LETTER FROM CAPTAIN G. J. LYDECKER, CORPS OF ENGINEERS, TO PRESIDENT OF THE BOARD OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Chicago, Ill., November 4, 1878.

MAJOR: In accordance with the resolution adopted by the Board of Engineers, of which you are the presiding officer, at its last meeting, I have the honor to present the following report bearing on the improvement of the harbor at Chicago, Ill.

Statistics are not needed to show the magnitude of Chicago's commercial and business interests, and I assume that the necessity of providing a complete harbor, sufficient not only for present but for future requirements, will be conceded without argument; the question before us, however, involves something more than the interest of Chicago, for her relations to the whole country—to the East as well as the West—elevate it to one of national importance, and it must be admitted that a harbor ample for the requirements of any other point on the upper lakes would utterly fail to supply what is needed here. This fact should be kept in view when deciding upon the necessary works, remembering that the demand for enlarged facilities is a growing one, and that those which are abundant for to-day will fall far short of what will be required a few years hence. The great depression in the business of the lake marine during the past five years cannot be regarded as a prelude to its extinction; as well assume the general depression in all business to indicate *its* coming destruction. In times of prosperity, railroads will not compete with lake transportation at losing rates, and without such rates it is difficult to see how any competition will not leave good margins for profit to vessels.

Prior to 1870 the plan of improvement at Chicago was that common to most of our lake harbors, viz, two parallel piers extending to deep water and furnishing an entrance to the river, this, with its branches, constituting the harbor to which the commerce of the port was restricted. In his report dated November 30, 1869, Maj. J. B. Wheeler, Corps of Engineers, after calling attention to the general interests involved and the extent of Chicago's commerce, states:

> It is manifest that the Chicago River is taxed to its utmost capacity to accommodate the present condition of affairs, and that it is utterly inadequate to meet the wants of commerce rapidly growing. I would therefore propose inclosing a portion of the lake forming an outer harbor that would meet the present wants, and capable of being enlarged as the future might require. My plan would be to continue the work on the extension of the south pier until it is equal in length to the north, then build a breakwater at right angles and extending southward for 4,000 feet, and then join the extremity of this breakwater to the shore by a pier. An opening of 300 feet or more to be left in the pier forming the north side of the basin to admit vessels from the harbor entrance. This basin would contain an area of about 275 acres, one-third of which would have a depth of over 12 feet of water and the remainder a depth of over 7 feet that can easily be deepened to 12 feet, affording a splendid harbor of refuge for all classes of vessels sailing to and from this port at the present time.

The estimated cost of completing the outer harbor as here proposed was, in round numbers, $900,000. (See Report Chief of Engineers for 1870, pp. 99–103.)

I would call particular attention to Colonel Wheeler's use of the expression "harbor of refuge," and note that he in no manner states *this* to have been the object of his improvement; it was suggested as an incidental advantage only, but his object seems to be clearly defined in the first part of the paragraph quoted—

> The Chicago River is taxed to its utmost capacity. * * * It is utterly inadequate to meet the wants of commerce rapidly growing. I would *therefore* propose * * * an outer harbor that would meet the present wants, &c.

His project was considered by the Board of Engineers, convened by Special Order No. 1, Headquarters Corps of Engineers, January 5, 1870, and its report thereon is as follows:

> The Board is unanimous in the opinion that great necessity exists for the construction of an outer harbor at this place, and approves the location and method of construction recommended by Colonel Wheeler, suggesting, however, that the construction of the south or closing pier of the proposed harbor be deferred until the effect upon the bottom by the construction of the breakwater is observed and the necessity for such a pier shown. * * *
>
> The Board is of the opinion that the improvement of the Calumet River will not afford the relief needed by the crowded commerce of Chicago, * * * the plan of an outer harbor, already recommended, being capable of any extension demanded by the future commerce of the city.

(See Report Chief of Engineers for 1870, pp. 124, 125.)

The next appropriation bill (act approved July 11, 1870) contains the following item:

> For enlargement of harbor facilities at Chicago, Ill., according to the plans of the Engineer Department, $100,000, and for a harbor of refuge, $50,000.

