

ANNUAL REPORTS
OF THE
HARBOUR COMMISSIONERS
OF MONTREAL.

FOR THE YEAR 1882.



Commissioners:

ANDREW ROBERTSON, Esq., CHAIRMAN.

J. B. ROLLAND, Esq.

EDWARD MURPHY, Esq.

HENRY BULMER, Esq.

VICTOR HUDON, Esq.

HUGH McLENNAN, Esq.

CHARLES H. GOULD, Esq.

HON. J. L. BEAUDRY (MAYOR).

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H. D. WHITNEY, SECRETARY.

Montreal:

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STATEMENT

MADE BY

MR. ANDREW ROBERTSON, CHAIRMAN,

OF THE

*Business of the Port for the year 1882, and other matters connected
with the Trust,*

AT THE PUBLIC MEETING OF THE BOARD, HELD ON 8TH FEBRUARY, 1883.

GENTLEMEN :—

Another year has passed away, but its history will be remembered as one of unusual interest to this Trust. Last year the Harbour Commissioners found that the loan of one and a half million dollars would not complete the channel to 25 feet, and therefore applied to the Government for an additional advance of \$280,000, which was granted them ; the Commissioners paying as usual the interest for the same.

This sum enabled the works to be carried on, and on the 3rd October, the channel was formally opened, 25 feet having been attained all along the river except at Cap Charles and Cap la Roche, where it is necessary to pass at high tide, as at lowest water there is only 22 feet—this should be deepened 2 feet more to make it regularly available at half tide—so as to prevent delay in waiting for high water.

The Commissioners again memorialized the Government as to the expediency of their assuming the debt incurred for this deepening ; they also laid the case as strongly as

they could before them by a personal visit to Ottawa, where they were courteously received and their arguments listened to, receiving the assurance that it would receive the most favorable consideration of the Government. The Commissioners are not without hope that if it is not immediately done, the time is not far distant when this measure of justice will be accorded to the great National Waterway of the Dominion of Canada.

In this connection there came into my hands the other day, through the kindness of Sir Francis Hincks, copies of a series of letters on this subject; they show that forty years ago the deepening of the channel was then receiving the careful attention of Government, and was begun as one of the Public Works of Canada. These are too long to read here, but they are of such historic value that they will be printed as an *addenda* to the Report for this year.

The Commissioners also memorialized the Government as to the further deepening of the channel, and recommended that, seeing the plant was of such consequence and of so great a value, that before disposing of the same and dispersing the well-trained crews, another cut of $2\frac{1}{2}$ feet should be made, at an estimated cost of \$860,000, or under \$900,000. The nearness of the estimates for the 25 feet channel to the amount expended, considering the value of the plant on hand, was surprisingly close, and they, therefore, had no hesitation in urging this view upon the Government, convinced that the result when accomplished, will be found within the sum named.

Mr. Kennedy made a report, dealing with the subject, which was also forwarded to the Government, objections having been made by some that it would be impossible to further deepen, and that it will cost millions, &c., but these are mistaken views, and in corroboration of Mr. Kennedy's views, a report has been received from Thomas C. Keefer, Esq., endorsing Mr. Kennedy's report, and recommending in the future even a greater depth.

These two questions are now being considered by the Government, and the Commissioners hope they will be dealt with in a proper spirit ; should all that has been asked for not be granted, it is to be hoped that at least such measures of relief will be afforded as to further relieve the shipping trade, and help to secure for the St, Lawrence Route a fair share of the traffic passing from the boundless West to the Eastern continent.

Under any circumstances it will be a great mistake to allow the fleet to go to waste, and the skilled workmen to be dispersed should it be afterwards found that it is advisable or become necessary to continue the work at some future time,

During last Session of Parliament the increased powers referred to last year were granted to the Commissioners enabling them to commute for vessels plying within the Harbour of Montreal as well as outside its limits, and also to make by-laws subject to the approval of the Governor-General in Council for the regulation of the traffic in the deep water channels, so that where two channels existed the new one should be kept for the deep draught vessels.

The By-laws have not yet been framed as certain parties objected, lest through stress of weather they might be forced into them or by currents,—in the meantime the Act has been of use in making known what is required and experience will probably soon show that the By-laws when drafted will not be so hurtful to the parties who feared that they might be too onerous.

The Railway tracks upon the wharves have been extended and preparations have been made so as to lay them down on Wind Mill Point ; it is unfortunate that so far the Commissioners have been unable to bring all the Railways now using the tracks into one common understanding. The views of the Harbour Commissioners are

that all tracks upon the wharves should be owned by them and be open on equal terms to all Railways wishing to use them at a reasonable charge—one or other of the Railway Companies being entrusted with the working of the traffic under reasonable regulations to be laid down by the Commissioners.

Considerable discussion was caused a year ago by the want of Cranes or Shears to lift heavy weights, although the Commissioners had shears ready all last year to lift up to 20 tons, they were not even once applied for.

Application was made to introduce new appliances for the more rapid discharge of coal; these machines are expected to be in use this season; they are not to be compulsory, and will not interfere in any way with those who wish to use the ordinary means they have been accustomed in discharging coal cargoes.

New By-laws regarding Pilotage were passed, based on an understanding made with the Pilots, and were sanctioned 29th July, by the Governor-in-Council; they have not so far required to be invoked, and it is again most pleasing to report that no accident of any moment has happened during the past year, as was also the case for the previous year.

Mr. Hugh McLennan's term of office expired last August, but he was again elected by the Board of Trade to act as their representative for another term of four years.

The Shearer-Bateman Scheme, the Honorable the Minister of Public Works referred the subject to several Engineers, among them our Chief Engineer, Mr. Kennedy, who made an able report on the same.

Mr. Bateman had the privilege of explaining his views before the Board and a large number of prominent members of the Board of Trade, Corn Exchange and Citizens who felt interested in the subject.

If the promoters of the Scheme intend to bring forward a Bill during the coming session of Parliament, the Commissioners will require to secure such engineering evidence as may appear to be necessary to protect the interests of the Harbour.

The Revenue shows an increase this year of $4\frac{1}{2}$ per cent

That for 1882, having been.. .. .	\$249,130.91
That for 1881, having been.....	238,140.31
	<hr/>
Increase	\$10,990.60
	<hr/>

There has been an Increase in

Inward Wharfage of	\$19,172.49
Decrease on Outward Wharfage...	\$5,180.34
Decrease on Tonnage Dues Steamers	2,949.79
" " " Sailing Ships	1,938.60
	<hr/>
	\$10,068.73
	<hr/>
	\$9,103.76
Increase in Local Traffic.....	1,886.84
	<hr/>
Total Increase.....	\$10,990.60
	<hr/>

The tonnage of steam and sailing were :

For 1881, Steam	446,457
" 1882 "	466,460
	<hr/>
Increase	20,003
For 1881, Sail.....	85,472
" 1882 "	88,186
	<hr/>
Increase	2,714

which shows that while the tonnage had increased by 22,717 tons, the dues had decreased by \$4,888.39, thus showing the rapid dispatch given to the vessels this year as compared with last. The rate per ton registered being for

Steamers' dues $7\frac{7}{10}$ cents in 1881 as against $6\frac{3}{10}$ cents in 1882; Ships being respectively $12\frac{2}{10}$ cents and $9\frac{6}{10}$ cents average per ton for each visit made to the port.

The total tonnage has been 554,646 against 531,929 or an increase of 22,717 tons. The local tonnage was 949,380 in 1881, and 848,780 in 1882, or a decrease of 100,600.

The total Ocean and Inland tonnage for the year being 6,693 vessels, 1,403,426 tons.

The Coal trade from the Maritime Provinces continues to increase; the tons received in 1880 were 163,766; this year 267,301, or an increase of 103,535 tons in two years.

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MEMORIAL
OF THE
HARBOUR COMMISSIONERS OF MONTREAL.

*To His Excellency the Right Honorable Sir John Douglas
Sutherland Campbell, Marquis of Lorne, P.C., K.T.,
G.C.M.G., Governor-General of Canada, &c., &c., in
Council assembled.*

The Memorial of the Harbour Commissioners of Montreal respectfully represents :

That your memorialists desire again to approach your Excellency in Council, regarding the debt incurred in improving the Ship Channel of the River St. Lawrence, between Montreal and Quebec, and the further prosecution of this work.

That on the 1st of December 1880, your memorialists had the honor of making certain representations to your Excellency in Council on this subject, with a view to obtaining some assistance, and they were so far successful that by the Act 44 Vic. Chap. 7, the rate of interest on the amounts advanced the Commissioners by the Government was reduced from 5% to 4% and the obligation imposed on the Trust by the Act 36 Vic. Chap. 60, to provide a sinking fund to pay off the said advances was cancelled. And, further, by the Act 45 Vic. Chap. 44, an additional loan of \$280,000 was made on the same terms, towards

enabling the Commissioners to complete the Ship Channel to 25 feet at low water.

That in consequence of this reduction of interest your memorialists were enabled to reduce the tonnage dues on shipping $33\frac{1}{3}\%$, to that extent cheapening the St. Lawrence route.

That the grants made to the Commissioners amounting to \$1,780,000, have now been expended, and the 25 feet depth of water has been obtained, except at Cap La Roche, where vessels are obliged to take advantage of the high tide in order to have the full benefit of the improved channel. This should be further deepened two feet, and at some of the bends and places where cross-currents exist, the channel should be widened to insure greater safety.

That your memorialists would further desire to observe that although the improvements now made are of great advantage to the trade by the St. Lawrence, it is generally admitted that the depth of water must still be increased to meet the demands of trade and enable the St. Lawrence route to successfully compete with American Ports.

Your memorialists would also state that they have a large and valuable dredging plant and experienced staff for the further carrying on of these operations, and it would seem injudicious to allow the same to be dispersed, in view of the facts herein stated. That for the further improvements of the River additional dredging to the extent of $2\frac{1}{2}$ feet is required, and it is estimated that this would cost about \$900,000 and that the work could be accomplished in five years.

Your memorialists would further draw your attention to the fact that of the \$1,780,000 expended, \$575,000 was paid for plant alone, leaving only \$1,205,000 as the cost of the work already done, in deepening the channel from 20 to 25 feet. Should the deepening be now continued this plant is available for it, but should the work be stopped, and the plant disposed of, and should it afterwards be found

desirable to resume, a similar outlay would require to be made before operations could be again commenced.

That it is expected in five years time that the Canadian Pacific Railway will be completed from British Columbia to the St. Lawrence, when it is believed an enormous development of traffic will take place. Your memorialists are therefore most anxious that the requirements of this new trade should be anticipated and provided for, both by increased depth in the river and accommodation in the Harbour. Your memorialists are unable to undertake both, but should the Government be pleased to relieve them of the ship channel they will then be able to increase the accommodation in the Harbour.

Your memorialists would also observe that large grants are annually voted by Parliament for the improvements of Harbours and Rivers in all parts of the Dominion, while Montreal, the central shipping port in the country, has since Confederation received no grants whatever, and has not only constructed her own Harbour works, but has been obliged to incur large obligations for the improvement of the ship channel of the St. Lawrence, a work which they think is as much a public work as the enlargement of the Canals, it being part of the great national waterway to Ontario and the North-West.

That as a further evidence of the additional burdens which are imposed upon the Revenues of the Trust, your memorialists would state that since 1873 it has fallen to them to maintain the buoys and beacons on the river from Montreal to Portneuf, and in doing so they have expended upwards of \$70,000 and have only received from your Excellency's Government the sum of \$7,000 on account of said disbursements. Your memorialists would beg to remark that they consider this service should be carried on at the public expense, as is done elsewhere in the Dominion, and should be permanently provided for, as a charge upon the public revenue.

That your memorialists would also call your attention to the fact that the Revenues of the Trust are all required for the due maintenance and improvement of the Harbour, the payment of the interest on the Harbour debt proper, and of the interest to the Government on the above mentioned loans, which latter sum now amounts to \$71,200 per annum, and on which account nearly \$400,000 has been paid to the Government out of revenue during the progress of the work.

That were the Government to assume the debt and the further deepening of the channel, your memorialists would be enabled to abolish the tonnage dues, which in 1880, the year before the reduction of tonnage dues already referred to took place, amounted to \$78,765, and which if accomplished would be an important concession to the shipping interests of the Dominion.

Your memorialists are aware that the Government is having the Channel between Cap la Roche and Quebec carefully examined for suspected obstructions, and they urge that a similar examination be made at Crane Island, below Quebec, where deep draught vessels can only pass at certain stages of the tide, and that such improvements as may be found necessary should be made.

That your memorialists view with considerable anxiety the action of the New York State by their recent vote in proposing to entirely abolish the Tolls on the Erie Canal, which will no doubt be carried into effect, and be a direct blow at the St. Lawrence Route; they would therefore respectfully urge your attention to this subject.

Your memorialists would further call special attention to the fact that at the American Seaports, with which the St. Lawrence must compete, the approaches to the Harbours are improved entirely at the cost of the United States Government and without charge against the Harbours. Within the past few years there has been thus expended by them over \$15,000,000 for the Ports of Boston, New

York, Philadelphia, Baltimore and New Orleans, for works which are exactly analagous to the improvement of the Ship Channel of the St. Lawrence, with which its shipping is now burdened.

Your memorialists would, therefore, for these and other reasons, most respectfully and earnestly request that the representations herein contained may receive the serious and favourable consideration of your Excellency in Council, and that such steps may be taken as will relieve the Harbour of Montreal of the burdens above referred to, and at the same time admit of the further improvement of the river, as herein suggested.

And your memorialists, as in duty bound, will ever pray.

ANDREW ROBERTSON,
Chairman.

H. D. WHITNEY,
Secretary.

HARBOUR COMMISSIONERS OFFICE,
MONTREAL, 15th November, 1882.

REPORT
ON THE
PRACTICABILITY AND COST OF DEEPENING THE SHIP CHANNEL
BETWEEN
MONTREAL AND QUEBEC
TO
TWENTY-SEVEN AND A-HALF FEET,
BY
JOHN KENNEDY, M. INST. C. E.

HARBOUR COMMISSIONERS OF MONTREAL,
Chief Engineer's Office,

MONTREAL, 25th January, 1882.

H. D. WHITNEY, ESQ.,
Secretary-Treasurer.

SIR,

In compliance with the instructions of the Board, I beg to report upon the further deepening of the Ship Channel between Montreal and Quebec to $27\frac{1}{2}$ feet, and also to furnish an estimate of the cost.

FROM QUEBEC TO CAP CHARLES, a distance of 50 miles, there are some points where it is rather doubtful if there is a clear depth of $27\frac{1}{2}$ feet at low water in the present course of vessels, but it is believed that there would be no difficulty in obtaining this depth, either by slight changes in the course or by clearing away insignificant obstructions.

FROM CAP CHARLES UPWARD, the extent of the work to be done has been carefully ascertained by special surveys extending over an aggregate of seventy-seven miles of the Channel, as also by sweeping over the bottom of the remaining portions with gauge-bars set at the required depth.

The nature of the materials to be dealt with, and the rate and cost at which they can be removed, are also well known from actual experience in the dredging now in hand, and from borings to greater depths at doubtful points.

This information shows that there would be no special difficulties met in the proposed further deepening, and that it would simply be $2\frac{1}{2}$ feet deeper cutting in all places already dredged over, and an extension in area due to other places where there are shoals with over 25 and less than $27\frac{1}{2}$ feet depth of water.

For the larger vessels which would be expected to use the deeper channel, all bends and places of any special difficulty in navigation would also require to be widened out to one and a half times to twice the width of the straight dredged channels which are generally 300 feet in breadth.

The floating plant on hand and engaged in the present deepening would be adequate in extent, and in the main well adapted to the further deepening, but some alterations in the dredges would be necessary to enable them to reach the extra depth without loss of time during high water. It would be wise also, if the increased work be undertaken, to strengthen and improve them, so as to enable them to work more rapidly, and thus lessen both the cost and time for the completion of the work. Their efficiency has already been improved to about two and a half times greater than at the commencement of the recent work, and though not now surpassed by any dredges of which records are obtainable, they could, at a

reasonable cost, and by special adaptations to their work, be still further improved in their working rate.

If this be done, the work could, I estimate, be completed in five summers' dredging.

As regards cost, the expenses of the dredging fleet for the past few years have averaged about \$140,000 per annum; but with heavier repairs, as the vessels grow older, and the increased prices of labour and fuel, it would not be safe in future to reckon upon less than \$160,000 a year.

Upon this basis I estimate that the cost of increasing the depth of the Channel from 25 feet at ordinary low water, as now in progress, to 27½ feet as proposed, and for a width of 300 feet in the straight portions and 450 to 600 feet in bends and difficult places, would be:—

For improving the dredging plant.....	\$ 60,000
Working and maintaining the same 5	
years, at \$160,000 per annum.....	800,000
	\$860,000

I may add, as bearing upon the matter, that the cost of the new dredging plant specially purchased for the deepening to 25 feet now in progress, together with the equipment of the Ship yard and Shops at Sorel is.....\$534,810

In addition to this there has been appropriated to the work, dredging plant formerly on hand to the value of about..... 100,000

\$634,810

Yours respectfully,

(Signed,)

JOHN KENNEDY,
Chief Engineer.

N.B.—Accompanying this is a small scale profile showing the principal points at which deepening would be required.

SAN GABRIEL, CALIFORNIA,
20th January, 1883.

JOHN KENNEDY, ESQ.,
Chief Engineer,
Harbour Commissioners, Montreal.

DEAR SIR,

I beg to acknowledge the receipt of your letter of 21st ult., informing me that you are directed to ask, for the information of the Harbour Commissioners, my opinion "as to the feasibility of deepening the Ship channel between Montreal and Quebec to $27\frac{1}{2}$ feet, or possibly to 30 feet, at low water—the effect of such further deepening on the level of water in the Harbour of Montreal and elsewhere—and upon any other point I may deem important." I have received, in connection with this, a Profile of the River bottom, showing character of materials met with in dredging for 25 feet depth. I also learn that test-borings have been made at Point-aux-Trembles, Nicolet Traverse, Port St. Francis, Champlain and Batiscan Traverse, to a depth of 30 feet at low water, and that in all cases the material is practically uniform to this depth; that in certain parts of the Contrecoeur channel, and in many places in Lake St. Peter screw anchors and poles have been put down to a much greater depth without revealing any change. Also that in the shale rock of Cap Charles and Cap la Roche many borings for "lewis bolts" and for blasts have been made to depths of about 26 feet at low water, and a few to greater depths without meeting strata different from those already dredged.

There does not seem to be any reason to doubt the feasibility of deepening the ship channel to $27\frac{1}{2}$ or 30 feet, (the practicability of doing so is undoubted, as it is at most a question of expense) without greater difficulties or greater relative expenditure than have been encountered in the

deepening already attained, and without injurious effects on the levels of the River. The only rock encountered is shale—removable by dredging, and as this is a formation known to be elsewhere of great thickness it is more than probable that it will *everywhere* extend below the 30 feet line, as I understand it has done in some of the cases where borings have been made. So much of the work of deepening the ship channel has already been done, efficiently and economically, that the cost of completion can be closely determined, and to the alterations in the dredges which will be necessary to enable them to reach the extra depth, those you recommend to improve their working rate will no doubt be added, so that the proportional cost of the new work to that which has already been done will not be increased. The great result within the reach of the Harbour Commission can be obtained at a comparatively small expenditure, in consequence of the very large and efficient dredging plant on hand, which has cost over \$600,000, and is in itself nearly half the battle.

I do not think that the deepening of the Ship channel to 30 feet can have any effect on the level in the Harbour of Montreal, because that level is governed by the contraction of the channel at Ile Ronde and the general conditions of the River's breadth and depth thence to Lake St. Peter. The effect at other points (below Montreal, will be extremely slight and local, confined to the points where dredging is done, and will not reduce the navigable depth of the River anywhere. In cutting through a shoal of greater or less extent there will probably be a lengthening of the slope of the surface current or ripple at that shoal at the point where the cutting is made, but no effect will be produced on the surface of the deep reaches above that shoal, the water of which cannot be permanently lowered, so long as there is as much coming into that reach as there is going out of it, which obviously must be the condition of things all over the St. Lawrence

at the same period of time. No amount of deepening at a point can increase the general discharging capacity of the river, which increase could alone lower its levels at that point. Moreover, the dredged channel is insignificant as compared with the general dimensions of the St. Lawrence, a general enlargement of which would be necessary in order to lower its level between Montreal and Lake St. Peter. In this lake where the greatest length and depth of dredging has been done, no permanent lowering of its level can be artificially produced on account of the tide and the great expanse of surface the level of which is not seriously affected by the short duration of the ebb, though subject to variations by freshets, winds and tides. In the 50 miles of river above this lake there are a dozen points where deepening has been done, aggregating about thirteen miles, between 25 and 30 per cent of the whole distance. In the reaches between the points of dredging, the depths range between 40 and 50 feet generally. The River in these sections cannot be disturbed in its regimen by any local effect produced by the dredge on the shoals below them. If more water passes at the dredged channel, less will pass the shoals at other points, and as all the dredged material is dropped in the river it is obvious that it can, if found desirable, be so deposited as to leave the discharging capacity at the shoal as before.

I think, however, that the most satisfactory evidence of the probable effect of increased deepening is that which is afforded by experience. A channel 300 feet wide has been excavated through the bed of Lake St. Peter for a distance of over 17 miles continuously, much of it to a depth of 14 feet below Lake bottom, and a similar channel has been cut through all the shoals above, between this Lake and Montreal, without disturbing the ordinary levels of the St. Lawrence either in the Harbour of Montreal, or elsewhere. If this has been the result of cutting through shoals to the extent of 14 feet, in many cases, there is

little reason to fear the effect of an additional $2\frac{1}{2}$ or 5 feet of deepening.

The river level below Montreal depends upon the levels of the Ottawa and St. Lawrence Rivers above that point, and if lower water than usual has been observed since the dredging operations were far advanced, as in 1879, it will be found to have been general and as unprecedented, above Montreal as above and below it.

As to the general question—the policy of further deepening at the present time—every consideration seems to favor it. Ocean steamers are built and building with a load line requiring more than 25 feet depth of canal, a greater depth being needed in a narrow channel than in a wide one. These vessels should, if possible, be enabled to ascend to Montreal in the interest of the whole Dominion West to the Rocky Mountains. Practically ocean freight with foreign ports will be the same to and from Montreal as to and from any port in the River below it, perhaps more favorable, as Montreal must continue to be the best point for finding outward cargo. The farther the Ocean vessel can come inland, the greater will be the reduction in the cost of through transportation. Glasgow has drawn the Ocean vessel from Greenock, Manchester is seeking to extend ship navigation from Liverpool, and Paris from Rouen, for economic considerations.

The possession of the "Plant" enables the Harbour Trust to continue the work now as fast or as slowly as its available means may determine.

