58TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 168.

MISSISSIPPI RIVER.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT OF BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN THE MOUTHS OF THE MISSOURI AND OHIO RIVERS.

DECEMBER 18, 1903.—Referred to the Committee on Rivers and Harbors and ordered to be printed.

WAR DEPARTMENT,
Washington, December 16, 1903.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated December 3, instant, together with copy of a report from the Board of Engineers for Rivers and Harbors, dated November 12, 1903, relative to the improvement of the Mississippi River between the mouth of the Missouri River and the Ohio River, made by the Board in compliance with the provisions of a resolution of the Committee on Rivers and Harbors of the House of Representatives, of April 25, 1903.

Very respectfully,

ELIHU ROOT,
Secretary of War.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, December 3, 1903.

SIR: I have the honor to submit herewith a report, dated November 12, 1903, by the Board of Engineers for Rivers and Harbors, constituted under the provision of section 3 of the act approved June 13, 1902, relative to the improvement of the Mississippi River between

the mouth of the Missouri River and the mouth of the Ohio River, with a view to ascertaining whether, by dredging or otherwise, a suitable channel can not be established and maintained at less expense than in accordance with the existing project. This report is made in pursuance of a resolution of the Committee on Rivers and Harbors of the House of Representatives, transmitted to this office by Hon. T. E. Burton, with letter dated April 25, 1903, an extract from which is quoted in the accompanying report.

The object to be attained under the present project is stated in full in the Board's report. For reasons given in its report, the Board states that its estimate of the cost of completing the improvement by the methods of the present project must be regarded as merely tentative. It considers that a suitable channel between St. Louis and Cairo is one 8 feet deep and 200 feet wide where alignment is favorable, and of suitably greater width in the bends and where alignment is unfavorable, and 6 feet deep from St. Louis to the mouth of the Missouri at low stages. The Board considers it practicable to secure this result by contraction works and shore protection, the tentative estimated cost being $20,000,000 in addition to expenditures already made, with annual expenditures thereafter for maintenance amounting to $400,000. The Board considers also that there is reasonable prospect that this cost can be materially reduced by more extensive dredging than at present, the estimated cost of adequate additional plant being $450,000, with $250,000 annually for operation, maintenance, and renewal.

In the opinion of the Board, $1,200,000 should be appropriated in one sum for the dredging plant to insure its completion and operation for a term of three years; and until the results of the dredging be known there should be expended annually for permanent work and temporary expedients (except dredging) the sum of $300,000.

I recommend that this letter and the accompanying paper be transmitted to the Speaker of the House of Representatives for the information of Congress, in response to request in the above-mentioned resolution.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. ELIHU ROOT,
Secretary of War.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS RELATIVE TO ESTABLISHING AND MAINTAINING IN THE MISSISSIPPI RIVER BETWEEN THE MOUTHS OF THE MISSOURI AND OHIO RIVERS A SUITABLE CHANNEL AT LESS EXPENSE THAN THAT UNDER THE EXISTING PROJECT.

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C., November 12, 1903.

GENERAL: By first indorsement, Office Chief of Engineers, United States Army, May 1, 1903, there was referred to the Board of Engineers for Rivers and Harbors a resolution adopted by the Committee on Rivers and Harbors of the House of Representatives, of which the following are extracts:

Resolved by the Committee on Rivers and Harbors, That the Board of five engineer officers established by section 3 of the river and harbor act of June 13, 1902, be requested to make reports to Congress not later than the first Monday in December, 1903, upon the following projects, with a view to making recommendations upon the desirability of continuing the same, or any modification thereof, or to report as specifically stated, with the designation of the respective projects:

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The Mississippi River between the mouth of the Missouri River and the mouth of the Ohio River, with a view to ascertaining whether, by dredging or otherwise, a suitable channel can not be established and maintained at less expense than in accordance with the existing project.

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In its study of this question the Board has had the benefit of the written opinions and arguments of the district officers now and formerly in charge of the improvement of this section of river. A committee of the Board has inspected the river between the mouth of the Missouri and the mouth of the Ohio, and has studied on the ground the dredging operations and plant employed between Cairo and Memphis. Estimates and other data have been secured from the engineer office at St. Louis and from the office of the Mississippi River Commission. Assistant engineers in local charge of the work of regularization between St. Louis and Cairo and of dredging operations below Cairo have been freely consulted. Finally the Board availed itself of the services of Dr. John Franklin Crowell, internal-commerce expert of the Bureau of Statistics, in its study of the question of most suitable channel dimensions as related to the commercial needs of the territory affected by the existence of this waterway.

