is completed, the great bituminous and anthracite coal regions will send down their hundreds of thousands of tons annually; and this consideration alone, if there were none others, would be sufficient to justify, and even imperiously demand this improvement. The annual consumption of coal in the Atlantic States is now one million of tons, and increases at the rate of two hundred thousand tons per annum; and in less than five years will probably exceed two millions of tons per annum. This will give employment to hundreds of thousands of persons in different capacities, and will, of itself, build up a great commercial marine, from which the government may draw in times of emergency. These considerations are so evidently important, that a mere statement of them is demonstration."

Line 102. *Bridgeport, Connecticut.*—The following description of the impediments to this harbor is taken from a report of the superintending engineer, Captain Swift, of September, 1838:

"There are two bars at this harbor which obstruct the passage of ves-

sels from the sound to the village of Bridgeport. The outer bar is nearly two miles below the village; the inner bar is about one and a quarter mile from the village; prior to the year 1837, there was 5 feet at low water upon the outer bar, and 6 feet at the inner bar.

"The operations at this place were confined to dredging a channel through the outer bar, and for this purpose an appropriation of $10,000 was made in 1837.

"The agent was instructed by the Engineer Department to the following effect:

"1st. To dredge a channel 8 feet deep and 100 feet wide through the outer bar.

"2d. To increase the width of the same to 150 feet, provided the sum appropriated would justify it.

"3d. Should the funds still be unexpended, to increase the channel to 200 feet in width.

"4th. If any funds remained, to open a channel of 8 feet in depth and 100 feet in width through the inner bar.

"In accordance with the foregoing instructions, a contract was made with Holmes & Randall to dredge the proposed channel at a certain price per cubic yard. The lowest terms which could be procured by the agent were secured; but there being but little competition for this description of work, the price paid was necessarily high; and the consequence was that the width of the channel was reduced to 60 feet instead of 100 feet, as intended by the instructions. It was excavated to the depth of 8 feet at low water, and the whole was accomplished during the last season. The result of the operation has been highly satisfactory; for on the 8th instant it was carefully sounded by Captain Brooks, of the steamboat Nimrod, and found to be 12 feet deep at low water—4 feet deeper than it was left by the dredging machine. The appropriation having been expended in opening this channel through the outer bar, nothing of course has been done at the inner bar. The experiment has succeeded so well that it would seem to be sound policy to continue the improvement both by widening the channel through the outer bar, and by opening a similar channel through the inner bar. Although the present channel is wide enough for the steamboats which pass daily through it, still, it is obvious that it is too narrow for any other description of vessel to pass through it, unless she have a leading wind. A *boating* channel is an object of great importance to the commercial interests of Bridgeport.

"The accompanying letter (marked B) from Doctor Samuel Simons, agent for the United States at Bridgeport, will convey much information relative to the growing importance of this harbor, and the advantages which would ensue to the place by continuing the improvements to the extent originally contemplated."

And in a report from this bureau, dated in December, 1844, it is stated:

"The obstructions to the entrance of the harbor of Bridgeport consist of two bars, distant nearly one mile from each other; the outer bar is about two miles below the city of Bridgeport, and had, prior to the dredging, 5 feet at low water, and on the inner bar 6 feet.

"In 1837 an appropriation of $10,000 was made by Congress for improving the entrance to the harbor; but owing to the inadequacy of the sum, a channel of but limited width could be opened.

"In the report which was made upon this harbor by the engineer charged originally with the investigation of the subject, it was recommended that a channel of 200 feet through the outer bar should be dredged, and a channel of 100 feet in width should be opened through the inner bar, provided the funds appropriated by Congress should be sufficient to effect both objects; if not sufficient, that the cut through the outer bar should be made as wide as the funds granted would justify.

"The excavation was contracted for at 62½ cents per cubic yard, and the sum appropriated being but $10,000, a channel of 60 feet in width only, and 8 feet in depth, was opened; the inner bar remaining untouched.

"Now, a channel of 60 feet is of great use in facilitating the ingress and egress of steamboats, but for sailing vessels it is too narrow, except there be a leading wind. To complete the improvement according to the original plan, the outer bar should be opened to 150 or 200 feet, and the inner bar to the width of 100 feet.

"If both bars should be opened to the width of 150 feet, it is presumed that the wants of navigation would for the present be subserved.

"In a communication from this bureau, under date of 23d May last, it was stated 'that if $20,000 could be obtained for this work, it would be sufficient for the next year, (1844;) but it is not believed that less than $30,000 will make a channel through both bars.