It would be deplorable if this great work of the Ship Channel were stopped at a point where it is so near meeting every requisition which may be made upon it, so near making Montreal accessible for any draft of vessel as the best Harbours on the Atlantic Coast or elsewhere. The depth aimed at from time to time during the last forty years has never yet been with the view of meeting every emergency but has rather been experimental and more a financial than a commercial question. Before 1850 the

depth provided for was $16\frac{1}{2}$ feet at low water. After that date it was decided to extend to 20 feet, not that 20 feet was the proper figure, but it was as much as could be carried at the time, though only a step in the right direction. Up to this time opposition was variously based on the assertion that the channel would fill up, but the success attending the attainment and maintenance of this depth extended it to 25 feet, which, valuable as it is, is insufficient at low water for vessels of 25 feet draught and over, such as are now to be found on the Atlantic. Another 5 feet will certainly be a final demand and no doubt less than that depth will serve for some time to come. In all cases when the shoals are very short, it will be as well to go to the fuller depth at once, as the time for reaching the ground, mooring, etc., and the preparations required, form for a small amount of dredging so large a proportion of the cost.

If what has been undertaken, in the past, was warranted by the then condition of things, *a fortiori*, present prospects and necessities make it imperative that the Chief Dominion Seaport should be placed upon a par with any American one, as to its accessibility by the largest ocean vessels. Montreal, a fresh water seaport, 250 miles above salt water, and nearly 100 miles above tide, is nearer to Europe, the market, and nearer to the great grain and provision areas of this continent, the sources of supply for that market, than any of her Atlantic competitors in that trade, not excepting New York, the great emporium of the export and import trade of the United States. She is the terminus of the longest inland water communication between the Atlantic and those areas, and has two distinct railway systems of the first magnitude, to supplement and perfect her communication with the interior—the Grand Trunk, in full operation, and the Canadian Pacific, an assured reality in the near future, besides the more than probable future extension of the Northern Pacific Railway to tide water by its

shortest route, Sault Ste. Marie and the Ottawa Valley. Nor is it improbable that a Trunk line on the South side of the St. Lawrence will sooner or later connect Northern and Western New York, Western Pennsylvania and Ohio, and points beyond with the coolest route for grain and provisions and the most favorable one for live stock by reason of the extent of river and gulf navigation and the minimum of ocean transit. With such a position and prospect nothing but poverty can warrant any delay in making the Canadian New York accessible to the largest ocean steamers. I fully recognize the grave objection to burdening the commerce of the port with an expenditure for a work which is as much a public one as the canals and harbours above or below it. The rivers and harbours of the inland waters of the United States are recognized as Federal works, and this is the case in Canada with respect to the St. Lawrence at all other points, the navigation of which is exclusively under Dominion control. I believe, therefore, that the entire assumption of this work by the Dominion is but a question of time (and that a very short time) and there is certainly no national expenditure to which the surplus revenues of the Federal Government can be more usefully devoted than that which brings the largest ocean vessels within the greatest possible proximity to the heart of the continent.

I remain,

Your obedient servant,

(Signed), THOS. C. KEEFER.

REPORT
ON THE
ST. LAWRENCE BRIDGE AND MANUFACTURING SCHEME

BY
JOHN KENNEDY, M. INST. C.E.

HARBOUR COMMISSIONERS OF MONTREAL,
CHIEF ENGINEER'S OFFICE,
MONTREAL, December 13th, 1882.

H. D. WHITNEY, Esq.

Secretary-Treasurer

Harbour Commissioners of Montreal.

SIR,

In compliance with instructions from the Board of Harbour Commissioners, and also of the Department of Public Works, conveyed through the Commissioners, I beg to make the following Report upon *The St. Lawrence Bridge and Manufacturing Scheme* usually called *The Shearer Scheme*.

The instructions direct me to report upon the feasibility of the scheme and upon its probable effect upon the Harbour if carried out. By the feasibility of the scheme, I understand not only the practicability of constructing the proposed works, but also the feasibility of attaining the purposes for which the works are designed, and I have therefore considered the question in this sense.

The information furnished me as to the scheme consists of copies of the draft of the proposed Act of Incorporation,

presented at the last Session of the Dominion Parliament, and a Report addressed to the Hon. the Minister of Public Works, on the 18th January, 1882, by Mr. F. Foster Bateman, M. Inst. C. E., Engineer for the projectors. Besides these I have been favored with personal explanations by Mr. James Shearer, the originator of the Scheme, and by Mr. Bateman.

PROPOSED WORKS.

The main features of the Scheme as set forth in the Bill and in Mr. Bateman's Report, are an embankment dam across the main Channel of the St. Lawrence, from the Montreal abutment of the Victoria Bridge to St. Helen's Island, and a high level Bridge across the remaining part of the River between St. Helen's Island and the East or St. Lambert Shore.

The embankment is intended to be "76 feet wide at the top, with a solid masonry wall on the river or upper side, and will be left on the Harbour side in an unfinished condition, at a slope from 3 to 1, until such time as the requirements of the Harbour of Montreal may necessitate from time to time the finishing of portions on that side."

"A highway 30 feet wide, with a trottoir 10 feet wide, and a double track of rails will run along the embankment. The top of the masonry wall on the outer or river side of the embankment, at the point at which it starts (the north-west corner of the west abutment of Victoria Bridge) will be of the same height as that abutment, or about 30 feet above the ordinary level of the St. Lawrence. It will run thence to St. Helen's Island, rising gradually to a height of 60 feet above the ordinary water level, which height it will attain when it arrives at the point at which the proposed bridge will commence."

"The embankment will be provided with three series of controlling sluices. These sluices will be capable of passing into the Harbour 486 million cubic feet of water

per hour, and will be placed at 11 feet 6 inches below the ascertained low level of the water of the St. Lawrence ”

“The embankment will further be supplied with thirty-five sluices, for milling, lifts and manufacturing purposes. These sluices will be capable of discharging into the Harbour about 364 million cubic feet of water per hour. They should be generally superintended and controlled by the Harbour Board, but will be used at the same time independently and without restriction for the above mentioned purposes.”

“The highway and railroad will run along the embankment having connection with the different lines running to Montreal, with a gradient of about 1 to 250 to the point on St. Helen’s Island from which it is proposed to throw the bridge across the river.”

The bridge between St. Helen’s Island and the St. Lambert shore will be 3,050 feet clear length between the abutments, and will have eleven lattice spans of 250 to 294 feet each, or should Government require it, a suspension bridge with four openings will be substituted. The clear height from high water to the bottom of the bridge is shown on the plans as about 48 feet.

It is proposed to remove Moffat’s Island, the old St. Lambert or Grand Trunk Wharf, and all obstructions to the flow of water and ice through the South Channel, or that between St. Helen’s Island and the St. Lambert Shore ; to straighten and widen it at certain points, and excavate throughout its length a navigable channel, which, according to the Bill, shall not be of a less width than 300 feet, with a low water depth of not less than 16 feet.

The Channel between St. Helen’s Island and Ile Ronde, will be straightened and widened, so as to pass a maximum quantity of water of some 85 million cubic feet per hour.

Levees will be built wherever necessary, to prevent the flooding of low lands, either above or below the works.

Power is asked in the Bill for the construction of Basins and Wharves, but their proposed character and position are not defined.

ADVANTAGES CLAIMED.

The promoters of the scheme, state, in effect, in the preamble to the Bill, and in the Engineer's Report, that the proposed works will, amongst other things, secure the following advantages :—

1. Increased Harbour accommodation in the Port of Montreal.
2. The rapid current of 12 miles an hour between Sous le Mont and Ile Verte will be completely done away with.
3. The present carrying down of detritus by the ice, and deposit of the same in the deep portions of the Harbour will be stopped, and the sediment formed by local causes may be scoured out at high water by the discharge from the large sluices.
4. The Current St. Mary will be reduced from its present rate of $8\frac{1}{2}$ miles per hour, to a maximum rate of 5 miles per hour.
5. The water in the Harbour will not be lowered, but the Harbour Board will be able to regulate it and keep it at a uniform depth by means of the sluices in the embankment.
6. The packing of the ice in Current St. Mary, and consequent rise of water in the Harbour and lower portions of the City, and the piling of ice on the wharves, will be prevented.
7. The embankment and bridge will allow of railway connection between Montreal and the St. Lambert shore.
8. A footpath and roadway will be provided for foot passengers and ordinary vehicles.

9. Water power will be provided by thirty-five sluices for milling, lifts and manufacturing purposes.

In looking at the scheme as thus sketched out, it appears to me, that as a mere matter of construction and maintenance, the proposed works are entirely feasible. It can hardly be called an easy thing to build the portion of the dam and the sluices which are to be placed in the deep channel, but there are no extreme difficulties in the way. The building of the bridge is a simple matter and presents no difficulties. Neither is there anything in the main features of the design which need make it difficult to secure the details from damage by the action of the ice.

In considering the feasibility of the scheme in the wider sense of producing the physical effects for which it is designed, I purpose to touch upon the above points of advantage claimed by the projectors, and then to deal with other features which appear to me of importance.

1.—*Increased Harbour Accommodation.*

The Bill, in Section 8, asks for power "to construct and maintain locks, gates, sluices, basins, wharves, water-powers, mills, machinery, warehouses, sheds, buildings, elevators, weigh-beams, and all such other work;" and especially "for facilitating the unloading, shipment, storing and handling of merchandise," etc., "such erections being subject to the approval and consent of the Board of Harbour Commissioners of the Port of Montreal."

The powers asked for are merely permissive, and would give the Company the right, under the approval of the Harbour Commissioners, to make basins, wharves. etc., should they choose to do so; but neither here nor elsewhere in the Bill, nor by the plan, do I find that the Company is obliged to construct anything which would, in the ordinary sense, afford increased harbour accommodation. The plan shows an embankment wide enough for railways and roadways, and a line of possible widen-

ing, but no basins nor wharves are shown. Mr. Bateman's Report however explains that it is intended that the embankment "would be left on the Harbour side in an unfinished condition at a slope of three to one until such time as the requirements of the Harbour of Montreal may necessitate from time to time the finishing of portions on that side," and also that, as the removal of Moffat's Island and the excavation in the south channel will not yield sufficient material to finish the embankment, the balance must be taken from the Harbour, and therefore the proposed Company will be able "to offer to the Harbour Commissioners the advantage of deepening the Harbour to whatever depth might be considered necessary within reasonable distance of the proposed site of the embankment, without any considerable extra cost to themselves."

Taking Mr. Bateman's report as indicating the ultimate intention of the Company, and that the Bill may yet be amended so as to include it, it appears to me that the increased Harbour accommodation will at first be merely such increased depth or area of basins as this excavation will make, and at subsequent times, when the embankment may be widened, it will be provided with a line of wharf on its Harbour side.

Mr. Bateman has kindly informed me that he estimates about a million cubic yards of excavation will thus be required in the first instance from the Harbour. In considering how this may be utilized, it appears to me that at first some 100,000 cubic yards will be taken up in lowering the present bottom of the upper portions of the Harbour, in order to compensate for the lowering of the water surface which I think will take place for reasons hereafter given. To get a practical idea of what may be done with the remainder of the excavation, it may be considered as sufficient to make the deep water of the Harber 200 feet wider than at present, from the head of

the Windmill Point Basin to the lower end of Victoria Pier. This, or something equivalent, would be felt as a very great convenience in moving vessels in the Harbour, but it could not be considered as increased accommodation, in the sense of providing more berths for ships. The increase, in that sense, would only be made when the Company, from time to time, finished up portions of the Harbour side of the embankment, and faced them with wharves. The whole, when completed, and without interfering with the Bell, Newton and Fleming scheme, would afford a range of about 6,000 feet, or $1\frac{1}{2}$ miles of new wharfage fronting the City and extending from opposite Black's Bridge to the head of St. Helen's Island. As to access by land, for cartage, its upper end would be distant, for instance, from the Custom House about $1\frac{3}{4}$ miles, or a little farther than the Adams' Tobacco Factory, while the St. Helen's Island end would be $2\frac{3}{8}$ miles, or nearly the same as Ruisseau Migeon, but with the additional disadvantage of the intervening draw-bridges on the Lachine Canal.

The controlling sluices are shown on the plan as arranged in three groups, the middle group facing the Island Wharf, and the others at about 1,600 feet, clear distance on each side. In the intervening spaces, and in the spaces towards the ends of the embankment, are arranged the mill or scouring sluices. Each group of controlling sluices occupies 450 feet, or in all 1,350 feet, and the remaining 4,450 feet of the wharf is occupied with the mill sluices; that is to say, the whole wharfage will be pierced with openings through which it is intended to pour about three-fourths of the low water flow of the St. Lawrence. Each of the thirty controlling sluices is intended to discharge, when needed, 16,200,000 cubic feet of water per hour through a culvert 40 feet wide, and each of the thirty-five mill sluices is to discharge 10,400,000 cubic feet per hour through a culvert 20 feet wide.

The depths of the sluices at the finished outlet are not shown on the plans; but supposing them to be, say 22 feet, or as deep as an ordinary Basin would well allow, the controlling sluices would each discharge a stream of 40 feet wide by 22 feet deep, with a speed of $3\frac{1}{2}$ miles an hour, while the mill sluices would each discharge a stream 20 feet by 22 feet at $4\frac{1}{2}$ miles per hour.

Within the length of an ordinary steamer there would be at least two of the mill sluices, or about five of the great controlling sluices, and it is, I think, obvious that with such powerful discharges of water no vessel could either moor or move in front of them with safety, or in other words the wharf with the sluices as arranged would be unfit for berthing vessels.

A more favorable arrangement of sluices can doubtless be made; but at the best, three-fourths of the water which flows under the Victoria Bridge in autumn must be brought through a wharf which is shorter than the clear opening of the Bridge by two spans, and the flow will certainly create currents of most objectionable kind and strength.

2.—*Abolishing the rapid current of 12 miles an hour between Sous le Mont and Ile Verte.*

The only point thereabouts at which there is a current approaching this rate, is that known as Sault Normand, where the water drops over the side of a shoal and shows as a broken rapid at low stages of the river. This sault is directly below the middle group of the great controlling sluices, and until the shoal is removed the water from the sluices will flow over it, and make, I think, a current practically the same as at present. After the wharf is built and a deep water basin made in front of it, the site of the sault will be occupied by the larger but slower flow from the sluices already described. This will certainly be a consequence of the completion of the scheme, but

it appears to me rather as an incidental matter than a point of advantage in itself.

Altogether clear of the Sault Normand, and Sous le Mont, and between them and Ile Verte, there is the Boat and Raft Channel, the head of the pocket in fact, with a current averaging only $6\frac{1}{2}$ miles an hour through which the river steamers run with ease and very often tow barges besides. This important Channel can hardly be said to be altered by the embankment, for it will be entirely closed, and it therefore forms a feature in the scheme of such moment as to require separate consideration.

3.—*The stoppage of the present carrying down of detritus by the ice and the deposit of the same in the Harbour, and the provision for scouring out local deposit by the sluices.*

The shoals immediately above the Harbour are formed almost entirely of soft rock overlaid in places with boulders and gravel. Boulders even of large size are known to be occasionally lifted by the ice and dropped in the Harbour, and enough gravel is scoured down by the violent currents formed under the ice jams to be felt in the cost of dredging. I cannot, however, think this a matter of serious expense; for it must be remembered that the great bulk of the dredging of recent years has been for deepening the Harbour to keep pace with the deepening of the Ship Channel, and not for merely clearing out yearly deposit. But whether much or little be now brought down, I quite agree with Mr. Batemen that the embankment would effectually stop it for the future.

As to the deposit from local causes, by which I understand sewage deposit, rubbish from ships, etc., which collects at the wharves, I cannot see how the lesser scour which would be obtained from the sluices would clear this out when the winter and spring flood of the river at present fail to do so. On the contrary, it seems to me that the reduced current, especially during winter, would

allow the deposit of some of the sewage matter now swept away.

4.—*Reduction of the St. Mary's Current from its present rate of $8\frac{1}{2}$ miles to a maximum of 5 miles an hour.*

At low water I find the highest mean rate, taken with a loaded rod, of 20 feet depth, and showing fairly what a ship has to stem, to be about $4\frac{3}{4}$ miles at the head of St. Helen's Island; 6 miles at the Canadian Rubber Factory, Papineau Square, and 7 miles at the middle of Ile Ronde, where it attains the highest speed. At ordinary high water of 22 feet on the sill, the rate at Ile Ronde rises to $7\frac{1}{2}$ miles, and at other places in proportion. In every case the speed falls off rapidly towards the shores, and vessels according to their draft can find water at one-fourth to one-third less speed of current. The highest rate at Ile Ronde extends only about a quarter of a mile in length up and down.

With the embankment built and 935 million cubic feet of water per hour flowing past Ile Ronde, the maximum rate of current at the centre at low water would, I estimate, be reduced to about $5\frac{1}{2}$ miles an hour, and at high water it would be reduced to $4\frac{3}{4}$ miles.

These reductions are less than Mr. Batemen gives, but they are enough to be felt as a great relief to slow vessels, and especially to tows in ascending the current. But, troublesome as the current St. Mary is, it does not seem to represent a very serious money loss. An average of four ordinary screw tugs do all the casual towing and moving of vessels of all sorts about the Harbour, and less than half their time is spent in the current, or because of it. The Harbour Commissioners' chain tug, built under special circumstances, expressly to do the towing in the current, and successful mechanically, was found to be unneeded. After lying on her station, ready at signal for two or three seasons with nothing to do, she was withdrawn, and

has been laid up uncalled for during the past four years. With these facts in mind as regards the whole current, it would seem that taking away only about a third of its rate can hardly be of such practical value as to be much felt.

5. *The water in the Harbour not to be lowered, but the Harbour Board, by means of the Sluices, to be able to regulate it to a uniform depth.*

Mr. Bateman makes the present summer fall, or difference in level between the surface of the water at the foot of the Lachine Canal, and the foot of the Current St. Mary, to be 2 feet 3 inches. My own observations make it somewhat less than this, and go to show that it may be taken as between 22 and 24 inches. I find, too, that the swift water of the Current St. Mary does not suddenly lose nearly all its velocity, but at the Hudon Cotton Mill has a rate of nearly 4 miles, and at a mile further down, $3\frac{1}{4}$ miles an hour, and also that on being reduced in velocity at the foot of Ile Ronde it throws up a stationary wave of only about $1\frac{1}{2}$ to 3 inches. From this and the present current rates, I estimate that with the sluices in the embankment discharging 90 per cent. of their intended capacity, or 765 million cubic feet per hour, there would, at time of low water, be about eight inches lower water in the Harbour at the foot of the canal than at present, the loss decreasing to about six inches at the middle of Ile Ronde, and running out to nothing at the Hudon Cotton Mills. At high water of 22 feet on the lock sill, the loss above Military Basin would be 13 to 14 inches, and below that it would run out to nothing at Hochelaga.

These results differ considerably from Mr. Bateman's, as a mere matter of data and calculation, but practically the difference is of little importance; for, at the worst, the loss of 8 inches and under, at the time of low water, could

be easily compensated for in the dredging which must be done to find material for the embankment, and the larger lowering of 13 inches when the river is as high as 22 feet on the sill, or 5 feet above low water, would be rather a benefit than otherwise.

6.—*The prevention of the packing of ice in the Current St. Mary, and consequent rise of water in the Harbour and lower parts of the City, and the piling of ice on the Wharves.*

The packing of ice in the Current St. Mary would, I think, most certainly be stopped by the proposed embankment. If the controlling sluices be kept closed in winter as intended, the whole Harbour from the Hudon Cotton Mill up, would have only about one-fifth the present rate of currents, and would freeze over in a smooth sheet like any other slack water. So much of the rise in the upper part of the Harbour, as is due to ice jams in St. Mary's Current, would also be prevented, but below that matters would probably be just the same as now; for it must be remembered that a frequent cause of the rise from ice jams is the ice gorge *below* St. Mary's Current, and not in it or above it. In the great flood of 1861, when Griffintown, Victoria Square, and St. Paul Street were overflowed, the water at the foot of McGill Street was at the worst only 3 feet 2 inches higher than at Hochelaga, and about half of this would be due to the natural fall between these points.

Gaugings are kept at Hochelaga only occasionally, so that neither averages nor extremes can be got at with exactness, but from a number of isolated measurements and general knowledge of the matter, I should estimate that the higher floods would be one to four feet less with the proposed embankment than without it. This would by no means do away with floods, but it would be a very beneficial reduction.

As regards the lodging of ice on the wharves in the spring, there would with the embankment be no piled up masses as are often left now, but the wharves would overflow from the rise of the river below as at present, and sheet ice forming at the high level would often be left on top of them when the water fell. There would be no current to form piles as now, but there might be plenty of smooth sheet ice instead.

7.—*Providing Railway connection between Montreal and St. Lambert Shores.*

It is obvious that this most important object would be attained, and in what seems to me a most excellent and effective manner.

8.—*Highway and footpath connection between Montreal and St. Lambert.*

This new and important desideratum would also be attained, though perhaps not in quite as convenient a form as could be wished. The great height of the bridge, the length of the combined bridge and embankment, and the position of the shore ends, would, I think, always be felt as disadvantages in so important a thoroughfare.

9.—*Providing Water Power at the Embankment.*

The Scheme would certainly supply water power of great extent and fairly satisfactory character during summer, but in winter it would, I think, be so inconstant as to be practically useless.

During the taking and breaking up of the ice in every autumn and spring, there are periods, varying from a few days to several weeks, when the river at and below Hochelaga and the Boucherville Islands, is nearly or wholly covered with stationary ice, while from there to Lachine, and often through Lake St Louis, there is open

water and running ice. During such times the floating ice brought down by the Lachine Rapids and passed through the Harbour, packs under and amongst the stationary ice and gorges the channel below the City. The hydraulic condition of the river below is also changed from an open channel to a closed one with a double perimeter, and from these causes the surface level rises so as to obliterate the swift current at the site of the embankment ; or in other words, the water power at such times would be drowned out by back water.

Following the drowning out of the current, and after a lapse of time determined by the quantity of running ice, come the great "ice shoves," for which the St. Lawrence at Montreal is noted. A glance at the map of the river and its shoals opposite the City, reveals the causes which make the main body of the water flow strongly towards the Montreal shore, bringing with it fields of ice which are thrown against the bank and piled up in huge masses. From the plan of the scheme too, it will be seen that the line of embankment is almost exactly parallel with the Montreal shore. The main shoals, the deepest water, the set of the current above the dam, and the narrowing in of the river below it, all bear substantially similar relations to each other and to the dam, as the same features do to each other and to the shore opposite the central part of the City ; and plainly the causes which now work to heap up mounds of ice on the City front would hereafter act upon the dam, and would as certainly lodge the ice in similar great masses reaching to the bottom and choking the sluices beyond possibility of usefulness until cleared in the spring.

In all our northern rivers that are used for water power, and do not freeze over, it is well known that more or less difficulty is experienced from anchor ice or *frasil*, but probably in no river is it formed on a grander scale than in the St. Lawrence, and at few places is it gathered in greater quantity than at Montreal.

The long stretch of open and agitated water in and above the Lachine Rapids, supply the required conditions for its formation and storage in vast quantities, and with every rise of temperature masses are detached and swept down and lodged under the solid ice of the Laprairie Basin, the Harbour of Montreal, and the River far below.

Winter surveys in the Harbour, show that nearly the whole area from Victoria Bridge to Hochelaga, is filled to depths of 10, 15 or even 30 feet, and great spaces are often packed full to the bottom. And this occurs not only, nor chiefly, in the slacker currents, but in the fastest as well. In the swiftest part of St. Mary's Current, it is always found, and sometimes in such quantity as to occupy at least one-third of the channel section. Last winter the St. Lambert Channel at the site of the proposed bridge, was also filled so as to reduce it to less than half its effective capacity.