The report[a] submitted by Doctor Crowell confirms the Board in its opinion that a barge channel from St. Louis to Cairo, 8 feet deep at the lowest stages, would, as an actual and potential freight route, confer benefits upon a wide section of country far beyond its cost. Great engineering difficulties stand in the way of a deeper channel. From the mouth of the Missouri to St. Louis a steamboat channel 6 feet deep at low water will be ample. The Board therefore adopts these depths for the "suitable" channel referred to in the resolution of the Committee of Congress.

Regularization assisted by dredging is the method contemplated by the present project for the improvement of this stretch of river. This project is thus described in the Annual Report of the Chief of Engineers for 1903:

The present project is a continuation of the plan adopted in 1881.

It contemplates confining the flow of the river to a single channel having an approximate width below St. Louis of 2,500 feet at bank-full stage, the natural width in many places being a mile or more at mean high water. This result is to be attempted by closing sloughs and secondary channels and by building out new banks where the natural width is excessive, using for this purpose permeable dikes or hurdles of piling that collect and hold the solid matter that is carried in suspension or rolled on the bottom by the river. The banks, both old and new, are to be revetted or otherwise protected where necessary to secure permanency. Pending the completion of the permanent improvement the low-water channel is to be improved each season by the use of dredges and other temporary expedients.

The object of the improvement is to obtain eventually a minimum depth at standard low water of 6 feet from the mouth of the Missouri to St. Louis, and of 8 feet from St. Louis to the mouth of the Ohio.

The original estimate of the cost of the improvement, as revised in 1883, is $16,397,500. The total amount expended to June 30, 1903, was $10,037,957.77. * * *

[a] Not printed.

The effect of the work done is thus stated in the same report:

The result of the expenditure of this amount has been the partial improvement of the entire reach of the river from St. Louis to Cairo. During the past year there was at all times during open navigation a channel depth of 6 feet or more throughout this reach. The river attained a low-water stage of 3.5 feet above standard low water.

With the present appliances and such others as may be developed for the temporary improvement of low-water channels, it is expected that a navigable depth of at least 6 feet will be maintained between St. Louis and Cairo during all stages, while the river is open to navigation, until the projected depth can be obtained throughout by the extension and completion of the permanent works.

It is impossible to estimate the cost of the work remaining to be done in the manner common to most engineering works. If a river is to be improved by means of locks and dams, it is practicable to determine in advance the number of structures required and the best type and approximate cost of each. Reasonably close estimates of cost may be made in the case of harbor improvements. In the case of river regularization, however, the required structures and their definite locations can be determined upon only from time to time as groups of structures are about to be begun. The channel before improvement is continually changing and local conditions in any reach of river can not be known years in advance of its proposed improvement. For this reason the Board's estimate of cost of completing the improvement by the methods of the present project must be regarded as merely tentative. This estimate will be found hereinafter stated.

With regard to dredging, it is well known that improvements in plant in the last few years have modified many engineering projects. As to dredging in large alluvial rivers, much experience has been recently gained, especially upon Russian rivers and upon the lower Mississippi. It is believed that favorable results have been secured abroad, especially upon the Volga. As to experience upon the lower Mississippi, attention is invited to the following extracts from the report of the Mississippi River Commission for 1903:

The system of hydraulic dredging was therefore adopted in 1896, and under the requirements of recent acts of Congress there is now maintained by this means a channel 9 feet in depth and 250 feet in width at all stages of the river from Cairo southward.

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The dredging operations covered the low-water intervals during the period from the latter part of August to the latter part of November. The season was unusually favorable as far as the state of the river was concerned, and as a consequence but little time was actually employed in dredging.

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Dredging during the season was confined to the river between Darnells bar (80) and Ashley Point (271). In this reach channels were opened through 11 different bars, and some dredging was done to remove the bar in front of Memphis wharf. A depth of 9 feet or more was maintained throughout the entire season on all crossings from Cairo to the lower limits covered by the dredging operations.