"'In saying that $30,000 will make a channel through both bars, I wish it to be understood that the width of channel to be opened for that sum will depend upon the price to be paid per cubic yard for dredging. The price formerly paid (62½ cents) was high, but competition in that species of work has probably reduced the cost. I would therefore say that the sum of $30,000 is intended to open a channel of certainly 100 to 120 feet in width through both bars, and possibly that one of greater width may be secured for the sum named.'"

Line 104. *Harbor of Savannah, Georgia.*—The last survey and report in reference to the improvement at this place are so recent, that it is not considered necessary to do more than to refer to it. The report, plan, and estimate are printed as Ex. Doc. No. 19, 1st session 31st Congress. The engineer who made the survey submits three estimates, in accordance with the different kinds of work proposed:

1st class work - - - - - - - -	$160,000
2d class work - - - - - - - -	113,000
3d class work - - - - - - - -	57,100

These different classes of work are fully described in the printed report referred to.

Line 107. *Stamford ledge breakwater.*—This work was commenced in 1832. The plan contemplated two distinct works, namely, the breakwater at Stamford ledge, at the southern part of the harbor, and a breakwater extending from Mount Joy, the northern part of the harbor, to the Middle Ground.

The first of these works was intended to be 842 yards long; the second to be 360 yards long.

The first, as the most necessary, has been attended to by various appropriations, amounting in the whole to $61,366. The last appropriation was in 1838. In 1839 an estimate to complete the work was submitted, amounting to $29,784 83. This would probably not complete the work now, as the machinery then in existence has since then decayed, and

has been partially sold; also, the work itself has suffered some injuries and dilapidations.

In reference to its importance, the following extract is taken from the report of the agent, T. Bradford, esq., of September 30, 1839:

"The views entertained by Colonel Anderson at the time he made the survey for the breakwater, in regard to the utility of this work, have been proved during the past year to a demonstration. The storm of the 26th and 27th of January last, notwithstanding its great violence and length, did no injury to the wharves and shipping in the harbor. Previous to the construction of the breakwater, it was found impracticable to erect and sustain wharves in the lower part of the town, in consequence of the violence of the swell which broke upon them in the southeast storms. The vessels that were moored to the wharves were beat against them in such a manner as to render them unsafe. The breakwater, though not extended out upon the ledge so far as contemplated by about 600 feet, and not so far by 250 feet as it is at present, served to break off the heavy swell occasioned by the violent southeast storm of January last, and rendered the harbor thus protected by it perfectly safe. No damage was done to the shipping, although a portion of the most valuable owned by our merchants was in the harbor and at the wharves at the lower part of the town. The opinion of our merchants is, that the preservation of the wharves and their shipping was owing to the breakwater. If its utility is thus apparent when incomplete, and without the sea-wall, the benefits resulting from it when carried out to its full length must be undoubted. It serves to strengthen and increase the current in the harbor, and by this means will keep it free from ice, and prevent the accumulation of sand on the Middle Ground, which, it if should continue, would render our harbor in a few years inaccessible to vessels of the larger size."

Line 128. *Delaware breakwater.*—The first appropriation for the Delaware breakwater was made in 1828, and, with the exception of one year, was continued yearly up to and including 1838.

The total amount of the original estimate (as revised in 1836) under which the work was authorized and commenced, was - - - - - - - -	$2,690,125
And the total amount appropriated - - - -	1,921,000
From which it will be perceived that expenditures and appropriations have as yet fallen short of the original estimate by the amount of - - - - -	769,125

Our present plan is to finish the works on their present base, which, it is supposed, will require $150,000.

The following information in reference to this work, describing its condition and usefulness, and furnishing an estimate for completing it to the extent proposed, is taken from the report of Major H. Bache, the superintending engineer, dated the 12th September, 1849:

"The last appropriation for this harbor was made in the session of 1837–'38, and all operations in the prosecution of the works ceased on the expenditure of the means thus provided, in 1839. Since that time the duties of superintendence have been confined to a general supervision of the works; to the custody and preservation, as far as this was possible, of the public property, and to keeping up the light at the harbor; and constitute,

in consequence, with a single exception, the detail of the usual annual reports submitting estimates to continue the construction. The exception is in the case of the report of 1843, (Doc. No. 85, 28th Congress, 1st session, House of Reps., War Department,) the next succeeding to, and for the most part based upon, the survey of the previous year. This report embodies many interesting statistical details elicited in the course of construction, and demonstrates, by a statement of the number of days' shelter it has afforded, the usefulness of the harbor as a harbor of refuge. A like statement is now also presented, brought down to the 30th of May of the present year; from which date no record has been kept, in consequence of the agent of this office being obliged to yield up his residence on the works.