With this enormous supply of *frasil*, and with the current sweeping the front of the embankment, the conditions are precisely such as are requisite to fill the sluices and flumes, and choke fast the gates and water wheels, and thus further contribute to render useless the water power during the winter.

But a scheme of water power fit for use only in summer, cannot be considered a completely, or at least a commercially, feasible one. Few mills or factories using large power, can afford to be idle during winter, and if they cannot have water they must have steam, which in this case would mean steam power four or five months of the year with water wheels and flumes of unusually large size, in order to utilize a very low water fall for the remaining months.

There are some notable examples of factories on the St. Lawrence Canals, where the power is from water part of the year, and steam and water together the remainder, but in these cases the falls are high, and therefore the

wheels and flumes small, construction and land are cheap, and the lease or purchase of water merely nominal. With the present scheme all these would be reversed.

Lifts and warehouses for goods and grain are mentioned as cases in which a summer power only is required, but all that would probably be needed in this way on a mile and a quarter of wharf, would not utilize the power of a single sluice of the size proposed.

OTHER EFFECTS OF THE SCHEME.

Floods from Ice Shoves.

By far the greatest question raised by the Scheme is that of its probable effect upon the height of the River at the time of the great "Ice Shoves." Sir Wm. Logan has vividly described, and clearly discussed the causes of these grand phenomena of the St. Lawrence, and the following extract from his description will greatly assist in considering them in relation to the question in hand:—

"The frosts commence about the end of November, and a margin of ice of some strength soon forms along the shores of the river and around every island and projecting rock in it; and wherever there is still water it is immediately caked over. The wind acting on this glacial fringe, breaks off portions in various parts, and these proceeding down the stream, constitute a moving border on the outside of the stationary one which, as the intensity of the cold increases, is continually augmented by the adherence of the ice sheets which have been coasting along it; and as the stationary one thus robs the moving one this still further outflanks the other, until in some parts the margins from the opposite shores nearly meeting, the floating ice becomes jammed up between them, and a night of severe frost forms a bridge across the river. The first ice bridge below Montreal is usually formed at the entrance of the river into Lake St. Peter, where the many channels into which the stream is split up greatly assists the process.

As soon as this winter barrier is thrown across (generally towards Christmas) it of course rapidly increases by stopping the progress of the downward floating ice, which has by this time assumed a character of considerable grandeur, nearly the whole surface of the stream being covered with it, and the quantity is so great, that to account for the supply, many, unsatisfied with the supposition of a marginal origin, have recourse to the hypothesis that a very large portion is formed on, and derived from the bottom of the river where rapid currents exist.

But whatever its origin it now moves in solid and extensive fields, and wherever it meets with obstacles in its course the momentum of the mass breaks up the striking pack into huge fragments that pile over one another; or if the object be stationary ice, the fragments are driven under it, and there closely packed.

Beneath the constantly widening ice barrier mentioned, an enormous quantity is thus driven, particularly when the barrier gains any position where the current is stronger than usual. The augmented force with which the masses then move pushes and packs so much below that the space kept for the river to flow in is greatly diminished, and the consequence is a perceptible rise of the waters above, which indeed from the very first taking of the "bridge," gradually and slowly increases for a considerable way up.

There is no place on the St. Lawrence where all the phenomena of the taking, packing, and shoving of the ice are so grandly displayed as in the neighbourhood of Montreal. The violence of the currents here is so great, and the river in some places expands to such a width, that whether we consider the prodigious extent of the masses moved, or the force with which they are propelled, nothing can afford a more majestic spectacle or impress the mind more thoroughly with a sense of irresistible power. Standing for hours together upon the bank overlooking St. Mary's current, I have seen league after league of ice crushed and broken against the barrier lower down, and there submerged and crammed beneath. And when we reflect that an operation similar to this occurs in several parts, from Lake St. Peter upwards, it will not surprise us that the river should gradually swell.

By the time the ice has become stationary at the foot of St. Mary's Current, the waters of the St. Lawrence have usually risen several feet in the Harbour of Montreal, and as the space through which this current flows affords a deep and narrow passage for nearly the whole body of the river, it may well be imagined that when the packing here begins, the inundation rapidly increases. The confined nature of this part of the channel affords a more ready resistance to the progress of the ice, while the violence of the current brings such an abundant supply and packs it with so much force that the river, dammed up by the barrier which in many places reaches to the bottom, attains in the Harbour a height usually twenty, and sometimes twenty-five feet above its summer level; and it is not uncommon between this point and the foot of the current, within the distance of a mile, to see a difference in elevation of several feet which undergoes many rapid changes, the waters ebbing or flowing according to the amount of impediment they meet with in their progress, from submerged ice.

It is at this period that the grandest movements of the ice occur. From the effect of packing and piling, and the accumulation of the snows of the season, the saturation of these with water and the freezing of the whole into a solid body, it attains the thickness of ten to twenty feet and even more; and often it has become fixed as far as the eye can reach, a sudden rise in the water (occasioned no doubt in the manner mentioned) lifting up a wide expanse of the whole covering of the river, so high as to free and start it from the many points of rock and resistance offered by the bottom, where it has been packed deep enough to touch it, the vast mass is set in motion by the whole hydraulic power of this gigantic stream. Proceeding onward with a truly terrific majesty it piles up over every obstacle it encounters; and when forced into a narrow part of the channel the lateral pressure it there asserts drives the bodge up the banks, where it sometimes accumulates to the height of forty or fifty feet."

In looking more closely at the physical characteristics which contribute to produce these grand phenomena, it will be seen that after passing the Lachine Rapids with

a fall of some thirty feet, the River widens into the Laprairie Basin, 4 miles in breadth, and is again narrowed by the abutments of the Victoria Bridge to 6,570 feet, or $1\frac{1}{4}$ miles. Opposite Montreal, where divided by St. Helen's Island, it has a width of 1,900 feet in the Montreal channel, and 2,700 feet in the St. Lambert channel, making 4,600 feet, or $\frac{7}{8}$ of a mile total water way, measured at the high water line. Below St. Helen's and Ile Ronde the River unites and passes Longueuil with a breadth of $\frac{7}{8}$ of a mile, and again widens out to the Boucherville Islands which it passes in a main channel $1\frac{1}{4}$ mile wide, and another a quarter of a mile wide. Between the St. Lambert and the old Brassey wharf, just below the Victoria Bridge, the River's breadth is reduced to 5,000 feet, or a little under a mile, (counting in the openings in the St. Lambert pier,) but at high water these wharves are submerged to a considerable depth and floating ice passes freely over them. At Ile Ronde too, where the St. Mary's Current is narrowed, the Island is submerged at high water, and the loss of breadth is made up by the enlargement and deepening of the channel between Ile Ronde and St. Helen's.

The height of the river at which the great ice packs take place, varies very much, but taking 15 feet above low water at Montreal and 10 feet above low water in the Laprairie Basin as common heights, the depth of water over a large area in the central part of the Basin, will then be from 20 to 25 feet, and at the Victoria Bridge 14 to 28 feet. In the Current St. Mary, 1,900 feet wide, the greatest depth will be 65 feet, and the average 35 feet, giving a cross section of water way of about 73,000 square feet. The St. Lambert Channel of 2,700 feet, (or say $\frac{1}{2}$ a mile,) is 26 feet maximum, and 15 feet average depth with 40,000 square feet cross section. In the two channels at St. Helen's, there is therefore at this height of water a sectional area of 113,000 square feet, equivalent to an average depth of $24\frac{1}{2}$ feet over the whole 4,600 feet width.

At Victoria Bridge the sectional area, after deducting the piers, is about the same; at Longueuil it is considerably larger, and at Boucherville it is over twice as large.

As regards currents, the motive power in ice shoves, there is in summer a rate of about $1\frac{1}{2}$ to 3 miles an hour in the main channel through the Laprairie Basin; 3 to 6 miles between the piers of the Victoria Bridge; $4\frac{3}{4}$ to $7\frac{1}{2}$ miles in the St. Mary's Current; $3\frac{1}{2}$ to 4 miles at Hochelaga, and about $2\frac{1}{2}$ miles further down. In winter the packing of the ice into inverted shoals, solid islands and dams of every size, often throws the currents entirely out of their ordinary courses and changes them to any speed from a sluggish flow to a rush of 10 or 15 miles an hour.

The condition of the ice itself and the force with which it is brought down by the currents, are well described by Sir Wm. Logan in the extract already given; but it must be noted, that as regards the Harbour, the ice fields are now limited in their breadth to the 330 and 240 feet which can pass the spans of the Victoria Bridge.

The gorging of the river and the formation of ice dams are, however, not due to the size of the masses, but to their quantity, for only such blocks as can be rolled under the stationary ice are effective in choking up the water channel.

In investigating the practical consequences of ice jams, as distinct from their causes, it appears at once that it is only the floods which accompany the jams that are of serious importance. The movements of the ice itself for the most part occur within well known limits and are easily guarded against, but the floods extend over great and indefinite areas and work serious damage.

For instance, the flood of April, 1861, already mentioned, was caused by the packing of the ice at one or more places about the Boucherville Islands. The water rose until at McGill Street it stood 25 ft. 2 ins. above low water, (42 ft. 2 ins. above the lower lock sill, Lachine

Canal) flooding the low parts of the City and causing great suffering and damage. A considerable part of Longueuil, St. Lambert and Laprairie Villages, and a large area of country on that side of the River, and along the Lower Lachine Road on the other side were also submerged and serious damage done. In April, 1865, another flood occurred, only 1 ft. 6 ins. lower, and with proportionate damage. In April, 1858, a flood occurred from a jam somewhere in the neighborhood of the Victoria Bridge, and the water in the Laprairie Basin was raised to 44 feet above the level of the Lock sill, or about 14 feet above low water, and overflowed more than half the ground from Point St. Charles to half a mile above the St. Pierre Road, and between the river and the Water Works Aqueduct. In January 1857, during a period of unusual cold, a great part of the ordinarily open water of the Lachine Rapids was frozen over, and on the ice breaking loose shortly after, it packed in the upper part of the Laprairie Basin, then partly burst away and reformed at Nun's Island, when the water in the Basin above suddenly rose to 17 feet over low water at the St. Pierre Road, 19 feet at Mr. J. S. Hall's, and 24 feet at Mr. Lesage's. The Lachine Rapids were almost obliterated; the whole country between the River and the Aqueduct overflowed; the Aqueduct banks were sufficiently overflowed to pour river water down the Aqueduct and flood the Water-works Wheel-house; the ice shoved over the river bank and road near Nun's Island, and demolished two houses and did much petty damage.

These and other instances which might be quoted, all go to show that the channels of the river are already too small, that they are liable to be choked with ice in any winter, and the experiences of the past to be repeated.

But in the Scheme it is proposed to close up the Main Channel on the Montreal side of St. Helen's Island, which is two-thirds of the whole water way of the river, and turn its flow through the other third alone.

It is not at all a question of the capacity of the St. Lambert Channel as compared to that of the Montreal Channel ; but as compared to their capacities combined ; and as compared to the capacity of the whole river channel in the vicinity. Whatever increase of capacity the St. Lambert Channel can have given it by the highest permissible rise of water with the completed scheme, it may have and does have now ; and it has the main, or Montreal channel, beside, with all the addition that the same rise of water will make in that too. It is not proposed to do anything of importance towards enlarging the St. Lambert Channel ; for the deepening of a portion for the boat channel will just about compensate for the space taken by the piers of the proposed bridge and will leave its capacity practically the same as now. The water is intended to be raised high enough to force itself through, but no elevation of the surface, within the safe flood level, can give this channel alone a sectional area equal to that of both channels. But it is not a mere question of sectional area, for manifestly the great depth of the central part of St. Mary's current is a safe-guard against its being choked by the ice while a shallow one is especially liable. If however a pack does take place in the deep channel of sufficient extent to retard the water and cause it to rise further up, the St. Lambert Channel comes in to assist, and the two together pass the water with ease.

The bottom of the St. Lambert Channel, even when cleaned out as contemplated in the Scheme, will be higher than the river bottom elsewhere in the vicinity. Apart from the boat channel in it, the bottom will be about five feet higher than the present bed of the river in the main channel above it ; in fact the embankment and the St. Lambert shore may be looked upon as the banks of a huge mill race, and the bottom at the site of the proposed bridge, as the weir over which the surplus water is to pass. Or, to place it in a form which we may more readily realize :— Suppose that eleven of the south-eastern spans of the

Victoria Bridge on the St. Lambert shoals be left open, and that the intended embankment, sluices and all, to be placed from the eleventh to Nun's Island, so as to close the remaining fourteen spans on this side, and to pass the whole river, or at least seven-eighths of it, through the eleven open spans. And, to complete the comparison, suppose the river bank at St. Lamberts to be filled out above the bridge to the end of the abutment, there would then be practically the same condition of things as proposed in the scheme. There would be the same funnel shape for the ice to wedge into, and the same bridge and shallow bottom to obstruct its getting through. With such conditions, and they are fairly similar, any resident of Montreal will readily see the certainty of such ice jams as would produce most disastrous floods over the whole banks of Laprairie Basin.

But returning to the actual scheme; it will be remembered that the controlling sluices are intended to be shut in the fall and kept so until spring, and only the mill sluices, with a nominal discharging capacity of about one-fourth of the river, are to be kept open. The contingency of an ice jam at the proposed bridge suggests the opening of the sluices to pass the surplus water through the embankment, but it is more than probable that such a jam would also choke the mouths of the sluices and render them unfit for use precisely when needed for relief.

It has been suggested that the speed of the current in the St. Lambert Channel, after the carrying out of the Scheme, would sweep the ice through it and prevent a serious block; but Mr. Bateman estimates that the current in the St Lambert Channel would be $1\frac{1}{2}$ miles less, or at most no greater, than that in the St Mary's Current, where so much packing now takes place.

Mr. Bateman's report states that levees will be built wherever necessary, to prevent low lands being flooded, but nothing of the kind is mentioned in the Bill, nor

shown on the plans, and it can hardly be understood that the brief statement in the report would insure the construction of works of the required magnitude. In fact, Mr. Bateman, says that while the proposed works are expected to raise the water at Laprairie only $4\frac{1}{2}$ feet, the lowest land is some 11 feet above present water, and it is therefore impossible that it would be flooded. But it floods already. With all the channels we now have, several square miles of country have been submerged and people have paddled over their farms in canoes.

In view, therefore, of the known choking of the St. Lawrence by ice in the greatly larger, and deeper, and better formed channels in the vicinity of Montreal, I am decidedly of the opinion that to attempt to confine the river to the St. Lambert Channel in winter, as proposed in the Scheme, would cause much greater and more frequent floods, on the banks of the Laprairie Basin and in the neighbourhood of the proposed embankment, than have hitherto occurred.

Deviation of the Navigable Channel between the Harbour and Victoria Bridge.

The new channel which is proposed in compensation for closing the present one, would pass round the south-east side of St. Helen's Island and Ile Ronde, and enter the Harbour at Hochelaga. It would, according to the bill, be not less than 300 feet wide and 16 feet deep at low water, and its greatest current as estimated by Mr. Bateman, would not be over 7 miles an hour. It is intended too, that passengers may be landed from the Laprairie and other boats on the up stream side of the embankment.

The breadth and depth of the proposed new channel east of St Helen's, appear to me to be sufficient for the requirements of navigation, and although I am at a loss to see how its current, under the conditions sketched out

in the bill, would not considerably exceed 7 miles an hour, I have no doubt that it could easily be so arranged as to have speeds not exceeding some of those in the present current. Its chief advantage is obviously its circuitous course: it would add $2\frac{1}{2}$ miles to every trip to and from the upper part of the harbour, with the additional disadvantage that there would either be the Current St. Mary, or that in the new channel to be ascended every trip; while now there is a current only one way. Practically, it would amount to about 20 minutes extra running in each down trip, and 30 minutes in each up trip of a boat capable of making 12 miles an hour in still water. Beyond the extra running of boats, and loss of time to their passengers, I see no important objection to the proposed deviation of the channel.

For rafts, the St. Lambert Channel would be equally as good as the present Main Channel, and it would be a benefit of some importance to have them prevented from passing through the harbour.

The plans show a clear headway under the proposed bridge of only about 48 feet, which is 12 feet less than that under the Victoria Bridge, and this is, I think, an objectionable feature in the Scheme.

Although not strictly within the scope of my instructions, it may not be out of place to draw attention to the fact that the wharfage proposed in the Scheme, would be within the boundaries of the Montreal Harbour. The bill, as I understand it, would confer upon the Company independent powers to act as wharfingers at their own wharves, and there might thus be established within the Harbour a system of wharfage, which to say the least, might be very embarrassing to the Harbour Commissioners in carrying out their Public Trust.

Yours respectfully,

JOHN KENNEDY

Chief Engineer.

RECEIPTS AND EXPENDITURE
OF THE
HARBOUR COMMISSIONERS OF MONTREAL.
For the Year 1882.

HARBOUR COMMISSIONERS OF MONTREAL,
Secretary's Office,
MONTREAL, 1st February, 1883.

WM. SMITH, Esq.,
Deputy Minister of Marine and Fisheries,
OTTAWA.

SIR,

I have the honour, by direction of the Harbour Commissioners of Montreal, to forward herewith, for the information of the Honorable the Minister of Marine and Fisheries, statements of the receipts and disbursements of the Trust for the year ended 31st December, 1882.

The receipts from all sources were as follows, viz :

FROM COLLECTOR OF CUSTOMS, MONTREAL :

Wharfage on goods—Inwards	\$118,438 52
“ “ —Outwards	46,821 13
Tonage Dues on Steamships	31,822 21
“ “ Sailing Vessels	8,506 50
	<hr/> \$205,588 36

Brought forward..... \$205,588 36

LOCAL TRAFFIC

Wharfage on goods—Inwards.....	\$4,816 84	
“ “ —Outwards.....	1,103 87	
Harbour Dues on Barges.....	10,127 54	
“ “ Steamers.....	3,069 37	
Commutation “.....	14,762 53	
Received for piling Lumber on Wharves.....	4,118 00	
“ “ “ Coal “ “.....	3,492 68	
“ “ Small Offices “ “.....	793 35	
“ “ Weigh Scales “ “.....	800 00	
“ “ Piling Firewood “ “.....	383 37	
“ “ Penalties.....	75 00	
		<u>\$43,542 55</u>
NET REVENUE.....		<u>\$249,130 91</u>

FROM DOMINION GOVERNMENT:

Received on account of New Channel Operations.....	\$374,000 00	
“ “ Buoys and Beacons (1881).....	7,000 00	
		<u>\$381,000 00</u>

SUNDRY AMOUNTS RECEIVED FOR CREDIT AS UNDER:

New Channel Operations.....	\$1,186 63	
Harbour Dredging.....	2,425 29	
“ Repairs.....	184 79	
Lighting the Wharves—Electric light.....	31 70	
Printing, Advertising and Stationery.....	18 75	
		<u>3,847 16</u>
Rent of Offices in Old Building.....	\$1,260 00	
“ “ New “.....	2,000 00	
		<u>3,260 00</u>
Received from the Quebec, Montreal, Ottawa & Occidental Railway —Car transfer.....	\$1,797 75	
Received from the Province of Quebec—Communi- cation on Railway Ferry.....	2,142 85	
“ “ Cost of Railway Ferry slip.....	4,722 14	
“ “ Interest on Cost.....	71 41	
“ “ Laying Railway Tracks.....	331 70	
“ for Rent of Railway Sidings.....	350 00	
		<u>9,415 85</u>
Interest on Bank Account.....	1,048 70	
		<u><u>\$647,702 62</u></u>
TOTAL RECEIPTS.....		<u><u>\$647,702 62</u></u>

The Expenditure was as follows :

Harbour Survey.....	\$ 431 87	
Harbour Repairs	28,147 13	
		\$28,579 00
New Channel Operations.....		161,111 70
Mrs. John Young—Annuity 1882.....		600 00
Wharfage dues returned		959 57
Accounts written off		124 45
Harbour Dredging.....		37,208 32
Interest on Harbour Debt		110,207 50
Printing, Advertising and Stationery.....		1,394 18
Harbour Expenses.....		25,267 77
Travelling and Incidental Expenses		338 70
Buoys and Beacons.....		6,131 74
St. Lambert Channel—Govt. Survey		879 19
Lighting Wharves—Electric Light, Engine, &c.....	\$1,325 17	
“ “ Electric Light, Working Expenses.....	1,578 57	
		\$2,903 74
Lighting Wharves—Coal Oil.....	479 89	
		3,383 63
Robert Forsyth—Paid for paving.....		2,432 63
CONSTRUCTION ACCOUNT, <i>as under</i> —		
Hochelaga Wharf—Sec. 38 and 39.....	\$15,204 10	
Windmill Point Wharf.....	4,466 00	
Island Wharf	7,482 38	
		\$27,152 48
Harbour Railway.....		17,178 05
Dominion Government Interest.....		70,721 85
		<u>\$493,670 76</u>

The net Revenue for the past year gives an increase over 1881 of \$10,990.60, or say 4½ per cent, which is derived almost entirely from the wharfage on Goods Inwards, amounting to \$118,438.52 as against \$99,266.03, the other items of sea-going traffic show more or less of a falling off. The Local Traffic has increased \$1,886.84.

A copy of the Chief Engineer's Report, which is forwarded to you, gives full descriptions of the wharf building, dredging operations, &c., within the Harbour.

I also send you copies of the following reports: (1st) The Harbour Master's with the comparative statements of the Trade of the Port; (2nd) that of the Superintendent of Pilots; giving particulars to the maintenance of the buoys and beacons on the Rivers St. Lawrence, Richelieu and Rivere des Prairies; and (3rd) that of the Pilotage District of Montreal.

In examining the Harbour Master's statements, it will be seen that the steam tonnage continues to increase, being for

1881,	321 steamers,	of	446,457 tons,
1882,	379 "	"	475,479 "
	<u>58 steamers</u>	and	<u>29,022 tons.</u>

The ratio of steam tonnage to that of sailing ships is now 86 per cent. to 14 per cent. The total sea-going tonnage was 554,692 tons, and the total inland tonnage was 848,780 tons.

The work of deepening the Ship Channel to Quebec to 25 feet at ordinary low water was completed, except at Cap la Roche and Cap Charles, where advantage has to be taken of high tide, and officially tested on 3rd October last. A report on the same for the past year ended 30th June, 1882, was sent to the Department of Public Works as usual.

I have the honor to be,

Sir,

Your obedient servant,

H. D. WHITNEY,

Secretary.

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REPORT
ON THE
WORKS FOR THE IMPROVEMENT & MAINTENANCE
OF THE
HARBOUR OF MONTREAL.
FOR THE YEAR 1882.

JOHN KENNEDY, M. Inst., C. E., *Chief Engineer.*

HARBOUR COMMISSIONERS OF MONTREAL,
Chief Engineer's Office,

MONTREAL, 24th January, 1883.

H. D. WHITNEY, Esq.,

Secretary,

Harbour Commissioners of Montreal.

SIR,

I beg to submit, for the information of the Board of Harbour Commissioners, the following Report upon the works in the Harbour of Montreal, for the year ended 31st December, 1882.