The maintenance of a navigable channel, ample in width and depth throughout several successive low-water seasons, emphasizes the conclusions announced in previous reports—that it is entirely practicable to maintain at all stages, by means of suitable equipment of dredges, a navigable channel at least 9 feet in depth and 250 feet in width, as required by act of Congress.

Two large modern dredges are already available for work between St. Louis and Cairo, having been built in accordance with the will of Congress as expressed in section 1 of the river and harbor act approved May 11, 1896. In the light of recent experience, which requires that

dredging operations should begin while there is still a considerable depth upon the bars, it is certain that the efficiency of these dredges will be promoted if their suction pipes be lengthened. The alteration of these dredges and the procurement of two self-propelling dredges of the type of the *Kappa*, recently constructed for work below Cairo, would equip the St. Louis-Cairo section with the minimum plant which might reasonably be expected to maintain a suitable channel. The alterations, the new dredges, and incidental plant would cost $450,000, while the annual charge for operation, maintenance, and renewal of plant may be estimated at $250,000. These estimates are made upon the assumption that the dredging plant would be supplemented by tenders, etc., drawn from the plant now engaged in the improvement of the river.

The Board invites especial attention to the fact that a channel, to be most efficient commercially, must be maintained of suitable dimensions throughout the season of navigation for a considerable period of years. Otherwise the capital will not be found for the freight carriers. If there be a greater resort to dredging, there should be an increased certainty of appropriation.

In recommending hereinafter a policy to be pursued in the improvement of the Mississippi River between the mouth of the Missouri and the mouth of the Ohio, and a project for work in the immediate future, the Board is convinced that such policy and project, if adopted, will provide the desired results at a minimum of expenditure, and, furthermore, in the shortest practicable time.

The Board has the honor to submit the following statement of its recommendations and conclusions:

(*a*) A suitable channel in the Mississippi River between St. Louis and Cairo is one 8 feet deep, 200 feet wide where alignment is favorable, and of suitably greater width where alignment is unfavorable, adapted to a barge navigation throughout all seasons of the year, except when the river is closed by ice. A suitable channel from the mouth of the Missouri to St. Louis is a steamboat channel 6 feet deep at low stages.

(*b*) To secure this result by contraction work and shore protection is practicable.

(*c*) The cost of securing the desired result in the manner last mentioned would be at least $20,000,000 in addition to expenditures already made, with annual expenditures thereafter for maintenance amounting to $400,000.

(*d*) There is a reasonable prospect that this cost can be materially reduced by a use of dredging more extensive than is made at the present time. A dredging plant adequate for a trial would cost $450,000 for alterations and additions to existing plant, with annual expenditures for operation, maintenance, and renewal of plant amounting to $250,000.

(*e*) One million two hundred thousand dollars should be appropriated in one sum for the dredging plant to insure its completion and operation for a term of three years.

(*f*) Until the results of the dredging be known, there should be expended annually for permanent work and temporary expedients (except dredging) the sum of $300,000.

(*g*) After a trial of the more extended dredging, the project for

establishing the channel should be revised in the light of the experience thus gained.

Respectfully submitted.

CHAS. J. ALLEN,
Lieut. Col., Corps of Engineers.
H. F. HODGES,
Major, Corps of Engineers.
C. H. MCKINSTRY,
Captain, Corps of Engineers.
W. V. JUDSON,
Captain, Corps of Engineers.

Brig. Gen. G. L. GILLESPIE,
Chief of Engineers, U. S. A.

MINORITY REPORT OF THE BOARD.

I can not concur in full with the recommendations made in its report by the majority of the Board of Engineers for Rivers and Harbors.

The improvements made in recent years in the construction of hydraulic dredges and the better results obtained by the operation of such dredges in alluvial streams, as experience is gained in such work from year to year, are all fully appreciated, as is also the probability that such operations have as yet by no means reached their maximum efficiency. The value of these machines, aided by other expedients, in temporarily improving the conditions of low-water navigation in the Mississippi River between St. Louis and the mouth of the Ohio River is by no means overlooked. Indeed, it is my opinion that such operations should be extended in scope to the extent necessary to produce temporarily the best channel practicable, and I therefore concur in the recommendations of the Board in regard to dredges and dredging, but only as a temporary expedient.