Statement showing the number of days' shelter afforded to vessels by the harbor of the Delaware breakwater, from the 1st of September, 1833, to the 30th of May, 1849, inclusive; omitting the periods embraced between the 1st of July and the 17th of October, 1834, and the 4th of June, 1840, and the 30th of April, 1841, when no record was kept; and also omitting vessels carrying stone for, or otherwise connected with the works.

Years.	Ships.	Brigs.	Schooners.	Sloops.	Pilot boats.	Total.	Remarks.
1833.....	22	178	372	167	127	866	From September 1, inclusive.
1834.....	48	315	667	303	411	1,744	July 1 to October 17, inclusive, not recorded.
1835.....	133	569	1,719	461	644	3,526	
1836.....	301	1,027	2,719	620	767	5,434	
1837.....	227	478	2,777	629	732	4,843	
1838.....	165	732	3,191	765	685	5,538	
1839.....	165	504	3,561	734	697	5,661	
1840.....	172	279	1,909	308	371	3,039	To June 3, inclusive.
1841.....	111	902	3,916	590	483	6,002	From May 1, inclusive.
1842.....	107	1,060	5,335	802	794	8,098	
1843.....	103	841	4,981	1,167	792	7,884	
1844.....	231	969	5,797	854	744	8,595	
1845.....	265	1,042	5,446	597	776	8,126	
1846.....	258	1,625	6,711	614	781	9,989	
1847.....	242	1,937	7,742	358	874	11,253	
1848.....	340	1,457	6,037	374	918	9,126	
1849.....	329	804	3,261	168	553	5,115	To May 30, inclusive.
	3,319	14,719	66,141	9,511	11,149	104,839	

A statement is also given, from records made expressly with a view to that object, to the effect that the advantages of the harbor "to general commerce and the local trade are in the relation of four to five."

Besides these statistical details, the report gives:

1. A statement of the sources from which the means for the support of the light had, to the close of the year, been derived.

2. An account of the origin of the harbor; of the objects sought to be gained by its construction, and also of the position, plan, and dimensions of the works.

3. A statement showing the extent to which the design had been carried out.

4. A notice of the action of the board of survey of 1834 on the shoal formation, which, as early as 1831, in the progress of the work, had appeared just within the west end of the breakwater proper; and,

5. The reasons for believing "this shoal, and indeed all the other shoals resulting from the works, had nearly, if not fully, reached their utmost probable extent."

The report then goes on to state in what respects the harbor, as far as completed, has failed to accomplish the objects had in view by its formation; and attempts to discuss, accompanied by estimates of cost, the relative advantages of three several plans, to correct the principal defect, namely: from so much of "the action of waves, caused by the wind blowing from east to northwest round by the north," as is raised by the east-northeast winds, to which the harbor is, at present, obnoxious. These plans are:

1. To cover the gap by extending the ice-breaker.

2. To cover the gap by extending the breakwater proper; and,

3. To cover the gap by a detached work.

The absence of protection to vessels in the harbor from running ice is also adverted to, and a proposition made to correct the evil by means of iron screw piles. The opinion of the board of survey, namely, that operations be confined to raising the present works to the proposed height, and that any modification of the design of the harbor would be premature until this was done, and further information obtained in reference to the shoal formations, are then endorsed; when the report concludes with the recommendation made as far back as the 16th of September, 1839, in a communication of that date, on a special occasion, in the following words: "that whenever it shall be determined to extend the works beyond their present limits, a board of officers of experience be formed to report what, if any modifications are in their opinion necessary to carry out the design originally had in the formation of the harbor."