The principal works of the year were the extension of the new wharf at Sections 38 and 39, Hochelaga; the enlargement of the Island Wharf, Section 15; the enlargement and deepening of the Ship Channel through the Harbour; deepening opposite sections 21 to 24; deepening the basins in sections 19, 17, 14 to 12, and 10 to 5.

The chief details are as follows :—

Sections 5 to 10 (Windmill Point Basin).—No increase has been made in the length of the basin, but it has been deepened and widened, chiefly at the lower end, and many loose boulders left by the dredges have been lifted with a stone-lifting barge. The back-filling has been extended up beyond the present upper end of the timber wharf, and four culverts over mill-races have been built in it. An embankment has been made from this to the main shore at Point St. Charles, so as to allow of a track being laid for railway connection with the Windmill Point wharves. Total expenditure for dredging, \$14,296, and for back-filling culverts and embankments, &c., \$6,609.

Section 15 (Island Wharf).—The upper face of the pier and wharf have been widened and straightened, and also extended outward to the line of the outer face of the Island Wharf, and the latter line was extended upward to meet the new line of pier. The upper and outer sides, which formerly consisted of several short straight lengths, have thus been changed into two straight faces of 300 feet and 420 feet in length; 41 lineal feet have been added to the available wharfage front, and 10,610 square feet added to the area of the wharf. The new wharfage is adapted for 25 feet depth of water, and requires only a small quantity of dredging to make it available to this depth. Total cost, \$7,482.

Section 19 (Victoria Pier).—A piece of red granite paving, 748½ square yards in extent, was laid across the pier at the main shore end, where, exposed to severe action of the ice and winter currents, in order to practically test the suitability of such paving for the wharves, and with a view to its adoption on a larger scale if found satisfactory. Cost, \$2,432.

Sections 38 to 40 (Hochelaga).—The wharf commenced in 1880 to fill the gap between the old Hochelaga Wharf

and that at the Hudon Cotton Mill was completed in the past year, with the exception of a small part for back-filling. The total length of the new wharfage thus added is 1,102 lineal feet, with a breadth of 130 feet to 185 feet, and of depth in front of 25 feet to 30 feet at low water. The length added last year was 100 feet of timber work below water, and 581 feet above water, with a corresponding length of back-filling. Total cost of new wharf \$44,015, of which there was expended \$15,184 in 1882.

Railway Track. Sections 12 to 24.—The Harbour Commissioners railway track, which formerly extended from Sections 24 to 36, was continued up to section 12 with steel rails of $57\frac{1}{4}$ lbs per yard. The additional length is 9,790 feet, or $1\frac{7}{8}$ miles nearly, and the cost was \$8,419.

Ship Channel through the Harbour.—The main channel was further deepened and widened to correspond with the deepening at the other points in the River; many loose boulders, left from the dredging of former years, were also removed. Expenditure, \$32,068.

HARBOUR REPAIRS.

In *Section 9 (Windmill Point)* 390 feet of the wharf, which had sunk out of shape, was raised and covered anew. The other repairs for the year have been light, and mainly consisted of ordinary maintenance, and repairs of the wharves and roadways.

The total expenditure under the head of Harbour Repairs has amounted to \$27,962, and compares as follows with that of previous years:—

1875.....	\$16,449
1876.....	35,711
1877.....	26,077
1878.....	18,974
1879.....	18,819
1880.....	17,330
1881.....	16,159
1882.....	27,962

DREDGING.

The Harbour dredges, derricks, and tugs were, as usual, wintered at the Harbour Commissioners' Ship-yard at Sorel, and the scows were wintered at Boucherville Islands.

No. 5 Spoon dredge was hauled out and altered from an ordinary crane to an Osgoode boom dredge, and was at the same time much strengthened in machinery and hull, and generally overhauled. No. 2 derrick was also hauled out and received heavy repairs to the hull. The other vessels received ordinary light repairs. During the summer the tugs St. Peter and St. Louis were put in dry dock for replacing broken screws, and were at the same time caulked and received light repairs below water-line.

As soon as the clearing away of the ice in the spring permitted, the dredging fleet was brought up to Montreal, and all the Dredges, except No. 5, commenced work on the 21st April. No. 5, on account of the alterations was delayed and did not begin work until 12th June. All continued in service until No. 2 was chartered to work at the head of the Carillon and Grenville Canal, and left the Harbour for this purpose on November 14th. The others continued until the 25th November, when No. 6 was sent to Sorel to be hauled out, and was accompanied by No. 4. By the 30th the frost had become so severe that the other two, Nos. 5 and 7, were stopped and also sent to Sorel to winter.

Beside the ordinary service of the Spoon dredges in the Harbour work proper, part of their time during summer was spent in the Ship Channel at Pointe-aux-Trembles *en haut*, and through the Harbour, in doing such dredging as they are specially adapted for.

The number of days in which the spoon dredges were on duty, that is all days except Sundays, from commencing in spring until leaving in the fall, was 147½ days for No. 5 dredge, 152 days for No. 6 (beside the time at Pointe-aux-Trembles), 160 days for No. 2, and 187 and

191 days for Nos. 4 and 7, making an aggregate of 837½ days without deduction for stoppages. The nominal working time is 10 hours per day, which gives a total of 8,375 hours service; but the actual dredging time, after deducting time lost for repairs, changing position, detention by vessels, short days in autumn, and all other causes, is reduced to 7,159 hours, or an average of 85.1% per cent. of the gross time of service, as against 86% per cent. average for the 5 years immediately preceding.

A further rise in the cost of labour and fuel, and the alteration and heavy repairs to No. 5 dredge have again caused the total cost of working the fleet for the year to be high as compared with years before the rise, but the total has not exceeded that of 1881.

The total outlay for working the fleet, consisting of the spoon dredges, unloading derricks, tugs and scows, was \$53,598 and this, as usual, represents the entire cost of working the plant, machinery, repairs, outfit, fuel, wages, salaries, insurance, and all other outlays except interest on capital and depreciation of plant.

The following are the comparative costs and quantities of dredging for 1882, and those of previous years.

YEAR.	COST.	Cubic Yards. Dredged.	Cost per Cubic Yard. Cents.	REMARKS.
1875	\$68,979	151,719	45	
1876	55,462	156,082	35½	
1877	45,103	173,449	26	
1878	48,748	211,731	23	
1879	41,006	189,609	21.63 100	
1880	46,914	186,430	25.16 100	
1881	54,128	170,764	31.69 100	
1882	53,598	187,339	28.61 100	Average.
	13,254	9,429	\$1.40.6 10	
	66,852	196,768	33.96 100	

The following are the cost and character of the dredging done in the different parts of the Harbour during the year :

Sections 5 to 10 (Windmill Point Basin).—Extending, widening and deepening the basin ; chiefly shale with trap veins, the remainder hard pan and boulders. Depth of water at time of dredging : mostly 25 to 30 feet, with some portions 8 to 20 feet ; quantity dredged, 31,189 cubic yards, measured loose on the scows, costing \$14,296, or an average of 45⁸³/₁₀₀ cents per yard.

Sections 12 to 14.—Chiefly clearing off small lumps and boulders from ground previously dredged, hard pan, clay, gravel and boulders, 20 to 28 feet depth of water ; 40,006 cubic yards, cost \$12,565 or 31⁴⁰/₁₀₀ cents per yard.

Section 14 (Elgin Basin)—Clearing out, deepening and preparing site for crib work ; sand, gravel and sewage deposit ; 25 to 27 feet depth of water ; 900 cubic yards costing \$247 or 27¹/₂ cents per yard.

Sections 16 and 17.—Cleaning off small lumps, sand, gravel and boulders ; 25 to 27 feet depth of water ; 1,665 cubic yards, costing \$371 or 22³⁰/₁₀₀ cents per yard.

Section 19 (Bonsecours Basin).—Deepening the basin to 25 feet at low water ; sand, gravel and soft mud ; 25 to 27 feet depth of water ; 8,842 cubic yards, costing \$1,609, or 18⁰/₁₀₀ cents per yard.

Section 20 (Military Basin).—Cleaning off lumps and lifting boulders ; sand, gravel and boulders ; 25 to 30 feet depth of water ; 4,027 cubic yards, costing \$774, or 19⁸⁰/₁₀₀ per yard.

Sections 21 to 24 (Commissioners Wharf).—Cleaning off lumps and small shoals ; sand and gravel, with some boulders ; 25 to 30 feet depth of water ; 29,227 cubic yards, costing \$4,920, or 16⁰/₁₀₀ cents per yard.

Ship Channel (opposite Secs. 13 to 22).—Cleaning off small lumps and lifting boulders; sand and gravel with boulders, and in some places small stones and boulders only; 25 to 28 feet depth of water. Quantity lifted by spoon dredges, 71,483 cubic yards, costing \$18,815, or 26 cents per yard. Besides this there was lifted by elevator dredges and stone lifters 9,427 cubic yards, costing \$13,254, or \$1.40⁵ per yard.

Yours respectfully,

(Signed)

JOHN KENNEDY,

Chief Engineer.

ABSTRACT of DREDGING done in different parts of the HARBOUR of
MONTREAL in 1882.

PLACES WHERE DREDGES WORKED.	DREDGES.	Quantities dredged at each place.	Totals dredged.	REMARKS.
		<i>Cubic yds.</i>	<i>Cubic yds.</i>	
Sections 5 to 10	Dredge No. 2 ...	4,005		
Windmill Point Basin...	" No. 4 ...	7,796		
	" No. 5 ...	11,002		
	" No. 6 ...	8,133		
	Stone-lifter, No. 1	253	31,189	Shale rock & hard pan, with gravel, sand and boulders.
Sections 12 to 14	Dredge No. 4 ...	25,751		
	" No. 5 ...	13,916		
	Stone-lifter No. 1	339	40,006	Hard pan, clay, gravel and boulders.
Section 14, Elgin Basin ..	Dredge No. 4 ...	900	900	Sand and sewage deposit
Sections 16 and 17	Dredge No. 7 ...	1,665	1,665	Gravel and sand.
Sec. 19, Bonsecours Basin	Dredge No. 2 ...	8,842	8,842	Gravel and sand.
Sec. 20, Military Basin ..	Dredge No. 7 ...	4,027	4,027	Sand, gravel and bould- ers.
Sections 21 to 24	Dredge No. 7 ...	29,257	29,227	Sand, gravel and bould- ers.
Ship Channel	Dredge No. 2 ...	29,160		
Sections 13 to 20	" No. 5 ...	2,723		
	" No. 6 ...	11,722		
	" No. 7 ...	27,878		
	" No. 8 ...	6,870		
	" No. 9 ...	2,100		
	" No. 10 ...	360		
	Stone-lifter No. 1	77		
	" No. 2	22	80,912	Sand, gravel and bould- ers.
Total			196,768	

ABSTRACT OF DREDGING DONE BY EACH DREDGE IN THE HARBOUR OF MONTREAL IN 1882.

DREDGES.	Com- menced working.	Stopped working.	Time of Ser- vice.	PLACES AT WHICH DREDGES WORKED.	Quantity dredged at each place.	Total Dredged.	REMARKS.
Spoon Dredge, No. 2.	April 21.	Nov. 14.	Days. 160	Section 5 to 10, Windmill Point.....	Cubic Yds. 4,005	Cubic Yds.	Shale rock, hard pan, with gravel, sand and boulders.
				" 19, Bourseours Basin.....	8,842		Gravel and sand.
				" 13 to 20, Ship Channel.....	29,160		Sand, Gravel and boulders.
Spoon Dredge, No. 4	April 21..	Nov. 25..	187	" 5 to 10, Windmill Point.....	7,796	42,007	[boulders, Hard pan, clay, gravel, sand and boulders.
				" 12 to 14, Allan's Basin.....	25,751		
				" 14, Elgin Basin.....	900		Sand and sewage deposit.
Boom Dredge, No. 5.	June 15..	Nov. 30..	147½	" 5 to 10, Windmill Point.....	11,002	34,447	[boulders, Hard pan, clay, gravel, sand and boulders.
				" 12 to 14, Ship Channel.....	13,916		
				" 13 to 20, Ship Channel.....	2,723		Sand, gravel and boulders.
Boom Dredge, No. 6.	April 21..	Nov. 25..	152	" 5 to 10, Windmill Point.....	8,133	27,641	[boulders, Hard pan, clay, gravel, sand and boulders.
				" 13 to 20, Ship Channel.....	11,722		
Spoon Dredge, No. 7.	April 21..	Nov. 30..	191	" 16 and 17.....	1,665	19,855	Shale rock, hard pan, with gravel, sand and boulders.
				" 20, Military Basin.....	4,027		Sand, gravel and boulders.
				" 21 to 24, Commissioners' Wharf.....	29,227		Do. do. do.
				" 13 to 20, Ship Channel.....	27,878		Do. do. do.
El'vat'r Dredge, No. 8			62	" 13 to 20, Ship Channel.....	6,870	62,797	Do. do. do.
Do. do. No. 9			59	" 13 to 20, Ship Channel.....	2,100	2,100	Do. do. do.
Do. do. No. 10			10	" 13 to 20, Ship Channel.....	360	360	Do. do. do.
Stone-Lifter, No. 1			133	" 12 to 14, Allan's Basin.....	339		
				" 5 to 10, Windmill Point.....	253		
				" 13 to 20, Ship Channel.....	77		Boulders.
Do. do. No. 2			7	" 13 to 20, Ship Channel.....	22	669	
Total						22	Boulders.
						196,768	Boulders.

HARBOUR COMMISSIONERS' DREDGING PLANT EMPLOYED IN THE HARBOUR OF MONTREAL, 1882.

DESCRIPTION OF VESSEL	HULL			ENGINES.				Capacity of Bucket.	Depth to which Dredge can work	REMARKS.	
	Length over all.	Breadth of Beam.	Depth of Hold.	When Built.	Kind of Engine.	No. of Cylinder.	Diameter of Cylinders.				Length of Stroke.	Pressure of Steam.
DREDGES.											
Crane Spoon Dredge, No. 2.	77.0	26.6	6.3	1872	Horizontal, non-condensing.	1	12	16	40 to 70	32	Wooden Hull,
" " " No. 4.	77.3	27.0	6.6	1873		1	14	16	40 to 70	32	" "
Boom Spoon " No. 5.	77.6	27.0	6.6	1874		1	14	16	50 to 85	40	Altered in 1882.
Crane " " No. 6.	77.0	27.0	7.6	1874		1	14	16	40 to 75	40	Altered in 1881.
Crane " " No. 7.	77.3	27.0	7.0	1874	1	14	16	40 to 70	70	32	
DERRICKS.											
Clam Shell Derrick, No. 1.	56.8	23.9	5.9	1872	Horizontal, non-condensing.	1	8	12	60 to 70	.....	Used as a Pile-driver
" " " No. 2.	57.0	23.6	5.9	1875		2	7	12	60 to 90	.....	Wooden Hull.
" " " No. 3.	61.9	24.0	5.9	1875	1	10	12	60 to 90	.....	.....
TUG BOATS.											
Tug St. Louis.	67.0	15.0	8.7	1875	Vertical, non-condensing.	1	16	20	85 to 95	.....	Wooden Hull.
" " St. Peter.	71.6	16.6	8.6	1875		1	20	22	80 to 90	.....	" "
" " St. Paul.	65.6	15.0	8.0	1875		1	16	18	80 to 100	.....	" "
BARGE.											
Staghound, floating shop.	103.4	21.5	7.6	1869	.....	.....	.....	.....	.....	.....	Wooden Hull.
SCOWS.											
7 Dumping Scows.	80.0	16.0	7.6	1875	.....	.....	.....	.....	.....	.....	All Wood.
3 Flat Scows.	70.0	18.0	5.0	1876	" "
2 " " "	75.0	20.0	5.9	1876	" "
2 " " "	75.0	20.0	6.0	1878	" "
6 " " " various sizes and ages.	" "

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REPORT
OF THE
HARBOUR MASTER OF THE PORT OF MONTREAL
FOR THE YEAR 1882.

CAPTAIN THOMAS HOWARD, *Harbour Master.*

HARBOUR COMMISSIONERS OF MONTREAL,
HARBOUR MASTER'S OFFICE,
MONTREAL, 10th January, 1883.

H. D. WHITNEY, Esq.,
Secretary,
Harbour Commissioners of Montreal.

SIR,

I beg to submit for the information of the Board of Harbour Commissioners, the following as my Annual Report for the year 1882, with comparative statements showing the Number, Tonnage, Classification, Nationality, and the greatest number of vessels in Port at one time; also statements showing the dates of the opening and closing of Navigation, first arrival from sea, and the last departure for sea, with statements showing the number and tonnage of Inland vessels, and the greatest number in port at one time, during the past ten years.

Six hundred and forty-eight (648) sea-going vessels arrived in port during the past season, of the aggregate

tonnage, of 554,692 tons showing an increase of 79 vessels and 22,763 tons in tonnage over the year 1881; of those vessels 384 were built of iron of an aggregate tonnage of 481,429 tons, and 264 built of wood of an aggregate tonnage of 73,263 tons; of inland vessels there arrived in port 5,947, of an aggregate tonnage of 848,780; and a total of 6,595 vessels of all classes, and 1,403,472 tons in tonnage.

There were 21,733,262 feet of lumber shipped for South America this season, in 48 vessels, of the aggregate tonnage of 27,814 tons; showing an increase of 8,903,466 feet, and 11,555 tons in tonnage, and 21 vessels.

There were shipped during the season to the United Kingdom by steamers and sailing-ships, 44,868,125 feet, making a grand total of 66,601,387 feet shipped from this port during the season of 1882.

The increase of wharf accommodation made this year at Hochelaga, has been of great advantage to shippers of lumber; every foot of ground was occupied, and if we had it, shippers would have taken much more; it is expected by those in the trade that we will have a large increase next season.

The coal trade has become another very important business in this port. During the season we had 255,784 tons from the Maritime Provinces; 25,781 tons from Britain, and 175,713 of Anthracite from the United States, making a total of 457,278 tons.

The improvement made to the Island wharf in the Autumn will be of great advantage, as it will give increased accommodation for transient vessels.

JANUARY. The year commenced with navigation open; on the 2nd, the Longueuil Ferry steamer went to winter quarters, and navigation closed; on the 12th sleighing was good; on 24th it was 24° below zero; on the 25th the roads were bushed on the ice.

FEBRUARY set in mild, with good sleighing; on the 10th it was 10° below zero; by the 15th the snow had nearly all disappeared; on 22nd we had one of our old fashioned snow-storms; the latter part of the month was mild.

MARCH commenced mild; the month throughout was very changeable, with flurries of snow; on 31st, Lake St. Louis ice came down.

APRIL commenced cold for the season; on the 3rd, ice shoved; on 11th, Steamer "St. Lamberts" arrived from winter quarters at Boucherville, being the first arrival of the season; on the 27th the Steamer "Montreal" left for Quebec; the month ended fine and mild; the winter throughout was very changeable and disagreeable; we had very little sleighing.

MAY 1st, fine and warm; on 6th the S. S. "Manitoban" arrived at 8 a. m., being the first arrival from sea; the month throughout was cold, with quantities of rain.

JUNE 1st, set in wet; on the 17th the Canada Pacific Railway commenced using the new track on the wharves built by the Commissioners; the month throughout was fine and warm, with occasional showers.

JULY 1st, set in cold with rain; the latter part of the month was warm, with continuous high winds from the westward, and rain storms.

AUGUST commenced fine and warm; on the 6th we had it 90° in the shade; as the month advanced it became much cooler, with north-easterly winds.

SEPTEMBER commenced with showers and cool weather; on the 13th we had frost; the latter part of the month was fine and warm for the season.

OCTOBER 1st, fine weather; on the morning of the 3rd, at 6 a. m., the S. S. "Peruvian" left port with the Commissioners and a number of invited guests for Quebec, for the purpose of inaugurating the new 25 feet channel. The trip

was a great success throughout, all expressing themselves highly pleased, particularly with the treatment they received while on board the "Peruvian." The month throughout was fine, and very dry.

NOVEMBER set in fine and bright, with mild weather; on the 2nd, we had a great change; on the 6th, frost; 24th, rain and snow; the month throughout was cold; temperature on the 30th, 23°.

DECEMBER commenced cold, with snow-storms; on the 9th, very cold; ice making fast; Longueuil Ferry steamer left for winter quarters, navigation closed; 10th, good sleighing; 19th, much colder, to-day water level with the wharves; 21st, crossing at Longueuil; 31st, good crossing at Longueuil, but still open opposite the city; the month throughout was cold, with good sleighing from the 10th.

Yours respectfully,

(Signed)

THOMAS HOWARD,
Harbour-Master.

PORT OF MONTREAL.

Statement showing the Nationality and Tonnage of sea-going Vessels that arrived in Port during the season of 1882, that were navigated by 16,899 seamen :

NATIONALITY.	NO. OF VESSELS.	TONNAGE.
British.....	598	527,400
French.....	5	6,102
Norwegian.....	14	5,771
Belgian.....	4	5,161
German.....	5	2,178
Austrian.....	3	1,850
American.....	8	1,743
Swedish.....	4	1,636
Spanish.....	2	1,288
Danish.....	2	708
Holland.....	2	575
Portuguese.....	1	280
Total.....	648	554,692

PORT OF MONTREAL.

Comparative Statement, showing the dates of the Opening and Closing of Navigation, first arrival from Sea, and the last Departure for Sea, the past ten years.

YEARS.	Opening of Navigation.	Closing of Navigation.	First Arrival from Sea.	Last Departure for Sea.
1873.....	April 25.	Nov. 26.	May 4.	Nov. 21.
1874.....	" 25.	Dec. 13.	" 11.	" 21.
1875.....	May 3.	Nov. 29.	" 9.	" 22.
1876.....	April 27.	Dec. 10.	" 8.	" 23.
1877.....	" 17.	Jan. 2, '78.	April 29.	" 24.
1878.....	March 30.	Dec. 23.	" 20.	" 24.
1879.....	April 24.	" 19.	May 1.	" 24.
1880.....	" 17.	" 3.	" 2.	" 22.
1881.....	" 21.	Jan. 2, '82.	April 29.	" 23.
1882.....	" 11.	Dec. 9.	May 6.	" 21.

PORT OF MONTREAL.

*Comparative Statement, showing the Number and Tonnage of
Inland Vessels that arrived in Port the past ten years, with
the greatest number in Port at one time.*

YEARS.	No. of Vessels.	Tonnage.	Greatest Number in Port at one time.
1873.....	6,751	933,462	296 .....June 8
1874.....	6,855	956,837	301 .....June 14
1875.....	6,178	811,410	256 .....Aug. 4
1876.....	6,083	786,083	262 .....Nov. 9
1877.....	6,333	847,978	258 .....Oct. 3
1878.....	5,502	764,243	261 .....Oct. 15
1879.....	5,698	817,243	227 .....Nov. 6
1880.....	6,489	1,044,380	253 .....July 7
1881.....	6,030	949,380	191 .....Nov. 4
1882.....	5,947	848,780	190 .....Sept. 29

PORT OF MONTREAL.

COMPARATIVE STATEMENT, showing the Number, Tonnage, and Classification of Sea-going Vessels that arrived in Port from the Maritime Provinces the Past Ten Years.