Only the first part of this is for work according to plans of the Engineer Department; the harbor of refuge is something outside of these plans. Its location is not even specified, but it was construed to apply to the improvement at the mouth of the Calumet River. These extracts from the record seem to establish conclusively that this outer harbor was designed to give increased facilities for commerce, and to relieve the overcrowded state of the river. Besides the record, the plan of work itself proclaims that it was not designed as a harbor of refuge; the only way provided for entering the outer harbor was an opening 300 feet wide, to be left in the pier forming the north side of the basin, so that a vessel entering between the north and south piers, on a westerly course, would have to make an abrupt change of course to the south before getting into the outer harbor; this she would not be apt to do, for having come under the lee of the north pier, she would be perfectly sheltered, and could proceed quietly up the river, if it were not too crowded. Again, the depth of water in the outer harbor was not sufficient for safe anchorage in heavy weather, and the bottom being sand to a depth varying from 8 feet to 10 feet, would furnish no good holding-ground. While it may have been unnecessary to discuss this point at such length, it has seemed to me important to show that this outer harbor was *not* designed for a harbor of refuge. I have conversed with many prominent business men, vesselmen, shippers, and others interested in the harbor, without finding a single one who appreciated this fact, while a misconception of the object of the work has caused a great deal of unfavorable comment.

Since the adoption of Colonel Wheeler's plan operations have been in substantial conformity therewith, but slightly modified, as follows: The south pier was not extended as proposed; a return 300 feet long was built on the north end of the main breakwater, leaving on the north side of the basin a clear entrance of 650 feet; the north pier has been extended 600 feet—not contemplated at the outset. The easterly breakwater has been completed as designed.

The Board of 1870 suggested that the construction of the south or closing pier be deferred until the necessity for such a pier is shown. In its present condition the outer harbor is exposed to southeasterly storms, which prevail with considerable violence, and having a sweep of from 25 to 50 miles over the lake, create a heavy sea sufficient to cause vessels to drag anchor and which would prevent their lying at wharves. It would therefore appear that the construction of a closing pier is now

necessary in order to protect the harbor from southeasterly storms, and thereby render it available for safe occupation at all times. The south pier as originally designed would furnish the required protection, but it would be objectionable in certain features which could not have been so apparent in 1870 as they have become since the construction of the eastern breakwater was commenced. Very few sailing-vessels seeking this port in times of northerly storms attempt the river entrance, but if *any* entrance is attempted, they round the southerly end of the breakwater and try to anchor under its shelter or to reach a place where they can be picked up and towed in by tugs which could not venture outside; this course will be still more generally adopted when the work of deepening the outer harbor (now in progress) shall have been finished, and it is therefore important to modify the original plan so that the closing pier will not interfere with this way of entering. My memoranda of May 4, 1878, already before the Board, give reasons against carrying the south pier to the shore line as originally proposed. During our last session doubts were expressed as to whether wharves would ever be built in the outer harbor, but since then I have made extensive inquiries on this point and feel justified in the opinion that wharves will be constructed very soon after the necessary protection from all storms and sufficient depth for all vessels are furnished. It is true that only one wharf (that belonging to the Illinois Central Railroad, and which is seldom used) has yet been built; but it must be noted that the depressed condition of business interests since the breakwater was completed has interfered with many projected enterprises all over the country, and even before this the great fires in Chicago rendered it impossible to carry out improvements in contemplation at the time of their occurrence; besides, we have seen that wharves could not be occupied during southeasterly storms, and this fact would probably have been urged against their construction until after the completion of a closing pier, even in times of prosperity. The reserved rights to an unobstructed water front within the limits of the Lake Park (viz, from the north line of Randolph street south to near Twelfth street) may present some obstacle to the construction of wharves on that part of the lake shore; but it is stated that these rights can and will be purchased when the time for building comes. South of the park limits there appears to be no obstacle to the construction of wharves, and the plan of closing pier should lend itself to an easy extension of the system of docks as far south on the lake front as the future wants of commerce may require.