My experience in charge of this improvement during the low-water seasons of 1899, 1900, and 1901 leads me to believe that the permanent improvement of this river is feasible from a technical standpoint, and that such an improvement will produce a low-water barge channel so superior in location, width, permanence, and certainty to any temporary dredged channel, that it is much to be preferred to the latter even at a conceded greater cost.

The commerce of the Mississippi in the past has been large and important, notwithstanding the obstructions to a free and economical navigation. Of recent years its importance has declined, and for the reason that the delays and expense of an uncertain navigation have made water transportation via this route unable to compete with the economies achieved in modern railroad transportation. The value of the Mississippi River as a transportation route is not disputed, and should increase in the future rather than decline; but this value can be fully realized only by providing a low-water channel that will permit of barge transportation with safety, certainty, and the least practicable delay en route. Such a channel appears to have been produced and maintained below the mouth of the Ohio by the dredging operations carried on under the direction of the Mississippi River Commission.

The full value of the Commission's low-water dredged channel can, however, be realized only by the permanent and certain maintenance

of a corresponding channel from St. Louis to the Ohio. The Ohio does not now, and can not for many years to come, contribute any low-water traffic to the lower Mississippi. That traffic must come from the middle Mississippi and mainly from St. Louis, where trade and crop conditions are such that transportation to the seaboard is most active during the low-water season of the summer and fall. The maintenance with certainty of a thoroughly satisfactory low-water barge channel in the middle Mississippi is therefore not only a prerequisite to the reestablishment of the former large commerce of that section of the river, but is also the only means of supplying to the improved dredged channels of the lower river a low-water commerce of any magnitude. I differ from the majority of the Board only as to the means and methods to be employed to secure such a channel with that certainty as to satisfactory maintenance which is necessary to attract the large amount of capital required for the reestablishment of barge transportation from St. Louis to New Orleans after the discouraging results of recent years.

The hydraulic conditions below the Ohio are materially different from those that exist between the mouths of the Ohio and the Missouri. Indeed, the very factors—greater discharge and relatively smaller amounts of alluvial material in motion—that rendered financially and otherwise impracticable the permanent improvement of the lower river have made it more susceptible of satisfactory improvement by dredging. The contrary conditions above the Ohio favor the success of a permanent improvement, but very materially increase the difficulties of maintaining a dredged channel satisfactory as to depth, and, of greater importance and difficulty, suitably located and certainly maintained.

With the smaller flow of the middle river the difficulty of maintaining the desired channel, 8 feet in depth, will be relatively much greater than for the 9-foot channel of the lower river. My experience upon this improvement firmly convinces me that a suitable barge channel can not be maintained at all points by dredging alone. Its maintenance by dredging, aided by a liberal use of temporary and semipermanent expedients, designed to more or less fully serve the same purposes as the works for permanent improvement, is probably, but not certainly, feasible. Under that system great dependence must be placed upon these expedients for the maintenance of the channel in some localities, and this dependence must necessarily increase with the undoubted deterioration of the existing, partially completed works of permanent improvement, whose maintenance, together with the construction of temporary expedients in aid of dredging, can not be secured from the sum recommended for that combined purpose.

It is therefore my opinion that the permanent improvement of this section of the Mississippi should be continued under the existing project, with such reasonable modifications as are ordinarily left to the judgment of the constructing engineer, and with appropriations sufficient in amount to push it to completion within a reasonable time. Pending this completion the temporary improvement of the low-water channel by dredging, aided by other expedients, should be carried on more extensively than in the past in order to provide the best channel practicable with the use of such means. Such temporary or semipermanent expedients as are employed to assist in maintaining dredged

channels should, if properly applied, lead to an appreciable reduction in the total cost of the permanent improvement.

Under existing circumstances it is impracticable for me to submit an estimate of the cost of completing the existing project, but the district officer's estimate should, in my opinion, be ample for that purpose, if appropriations were made in amounts commensurate with the magnitude of the work. Under other circumstances it is impracticable to submit any estimate as to its final cost.

Respectfully submitted.

EDW. BURR,
Major, Corps of Engineers.

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