YEARS.	Steamships.	Tonnage	Ships.	Tonnage.	Barques.	Tonnage.	Brigs.	Tonnage.	Brigantines.	Tonnage.	Schooners.	Tonnage.	Total No. of Vessels.	Total Tonnage.
1873.....	91	59,061	6	4,790	36	18,595	6	1,422	36	4,824	98	8,056	273	96,748
1874.....	104	53,903	3	2,046	26	15,681	3	622	42	6,036	108	10,493	286	88,781
1875.....	120	69,544	3	1,874	27	13,180	2	331	35	5,397	92	8,526	279	98,852
1876.....	87	47,199	1	739	30	15,451	4	993	25	4,220	67	7,322	214	75,924
1877.....	72	39,277	5	4,306	25	13,566	3	758	18	2,744	37	3,924	160	64,575
1878.....	42	21,812	2	1,132	32	15,749	3	954	21	4,196	65	6,683	165	50,526
1879.....	62	40,686	2	1,733	59	33,271	1	457	16	3,680	80	8,573	220	88,380
1880.....	88	62,688	3	2,492	59	36,294	1	413	17	5,001	68	6,562	236	113,450
1881.....	104	80,040	1	734	44	10,666	2	553	13	2,502	48	4,883	212	99,378
1882.....	168	136,036	.....	.....	25	15,574	.....	.....	13	2,364	54	5,993	260	159,967

PORT OF MONTREAL.

COMPARATIVE STATEMENT, showing the Number, Tonnage, and Classification of Sea-going Vessels that arrived in Port from the Maritime Provinces the Past Ten Years.

PORT OF MONTREAL.

COMPARATIVE STATEMENT, showing the Number, Tonnage, and Classification of Sea-going Vessels that Arrived in Port the past Ten Years, with the dates of the greatest number in Port at one time each year.

YEARS.	Steamships	Tonnage.	Ships.	Tonnage.	Barques.	Tonnage.	Brigs.	Tonnage.	Brigantines.	Tonnage.	Schooners.	Tonnage.	Total No. of Vessels.	Total Tonnage.	Greatest No. in Port at one time.
1873..	242	245,237	72	65,823	164	75,594	18	4,660	59	8,581	149	12,583	702	412,478	84.....August 28th.
1874..	266	262,096	50	46,938	167	80,677	15	3,928	64	10,688	169	19,096	731	423,423	76.....July 6th.
1875..	256	255,435	40	39,895	138	63,167	17	3,833	53	9,801	138	13,981	642	386,112	60.....August 18th.
1876..	240	262,829	40	37,303	146	66,002	18	4,700	35	5,848	123	14,498	602	391,180	61.....July 24th.
1877..	247	261,764	41	41,904	108	56,909	10	2,560	25	4,987	78	8,735	513	376,859	59.....Oct. 19th.
1878..	207	269,878	44	47,577	113	58,711	9	2,610	34	6,537	109	11,953	516	397,266	45.....June 3rd.
1879..	289	378,353	33	38,412	121	65,223	5	1,404	37	8,560	127	15,017	612	506,969	49.....Aug. 13th.
1880..	354	475,741	42	50,141	143	76,816	11	3,252	41	9,715	119	12,606	710	628,271	67.....August 4th.
1881..	321	446,457	5	4,640	104	60,617	9	2,377	30	6,152	100	11,686	569	531,929	59.....August 18th.
1882..	379	475,679	4	4,330	93	51,195	10	2,702	37	7,182	125	13,604	648	554,692	53.....August 21st.

REPORT
OF THE
SUPERINTENDENT OF PILOTS.

JOSEPH LEVEILLÉ, *Superintendent of Pilots.*

HARBOUR COMMISSIONERS OF MONTREAL,
Superintendent of Pilot's Office,
MONTREAL, 3rd January, 1883.

H. D. WHITNEY, ESQ.,
Secretary,
Harbour Commissioners of Montreal.

SIR,

I beg to submit for the information of the Harbour Commissioners, the following report upon the work done during the season of navigation of 1882, in connection with the maintenance of the buoys and beacons on the River St. Lawrence, between the Harbour of Montreal and Point-aux-Trembles en-bas, also of the buoys on the Riche lieu River and the Riviere des Prairies.

In order to have the Channel properly buoyed as soon as possible after the opening of navigation, preparations were commenced on the 14th April, at the Commissioner's ship yard Sorel, to have the buoys, anchors, &c., ready. It

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may be mentioned here, as stated in my last year's report, that 98 buoys were left in position for the winter.

The first trip of the season lasted from 17th of April to 4th May, during which time all the buoys were thoroughly inspected and wherever necessary replaced by others, and the water-logged ones were taken to the ship-yard, Sorel, but those of lake St. Peter however were found to have been so badly damaged by the ice, that they were condemned for future use. It is satisfactory to be able to state that during the season only about a dozen buoys were lost or destroyed, probably carried away by rafts, steamers' screws or tows.

During the season, eleven other trips of inspection were made, varying in length from two days to a week, according to the number of buoys to be put in position, the amount of work to be done, or the state of the weather. If the weather were stormy, it was found impossible to keep the buoy scow alongside the tug, and consequently work had to be suspended; from this cause twelve days were lost. The final trip of the season for lifting the buoys, on the departure of the last sea-going vessel, was finished on the 30th November, when the tug "John Pratt" went into winter quarters at Sorel.

The following is a list showing the number of beacons and buoys in the Ship Channel between the Harbour of Montreal and Pointe-au-Trembles en-bas, and also the number of buoys left in position for the winter, from which it will be seen there are fewer left down this year than in the previous season, viz : 47 buoys against 97 in 1881 :—

PLACE.	BUOYS.					BEACONS.
	Left down.		Taken up.			
	Iron.	Cedars.	Iron.	Cedars.	Barrels.	
Harbour of Montreal.....				7		
Longue Pte. to Ile Bouchard..				25		
Varenes, Grand Ile						2
Ile Deslauriers						2
Lavaltrie.....	3			15		
Contrecœur.....		9		9	12	6
Lake St. Peter to Sorel	16	12		52		
Becancour and Three Rivers..	1			14		1
Cap Madeleine.....						2
Champlain				4		2
Batiscan and St. Pierre.....				2		1
Pointe Grondine						2
Grondine au Nord.....						2
Cap Levraut.....		2		7		2
Cap la Roche, old channel....				1		
do do new channel....		2	4			
Pouillier Rayer				2		
Cap Charles				2		
Batture Cadieux				2		
St. Croix and Pt. aux-Trembles en bas		2				
Total.....	20	27	4	143	12	22

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RECAPITULATION.

IRON BUOYS, left down	20
" " taken up.....	4
	24
CEDAR BUOYS, left down.....	27
" " taken up.....	143
	170
BARREL BUOYS, taken up.....	12
	206 buoys.
BEACONS, Total	22

It was intended during the past summer to have lifted a large number of chains and anchors which are lying on the bottom of the river at various points, but owing to the press of work it was found impossible to do so; however, it is hoped to raise them all this coming summer.

The buoys on the Richelieu River between St. Johns and Rouse's Point, 9 in number, as well as those on the Riviere des Prairies, 8 in number, were both inspected, during the year and found in satisfactory order.

I have the honor to be,

Sir,

Your obedient servant,

JOSEPH LEVEILLÉ,

Superintendent of Pilots.

REPORT
OF THE
PILOTAGE DISTRICT OF MONTREAL.
FOR THE YEAR 1882.

HARBOUR COMMISSIONERS OF MONTREAL,
Secretary's Office,
MONTREAL, 8th January, 1883.

WM. SMITH, ESQ.,
Deputy Minister of Marine and Fisheries,
OTTAWA.

SIR,

I have the honor to submit herewith for the information of the Honorable the Minister of Marine and Fisheries, the Annual Report of the Pilotage District of Montreal for the year ended 31st of December, 1882.

During the year the number of apprentices was not increased, nor was there any examination for the admission of Branch Pilots.

There are no deaths to record of Pilots on the active list during the year, but two superannuated Pilots have died, viz: Zéphirin Mayrand, on the 15th of January, at Contreccœur, and Henry Côté, on 29th of August, at Montreal.

The following is a list giving the name and age of each Pilot, for and above the Harbour of Quebec, acting under authority of this Commission with the earnings of each during the season of navigation of 1882:—

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No.	NAME.	AGE.	EARNINGS.	REMARKS.
1	F. A. Mayrand.....	63	\$ 488 03	
2	Joseph Leveillé.....	65	Suptd. of Pilots.
3	Hector Hamelin.....	65	627 70	
4	Zéphirin Bouillé.....	54	1,110 77	
5	Placide Gaillardet.....	67	525 05	
6	Cyrille Belisle.....	55	438 27	
7	Adolphe Lisé.....	53	346 42	
8	George Raymond.....	53	708 80	
9	Augustin Naud.....	56	790 74	
10	Hubert A. Belisle.....	52	443 00	
11	Athanase Dufresne.....	49	1,089 01		Pilot Str. Montreal.
12	J. B. Dorval.....	51	283 70	
13	L. N. Bouillé.....	56	1,000 00	
14	Edouard Naud.....	40	913 06	
15	Pierre Gagnon.....	55	963 79	
16	Jean George Belisle.....	43	884 24	
17	Onésime Naud.....	42	913 38	
18	J. O. Hamelin.....	49	1,376 99	
19	Joseph Chandonnet.....	42	888 86	
20	Louis A. Bouillé.....	43	1,143 32	
21	Prudent Baudet.....	41	1,366 29	
22	Elzéar Belisle.....	48	535 14	
23	Joseph Pleau.....	45	1,300 38	
24	Célestin Brunet.....	40	1,341 07	
25	Louis Belisle.....	37	2,266 22	
26	Damase Caien.....	42	234 91	
27	Ulric Groleau.....	35	512 29	
28	Alfred Frenette.....	43	591 08	
29	Alfred St. Amand.....	39	1,075 80	
30	Philippe Bélanger.....	44	1,055 55	
31	Victor Gagnon.....	44	563 30	
32	Narcisse Perreault.....	45	1,121 44	
33	Treffé Toupin.....	35	518 16	
34	Cléophas Auger.....	36	983 69	
35	François Desjordy.....	38	397 33	
36	Ferdinand Labranche.....	37	903 97	
37	David Perreault.....	41	562 32	
38	Alexis Gauthier.....	36	961 43	
39	Louis Z. Bouillé.....	34	1,008 20	
40	Joseph Toupin.....	33	1,285 79	
41	Laurent Gauthier.....	33	1,232 07	
42	Jean Arcand.....	30	1,204 62	
43	Delevoie Naud.....	31	1,202 90	
44	Wilbrod Gauthier.....	31	551 16	
45	Louis Mayrand.....	35	470 19	
46	George Dufresne.....	34	478 78	
47	Norbert Arcand.....	30	945 82	
48	Uldoric Toupin.....	28	567 89	
49	Tancrede Bouillé.....	29	762 65	
	Total.....		\$40,935 62	

The foregoing amount was received from the following sources, viz :—

BRITISH :		
Steamers	\$32,779 58	
Sailing Vessels	5,227 57	
		\$38,007 15
FOREIGN :		
Steamers	\$ 1,067 07	
Sailing Vessels	1,861 40	
		\$ 2,928 47
		\$40,935 62

The following list shows the name and age of each apprentice Pilot serving his time under the authority of this trust :

No.	NAME.	AGE.	RESIDENCE.
1	Alphonse Cossette	34	Champlain.
2	Nestor Arcand	26	Deschambault.
3	Gédéon Groleau	30	Grondine.
4	Néré Belisle	30	Deschambault.
5	Hubert Perrault	33	Montreal.
6	Audilon Portelance	29	Grondine.
7	Leboire Perrault	33	Deschambault.
8	John Naud	27	do
9	Joseph Hurteau	22	Contrecœur.
10	Wilfred Raymond	28	Deschambault.
11	Adolphe Richard	34	Contrecœur.
12	Joseph Langlois	27	Pointe-aux-Trembles(en bas)
13	Edouard Perrault	32	Deschambault.
14	Lydoric Bouillé	25	do
15	Elié Bouillé	23	do
16	N. Edson Angers	32	do
17	Honoré Dusseau	29	do
18	Joseph Dusseau	26	do
19	Narcisse Paquet	28	do
20	Jean Baptiste Nadeau	24	Levis.
21	Arthur Brière	25	Portneuf.
22	Aubert Naud	28	Deschambault.
23	J. Sifroy Labranche	26	Portneuf.
24	Alexis Perrault	20	Deschambault.

It is highly gratifying to be able to state that there were no casualties of any consequence to vessels within this district, nor special complaints against any of the pilots ; and this is especially noticeable as owing to the

opening of the 25 feet channel, vessels were loaded to greater depths than formerly.

The Commissioners have as usual maintained the buoys and beacons in the Ship Channel and the Harbour, as also in the Rivière des Prairies and in the Richelieu River between St. Johns and Rouse's Point.

The following is the Tariff of Pilotage now in force in the Pilotage District of Montreal.

QUEBEC TO MONTREAL, OR VICE VERSA.	UPWARDS.	DOWNWARDS.
Pilotage of Vessels in tow of Steamers, for each foot of draught of water.....	\$2 00	\$2 00
Pilotage of Vessels propelled by Steam, for each foot of draught of water.....	2 50	2 50
Pilotage of Vessels under sail, for each foot of draught of water.....	4 20	2 80
Moving a Vessel from one wharf to another in the Harbour of Montreal, or from foot of the Current St. Mary unto the Harbour...	5 00	5 00

The amount received by the Commissioners as the Pilotage authorities for this District was as follows:—

For poundage 5 per cent on the earnings of Pilots.....	\$2,046 78
Interest on investments.....	2,001 54
Sundries poundage from Sorel for 1881.....	15 22
“ poundage from Quebec, etc., for 1882.....	3 68
	<hr/> \$4,067 22

The disbursements for pensions to old and infirm Pilots and widows of Pilots were..... \$3,031 52

I have the honor to be,

Sir,

Your most obedient servant,

(Signed,)

H. D. WHITNEY,

Secretary.

REPORT
UPON THE
DEEPENING OF THE SHIP CHANNEL
BETWEEN
MONTREAL AND QUEBEC
For the Year 1882.

JOHN KENNEDY, M. Inst., C.E., *Chief Engineer.*

HARBOUR COMMISSIONERS OF MONTREAL,
Chief Engineer's Office,
MONTREAL, 5th February, 1883.

H. D. WHITNEY, Esq.,
Secretary-Treasurer.

SIR,

I beg to submit for the information of the Harbour Commissioners the following report upon the work accomplished during the year 1882, in deepening the Ship Channel between Montreal and Quebec.

The object kept in view in carrying on the summer's work was to redeem the promise of some years ago that the 25 feet channel should this year be open for navigation, and special efforts were made that this also should be done as early in the summer as possible, so that its

benefits to navigation might be felt during the low water of autumn. For this purpose two of the largest dredges and a stone lifter, with the tugs attending them, were worked night and day, and the Montreal Harbour dredging fleet was also as far as practicable made to assist the ordinary Ship Channel plant.

The object was so far attained as to allow of the formal opening of the deepened channel, by a trip through it by the Harbour Commissioners and a number of representative gentlemen on board the S.S. "Peruvian," on the 3rd October last. After the depth had been obtained most of the dredging plant was kept employed until nearly the close of navigation, in widening, straightening and otherwise further improving the channel at such points as it seemed most desirable to do so. The channel as it at present stands may be briefly described as having been deepened and tested to a clear depth of 25 feet at low water, of 11 feet on the Flats of Lake St. Peter at all places above Cap la Roche, but at that point and at Cap Charles adjoining, advantage must be taken of a good average tide, to pass with the full depth available elsewhere.

The breadth of the dredged channel is 325 feet in the straight parts in Lake St. Peter between the White Buoy and No. 1 Light Vessel; 300 feet minimum width in the straight parts elsewhere, with increased width at bends and other places where navigation requires.

The places at which the largest quantities of work have been done during the year are: Cap la Roche, Lake St. Peter, Contrecoeur Channel, and Pointe aux Trembles en haut.

The following are the chief details:

Cap Charles.—On the 24th April a dredge and stone lifter were set to work, and during the early part of the summer they went over the channel wherever necessary, re-

moving loose shale rock and boulders to 21 feet 6 ins. depth at ordinary low water. The breadth is 300 feet except at a point near the lower end, where it is only about 270 feet. Quantity lifted, 3,570 cubic yards shale, and 660 cubic yards boulders, scow measurement, or in all 4,230 cubic yards, costing \$6,935, or an average of \$1.64 per yard.

Pouiller Rayer.—All the south side of the shoal from a line 50 feet south of the line of Cap Charles range lights, and parallel with it, was dredged down to 22 feet depth at ordinary low water, and afterwards tested to 21 ft. 6 in. clear depth. An additional strip of 125 feet in width, extending to 75 feet north of the line of lights was passed over by a stone lifter, and the large boulders removed, but it yet remains to be dredged. Very great relief to the lower entrance of the Cap la Roche new channel is afforded by the dredging already done at Pouiller Rayer, but there is much need for carrying it on to 150 feet north of the line of the new Ste. Emilie lights, as ultimately intended.

The dredging, as shown by boring and by that already done, is of clay, with many large boulders on the surface. Total quantity of clay and boulders removed last year by dredge and stone-lifter, 1,601 cubic yards, costing \$2,114 or \$1.32 per yard.

Cap la Roche.—At the close of 1881 a considerable part of the channel had been dredged to 20 feet, a small part to 23 feet 3 inches, and the remainder to an average of 22 feet at ordinary low water. During the past year the whole was deepened to an average of 22 feet, and then passed over again to clear off loose shale and boulders, after which about three-fourths of the channel was tested to a clear depth of 21½ feet, and the remainder to 20 feet 9 inches depth at lowest water. The breadth of channel cut through the rock is 300 feet. At the lower end the boulders are cleared away on the south side, so as to give

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a much wider entrance. Total shale rock and boulders lifted, 33,567 cubic yards, costing \$32,314, or 96 $\frac{1}{4}$ cents per yard.

Champlain Point. (Pointe Citrouille.)—The artificial channel at this point is dredged through a bar of sand about 1,150 feet in width on the line of the 25 feet depth, and running diagonally across from the great Gentilly Shoal to the main land of the north shore. The bar is composed of very coarse loose sand, which is found to move with the current, and on examining the dredged channel last spring it was found to be filled in about 4 $\frac{1}{2}$ feet at the south side and about 1 $\frac{1}{2}$ feet near the north side.

A new channel 350 feet wide, and half its breadth further north than the former one, was therefore cut through the bar during the past summer and tested to 25 feet depth at ordinary low water.

It remains to be seen whether the new cut will not also be filled up, for there is evidently a movement of sand from south to north along the line of the bar, and it is possible the filling will go on as before. Further examination of the conditions of the case will, it is hoped, show what may be done either to avoid or overcome the difficulty should it recur. In the meantime it may be remarked that the shoal is narrow, and at the worst can be dredged through each year at no very serious cost, and also that it is fortunately the only point on the river in which such filling up of the Channel is now to be feared.

The quantity dredged last year was 9,210 cubic yards, costing \$2,766 or an average of 30 cents per yard.

Becancour.—In the Becancour Traverse opposite Ile Dorval, a bar of boulders, overlying clay, was cleared off in the fall of 1881. Last year the work was tested, and a few boulders and points found remaining were removed, and the channel again tested to a depth of 25 feet at ordinary low water, and 300 feet in width.

Port St. Francis. The cuts across the south ends of Batture au Fer and Pouiller la Force, nearly finished in 1881, were last year completed and tested to 25 feet at ordinary low water. The material as in the former work was hard pan with many stones and large boulders. Quantity dredged and lifted by stone-lifters, 2,365 cubic yards, costing \$3,683, or \$1.56 per yard.

Lake St. Peter.—At the close of 1881, there remained to be dredged in the Lake about $1\frac{1}{2}$ miles of the full breadth of the channel above No. 1 Light Ship, $1\frac{1}{2}$ miles of half the breadth just below No. 1 Light Ship, and 2 miles of irregular cutting at No. 3 Light Ship and the Nicolet Traverse. The material in the shoals of the Traverse consisted almost entirely of sand and very tough clay, with many boulders, and the rock-working dredges were employed in its removal.

Dredging was commenced in the Lake at the opening of navigation with four dredges, and in order to push on as rapidly as possible, two of them were worked night and day up to the completion of the work in August. The extra expenses in preparation and in boarding the crews were very considerable, and on the other hand the weather proved so exceptionally stormy that the dredges lost much time, and the work they accomplished was not greatly in excess of the rate of day work alone of ordinary years, so that the cost of that which was done was of course increased in inversed ratio.

The line of the finished channel is the same as that of the 20 ft. channel, with exception of the bend at No. 3 Light Vessel and the line of the Nicolet Traverse, both of which were moved considerably to the north in order to economize work, and to secure more room for vessels which might be carried out of their course by cross currents. In the straight lines above No. 1 Light Ship and below the White Buoy, the breadth is 300 feet, in other straight parts above No. 3 Light Ship it is 325 feet; in the

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Nicolet Traverse it is 450 feet, and at the bends connecting the straight lines it is generally 450 feet. In making the last cut for the 25 feet depth, the bottom of the long pools opposite Yamachiche and at No. 1 Light Ship was reached, and their great value in reducing the quantity of dredging, and in furnishing safe anchorage and turning places for the largest vessels, will therefore not be available in future deepening.

The quantity dredged in the past year was 557,625 cubic yards, at a cost of \$41,496, or an average of 7¹⁰/₁₀₀ cents per yard.

Ile de Grace.—Toward the close of summer an unfinished portion of the north side of the main cut and a point of the shoal on the north side were removed, and the channel finished. The breadth in the main cut is 300 feet. The material, as before, is coarse, loose sand, about 2½ feet in thickness, and beneath that, stiff blue clay. Quantity dredged, 11,670 cubic yards, costing \$2,470, or an average of 21¹⁰/₁₀₀ cents per yard.

Contrecoeur Channel.—The dredging has consisted largely of the removal of the tops of small isolated shoals and lumps found on testing and in cleaning up some places previously dredged. The breadth of the finished channel as it stands is 300 feet in the straight parts, and 450 feet at the bend in the middle of the main cut. The bend at the junction of the main cut with the wide water at the south side of the river is made by a curve of half a mile radius, but the currents are such that this is felt to be too quick a turn for large vessels, and it is therefore much in need of being eased off to about one or 1¼ miles radius. Quantity dredged last year, 67,871 cubic yards, costing \$11,886 or 17½ cents per yard.

Plum Island.—At the depth of 25 feet the shoal water along the Island was connected with that on the south shore of the river by a series of detached lumps of stiff

clay covered with boulders, and these were removed so as to form a clear channel of 400 feet in breadth. Quantity removed, 8,880 cubic yards, costing \$2,272.42, or 25⁴⁰/₁₀₀ cents per yard.

Pointe Marie.—A few small lumps and points of shoals were cut away to straighten and widen the channel and part of the former dredging was run over again. Quantity dredged, 2,790 cubic yards, costing \$988, or 35⁴⁰/₁₀₀ cents per yard.

Varenes.—At the line of the lower lights of Ile Ste. Therese, a few places left from the former dredging were removed, the upper curve was trimmed off and some points found in testing were also removed. Quantity dredged, 8,490 cubic yards, costing \$3,260, or 38⁴⁰/₁₀₀ cents per yard.