As fulfilling the conditions herein indicated, I would recommend the following plan of closing pier as a substitute for that originally proposed: Commencing at a point (A) on the prolongation of the line of eastern breakwater, and at a distance of 1,000 feet from the south end thereof; thence on a straight line to the point (B) of intersection of the north line of Twelfth street and a line drawn parallel to and 500 feet to the eastward of the dock line along the Lake Park, as established by the Board of Engineers in 1871. From the point (A) build a "return" to the north 200 feet in length, and more, if it be found that the opening is unnecessarily great or that it admits too much sea into the basin.

In the execution of this plan I would propose, first, to build and sink at the angular point (A) an angle crib 30 feet wide, corresponding to the directions of the pier and its "return"; to make the remaining part of the "return" of cribs 30 feet wide, and the pier of cribs 16 feet wide, using throughout the system of cribs on bearing piles, unless during the progress of the work something better should be developed. The total cost of this closing pier with its return, as per plans and estimate herewith, would be $135,500; the estimated cost of the pier originally proposed was $264,843.73. This plan will increase the area of the outer harbor, provide the necessary opening for the direct passage of vessels between the lake and basin, and extend the basin to the extreme south limit of the Lake Park; if wharves should be constructed south of this point, the communication between these and the river would be entirely protected. These wharves would have to be protected by a breakwater extending south from the proposed pier, and though it would not be the province of the government to build it, we may take note that its cost would be less than that of one further out in deep water, and, while leaving ample room for communication between it and the dock line (500 feet), vessels at the wharves would be better sheltered. Finally, even though no wharves should be built, when the outer harbor is completed as proposed a great number of vessels could safely ride at anchor in it while awaiting the opportunity to load or unload cargo, watching for a favorable sailing day, &c., and avoid in this way the frequent changes of berth—which are now necessary to make room for other vessels—save expense, and relieve the river.

It remains now for us to consider whether the proposed works will supply all that is needed or even desirable for the security of commerce; in other words, will vessels be able to enter the harbor in security at all times? Will the proposed works provide a good harbor of refuge? Northeasterly storms invariably bring a large number of vessels to this vicinity; at the same time the lower reach of the river (from Rush street bridge to the harbor entrance) is generally crowded with vessels waiting for a favorable wind to start on their voyage down the lakes; it is then a dangerous matter for any sailing-vessel to attempt this entrance. I have stated that some vessels round the south end of the breakwater at such times and anchor under its shelter, but this course being followed by any great number would soon fill up all the available anchorage ground and block out the late comers. The holding-ground in the outer harbor is in most places too poor to be relied upon during strong northerly blows, so that vessels at such times would be liable to drag anchor, drift to the south, go ashore, and become total wrecks. How many vessels have been lost in this way I have not yet been able to find out, but by my own observation I know that four were wrecked last fall and a number of others were badly damaged. It is true that the outer harbor might be dredged to a sufficient depth to obtain good holding-ground, viz, to clay. Examinations recently made show it would be necessary to dredge to a depth of about 20 feet below low-water to accomplish this object. The approximate amount of excavation east of the established dock-line would be 2,215,000 cubic yards, which, at 20 cents per cubic yard, would cost $443,000. But it does not appear to me that the outer harbor even then would be all that is required for a place of refuge, and therefore I would not recommend this course, but limit the dredging in the outer harbor to a depth sufficient for communication—say 16 feet.

The plan of an exterior breakwater, located in deep water to the northward and eastward of the north pier (as indicated on the tracing herewith, for instance), would, in my opinion, provide a perfect harbor of refuge, and, in connection with the other works, would complete a scheme of improvement sufficient for all the requirements of commerce and navigation, while anything less than such a scheme is incommensurate with the great interests involved. I have caused extensive inquiries to be made in order to obtain a general expression of opinion as to the desirability of such a breakwater, and have received a unanimous approval

of the project. This breakwater would cause a good anchorage of ample extent for all comers, of easy access in the most severe storms, and directly on the route to the port; tugs lying under its protection would be in good position to reach vessels arriving in distress, and the entrance to the inner harbor would at all times be safe. The cost of such a breakwater would not be excessive, when compared with the interests at stake and with the expenditures already made and contemplated at other places. For example, comparing the harbors of Buffalo, Cleveland, and Chicago, the number of vessels entered and cleared at these places, from 1872 to 1877, inclusive, as per published reports of the Chief of Engineers, are: Buffalo, 47,784; Cleveland, 40,209; Chicago, 127,479, or about 50 per cent. more at Chicago than at both other places combined. The amounts heretofore appropriated and the estimated cost of completing existing projects for the same places are shown in the following statement:

	Buffalo.	Cleveland.	Chicago.
Appropriated prior to 1865	$214,434 05	$205,538 84	$267,601 00
Appropriated from 1865 to June 30, 1878	947,600 00	349,686 00	765,404 00
Total appropriated to date	1,162,034 05	555,224 84	1,033,005 00
Estimated cost of completing existing projects	1,735,000 00	1,600,000 00	225,000 00
Aggregates	2,897,034 05	2,155,224 84	1,258,005 00

In this statement the estimated costs of completing are derived from the annual reports for 1877, by deducting from the amounts stated therein the amounts appropriated by the act approved June 18, 1878. If we should increase the aggregate for Chicago Harbor by $600,000 it would still be less than that for either of the other places, and should be sufficient, in addition to completing the outer harbor, to construct a detached breakwater a mile long, located as herein suggested, supposing the breakwater to be of cribs 30 feet wide, and, if necessary, on a pile foundation.

With the above showing I have no hesitation in recommending that this be done; in fixing upon the location of the breakwater, as indicated, I have endeavored to make its cost a minimum, and at the same time meet the following conditions: 1st, to cover a good anchorage ground; 2d, to extend its covering effect over the southerly entrance to the outer harbor; 3d, to provide for a continuous shelter from its outermost limits to the river.

In connection with this report, I have also to submit:

1st. A letter to the Secretary Board of Trade of Chicago, requesting an answer to certain questions, and any information bearing on the general subject of improvements contemplated.

2d. The answer to the foregoing of a committee appointed to consider the subject.

3d. A communication from R. S. Littlefield, overseer, containing memoranda of his inquiries among vessel-men and others.

4th. A tracing-scale, 1″ = 500′, showing the whole plan of harbor improvements herein suggested and recommended.

5th. Estimates of cost.

I have also several sketches on a larger scale to submit to the Board showing in more detail the results of surveys and examinations bearing on the locations of the closing pier and detached breakwater; also memoranda showing results of examinations bearing on the same subject, specimens of lake bottom, &c. Detailed plans of the angle crib and of cribs for the closing pier, with partial models, have been prepared.

A resurvey of the outer harbor has been made, but it has been impos-

sible, for lack of time, to plot the notes. Nothing bearing on the subject before us, beyond what is shown by existing maps, was developed by this survey.

Very respectfully, your obedient servant,

G. J. LYDECKER,
Captain of Engineers.

Maj. D. C. HOUSTON,
Corps of Engineers, U. S. A.,
President Board of Engineers.

BB 2.

IMPROVEMENT OF THE HARBOR OF CALUMET, ILLINOIS.

In the fall of 1869 a survey of the entrance to the Calumet River was made. A plan for constructing a harbor there was submitted by Maj. J. B. Wheeler, November 30, 1869, but he did not recommend its execution, believing that the local wants and other interests would not justify the necessary expenditure. The question was submitted to an Engineer Board in January, 1870; concurring in Major Wheeler's views, it did not recommend any work; nevertheless the act of July 11, 1870, appropriated $50,000 "for a harbor of refuge." Maj. D. C. Houston, then in charge of the district, was instructed that this appropriation was designed for the mouth of the Calumet, and he was directed to execute the plan submitted by Major Wheeler. The plan was, to cut from the river to the lake, and construct the usual piers to deep water. Work was commenced in August, 1870, since which time the piers have been gradually extended and the channel between them deepened by dredging. A detailed history of the work from its inception up to 1876 is published in Report of the Chief of Engineers for 1876 volume II. The present condition and extent of the improvement is indicated on the accompanying sketch. In submitting his plan, Major Wheeler says, "the rapid accretions that would follow immediately on the construction of the piers present so serious objections," &c. The sketch shows that the shore-line has advanced about 1,000 feet since the beginning of the work in 1870. The advance last year was 115 feet.