As the circumstances under which these several subjects, saving one, were considered in the above mentioned report, remain unchanged, the bureau is respectfully referred to that report, in which each is treated somewhat at large. Whatever consideration attaches to the views, opinions, and recommendations there given, loses none of its value by lapse of time. They are, therefore, now again with like confidence presented. The exception referred to is with regard to the harbor light, the history of which is brought down in the report to the close of the year 1843 only. At that date, the means at the disposal of this office for the maintenance of the light were exhausted. The board of underwriters of Philadelphia becoming acquainted with this state of things, and being fully impressed

with the importance of the light, not only to the trade of the Delaware, but also to the coastwise trade generally, assumed its support, and did so support it until the 30th of June, 1846, a period of two and a half years, at an outlay of $2,460 48, of which sum Congress, in the session of 1845-'46, reimbursed $1,600, leaving a balance of $860 48 still in advance by the board. From June 30, 1846, to the present time, the light has been sustained by the Treasury Department; the agent of this office having charge of the public property at the harbor being continued as light-keeper until the 21st of May last, when he was superseded by that department. Subsequently to this change, the possession of the dwelling on the breakwater proper, of which the light is a mere appendage, was yielded up to the agent of the Treasury Department, in compliance with the orders of the bureau of the 8th of June.

During the past season a new light has been erected on the breakwater proper. It is provided for in the general light-house bill of last session. The same bill makes appropriations for two light houses and one beacon, "to be expended under the direction of the Bureau of Topographical Engineers." It is a matter of regret, that as the harbor of the Delaware breakwater is still in course of construction, and in charge of the bureau, a like provision was not made in favor of this light also; and that, failing in this, a transfer was not directed by executive authority, as was done in the case of the light-houses for Flynn's knoll and Brandywine shoal. In the absence of any such action, the erection of the new light, as a matter of course, devolved on the Treasury Department, which having deferred to the bureau on the subject of the proper site only, is responsible for the work, both in the plan and execution. It is proper to state here with regard to the site selected, that the reports from this office, to which the subject had been referred, in consideration that the contractors were already on the ground, examined the question solely with reference to the present state of the works; whereas, had the entire matter been within its control, the extreme verge of the breakwater proper, though involving the time and cost of filling up the deep hole and finishing off the work at that point, would have been chosen. For these reports, and the correspondence generally which took place on the occasion of erecting the new light, and of removing the agent of this office as the keeper of the old one, the bureau is referred to its own files.

Estimate for completing the works on their present basis, the breakwater proper to fifteen feet, and the ice-breaker to twelve feet above water.

17,587 tons of stone, of pieces of two tons and upwards, for the breakwater proper, at $3 per ton - - - -	$52,761 00
9,054 tons of stone, of pieces of two tons and upwards, for the ice-breaker, at $3 per ton - - - - -	27,162 00
15,827 tons of stone, of pieces less than one-fourth of a ton, to raise the bottom at the ends of the breakwater proper to the level of forty feet below lowest spring tides, at $1 75 per ton - - - - - - - -	27,697 25
Renewal of machinery, &c., cranes, crabs, shears, boats, buoys, &c., buoy-chains, rope, blocks, hand spikes, water-barrels, spikes, nails, &c., necessary on renewing operations - - - - - - - -	7,750 00

Barracks on the works for men, including bunks, cambouches, mess furniture, &c. - - - -	$2,000 00
Reimburse board of underwriters of Philadelphia balance of sum advanced by them for support of light from January 1, 1844, to June 30, 1846 - - - -	860 48
Amount - - - - - -	118,230 73
Contingencies, 17½ per cent. - - -	20,690 38
Total amount - - - - -	138,921 11

The estimate differs slightly in the aggregate from the one which accompanied the report of 1843. Some items are stricken out, others changed, and a new one inserted. The quantities of stone under the first and second heads are now deduced from more accurate measurements both of the breakwater proper and the ice-breaker; and the quantity for the latter is further modified by giving that work a height of twelve, instead of ten feet above low water. An increase also, for "renewal and repairs of machinery, &c.," has become necessary by the almost total destruction since the close of operations, now ten years, of all property under this head. The balance of the sum advanced by the board of underwriters of Philadelphia in keeping up the light is likewise added as an actual arrearage. On the other hand, the items for "extraordinary emergencies, such as the destruction of the light-house," the "current expenses," and "probable arrearage" of the same, are omitted, as the light is no longer in charge of the War Department, and the probable arrearage gives place to an actual one. Again, the heavy item for iron "screw-piles, and fixing the same," as a "protection against ice," is also omitted, to conform the estimate to the recommendation that the operations be confined to completing the works on their present lengths.