Pointe-aux-Trembles to Longue Pointe.—The dredged channel was extended up to deep water near Longue Pointe; the bend at the head of Ile Ste. Therese and the line of the Pointe-aux-Trembles lights were finished, and the piece of rock dredging opposite the village was taken out and the channel generally was tested and completed. The minimum breadth in the straight dredging is 300 feet with an enlargement at the bend to 450 feet.

Quantity dredged, 102,074 cubic yards, clay and small boulders, costing \$20,869, or 20⁴⁰/₁₀₀ cents per yard, and 2,820 cubic yards rock and overlying gravel and boulders, costing \$2,166, or 76⁸⁰/₁₀₀ cents per yard.

Hochelaga.—Opposite the lower part of Hochelaga, or about a mile below the Hudon Cotton Mill, a neck of shoal, consisting entirely of large and small boulders, connects the shallow water of the north and south shores of the river, and through this a channel of 450 feet wide was made with dredges and stone lifters. Quantity of stones dredged and grappled, 5,025 cubic yards, costing \$6,620, or \$1.31¹/₂ per yard.

Montreal.—The greater part of the main channel through the Harbour was tested and run over by dredges, and cleaned of boulders and small lumps. Quantity dredged, 80,912 cubic yards, costing \$32,069, or 38⁰⁰/₁₀₀ cents per yard.

Abstracts of the quantity dredged at each place and by each dredge, together with other information as to the work, will be found in the annexed tables.

COST OF DREDGING.

The cost of working the dredging plant for the past year has been increased over that of other recent years by further advances in the cost of labour, fuel and stores and by night work on two of the dredges and their tugs. The quantity of work done in cubic yards is on the other hand much reduced from the fact that the dredging was for the most part merely cutting off tops of small isolated shoals, spread over great lengths at the margin of the larger shoals, which required that the dredge should pass over a larger area of ground for sometimes only a few stones and scow loads of earth.

The total amount expended for the past year, including repairs, outfit, fuel, wages, salaries, insurance, and every expense except interest and depreciation of plant, was, for the Ship Channel fleet proper, \$151,223, and for the Montreal Harbour plant employed in the channel, \$20,981, or in all \$172,204. The quantities dredged are 851,837 cubic yards earth, etc., and 47,398 cubic yards rock and boulders, making an aggregate of 899,235 cubic yards. Compared with the previous years, since the resumption of the Ship Channel deepening, the cost and quantity of work done are as follows :

YEARS.	No. of Dredges.	Quantity Dredged, cubic yds.	Total cost.	Average cost per cubic yard.
1875	7 elevators..	820,773	\$134,744	16 $\frac{4}{10}$ cents.
1876	8 " ..	922,808	130,744	14 $\frac{1}{10}$ "
1877	7 to 8 " ..	1,262,308	137,830	10 $\frac{8}{10}$ "
1878	8 elevators..	966,973	\$124,891	12 $\frac{9}{10}$ " }
	1 to 3 spoons..	117,663	24,125	20 $\frac{5}{10}$ " }
		1,084,636	\$149,016	13 $\frac{8}{10}$ " }
1879	8 elevators..	813,391	\$135,519	16 $\frac{66}{100}$ " }
	2 to 5 spoons..	29,819	7,835	26 $\frac{26}{100}$ " }
		843,210	\$143,354	17 " }
1880	8 elevators..	1,171,757	\$136,537	11 $\frac{65}{100}$ " }
	2 to 4 spoons..	47,474	10,500	22 $\frac{11}{100}$ " }
		1,219,231	\$147,037	12 $\frac{5}{100}$ " }
1881	8 elevators..	1,375,251	\$149,141	10 $\frac{84}{100}$ " }
	1 to 4 spoons..	78,537	18,160	23 $\frac{12}{100}$ " }
		1,453,788	\$167,301	11 $\frac{43}{100}$ " }
1882	7 elevators..	824,932	\$151,223	18 $\frac{36}{100}$ " }
	2 to 4 spoons..	74,303	20,981	28 $\frac{23}{100}$ " }
		899,235	\$172,204	19 $\frac{15}{100}$ " }

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The measurement of the quantity dredged is by tally of the scows, which, when filled level, hold 80 to 150 cubic yards, for the ordinary and large sizes respectively, but are reckoned at 60 and 120 cubic yards each, to allow for imperfect filling.

DREDGING PLANT.

The working plant employed consisted of the following vessels:

Three Elevator Dredges for working rock..Nos. 10, 11 & 13.
 Two " " for earth &c..... Nos. 3 & 9, small buckets.
 Two " " " "Nos. 8 & 12, large buckets.
 Three to four Spoon Dredges, during part of season.
 One side-wheel Tug.
 Eight to ten Screw Tugs.
 Two stone-lifting Barges.....Nos. 1 and 2.
 Five Barges (coal tenders and smiths' shops.)
 One boat for boarding night crews.
 Eighteen hopper bottom scows.
 Three to eight flat scows.

The elevator dredges, which constitute the Ship Channel fleet proper, commenced work at dates between April 19th and 24th, and continued work until dates between November 18th and 30th. Dredges 8 and 12, and stone-lifter No. 2, to expedite the work, were worked night and day from 29th April to 10th August, and from 15th May to 23rd September respectively, and the remainder of the plant was, as usual, worked during day only.

The number of days on duty, reckoning all except Sundays, from the date of leaving winter quarters to that of returning, and counting a night and a day on the night and day dredges as two days, was 180 to 191 days for the dredges which worked in day-time only, and 280 and 286 days for the two which worked for day and night; and the aggregate for the whole seven during the season was 1,504 days, or an average of 214 $\frac{2}{3}$ days each.

The nominal working hours during the long days of summer are 12 hours for the day dredges, and 11 hours

per shift for the night and day dredges; but the actual dredging time is reduced by short days in autumn, early stoppages on Saturdays, time lost in storms, changing positions, accidents, repairs and delays of all kinds, so that the time during which the dredges were actually dredging was 10,339 hours, or an average of $6\frac{7}{8}$ hours per day for the whole season.

The conditions under which the year's work has been done, have been very unfavorable indeed for showing large results in quantity of material dredged, or low cost per cubic yard; but on the other hand, the completion of the 25 feet channel and the closing up of the work, at least for the present, made it necessary that a very great extent of ground should be traversed by the dredges for the purpose of finding and cutting off the tops of mere lumps and points of shoals, and for clearing stones and loose obstructions found in testing both new places and former dredging. As previously noted too, the expenses have been somewhat large, owing to increased cost of labor, fuel and stores, while winds of unusual frequency and violence throughout the first half of the summer, caused much loss of time to the dredges on Lake St. Peter, and particularly to those working at night. These conditions have all contributed to reduce the quantity of work measured in cubic yards, and in the inverse ratio to swell its cost; but if it could be rated by the square mile of surface traversed, and cleaned, it would show a very favorable result.

The dredges and other vessels of the working fleet have been free from accidents worthy of note, except that the tug St. John caught fire, and was damaged to the extent of \$432; and the tug St. Francis became entangled in the anchor chains of a dredge, in a strong current, and broke her screw and lost the rudder.

The old No. 1 dredge, with machinery built in 1832, and so far as known, the pioneer dredge on the River St.

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Lawrence, could not be worked in the channel, in the past year, from the dredging having all become beyond its depth.

The wooden hull, and especially the framing of the machinery had also become too rotten for further safe use; the boiler was completely worn out, and the engine, though in all essential respects as good as when built, and a fine example of the ornamental design and faithful workmanship of its day, was not adapted for modern high speeds or high pressure steam. The dredge was thus unfit for further service as it was, the machinery not worth a new hull, and she was therefore reluctantly broken up in October last.

The old wooden hull tug, John Brown, built in 1857, and the first screw tug owned by the Harbour Commissioners, had also become unfit for further service, and she was disposed of last May, in exchange for the coal barge Alfred Demers.

With the exception of the old No. 1 dredge and the tug John Brown, which were wintered in dry dock in Montreal, all the dredges and tugs were wintered in 1881-2, at the Harbour Commissioners' Ship-yard, Sorel, and the necessary repairs were, as usual, done at the Commissioners' Works. The barges, scows and other vessels without machinery were chiefly wintered at Chenal du Moine.

The following are the principal repairs made upon each vessel during the past year.

Dredge No. 3.—Boiler heads moved in and tubes shortened and replaced; light repairs to many parts of engine and machinery; light repairs to hull.

Dredge No. 8.—Light repairs to winches and other parts of machinery; new bulk-head behind shoot.

Dredge No. 9.—Steam feed-pumps and winches overhauled and repaired; sundry repairs to main engine,

machinery, boilers and shoot ; smoke-stacks renewed ; light repairs to deck, main framing and bucket-frame.

Dredge No. 10.—Steam feed and shoot pumps overhauled and repaired in several parts ; steam winch and breasting gear repaired ; upper tumbler re-keyed, and lower tumbler replaced by a new one ; bucket frame repaired ; deck nearly all replanked, and beams over boilers renewed.

Dredge No. 11.—Bow and breasting winches received considerable repairs, new ends on shafts of bucket-rollers and new bushes in boxes ; light repairs to boilers, smoke-stacks and shoot ; bucket frame had light repairs.

Dredge No. 12.—Winches overhauled and several parts renewed ; condenser of main engine repaired ; boiler patched ; bucket frame repaired ; new posts in frame across centre of well ; deck repaired.

Dredge No. 13.—Feed and shoot pump repaired ; bow winch repaired ; breasting gear repaired. New upper tumbler with steel plate sides on oak packing and oak packing between eye and shell ; new dead eyes for supporting head of bucket frame ; boilers repaired ; shoot nearly all renewed ; wooden bulkhead and blocking behind and under shoot also renewed ; bucket frame repaired.

The following buckets, bucket links, pins, &c., were made and distributed amongst the dredges as required :—

211 buckets, small size, for earth dredges, repaired.

7 “ large size, “ “

12 toothed buckets, small size, for rock dredging repaired.

12 smooth lip buckets, small size, for rock dredging, repaired.

4 new buckets, small size, made for rock dredging, with steel bottoms and teeth.

52 new bucket teeth for rock dredging.

- 18 new ends on large bucket links.
- 13 " " small " "
- 250 small size bucket links, altered and bushed.
- 40 large " " bushed.
- 90 spare steel bushes for links.
- 800 new link pins.
- 240 new large do.

Steamer John Young.—Crank pins repaired; main and other beam centres re-keyed; boilers received heavy repairs about furnaces; tubes pieced and replaced; gallow frames of working beam repaired; sundry repairs to guards and joiner work.

Tug John Pratt.—Engines thoroughly overhauled and repaired; a number of small parts about the cylinders, valve chests, and valve motion were renewed; feed pump repaired; boiler received thorough repairs, including new crown sheet in furnace and renewal of ends of tubes; heater supplied with new tubes; new coal bunkers put in and a few light repairs to hull and joiner work.

Tug St. John.—Engine fitted with new throttle valve and some light repairs made to other parts. Furnace of boiler and spouting round bottom of furnace entirely renewed. Some tubes entirely renewed, and others renewed in ends, and boiler put in first-rate order generally. Keelson repaired and boiler blocks renewed; new coal bunkers and light repairs to hull in spring. The wheel house, a good part of the joiner work, and deck about the boiler were damaged by fire during summer, and these parts were renewed and repaired.

Tug St. Francis.—New throttle valve, and light repairs to engine; boiler caulked; four new tubes in heater; new timber heads; new coal bunkers and light repairs to hull in spring. In the latter part of summer the screw was broken, and the rudder carried away, from being fouled in the chains of a dredge. The tug was then hauled out

at Sorel and fitted with new screw, new stern bearing and new rudder. The hull was also caulked, and received a few light repairs, which put it in good order.

Tug St. James.—New balance box on back of steam valve; repairs to valve motion and light repairs to several other parts of engine; boiler repaired; tug hauled out at Sorel during summer, for repairs to stern bearing, and at the same time received such light repairs as were necessary to put hull in good order.

Tug C. J. Brydges.—Crank shaft lifted and lined, and couplings repaired; light repairs to boiler; tug hauled out at Sorel for leaks, and caulked and repaired where required.

Tug Minnie F. Parsons.—Hauled out and received heavy repairs to hull during winter, several timbers and about one-fourth of the planking renewed; arched iron tie beam put in across boiler; joiner work repaired and coamings renewed; cylinder bored out and fitted with new piston and steel piston rod; several parts of engine renewed or repaired; new brasses in thrust bearing; boiler caulked. The boat was overhauled in engine, boiler and hull and the whole put in thorough good order.

Tug Delisle.—Light repairs to engine; three patches put on boiler; light repairs to hull.

Stone Lifter No. 1.—Hauled out and wintered on the ways; steam winch altered and improved; new boiler setting; new deck planking and part new beams; additional knees to old deck beams; new rail and part new stancheons.

Stone Lifter No. 2.—Light repairs and some small alterations to winch engines; a set of new iron blocks prepared for inch wire rope; part new rail and stancheons, and repairs to deck.

Barge Waverley.—New tow post ; hull caulked.

Barge Caroline.—Hauled out at Sorel and thoroughly repaired during summer ; part new deck ; new tow posts ; new bits and knees for windlass, and several other repairs.

Barge Dreadnaught.—Caulked and part new deck aft.

Barge Alfred Demers.—Purchased in May and fitted with two new short masts, with gaffs and winches for handling coal.

Scows.—Six scows were hauled out at Sorel and repaired.

BUOYS AND BEACONS.

The buoys of the Ship Channel have been maintained as usual, under the immediate care of the Superintendent of Pilots.

At Cap la Roche an additional large iron buoy was placed on the new channel.

The opening of the 25 ft. channel required not only changes in the positions of some of the ordinary buoys, but also a very considerable addition to their number, in order to mark out both the increased length of dredging and the reduced breadth of natural channel. The effect of this in increasing the cost of the buoyage is already felt in the first cost of the buoys added, and it will hereafter be felt as a permanent increase, not only from the increased number of buoys to be maintained, but from the greater vigilance and accuracy with which they must be kept in place, in order to mark out the restricted area of deep water, and thus secure the safety of the larger vessels.

One pair of large range beacons has been erected below

Cap Madeleine, to mark out the new line of the Becan-
cour Traverse; one pair near Port St. Francis, to mark
out the new line of Nicolet Traverse, and one pair near
Longue Pointe, to mark out the extended line of the
Pointe-aux-Trembles Channel.

Yours respectfully,

JOHN KENNEDY,

Chief Engineer.

ABSTRACT OF DREDGING done at different places in 1882, in deepening the SHIP CHANNEL between MONTREAL and QUEBEC to 25 feet.

PLACES WHERE DREDGES WORKED.	DREDGES.	Quantities dredged at each place.	TOTALS DREDGED.		REMARKS.
			Earth, &c.	Rock.	
Cap Charles...	Dredge No. 11.	Cubic Yards 3,570	4,230	Shale rock and boulders. Clay and Stones.
	S. Lifter No. 2.	660			
Pouillier Rayer	Dredge No. 11.	585	585
	S. Lifter No. 2.	1,016			
Cap la Roche...	Dredge No. 10.	12,420	1,016	Boulders.
	" No. 11.	6,480			
	" No. 13.	12,645			
	S. Lifter No. 2.	2,112			
Champlain Pt.	Dredge No. 3.	9,210	33,657	Shale rock and boulders.
Becancour.....	" No. 3.	15	9,210	Coarse sand.
Pt. St. Francis.	" No. 10.	645	15	Boulders, with some clay.
	" No. 11.	1,395			
	S. Lifter No. 1.	34			
	" No. 2.	291			
Lake St. Peter.	Dredge No. 8.	288,960	325	Boulders.
	" No. 10.	6,165			
	" No. 12.	260,010			
	" No. 13.	2,490			
Ile de Grace...	Dredge No. 3.	3,660	557,625	Soft clay.
	" No. 10.	4,725			
	" No. 13.	3,285			
Contrecoeur Ch.	Dredge No. 3.	32,715	11,670	Sand, silt and clay.
	" No. 9.	33,420			
	" No. 11.	1,725			
	S. Lifter No. 2.	11			
Plum Island...	Dredge No. 3.	8,475	11	Clay, with some stones. Boulders.
	" No. 12.	405			
Pte. Marie.....	Dredge No. 3.	2,790	8,880	Chiefly stones overlying clay.
Varennes.....	Dredge No. 12.	8,490	2,790	Clay, with boulders.
Pte. aux Trem- bles en haut	Dredge No. 3.	34,755	8,490	Clay, with boulders.
	" No. 8.	4,995			
	" No. 9.	21,315			
	" No. 12.	36,255			
	" No. 6.	2,820			
	" No. 10.	4,725			
S. Lifter No. 1.	29				
Hochelaga.....	Dredge No. 8.	2,910	7,574	Shale rock and boulders.
	" No. 9.	2,115			
Montreal.....	Dredge No. 2.	29,160	5,025	Stones and large boulders.
	" No. 5.	2,723			
	" No. 6.	11,722			
	" No. 7.	27,878			
	" No. 8.	6,870			
	" No. 9.	2,100			
	" No. 10.	360			
	S. Lifter No. 1.	77			
	" No. 2.	22			
	Total Earth, } Gravel, &c. }	.....				852,323	.....	99	Boulders.
Total Rock & } Boulders. }	46,912
Gross Total.....	899,235

ABSTRACT OF DREDGING done by each DREDGE in 1882, in deepening the SHIP CHANNEL between MONTREAL and QUEBEC to 25 feet.

DREDGES.	Com- menced working.	Stopped working.	Time of Service	Places at which Dredging was done.	QUANTITIES DREDGED.			REMARKS.
					Earth, Gravel, &c.	Totals.	Rock.	
Spoon Dredge No. 2	.....	.....	<i>Days.</i> 114½	Montreal.....	<i>Cubic Yards.</i> 29,160	<i>Cubic Yards.</i> .....	.....	.....
Elevator Dredge No. 3	April 24....	Nov. 28 ...	188	Champlain Point..... Becancour	9,210 15	.....	.....	Sand, gravel and boulders. Coarse sand. Boulders, with some clay. Sand, silt and clay.
				Contrecoeur Channel..... Plum Island	3,630 32,715	.....	.....	Clay, with some boulders. Chiefly stones overlying clay.
				Pointe Marie	8,475	.....	.....	Clay, with boulders.
Spoon Dredge No. 5	.....	.....	11	Pointe aux Trembles.....	2,790	.....	.....	Clay, with some boulders.
Do. do. No. 6	.....	.....	120	Montreal	34,755	.....	.....	Sand, gravel and boulders.
				Pointe aux Trembles.....	2,723	.....	.....	Shale rock.
Do. do. No. 7	.....	.....	93	Montreal	11,722	.....	.....	Sand, gravel and boulders.
Elevator Dredge No. 8	April 24....	Nov. 30 ...	286	Montreal	27,878	.....	.....	Sand, gravel and boulders.
				Lake St. Peter.....	288,960	.....	.....	Soft clay.
				Pointe aux Trembles.....	4,995	.....	.....	Clay, with some boulders.
				Hochelaga	2,910	.....	.....	Stones and large boulders.
				Montreal	6,870	.....	.....	Sand, gravel and boulders.
Elevator Dredge No. 9	April 22....	Nov. 30 ...	191	Contrecoeur Channel.....	33,420	.....	.....	Clay, with some stones & b'ld'rs.
				Pointe aux Trembles.....	21,215	.....	.....	Clay, with some boulders.
				Hochelaga	2,145	.....	.....	Stones and large boulders.
				Montreal	2,100	.....	.....	Sand, gravel and boulders.
Elevator Dredge No. 10	April 19....	Nov. 30 ...	191	Cap la Roche .....	.....	.....	.....	Shale rock and boulders.
				Port St. Francis.....	645	.....	.....	Hard pan and boulders.
				Lake St. Peter	6,165	.....	.....	Soft clay.
				Ile de Grace	4,725	.....	.....	Sand, silt and clay.
				Pointe aux Trembles.....	.....	.....	.....	Shale rock.
				Hochelaga .....	.....	.....	.....	Stones and large boulders.
				Montreal	360	.....	.....	Sand, gravel and boulders.
<i>Carried forward.</i>	.....	.....	.....	.....	11,895	.....	.....	.....
				.....	537,683	.....	.....	.....
				.....	19,985	.....	.....	.....

ABSTRACT OF DREDGING done by each DREDGE in 1882, in deepening the SHIP CHANNEL between MONTREAL & QUEBEC. — Continued.

DREDGES.	Com- menced working.	Stopped working.	Time of Service	Place at which Dredging was done.	QUANTITIES DREDGED.			REMARKS.	
					Earth, Gravel, &c.	Totals.	Rock.		
<i>Brought forward</i>			<i>Days.</i>		<i>Cubic Yards.</i>	<i>Cubic Yards.</i>			
Elevator Dredge No. 11.....	April 24...	Nov. 24 ...	184	Cap Charles..... Pouillier Rayer..... Cap la Roche..... Port St. Francis..... Contrecoeur Channel..	..... ..... ..... ..... .....	..... ..... ..... ..... .....	..... ..... ..... ..... .....	..... ..... ..... ..... .....
Elevator Dredge No. 12.....	April 24...	Nov. 23 ...	280	Lake St. Peter..... Pium Island..... Varenes..... Pointe aux Trembles..	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....
Elevator Dredge No. 13.....	May 1.....	Nov. 25 ...	180	Cap la Roche..... Lake St. Peter..... Ile de Grace.....	..... ..... .....	..... ..... .....	..... ..... .....	..... ..... .....
Stone Lifter No. 1.....	May 8.....	Nov. 18 ...	51	Port St. Francis..... Pointe aux Trembles.. Montreal.....	..... ..... .....	..... ..... .....	..... ..... .....	..... ..... .....
Stone Lifter No. 2.....	April 24...	Nov. 30 ...	184	Cap Charles..... Pouillier Rayer..... Cap la Roche..... Port St. Francis..... Contrecoeur Channel.. Montreal.....	..... ..... ..... ..... ..... .....	..... ..... ..... ..... ..... .....	..... ..... ..... ..... ..... .....	..... ..... ..... ..... ..... .....
Total Earth, Gravel, &c.....						852,323		4,112	Boulders.
Do. Rock and Boulders.....								46,912	
Gross Total.....								899,235	

DREDGING PLANT employed in Deepening the SHIP CHANNEL between MONTREAL and QUEBEC in 1882.