The act approved June 18, 1878, appropriated $15,000 and the project for its application provided for extending the north pier 200 feet, and afterwards dredging a channel through the bar at the entrance. The work of pier extension was commenced toward the end of July, and finished on the 5th of October, 4 cribs (each 50 by 20 by 14½ feet) being sunk on pile foundations, and crowned with a superstructure 6 feet high. The work was done by hired labor, and purchase of materials in open market, at the following cost:

69,562 feet, board measure, pine timber and plank, at $13 per M	$904 31
47,972 feet, board measure, pine lumber, at $15 per M	719 58
183,158 feet, board measure, hemlock timber, at $11 per M	201 47
2,929 linear feet pine piles, at 9 cents	263 61
470.37 cords stone, at $4.77	2,243 65
39,343 pounds iron, at 1.9 cents	747 52
Sundry bills, tools, machinery, &c	2,879 62
Labor (pay-rolls for July, August, September, and October)	3,053 38
Total	11,013 14

During the progress of this extension some minor repairs were made to the old work, such as replacing rotten timber and refilling the west

end of the south pier with slabs and stone, the cost of which is included in the above statement.

When the work of extending the north pier had been completed, a narrow 12-foot channel existed close along the north pier, and I deemed it best to postpone dredging through the bar until the spring, or, if possible, until the pier could be still further extended; for, until the end of the pier is in deep enough water to stop the bar formation, any dredged channel will be rapidly destroyed. Comparing the limits of the bar as developed by our survey this spring with the contours of last year's survey, it is seen that but little fresh material has been added, though the bar has flattened out somewhat. The least depth on the bar in the spring of 1878 was 10.3 feet; in the spring of 1879 the least depth was 10.7 feet.

The act approved March 3, 1879, appropriated $12,000. The money has not yet been made available, but a project for its application has been approved as follows:

For extending the north pier	$10,000
For dredging, repairs, &c	2,000

As soon as the money becomes available, work on the pier extension will be commenced, with the expectation of building 250 linear feet this season; though provision is made for dredging, if it should be necessary to maintain a navigable entrance to the harbor, it is proposed to postpone the work, as heretofore, until the pier has been sufficiently extended to protect the dredged channel. To accomplish this its end must reach to a depth of at least 18 feet, and possibly to 20 feet. An extension of 300 feet should, therefore, be made, beyond what can be accomplished with the present appropriation. It will also be seen that the shore line south of the piers continues to recede; that the sea breaking over the narrow sand-spit, between the "old outlet" and the lake, is rapidly washing away the interior shore line and carrying sand into the harbor; and that a clean breach around the west end of the south pier is liable to occur at any time. To guard against this danger, it is necessary that the south pier be continued to the mainland, as indicated on the sketch by dotted lines; and this should be done next year, unless the private parties interested in keeping the "old outlet" clear for dockage purposes construct a breakwater or shore protection along its easterly limit of sufficient strength to secure the harbor against further damage. This subject was referred to in my last annual report. Further, as soon as the north pier is extended to deep water the channel should be dredged to its full width.

I would therefore recommend that there be appropriated for the fiscal year ending June 30, 1881, the sum of $30,000, to be applied as follows:

For completing piers	$20,000
For dredging	10,000

The original estimate for the improvement of this harbor was (see Report Chief of Engineers for 1870, page 107) as follows:

For 4,096 linear feet piers	$221,771 52
For dredging	78,104 00
Total	299,875 52

The total amount appropriated to date is $277,000, of which there had been expended to June 30, 1879, $262,194.33. The total length of pier constructed to date is 4,260 linear feet. Total dredging, 280,000 cubic yards.

To maintain the improvement after completion will, for several years, require an annual average appropriation of about $5,000, for extension of piers and repairs to timber-work above water.

Money statement.

July 1, 1878, amount available	$16,030 04	
Amount appropriated by act approved March 3, 1879	12,000 00	
		$28,030 04
July 1, 1879, amount expended during fiscal year		13,224 37
July 1, 1879, amount available		14,805 67
Amount (estimated) required for completion of existing project		63,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881		30,000 00

BB 3.

IMPROVEMENT OF ILLINOIS RIVER.