True economy requires that, as the contingent expenses in such operations are nearly the same, whether the quantity of stone deposited be large or small, the whole amount of the estimate be appropriated at one time. No serious inconvenience, however, would arise, were the sum divided between two consecutive fiscal years. The remnant of the season of the first year may be profitably employed in building the barracks for the men, erecting cranes, &c., &c., measures necessary preparatory to receiving the vessels carrying the large size stone required for the works above water, and in depositing the small size stone provided for filling up the bottom, an operation which requires no such arrangements; and the next season, in receiving and bedding the large size stone, the contracts for which may be so framed that no payments be made until after the commencement of the second fiscal year. Under this division of labor, the first year would require the aggregate of all the items in the estimate, with the exception of the first and second, amounting, with contingencies, to $45,011 58; and the second the balance of the estimate, or $93,909 53.

I desire, though not strictly within the province of superintendence, to call attention to the necessity of providing a hospital in connexion with this harbor. The number of vessels which resort to the harbor, or, more properly, the number of days' shelter afforded to vessels by the harbor, is now very large. During last year, as shown by the table already given, there were 9,126 vessels, requiring 74,387 men to navigate, or an average

of 25 vessels and 204 men for every day. For each of the previous two years the number of vessels, or days' shelter to vessels, was even still greater. It is now a very rare occurrence that no vessels are seen in the harbor; 100 are frequently lying in it at the same time, and on the 27th of August, 1848, as many as 141, with crews numbering 1,149 men, were congregated in it. On one occasion, the 4th of July of the present year, it is said the fleet reached the extraordinary number of 240, requiring 1,956 men for their crews; but as the statement is not authenticated by the record, which, as stated, was discontinued because of the removal of the agent of this office from the works, it is not relied on in support of the present views. For this purpose, the facts established by the record are sufficient. In estimating the number of men, the crews for the different classes of vessels are rated as follows: for ships, 16; for brigs, 11; for schooners, 8; for sloops, 5; and for pilot-boats, 3. If passengers were taken into account, the results given would, in every instance, be very considerably increased. The record also shows that the number of vessels seeking the protection of the harbor has, with slight fluctuations, steadily increased from the first. In the early years of its existence, this was owing, in a great measure, to the extension, from time to time, of the works; but as they attained their present dimensions, in 1839, no part of this increase, the ratio of which is quite as great as it was previously, can be referred since that year to this cause, but is properly attributable to the increase of trade and the growing confidence of navigators. This fact, interesting generally in connexion with the harbor, is here put forth as evidence that a hospital for that most important roadstead is not likely hereafter to lose any of its usefulness.

The foregoing statements are of themselves sufficient to show how largely the class most interested, and which furnishes the means, in whole or in part, for the maintenance of marine hospitals, is likely to be benefited by the establishment of one of these provident resorts at the locality in question. But the subject has derived unusual interest from recent events of a most painful character. During the present year the harbor has received within its waters three vessels on board of which disease and death were exhibited in the most appalling forms. The first was the British ship Cambria, bound to New York with immigrants. She put into the breakwater in distress after a voyage of 91 days, short of provisions and water, and with sickness among her passengers, 55 of whom died at sea, and 17 after her arrival. The second, the schooner Martha Collins, from Norfolk, bound also to New York, with cholera on board, two of the crew dying shortly after coming to anchor. And the third, and under by far the most distressing circumstances, the three-masted schooner Florida, from Chagres, destined for the same port. This vessel was boarded, apparently abandoned, by a Delaware pilot-boat, about twenty miles from the capes. Three of her people had already died of the yellow fever, and the master and remainder of the crew were found below, sick with the same disease, and so entirely helpless as to be unable to navigate the vessel. In this condition she was towed into the harbor. The scene on board, both as regards the dead and the sick, is described as revolting in the highest degree to every feeling of humanity. The first case may not properly, except as to the crew, come within the objects of a hospital of the character of the one proposed. Of the other two there can be no doubt. In every instance the inhabitants, including the physicians, of Lewes, as

well as others, ministered with most commendable assiduity to the wants of the sufferers; and yet it will not be doubted their condition, both the healthy as well as the diseased, would have been greatly ameliorated had there existed a suitable refuge on shore to receive the latter."

Line 136. *Improvement of the Hudson river.*—In 1843 a report was made "on the present condition of that portion of the Hudson river embraced between Troy and New Baltimore, and of the public works erected for the improvement of its navigation." The report is from Captain G. W. Hughes, then superintending engineer of this improvement. It will be found printed as H. R. document No. 53, 1st session 28th Congress. The report is long, extending, with its appendix, over 62 printed pages. The report is full of interest. It discusses many interesting questions; gives a complete history of what had been done, and what was proposed to be done, illustrating the reasoning with maps of a recent survey. A condensed map is printed with the report. There is also in the same report the estimate of the special board of engineers of 1835, which had been organized for this work, and a statement of the amount appropriated. From this statement it appears that the appropriations were yet short of the estimate of the board by an amount of $449,634. The superintending engineer then recommends that this amount be met by annual appropriations of $100,000.