DESCRIPTION OF VESSEL.	HULL.				When Built.	Tonnage Register.	ENGINES.						REMARKS.
	Length over all.	Breadth of Beam.	Depth of Hold.	Depth of Hold.			Kind of Engines.	No. of Cylinders.	Diam. of Cylinder.	Length of Stroke.	Pressure of Steam.	Capacity of Bucket.		Depth to which dredge can work.
	ft. in.	ft. in.	ft. in.	ft. in.			Inches.	Inches.	Lbs.	C. feet	Feet.		
DREDGES.													
Elevator Dredge No. 3	135 0	20 0	10 0	10 0	1874		16	48	90 to 25	4	35	fin 1869.	
" " No. 8	135 0	20 0	10 0	10 0	1874	Two coupled vertical direct acting condensing engines to each dredge.	20	32	35 to 60	16	35	Wooden hull, re-built	
" " No. 9	135 0	20 0	10 0	10 0	1874		20	32	35 to 60	4	35	" "	
" " No. 10	135 0	20 0	10 0	10 0	1874		20	32	35 to 60	4	35	" "	
" " No. 11	135 0	20 0	10 0	10 0	1874		20	32	35 to 60	4	35	" "	
" " No. 12	135 0	20 0	10 0	10 0	1874		20	32	35 to 60	4	35	" "	
" " No. 13	135 0	20 0	10 0	10 0	1874		20	32	35 to 60	4	35	" "	
STEAMERS AND TUGS.													
John Young	125 0	22 0	8 1	8 1	1875	Independent beam.	2	30	45 to 50			Wooden hull.	
Minnie F. Parsons	76 0	15 0	6 6	6 6	1864	Condensing.	1	18 1/2	70 to 80			" "	
St. Francis	80 0	17 0	7 9	7 9	1875		1	20	70 to 80			" "	
St. John	80 0	17 0	7 9	7 9	1875		1	20	70 to 80			" "	
John Pratt	96 0	19 2	7 3	7 3	1874	Vertical non-condensing.	2	22	70 to 80			" "	
Delisle	62 5	14 9	7 5	7 5	1869		1	14	70 to 80			" "	
C. J. Brydges	62 2	16 0	8 0	8 0	1874		1	18	80 to 95			" "	
St. James	76 0	17 0	8 2	8 2	1875	Vertical compound.	2	20	70 to 95			" "	
BARGES.													
Waverley	130 0	20 11	7 1	7 1	1870							Wooden hull.	
Dreadnaught	104 2	21 5	7 4	7 4	1869							" "	
Caroline	103 8	22 6	3 3	3 3	1864							" "	
Alfred Demers	105 0	22 5	7 6	7 6	1878							" "	
Stone Lifter No. 1	65 0	22 0	6 0	6 0	1858							" "	
No. 2	75 0	24 0	9 9	9 9	1878							" "	
SCOWS.													
2 Hopper-bottomed	80 0	16 0	7 0	7 0	1870							3 hoppers.	
2 " "	80 0	16 0	6 9	6 9	1874							1 " "	
2 " "	54 6	18 0	7 0	7 0	1875	80						2 " "	
2 " "	50 0	19 9	7 3	7 3	1876	89						2 " "	
2 " "	80 0	18 0	7 9	7 9	1879	140						2 " "	
2 " "	80 0	18 0	7 9	7 9	1880	150						2 " "	
3 Flat Scows												Borrowed from Harbour works.	

NOTE.—Different Spoon Dredges belonging to the Montreal Harbour Fleet were, in addition to the above, temporarily employed upon the Ship Channel. Two Flat Scows used for sounding. Barge Hope broken up in April, 1882. Tug John Brown sold in May, and Dredge No. 1 broken up in October, 1882.

IMPROVEMENT
OF THE
SHIP CHANNEL OF THE ST. LAWRENCE
BETWEEN
MONTREAL AND QUEBEC.

Previous to the date of Confederation, 1st July, 1867, the Ship Channel had been improved at various times until at that date there was throughout the whole distance between Montreal and Quebec a minimum width of 300 feet, with a depth of 20 feet at ordinary low water.

Shortly after that the growing trade of the St. Lawrence, and the increasing size of vessels, demanded that the Ship Channel should be further deepened, and an Act was passed by the Dominion Legislature in May, 1873, (36 Vic. Cap 60) authorizing the Government to contract a loan of \$1,500,000 to defray the expenses of completing the Ship Channel from Montreal to tide water above Quebec to a "depth of not less than 22 feet at low water and a width "of not less than 300 feet," the work to be performed under the superintendence of the Department of Public Works, either by the Harbour Commissioners or in such other manner as the Governor-in-Council might determine. It was further provided that the interest on the loan—fixed at five per cent. per annum—and a sinking fund of one per cent., should be paid by the Harbour Commissioners out of the revenues of the Port of Montreal.

Authority was soon after given the Harbour Commissioners to proceed with the deepening in terms of the Act, and the Commissioners determined to carry out the work with their own staff and dredging plant as in the previous deepening. Operations were commenced in the spring of 1874 with one dredge and a stone-lifter, the only suitable plant on hand, and contracts were entered into for the building of six large elevator or ladder dredges, and also for the building and purchase of tugs, scows and other plant required for the work.

The new plant was finished and set to work in the spring of 1875, and was kept steadily at work, during the season of navigation of each year, until the close of 1878, when a minimum depth of 22 feet at ordinary low water had been attained at all points, except between Cap Levraut and Cap Charles where it was necessary to take advantage of the tide.

Up to that time there had been spent for the purchase of new dredging plant \$523,902.26, and for working expenses \$628,610.26, or in all \$1,152,512.52.

It was then decided, in view of the rapid increase of the size and draft of vessels engaged in the Atlantic trade and the moderate cost of carrying on the dredging with plant already on hand, that the deepening of the Ship Channel should be continued to 25 feet at low water.

Improvements and some additions were accordingly made to the dredging fleet, and work was continued till the fall of 1882, when a depth of 25 feet was attained at all places, except at Cap la Roche and Cap Charles, where it is necessary to take advantage of high water of an average tide to pass with the same draft as elsewhere.

It is suspected that there may be insufficient depth at some two or three places below Cap Charles, and that it may be necessary at these points to alter the course of the

Channel or to remove boulders. Surveys are being made by the Department of Public Works with a view to determine what, if anything, is required.

The following are the places at which dredging has been done :—

	English Miles.
Montreal.....	.90
Hochelaga.....	.22
Pointe aux Trembles Channel.....	3.15
Pouillier Varennes—opposite Varennes.....	.15
Varennes to Cap St. Michel.....	1.20
Curve at Cap St. Michel.....	1.35
Pointe Marie.....	.47
Vercheres.....	.05
Plum Island.....	.22
Contrecoeur Channel—upper entrance.....	.51
“ “ main portion.....	3.10
“ “ Ile St. Ours.....	.85
Ile de Grace.....	.50
Lake St. Peter, including Nicolet Traverse.....	17.47
Port St. Francis.....	.22
Becancour Traverse and Bend.....	.32
Champlain Village.....	.35
Pointe Citrouille.....	.25
St. Ann's Shoal and Cap Levraut.....	1.47
Cap La Roche.....	.93
Pouillier Rayer.....	.17
Cap Charles.....	.40
Total for 25 feet channel.....	34.25
Lavaltrie channel, 20 feet deep.....	5.00
Total length dredged.....	39.25

It the straight parts of the Channel between No. 1 Lightship and the White Buoy, Lake St. Peter, the dredging is 325 feet wide; in the straight parts elsewhere it is generally 300 feet, but in bends and all important places it is widened out to 450 feet or more.

The depth of the dredging at all places above Cap la Roche is 25 feet at ordinary low summer water in the River and low water of tides, but at Cap la Roche and Cap Charles there is only this depth at high water of average tides. About the beginning of June the spring freshets increase the depths everywhere above the Riche-lieu Rapids by 5 to 10 feet, after which the River gradually falls to normal low water about October.

The plant employed consists of:—

Eight Elevator Dredges.

One to four Spoon Dredges.

Two stone lifting barges.

Eight screw Tugs.

One side wheel Tug.

Five barges for coal tenders and floating shops.

Twenty-two scows.

The quantities of dredging done in deepening from 20 to 25 feet are shale rock 289,600 cubic yards, earth of all sorts including boulders lifted by dredges 8,200,000 cubic yards; large boulders lifted by stone lifting barges 16,700 cubic yards, making in all 8,508,400 cubic yards. The Channel in Lake St. Peter, the largest piece of dredging at any one place, is in all $17\frac{1}{4}$ miles in length, with bottom level 25 feet below ordinary low water surface, or $14\frac{1}{2}$ feet depth of cutting in the Flats, 300 to 450 feet in width, and involving the removal, since the beginning of dredging in the present Channel in 1851, of about 8,000,000 cubic yards.

The outlay for the deepening from 20 feet to 25 feet is for dredging plant \$534,809.65, and for working and other expenses \$1,245,321.18, or in all \$1,780,130.83.

JOHN KENNEDY,

Chief Engineer.

DISTANCES OF PLACES
BETWEEN MONTREAL AND QUEBEC

MEASURED ALONG THE CENTRE LINE OF THE SHIP CHANNEL.

	English Statute Miles.	Nautical Miles.
Montreal, Island Wharf—opposite Custom House.	0	0
Longue Pointe	6 $\frac{1}{8}$	5 $\frac{3}{8}$
Point-aux-Trembles en haut	10 $\frac{1}{8}$	8 $\frac{3}{4}$
Varenes	13 $\frac{1}{2}$	11 $\frac{1}{4}$
Cap St. Michel	15 $\frac{7}{8}$	13 $\frac{3}{4}$
Vercheres'	21 $\frac{3}{4}$	19
Plum Island	22 $\frac{7}{8}$	19 $\frac{7}{8}$
Contrecoeur Channel, upper entrance	28 $\frac{1}{2}$	24 $\frac{1}{4}$
Lavaltrie	30	26
Contrecoeur Channel, lower end	36	31 $\frac{1}{8}$
Lanoraie	36 $\frac{1}{4}$	31 $\frac{1}{2}$
Sorel, opposite Light-House	45	39
Ile de Grâce Light	48 $\frac{1}{2}$	42 $\frac{1}{8}$
Stone Island Light	52	45 $\frac{1}{4}$
Lightship No. 1	57 $\frac{1}{4}$	49 $\frac{1}{8}$
Lightship No. 2	60 $\frac{5}{8}$	52 $\frac{1}{4}$
White Buoy	64 $\frac{1}{2}$	56 $\frac{1}{8}$
Lightship No. 3	71	61 $\frac{3}{8}$
Port St. Francis	75 $\frac{1}{4}$	65 $\frac{3}{8}$
Three Rivers	81 $\frac{5}{8}$	71
Becancour, Iron Buoy at Bend	87 $\frac{1}{4}$	75 $\frac{7}{8}$
Champlain	93 $\frac{1}{2}$	81 $\frac{1}{8}$
Batiscan Wharf	101 $\frac{1}{4}$	87 $\frac{7}{8}$
Cap Levraut	105 $\frac{1}{4}$	91 $\frac{3}{8}$
Cap La Roche, centre of new channel	108	93 $\frac{3}{4}$
Cap Charles'	110 $\frac{1}{2}$	96 $\frac{1}{8}$
Richelieu Rapids	120	104 $\frac{1}{4}$
Platon Wharf	124 $\frac{7}{8}$	108 $\frac{3}{8}$
St. Croix	130 $\frac{1}{2}$	113 $\frac{3}{8}$
Ecureuil	132	114 $\frac{5}{8}$
Pointe-aux-Trembles en bas	139	120 $\frac{3}{4}$
Cap Rouge	151	131 $\frac{1}{4}$
Quebec—Custom House Wharf	160	139

HARBOUR OF MONTREAL.

HARBOUR COMMISSIONERS OF MONTREAL,
Chief Engineer's Office,
MONTREAL, 29th December, 1882.

The City and Harbour of Montreal are situated on the north side of the River St. Lawrence, 986 miles from the Straits of Belle Isle and immediately below the Lachine Rapids, or in other words, at the head of navigation in that part of the River level with the sea, and the highest point to which the larger sea-going vessels can ascend to meet the vessels of the great Inland Lakes.

Up to 1825, there were only two small wharves in existence. They were situated on the shore, between what is now the Custom House Square and the foot of the Lachine Canal, and had a frontage of about 1,120 feet with about 2 feet depth of water at the lowest stage.

In 1825, (the year following the opening of the first Lachine Canal,) the upper wharf was replaced by the "Canal Wharf" which was extended to 1,260 feet in length and placed in about 5 feet of water.

In 1830, the *Harbour Commissioners of Montreal* were constituted for the management of the Harbour, and by them the construction of the first regular system of wharfage was undertaken.

Between 1830 and 1832, several of the present wharves, including the Island Wharf, and those immediately above and below it, were built of piles, with from 5 to 20 feet of water in front of them. They replaced the remainder of the original shallow water wharves, and increased the wharfage to an aggregate frontage of 4,950 feet, or nearly a mile.

No further additions were made until 1840, but in that, and the following six years extensions were made both above and below those of 1830 and 1832, and increasing the total frontage to 7,070 feet, or 1.55 miles.

The basins of the enlarged Lachine Canal, opened in the spring of 1848, supplied a considerable extent of wharfage; but in the Harbour proper, excepting two new wharves built in 10 feet water in the then lower part, no further additions were made to the wharfage until 1856. Dredging operations which had been undertaken for deepening the river below the city were by that time sufficiently advanced to allow of vessels reaching Montreal with a draft of 13 feet at ordinary low water, instead of 11 feet as before, and it was then also determined to continue the deepening of the Ship Channel. A regular line of large steamers between Montreal and Liverpool had also been established, and the necessity for deep water wharfage which thus arose was met by the construction in 1856, of the Hochelaga Wharf in 20 feet water, at the lower limits of the City and below the Current St. Mary.

The deepening of the shallow upper parts of the Harbour, and the re-building of some of the old wharves to a greater depth, were also undertaken about the same time.

The deepening and improvement of the central part of the Harbour and the extension of its wharves upward and downward have been regularly carried on to the present time as the deepening of the Ship Channel and the increase of trade demanded, and until there is now an unbroken line of wharves from Pt. St. Charles to Hochelaga of $3\frac{1}{2}$ miles.

At the date of Confederation which was shortly after the Ship Channel had been deepened to 20 feet at ordinary low water, the wharfage was of the following extent:—

In 20 feet depth of water.....	1.39 miles.
Under 20 feet " " "	1.78 "
Total.....	<u>3.17</u> miles.

At the close of the fiscal year, 30th June, 1882, the extent was as follows :

In 25 feet depth of water.....	16,458	lineal feet.
" 20 " " " "	2,391	" "
" 10 to 20 feet depth of water (including Longue Point Wharf).....	5,960	" "
Total.....	<u>24,809</u>	lineal feet, or 4.7 miles.

As already stated, the earlier wharves were built of piles placed in a close row in front and secured to framing in rear, and also backed solid with earth and stone filling. From 1846 to 1878 the wharves were built exclusively of crib-work strongly framed of pine and other suitable timber, and filled and backed with stone ballast or with ordinary dredgings from the Harbour. Since 1878 open pile work has been used for some wharves; in sites not exposed to violent shoving of ice, or for enlargement of existing wharves, but the use of crib work for the more important wharves has been continued.

All the wharves are entirely submerged in winter, and owing doubtless to this the timber is of unusual durability. Some pile wharves of 1830, which are in deep water, and therefore did not need to be superseded are still in use. The crib-work wharves are found to suffer no serious decay for about fifteen or twenty years, and then only to a depth about half way between the top and the low water line.

At the date of Confederation, the indebtedness of the Harbour of Montreal was about \$1,126,000; since that time there has been expended on the Harbour proper over \$1,520,000, making in all \$2,646,000; the present indebtedness is \$1,881,000, being a difference of \$765,000, which has been paid out of the revenue. More than this sum has however been expended out of the revenue, and the total cost of the Harbour of Montreal extending from the River St. Pierre to Longue Point, was at the close of the year about \$3,000,000. The whole of this has been pro-

vided by the Harbour Commissioners and the interest on the borrowed portion is met by the dues levied upon vessels and their cargoes

The following is the number and tonnage of sea-going and inland vessels which arrived in Port since Confederation:—

SEA-GOING VESSELS.			INLAND VESSELS.		
YEAR.	No.	TONNAGE.	YEAR.	No.	TONNAGE.
1867...	464	199,053	1867...	5,248	744,477
1868...	478	198,759	1868...	5,822	746,927
1869...	557	259,863	1869...	5,866	721,334
1870...	680	316,846	1870...	6,345	819,476
1871...	664	351,721	1871...	6,878	624,787
1872...	727	398,800	1872...	7,150	936,782
1873...	702	412,478	1873...	6,751	933,462
1874...	731	423,423	1874...	6,855	956,837
1875...	642	386,112	1875...	6,178	811,410
1876...	602	391,180	1876...	6,083	786,083
1877...	513	376,859	1877...	6,333	847,978
1878...	516	397,266	1878...	5,502	764,243
1879...	612	506,969	1879...	5,698	817,243
1880...	710	628,271	1880...	6,489	1,044,380
1881...	569	531,929	1881...	6,030	949,380
1882...	648	554,692	1882...	5,947	848,780

(Signed,)

JOHN KENNEDY,
Chief Engineer.

LAKE ST. PETER.

The following is the correspondence between Mr. Killaly and Captains Bayfield and Beaufort on the subject of Lake St. Peter, referred to in our article on Lake St. Peter.

No. 1.—Mr. Killaly to Captain Bayfield.

[COPY.]

MONTREAL, 25th January, 1844.

SIR,

The importance to Canada of the results (if favorable) of the operation of an extensive dredging establishment, prepared to be put to work on the opening of navigation on Lake St. Peter, will, I trust, plead my excuse for thus bringing the subject under your consideration, with the view of having the benefit of your opinion thereon. The great weight and respect to which I consider that opinion entitled, from your experience and intimate acquaintance with the Lake, as evinced by the very minute Chart made by you (the perfect accuracy of which is fully confirmed by the various soundings and observations that from time to time I have had made,) impels me, although not having the honor of your acquaintance, to request that you will take the trouble of communicating to me your views on the subject.

Fearing accident or delay by post at this season, I have thought it better to send the bearer, Captain Vaughan, down to you specially, as he will be enabled to explain fully to you my own views, as well as the objections which I entertain against those of others.

I have been informed, whether truly or not I cannot say, that your opinion was adverse to the work, fearing the establishment of a more capacious Channel, by facilitating the discharge, would operate injuriously upon the river above. I admit I have approached it not without some hesitation, and I have therefore been very careful in so arranging the expenditure and dimensions of the vessels as to render all available on the River, Lakes and Harbours above Montreal, where much work of this description is required; and I also propose proceeding cautiously with the work on the Lake, by which I hope to avoid the risk of injuriously affecting the River in the manner alluded to.

In the outset I find myself differing as to the line of Channel with the gentleman to whom was entrusted by my Department, during the past year, the carrying out of the necessary preparations. He proposes to follow the Old Channel, as marked by a blue line shown on a trace which Mr. Vaughan brings down with him, and which is taken from your Chart. This very circuitous course, with more than one bad turn, I conceive, will every year be found more objectionable and dangerous, in proportion as the trade and employment of fast steamers increase. Frequent collisions take place annually, and on comparing this Channel with the direct one marked on the trace in red, I find the quantity to be removed in the latter, (to obtain, say, a fourteen feet channel) but little more than what would be necessary in the crooked one. This direct Channel, with at present, in low water, about 13 feet, is only obstructed at the upper end, and I am disposed strongly to think, that by removing this obstruction, the set of a larger proportion of the discharge of the River waters directly down it, would tend effectively to keep it open. Should it be found that the discharge is not sufficient to keep open *two* Channels through the Lake, I would expect that the circuitous one will be that likely to be effected by deposits, and that by carefully observing the effect of the work, and governing it accordingly as to breadth and depth, that with-

out injuring the navigation above, the great benefit of a perfectly direct channel *at all events* can be had; whereby risk of collision, cost of lighting and of pilotage, would be materially lessened. From the calculation I have made, however, I am induced to the conclusion that a Channel 15 feet in low water may be ultimately obtained; but in such a case as the present, I am far more inclined to judge and be guided by experience obtained during the progress of the work than by any calculation founded on theory.

The Legislature having decided on the experiment, the question to which I respectfully solicit your attention, therefore, is as to the channel which, in your judgment, it would be most expedient to adopt. The plan proposed as to the deposit excavated stuff, as well as the line in which it is to be laid down, (see trace) I am also disposed to differ from forming, as it would do, a kind of pier or bar, and extending more than one-third across the Lake, I conceive it would create a new direction of the current immediately; that this would at once effect the channel, and throw it by another bend more towards the north shore. From the present current and prevailing winds, the deposit appears to take place on the south shore, catching on all the jutting points. The effect which would be produced on this inclination to deposit, by the bar already alluded to, and found by the excavation, is obvious, I conceive.

As stated, my idea would be, first, to obtain a direct channel of moderate breadth, and 12 feet depth throughout, and subsequently to be governed, in adding to its depth and breadth by circumstances. The facility that exists for directing a column of water from two or three of the present channels into the new one, is, I think, also much in favor of adopting the straight channel.

Since I have formed my own opinion on this subject, I have taken much pains to collect those of the Pilots and others acquainted with the Lake, the greater number of whom appear, as far as I can learn, to support the conclu-

sion I have come to ; but I feel most sensibly the importance of having the benefit of your science and practice upon this most interesting subject. I have not considered it necessary to go more into detail, as Captain Vaughan can fully explain my views, and from his intelligence and long acquaintance with the Lake, I consider his opinion highly deserving of attention.

I beg to subscribe myself,

Sir,

With esteem, your obedient servt.,

(Signed,) H. H. KILLALY.

Captain Bayfield,

&c. &c. &c.

No. 2.—Captain Bayfield to Mr. Killaly.

[COPY]

CHARLOTTETOWN, PRINCE EDWARD ISLAND,

12th February, 1844.

SIR,

I have received your letter of the 20th January, by Captain Vaughan, whose early departure to-morrow morning (that he may avail himself of the mail, the only conveyance across the Strait), leaves me but little time to give you the opinion which you have done me the honor to request. But although my written communication must thus be necessarily brief, yet I have explained my views fully to Captain Vaughan, and feel that I can rely on his intelligence to explain them to you on his return.

Indeed, I agree so nearly with the views which you have communicated to me in your letter, that there remains little more to do than to express my concurrence therein.

My opinion has never been decidedly adverse to the attempt to deepen Lake St. Peter, as you have been informed ; but I have always viewed it, and still do view it, as a work of too great magnitude, importance and difficulty, to be lightly undertaken, or proceeded in without

all the cautious regard to the effect of the work as it proceeds, on the navigation of the river, above and otherwise, which you have so well expressed.

I quite agree with you that the old channel shown by the blue line in the trace, should be abandoned and the attempt made in the direction indicated by the red line, because it would only require about two nautical miles of excavation in the upper part of the proposed channel to give it a depth of from 12 to 13 feet at ordinary low water, if the depth has not diminished since our last survey; and even if the advantage gained should be limited to the attainment of a depth of 12 or 13 feet in a direct instead of a circuitous channel, the benefit to the navigation would, I conceive, be very great. But it would require no less than five miles of cutting by the old route, and nine miles by the proposed new and direct channel, to obtain a depth of 14 or 15 feet, either of which, I confess, appears to me a herculean task. Whether, if it were performed, the channel would not be constantly filling up with mud and sand, is a question which experience only could answer. Much will depend on the practicability or otherwise, of diverting any considerable portion of the main stream from the old and circuitous, into the new and direct channel; for there is little doubt, I think, that if a current can be formed it will tend to keep the channel open for some distance down, although it might cause a deposit lower down the lake, which might have to be, from time to time, removed.

The plan proposed for the deposit of the excavation stuff, as *shown in blue on the trace*, is, I think, very objectionable. It would, without doubt, direct the current over to the northward so as to form a new bend in the channel. I conceive that the deposit should be made parallel to the south shore of the lake, below the River St. Francois, and as close in shore as possible.