The first work done by the United States towards improving the Illinois River was in 1852, when the sum of $30,000 was appropriated for that purpose, and was applied to dredging channels through some of the worst bars. After this nothing was done until 1866, when surveys and examinations contemplating the preparation of a complete plan of improvement were commenced. A preliminary survey was made in the fall of that year, and this was followed by a detailed low-water survey during the following year. These surveys resulted in the recommendation of a slackwater system, but no appropriations applicable to this system were made, and in 1869 the work of improving the river by dredging was commenced; since then operations have been continued on the same plan, the work of dredging being supplemented by the construction of dams and dikes to contract the water-way, and assist in maintaining the dredged channels. A more minute history of the work is given in my letter to the Chief of Engineers, dated August 30, 1878, and which is forwarded herewith as a part of this report.

On the 2d of July I submitted to the Chief of Engineers a project of expending the amount appropriated June 18, 1878, as follows:

In compliance with instructions contained in circular letter of the 26th ultimo, I have the honor to submit the following project for prosecuting the work of improving the Illinois River, under the act approved June 18, 1878, appropriating $75,000.

It is proposed to continue the work of dredging channels through the various bars, removing obstructions to navigation, and constructing dams and dikes of brush and stone, for contracting the water-way, when necessary, in continuation of the plan of operations heretofore adopted.

From the most careful study and investigation, I am satisfied that this work could be carried on with the greatest economy, and to the best interests of the government, if we should purchase and operate our own machinery. Under the system of contract, as heretofore, the price of dredging on this river since 1874 has been 25 cents and 28 cents per cubic yard, the price under the last contract being 25 cents, while dredging at our exposed lake harbors is done at rates varying from 14 to 22 cents per cubic yard. If dredges could pass from the lake to the river there is no doubt that the price for river work would fall at least 40 to 50 per cent.; but the capacity of the Illinois and Michigan Canal will not admit of this, and there is no competition for the parties owning the plant at present on the river.

From previous experience, and particularly from that on the Fox River, I believe that if the government worked its own dredges, the work could be done for 10 cents per cubic yard. I know it ought not to exceed 15 cents, including the cost of engineering and superintendence. Hence, if we should apply, say, $35,000 of our present appropriation to the purchase of the necessary machinery, the balance, $40,000, would

excavate 266,666 cubic yards, at 15 cents per yard. The cost of this amount of excavation, at the present contract-price, 25 cents, would be $66,666; to this must be added the cost of the engineering party, which would exhaust the balance of the appropriation. In other words, the saving to the government on this appropriation would nearly pay for the necessary machinery. Therefore, I have to submit the following project for expending the present appropriation:

1. For building or purchasing machinery for carrying on the work, $35,000.

2. As it will take some time to provide the above machinery, probably two months at least, I would enter into a contract with Mr. H. S. Brown, the present contractor, for carrying on the work until the government can use its own outfit, and thereby avoid any delay in the progress of the work; $15,000 would cover all expenditures under this head.

The balance of the appropriation would then be applied to operating expenses and the purchase of materials (brush and stone) for the construction of dams and jetties.

I would recommend that all work be done by hired labor, and that materials be purchased in open market. In this way the advantage of low prices can best be secured to the government, and the work will be better and more rapidly done.

The following instructions from the department, dated July 16, 1878, were received in reply to the above:

The project submitted on the 2d instant for the application of the appropriation of $75,000, made by the river and harbor act of June 18, 1878, "for improving the Illinois River," has been received.

The present time appears opportune for the consideration of the various improvements of the Illinois River, having in view the preparation of a plan for its permanent and radical improvement, and it is accordingly suggested, before taking steps toward the application of funds now available, that you submit at an early day a history of the improvement from its inception to the present time, showing what general plan has been adopted, and how far the expenditures have been applied toward the carrying out of that plan; what changes, if any, have been rendered necessary during the progress of the work; whether any material changes are, in your judgment, now necessary, and whether in any plan for radical improvement the work already accomplished may not form a component part. The whole question is delegated to you, and you are requested in its consideration to refer to the annual reports of the Chief of Engineers generally, and especially to the reports upon the survey of the river contained in the reports for 1867 and 1868.