Line 139. *St. Clair Flats.*—It may be remarked, among other considerations involved in this matter, that a thorough survey of the locality was made in 1841.

Since then, further observations have proved that the obstructing bar of these flats is an old marly ledge, and not a recent deposite, which justifies the inference that if once cut through, the opening would be extremely enduring. The work would have to be done by a steam dredge, and means to tow the loaded scows to some place of discharge would also have to be provided.

All the navigation between Lake Erie and the upper lakes has to pass over these flats; the work may therefore be said to be necessarily connected with the whole lake commerce.

An estimate for dredging, made in June, 1844, at a rate of cost of 27½ cents the cubic yard, amounts to $85,000.

Line 157. *Manitowoc.*

Line 159. *Sheboygan.*—These two harbors are on the western coast of Lake Michigan. Sheboygan is about fifty miles north of Milwaukie, and Manitowoc is about twenty-five miles north of Sheboygan. Both are extremely important to the general commerce of the lakes, as they constitute the first point of refuge to that commerce after taking its departure from the Manitou islands, from which they are distant about one hundred miles. Both of these harbors were carefully surveyed in 1837, and the report, plan, and estimate in reference to each will be found printed as Senate document No. 175, 2d session 25th Congress. The river-way in each case is large and commodious, affording abundance of water for first-class steamers; but the entrance to each is obstructed by a shoal bar—such, however, as has yielded to our efforts in all other similar cases; therefore there exists no doubt with me that an adequately deep and safe entrance can be made at each of these places.

The estimate of the engineer for the work was, for Manitowoc $82,979; for Sheboygan $84,906. But I am disposed to think, that, with certain modifications of the work, the cost at each place will not exceed $60,000.

Line 179. *Black river, Michigan.*—Black river is the entrance into Black lake, Ottowa county, Michigan. The survey, plan, and estimate were made in 1849, and will be found printed as Senate Executive Document No. 20, of the last session—1st session 31st Congress.

I subjoin the following extract from that document:

"Black lake is situated about ten miles north of the Kalamazoo river, and twenty-two miles south of the mouth of Grand river, at a point where the general commerce requires for its protection a good harbor, which is fully attested by the number of wrecks that line this shore of Lake Michigan. This is the leeward shore at the seasons of the year most subject to heavy blows, viz: the spring and fall, when the prevailing winds are from the northward and westward; and, as no perfect harbor exists the whole length of this shore, the loss of property and lives has been great, and must always be so until good harbors are made.

"Black lake is five and a quarter miles in length, varying in breadth from a mile to eight hundred and twenty feet; its least breadth, which is eight hundred and twenty feet, is at about half its length, producing the appearance of two lakes connected by a narrow strait. Its shores, indented by bays, with their promontories, give to it the resemblance of a miniature sea. Its principal supply of water is from Black river, a small stream not navigable above its mouth, which enters this lake at its eastern extremity; it is also supplied by small creeks, which enter it at various points along its shores. At the head of the lake at the mouth of Black river is situated the enterprising village of Holland, and around it for some miles are also other large settlements of Hollanders, numbering now between five and six thousand, and increasing by constant immigration from Holland. They are a highly industrious and moral community; and although it is but two years since they first commenced their settlement here (which was until then a wilderness,) they have now large farms cleared and under cultivation, and soon must be large agricultural producers and exporters.

"Black lake has ample capacity and a depth of water sufficient to float all the marine that now or for some years shall exist on the whole chain of lakes, and will, when its connexion with Lake Michigan is perfected, make a perfect harbor. Its shores are lined with fine timber, and will afford excellent opportunities for ship-building and lumbering, in addition to agricultural exports."

The estimate for the work is $116,168. It is probable the whole work can be done for less, as it occasionally happens in the progress of such works that parts anticipated in estimates as necessary are not required. Probably the sheet piling and the sand excavation will not be required to the extent of the estimate, which would reduce the cost to about $100,000.

The other items of the bill, about which little has been said, relate chiefly to surveys, in reference to which it is presumed there are no doubts. Surveys are important in all cases. They furnish valuable topographical information and data upon which the advantage or disadvantage of any contemplated work, or rather its practicability and probable cost, can be reasonably inferred.

J. J. ABERT,
Colonel Corps Topographical Engineers.