My report, made in accordance with these instructions, was submitted under date of August 30, and, though it has been printed as House Ex. Doc. No. 81, Forty-fifth Congress, third session, a copy is transmitted herewith as a part of this report. The instructions from the Chief of Engineers, relating thereto, dated November 21, 1878, were as follows:

Referring to your project, submitted July 2, 1878, for the application of the appropriation of $75,000 made by the river and harbor act of June 18, 1878, for improving the Illinois River, and your report dated August 30, 1878, upon the means hitherto adopted for the improvement of that river, &c., you are now informed that, upon the recommendation of the Chief of Engineers, the Secretary of War has authorized the application of so much of the appropriation referred to as may be necessary to the construction or purchase of the requisite dredging machinery for use in connection with the improvement of the Illinois River, and of the balance remaining, to operating expenses of the machinery and to purchase of material (brush and stone) for continuing the construction of dams and jetties, as heretofore. The work is to be done by means of hired labor and purchase of materials in open market.

In the mean time, all work of dredging, &c., had been suspended, and operations were limited to the construction of a new office and quarter-boat, and the establishment of water-gauges at intervals between Copperas Creek Lock, and the mouth of the river; some current observations were also taken, to be applied to determining the discharge of the river, and local surveys were made at several of the bars, in most urgent need of improvement.

Immediately on receiving the instructions quoted above, arrangements were commenced for procuring the necessary outfit. Careful search was instituted among the various dredge-building establishments, and it was finally decided to have the machinery for one dredge built at the Vulcan

Iron Works at Chicago, modifying the style usually built there, to adapt it to the special work in view. It was completed by the close of the year, and has since then been subject to a preliminary trial, the result of which warrants the opinion that we have a good piece of machinery, capable of doing a good day's work; its capacity cannot be stated until further and more extended trial. In addition to the dredge, there have been built two side-dump scows, and one towboat; another dump-scow will be required to complete the present dredging outfit. The outfit for the construction of dams consists of one steam-scow, two deck-scows, and a quarter boat. The towboat was built, complete, at Saint Louis, but has not yet been delivered for trial; all the rest of the outfit was built at Peoria, by hired labor under the immediate superintendence of Mr. R. A. Brown, assistant engineer, in local charge of the improvement of the river. I desire here to commend him for the great care, zeal, and efficiency he has displayed in the execution of these difficult and unusual duties; through his watchfulness and attention to every minute detail, the entire outfit has been built in a manner most economical and satisfactory in every respect, so far as related to everything under his control. On the contrary, the repeated and inexcusable delays on the part of the manufacturers of the machinery, both here and at Saint Louis, have been the cause of great annoyance, vexation, and considerable unnecessary expense.

It is expected to move the entire outfit down the river this week to the vicinity of Pearl Shoals, and start there the season's work.

Commencing with these shoals there is a series of bars in close proximity, extending over about 5 miles of the river, and to improve that section is the work immediately before us; it will require about 100,000 cubic yards of dredging and the construction of about 6,500 linear feet of brush and stone dams.

The appropriation made by the act approved March 3, 1879, will be applied in continuation of this plan of improvement; another dredge should be added to the outfit, but not until the new one has received a thorough test, by which her capacity may be positively determined.

It is difficult to estimate the cost of completing the improvement on the present plan. To obtain a satisfactory 4½-foot channel, 200 feet wide, will cost in the neighborhood of $250,000; and this is the estimate submitted below. An annual expenditure thereafter of about $10,000 would be required for maintaining the improvement. If, however, a navigable 6-foot channel be completed, the total cost could not be placed at less than $1,250,000, with subsequent annual expenditures of $15,000.

For a vigorous prosecution of the work an appropriation of $100,000 is recommended for the year ending June 30, 1881.

Money statement.

July 1, 1878, amount available	$78,133 42	
Amount appropriated by act approved March 3, 1879	40,000 00	
		$118,133 42
July 1, 1879, amount expended during fiscal year	35,517 45	
July 1, 1879, outstanding liabilities	12,325 65	
		47,843 10
July 1, 1879, amount available		70,290 32
Amount (estimated) required for completion of existing project		250,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881		100,000 00