The smaller channels between the islands of Lake St. Peter appear to be in progress of filling up, and as it is de-

desirable to direct as much water as possible into one main channel, I conceive it would be desirable to assist that process; but on this and minor other points, I must, for want of time, refer you to Captain Vaughan for my opinion.

He will also explain to you the route which I think should be adopted so as to pass the dangerous shoals at the foot of the lake, of which I have sent you a trace.

You are, no doubt, aware that there is very little more water over the bar of Lavaltrie than over the flats of Lake St. Peter. The obstruction consists of large stones imbedded in clay, but is of small extent in comparison. I am, however, in hopes that this may be avoided altogether, by following a narrow but deep and direct channel close along the north shore, from Lanoraie up to Lavaltrie, passing between Lavaltrie Island and the main, as will be explained to you by Captain Vaughan, and as shown in the trace copy of the original survey which we have hastily made for your information.

I send, for your acceptance, three of the approved sheets of our survey of the St. Lawrence, from Montreal downwards. They have been so reduced in scale as to be of comparatively little use in many parts, but they may serve to give a general idea of the channels and shoals; and if you should wish a trace of any part of the river on a larger scale, I should have much pleasure in sending it to you.

Believe me to remain,

Sir,

With much esteem, your obdt. servant,

(Signed,) HENRY W. BAYFIELD, Captain,
Surveying the Gulf of St. Lawrence.

To HAMILTON H. KILLALY, Esq.,
Chairman Board of Works,
Canada.

No. 3.—*Captain Douglas to Captain Vaughan.*

STEAMER UNICORN,
HALIFAX, February 17th, 1844.

MY DEAR VAUGHAN,

According to your request, I lose no time in giving you my views on the question of cutting a straight channel through the Lake St. Peter, as shown by tracing copy of Captain Bayfield's survey. I was with the "Gulnare," and under the command of Captain Bayfield, R.N., when that survey was in progression, and subsequently in command of a steamer (the "Canada") for nine years, and was always of opinion that the present contemplated cut, as shown in tracing copy from Captain Bayfield's survey, as marked in red ink, was the only one that would give a satisfactory result, and I have no hesitation in recording now my unchanged sentiments on that subject.

And remain, dear Vaughan,
Yours very faithfully,

(Signed,) WALTER DOUGLAS.

No. 4.—*Captain Bayfield to Mr. Killuly.*

Copy.

GULNARE, AT CHARLOTTETOWN,
Prince Edward Island, 1st June, 1844.

DEAR SIR,

I beg to transmit to you a copy of a letter which I have just received from Captain Beaufort, the hydrographer, in which he expresses his own opinion and suggestions respecting Lake St. Peter, as well as those of J. M. Rendel. They do not differ much, if at all, from your views or mine, but thinking, nevertheless, they might interest you, I send them by post.

Copy of Captain Beaufort's Letter.

“DEAR CAPTAIN BAYFIELD,

“I sit down to answer your letters of the 9th and 26th April, and though the latter concerns more immediately my great work, yet the former is of such leading interest that I might begin by Lake St. Peter.

“A Civil Engineer of considerable eminence, J. M. Rendel, came in whilst I was reading it, and we have discussed the affair with all the earnestness due to an operation so generous and praiseworthy in the conception, and so big with future importance in its issue.

“It is obvious that the cause of the channel taking a northerly twist, is the action of the two rivers Yamaska and St. Francis; that the first impression on the mind is, adhere to that channel, act in concert with Dame Nature, and she will assist you. But on further reflection, he and I are convinced that the safe and sure process will be to make an artificial groin, from the point A in the direction of the south channel, so as to direct the streams of the two rivers above mentioned, and the main stream into it. This groin he proposes to form by a few piles from the adjacent woods, by wattling, if requisite, and by depositing there all the heavy part of the materials which you dredge up. To divert still more effectually the water from the alien channels it has taken between the Islands, some attempt might be made to deposit mud, &c., in their necks, and if that is not practicable, the streams of some of those channels might be deflected towards the new channel by groins similar to the above one, as at Band C, &c.

“After your groins are formed by the produce of the dredging machine, he would urge you to dredge no more, but to *rake*, and to leave the current to carry off the silt thus loosened and stirred up. The rake has been tried with very happy effects at Liverpool, where an 11-foot channel has been partly formed and successfully preserved by that instrument. That employed by Captain

Denham, and now used by Mr. Lord, is like an iron harrow, but Mr. Rendel thinks a chequered chain one, with deep teeth at every intersection, would take the lie of the ground better and work better, but this will be a matter of experiment. The enterprise cannot be in better hands than in Mr. Killaly's, and I shall be very much obliged by your telling me, from time to time, about his proceedings, and, I trust, about his success. I take it for granted that he will try his tools and initiate his workmen upon the upper bar of Lavaltrie, before he attacks the Lake, and if the distance be not too great for the dredging tug, it would be a good plan to throw what is brought up between the islands, and thus strangle some of those channels.

"If I can be of any use to Mr. Killaly, in procuring either books or opinions, pray tell me.

"Very truly yours,

(Signed)

"J. BEAUFORT."

I am in too great haste to comment upon Mr. Beaufort's letter, but I trust you will have the kindness to enable me to tell him of your proceedings from time to time, as he wishes, and I unite with him in wishing you every success. You will not, I hope, hesitate in availing yourself of the offer contained in the last paragraph of his letter, if it can be of any use to you.

Believe me, dear Sir,

Yours very truly,

(Signed)

HENRY W. BAYFIELD.

To the Honble. H. H. KILLALY,
&c., &c., &c.

No. 5.—*Mr. Killaly to Captain Bayfield.*

BOARD OF WORKS OFFICE,

MONTREAL, 27th November, 1844.

DEAR SIR,

Very many thanks for your kind letter of the 1st June last, and I would beg you to believe I am duly sensible of your valuable communications upon the subject of that (now to me) most interesting work, the effecting of a direct channel through Lake St. Peter, with an increased depth of water. I fear you must have set me down as undeserving of the trouble my letters respecting it had put you to from my long silence, but the fact is I deferred from day to day writing to you until I could give you, not *opinions*, but a statement of *facts*, and communicate to you the result of our season's operations. I was the more anxious to do this, as no doubt on Capt. Douglas' return from this quarter of the country he made you acquainted with the diversity of opinions which prevails here, respecting, *first*, the possibility of effecting anything; *secondly*, the extent of the probable improvement; and, *thirdly*, the propriety of the course adopted. For my part, I was perfectly satisfied, after much thought, that whatever is to be accomplished must be in the straight channel, and that the obtaining of a moderately increased depth of water, and of a direct course instead of the present very crooked one, were advantages certain to be derived from and sufficient to justify the experiment.—I have not been so presumptuous as to declare to what extent an increase of depth can be obtained, and I have taken good care that the outfit (which constitutes three-fourths of the past expenditure) is such as to be applicable to the improvement of the several portions of the Upper Navigation, and of the Harbours on the Lakes which require it. From the very nature and magnitude of the work, practical men would be cautious and slow in coming to a decision, but in such cases, where, as I conceive, *experiments* in conjunction

with theory and science. must be resorted to, before any final and satisfactory conclusion can be arrived at, were they to be deterred from having any recourse to it by unfavorable predictions, always plentiful on such occasions, and often emanating from very ill-informed sources, many of our noblest existing works would never have had being.

Under all circumstances you will easily imagine my gratification, I will say ease of mind, at having my own views sanctioned and strengthened by the scientific and practical observation of such men as Captain Beaufort, Mr. Rendel and yourself.

In a country situated as this is, no work can be embarked in without affecting directly the individual interests of several, and holding the position I do, I have much opposition and misrepresentation accordingly to encounter.—In the present instance all the proprietors of barges for the lightening of the vessels up to and down from Montreal, the steam-tug proprietor, some of the pilots, but especially the Quebec interests, are “at war to the knife” with the project of effecting the channel.—They will, no doubt, endeavour, during the approaching Session of the Legislature, to throw every obstacle in the way they possibly can, and I am sorry to say the opinions of Captain Boxer, much too freely given, (in my judgment) after a very cursory examination, *en passant*, without any previous knowledge of the Lake, its Channels, directions of its currents, their rates, the influence of the rivers discharging into it, &c., &c., will appear to give weight to the views of those who oppose the project. Whatever Captain Boxer’s merits may have been before Acre or in such service, (and I dispute them not), they do not, in my estimation, entitle his opinions, formed so hastily, and without any previous detailed or personal information, upon a question involving so much scientific as well as practical knowledge, to pass current. The station and acquirements of Captain Beaufort and Mr. Rendel, impress

at once a standard value upon *their* suggestions and opinions, and I assure you, on reading the portion of Capt. Beaufort's communication, quoted in your letter, I felt proud and happy at finding the course I have taken so much in accordance with their views.

I have ever been an advocate for following and acting in concert with "Dame Nature," especially in *water* operations; it was not, therefore, without a great deal of consideration that I took the direct South Channel. I need scarcely repeat to you the reasons for so doing. The power of diverting such a mass of water down it—its being capable of being easily made perfectly straight—the only obstruction in it being at the head, where we can bring the force of the St. Lawrence directly to bear on them,—the great facility of our working in it, compared with the present circuitous channel used by the trade, in which our vessels, leading chains, mooring cables, buoys, anchors, attendant lighters and tenders would be constantly in the way or getting foul of the vessels passing at all hours. The same reasons, or very nearly so, appear to have weighed with you and Captain Beaufort, in coming to the same decision as to the channel to be taken. The results of our operations this year are so satisfactory, and so much beyond what I had calculated on, that I do not hesitate to express to you my conviction that success is certain and will be speedy. I send herewith a section shewing the state of the work at the commencement and termination of the past season. It is formed from soundings taken most carefully by Captain Vaughan, our Superintendent of the Work, in connection with Captain Rayside, the Harbour Master and Chief Officer of the Trinity Board of this City. Of the experience and capabilities of both these gentlemen, you are, I believe, fully aware. The soundings were taken on the 19th of the present month, on a calm day, and with a pole marked into feet and inches. As the bank stands at its original height on each side the channel, and the depths in it

speak for themselves, there can be no mistake whatever in the matter.

Our apparatus in the commencement of the season was deficient in several respects; so much so, that, from the many unavoidable interruptions, I consider we in reality worked not much more than half a season; yet the results, I am sure, you will consider far greater than you would have calculated upon. By taking the most moderate measurement of the quantity which has disappeared and comparing it with that which the united loads of the number of barges discharged daily, during the working season, (and of which a regular log was kept,) would give, it is *certain* that the quantity carried off by the current is *equal to that absolutely lifted*. The current has obviously and seriously been increased. On commencing work a man sculled across the channel easily with one hand. It now requires stiff pulling to get across it without drifting much. Most of the rafts which used to be carried round the North Channel, are now brought down the direct one by the strength of the current, much to our annoyance, carrying away our moorings, getting foul of our vessels, &c., &c. The original buoys we put down to mark our locale, and which floated well up, are now under water from the same cause.

Not only had the dams and the groins suggested in Capt. Beaufort's letter and referred to in that I had the pleasure of receiving previously from you, been decided on, but the mode of their construction. I had directed that the piles should be cut away at low water, or a foot under it, so that the River on the "break up" would float the ice over them, and I had instructed Capt. Vaughan to have "wattled on" among these piles trees (branches and all.)—The stuff excavated has also been deposited, according to Capt. Beaufort's idea, namely, in stopping up the mouths of the alien Channels, the result of which the greatly increased current in the direct channel fully shows; and to the effect of a rake which I have had briskly at work,

I attribute the disappearance of so great a mass of stuff beyond that actually taken up. The chain harrow of Mr. Rendel is a good idea. The one we use assimilates to it much, as from being in joints it accommodates itself to the irregularities of the bottom. The dredges left a number of ribs in the bottom of the channel of from 1: 6 to 2: 6 in height, which the rake has prostrated.—So far as I can form an opinion the nature of the stuff is of a fortunate consistency. Sufficiently tenaceous not to threaten silting up, and yet capable of being raked up and carried off by the stream

You are aware that the ice on the great surface of the lake becomes grounded on the shoals, I expect much to be effected by this operation also, as the passage of a large portion of the waters of this vast river, instead of being diverted as heretofore into several small and crooked channels, will take place down the new and straight one, and I calculate therefore that considerable undercutting will take place. This I have observed occurs in the several second class rivers in the Province, wherever the bottom is not rock. The main groin, to throw the united volume directly down the new channel, we cannot complete until the channel is available to the trade.

When the channel is created, my idea is to construct at each end an isolated substantial pier, with a light-house on each. These together with the straightness of its course, will enable it to be used at all times, and I have no doubt the constant passage of the steam vessels will much aid the stream in the keeping clear and dressing of the channel.

Our outfit consists of two steam dredges with two engines and one chain of buckets each, working in the centre of the boats; also two steam-tug vessels; one of these is employed constantly at the towing of the scows, in which the other only assists, but when not so employed she works the rake. I am inclined to believe that we may be compelled to get a third, for if the dredges work

as well next season as they did towards the conclusion of the past one, the services of the two tug-boats would be required at the scows. We have but one rake, but I will have another made this winter, there being many days during the season, when from the roughness of the Lake the dredges cannot work, but the rakes could be used to great advantage. The discharging scows, fuel and attendant lighters compose the remainder of our squadron.

I will now hazard for your consideration my ideas generally upon the Lake, and the reasons which induce me strongly to entertain the impression that when the channel is once opened it will continue.

I agree fully with Capt. Beaufort and Mr. Rendel, "that the obvious cause of the present 'Northerly' twisted channel has been the effect of the action of the two Rivers, the Yamaska and St. Francis,"—but as the course of this channel is not that which the resolution of the respective forces of those two rivers combined, would, under ordinary circumstances, have been able to establish, so much is it across the line of the greater stream of the South branches of the St. Lawrence; and keeping in view the fact of the existence of the comparative wide and deep direct channel from the east end of the Lake up to the confluence of those rivers, I am disposed to consider that at a former period, *both* the north crooked channel and the south direct one existed—the former kept open chiefly by the stream of the St. Lawrence passing through the Islands, but that the main channel was the direct one, and that its waters, being divert or turned off into the former, which they now follow, was owing to the effects probably of an unusually heavy and early "break up" of the Yamaska and St. Francis, for two or more successive springs. The sources of these rivers are very much south of those of the St. Lawrence, and consequently every season the break up of their frozen surfaces takes place many days before that of the St. Lawrence. I imagine that the effects of some such unusually heavy and premature

“breaks up” anticipated the ordinary working of the St. Lawrence, and created the nucleus of what is now the outer St. Francis Bank; that this was added to subsequently by the St. Lawrence and served as it were as a groin, and caused the waters of the south channels of the St. Lawrence to glance off into the north channel. Those waters having taken that direction, their operation was to increase the bank, which bank, with the portions called the March Islands, &c., now form a barrier to, and throw the waters of the Yamaska and St. Francis down the Lake parallel with the shore. From my own observation and the best information I have been able to collect, I do not find that these lesser rivers are in the present day able to carry the debris, &c., out into the Lake for any distance—on the contrary all the trees, &c., which are annually brought down by them are lodged parallel with the south shore and at no great distance from it—that the operations of these rivers do not extend far out into the Lake is (to my mind) also clear, from the fact of the direct south channel, continuing for 30 years (to which period the experience of my informants extends) without the slightest evidence of having shallowed or silted up in any way, notwithstanding the disadvantage it labors under of being dammed across at the up stream end, and its current therefore acting through it as a scour—so far from being any evidence of this channel having shallowed, it continues precisely, as to depth, direction, width, &c., as laid down in your admirable Chart taken in 1830 (I believe) except that at the upper end of it the current of the St. Lawrence has since that period evidently acted on the bank, by eating away the head of it and forcing a deep water channel *again* down in the straight line for several hundred yards. This being the case we may be fairly said to be *acting with* “Dame Nature” in cutting through the impediment which was (as I conceive) temporarily thrown across the head of the direct channel.

In many parts of this Province, especially as connected

with the waters of it, are indications of there having been, at no very distant day forces in operation, which do not now exist, or if they do, in a very limited degree—enormous valleys and ravines worked out where there is not a particle of water now to effect it—the heights and beds of rivers totally changed, &c.

Near the commencement of this direct channel we have pretty much stopped a large crooked one of several hundred feet in width, which wound to the southward, by the deposit of our excavation—its original depth of from 15 to 20 feet we have in great part reduced to 7 or 8.

The winter will be disposed of in sundry alterations in the details of our vessels, and in constructing some groins, &c. On the break-up I will most carefully sound the channel, and I am sanguine in expecting to find it deepened by the undercutting of the current. I will acquaint you fully with the result of the examination, and will take the liberty of keeping you apprised, from time to time, of our progress and prospects.

I had intended writing to Capt. Beaufort, to express my sense of his kindness, and to give him a general statement much like the foregoing, but the "yarn" is so much longer than I intended to have spun on commencing, and our Parliament having assembled, at which I will be very much occupied, I came to the conclusion of sending him a copy of this, in which I trust you will see no objection. Portions of it, no doubt, will be considered irrelevant; but I could not well curtail it without writing it afresh.

Yours with much esteem,

Very truly and obliged,

(Signed,)

H. H. KILLALY.

No. 6.—Captain Becher to Mr. Killaly.

[COPY.]

ADMIRALTY, 1st March, 1845.

SIR,

In consequence of Capt. Beaufort's being prevented by a cold from attending to the immediate duties of his office, I am requested by him to express his thanks to you for your letter of the 21st January, and its enclosure relating to the very interesting experiment in which you are engaged, of forming a ship canal through Lake St. Peter. Of the method which you have so wisely adopted he has expressed his full approval, and it is with pleasure that I have to add to this letter the copy of one to him from Mr. Rendel, the Engineer, expressing his full concurrence in the soundness of the plan you are pursuing. You inform him of your intention of communicating to him from time to time the progress and result of your operations, and I am to assure you that he will look forward to your communications with much interest.—And wishing you heartily that every success may attend your operations in a scheme which has been planned with so much wisdom, and carried on with so much skill,

I am, Sir, your obedient servant,

A. B. BECHER,
Commander, R.N.

To Hon. H. H. KILLALY,
&c., &c., &c.

No. 7.—Mr. Rendel to Captain Beaufort.

[COPY.]

16th FEBRUARY, 1845.

MY DEAR SIR,

I have read the papers (which I return) with much interest. I have no doubt whatever that the completion of the groins and turn waters, now in course of construc-

tion, will not only have the effect of permanently maintaining the new or rather restoring the old channel, but will also materially aid the process of deepening, particularly in the winter season.

You may at all times command any information I possess in matters of this kind, so pray use me without any scruple.

I am, &c., &c.,

(Signed,) JAS. M. RENDEL.

To Captain BEAUFORT, R.N.

No. 8.—Captain Bayfield to Mr. Killaly.

[COPY.]

33, DORSET PLACE SQUARE,

LONDON, 3rd March, 1845.

DEAR SIR,

I have not time to do more, this mail, than offer you my thanks for your note of the 21st January, and the very interesting documents that accompanied it. I will write more at length, if I can find time, next mail; but if I should not, you will nevertheless, I trust, not doubt the interest which I feel in the success of the work which you are conducting with so much prudence, and yet with such skill and energy.

The facts you have stated to me, and which, together with the accompanying plans and sections, prove the success of the experiment thus far, were rendered doubly interesting to me, because I had, on the first January, been called upon by the Admiralty to *report fully* upon the subject of deepening Lake St. Peter, in consequence of a communication from Capt. Boxer to their Lordships, in which he decried the work in unmeasured terms.

My opinion of the work, its utility and its practicability; the direction in which the attempt should be made, the preference of the new and straight over the old and

crooked channel, and lastly respecting the mode in which the work was carrying on—were all directly opposed to his, and therefore I was much pleased to find myself borne out by your most gratifying account of the result of the operations of the first season.

I shall be up (God willing) to Quebec and Montreal in the *Gulnare* next July or August, to measure the meridian distance more accurately, and I am ordered to report to the Board of Admiralty on the information I can obtain, and shall of course have the pleasure of putting myself in communication with you.

Captain Beaufort has written to you he tells me.

Excuse haste, and believe me,

Dear Sir,

With much esteem,

Very truly yours,

(Signed,) HENRY W. BAYFIELD.

The Honorable H. H. KILLALY,
&c., &c., &c.

Lake St. Peter.

The following is the reply of His Excellency the Governor General to the address of the Corporation of Montreal, on the subject of the deepening of Lake St. Peter:—

MR. MAYOR AND GENTLEMEN,

It gives me great satisfaction to receive your valuable and interesting address.

I entirely concur with you in estimating the natural advantages of the great route of internal navigation by the River St. Lawrence; and improved as this has been by the magnificent canals now opened, I cannot doubt but that at a very early period, and under a free and liberal

system of Navigation Laws, the superiority of this route over all others — communicating from the sea to the interior of North America, will be universally and practically admitted.

I do not hesitate to express my opinion, that it would not be worthy of a community which has done so much to make the great River of Canada available for navigation, to permit itself to be stayed in its progress by the few difficulties remaining to be overcome before that navigation is perfect—or to allow heavy burthens on trade to continue, when these can be obviated by further outlay, the amount of which, under its most unfavourable aspect, must be inconsiderable as compared with its certain advantages.

Entertaining these opinions, I can the more freely say that you should not be discouraged by the temporary fiscal difficulties which prevent present exertion in the way of public improvement. The depression attending the present extraordinary crisis, has been felt heavily in Canada; but not so as compared with the condition of most other countries—while the profound internal tranquility enjoyed in the Province, is having its effect, in restoring public credit, and in opening a prospect for the future, which seems to me fair and bright, beyond all former precedent.

I assure you that on the important subject of your address, as well as on all others, aiming at the improvement of the country, and the restoration and advance of its commercial prosperity, you may rely upon my constant and zealous co-operation.

WESTERN CHAMBERS,
22 St. John Street,
MONTREAL, 28th February, 1883.

*To the Chairman of the
Harbour Commissioners of
Montreal.*

SIR,

Having audited the books of account of your Secretary-Treasurer for the year ending 31st December, 1882, we would beg to report thereon as follows :

We first checked the wharfinger's cash book, the summations of which we found correct, the items appearing therein corresponding with counterfoils of receipts issued by him for wharfages collected ; we next checked the Secretary-Treasurer's cash book and verified the items appearing to credit of harbour revenue consisting of dues, tolls, &c., collected (1) by Wharfinger and (2) by Custom House, Montreal, with return of such collections furnished to the Secretary-Treasurer. The items of disbursement under their various classified heads we found properly charged, and vouched, the calculations, extensions, and summations of the pay sheets having been previously checked by us. We checked the Bank accounts with the pass book and statements rendered by the Bank of Montreal, verifying the balances as stated in the Ledger at 31st December, 1882.

We examined the record of debentures issued, and found the amount of the different issues shown therein to be outstanding to correspond with the balances at the credit of the various debenture accounts in the Ledger.

With regard to the coupons paid during the year, we verified the various amounts charged to " Harbour interest "

in the Secretary-Treasurer's cash book with the debit entries in the "Bank of Montreal coupon account."

Finally we examined (1) the balance sheet at 31st December, 1882, and (2) statement of receipts and disbursements during the year, prepared by your Secretary-Treasurer; and beg to certify that they are correctly drawn up from the books of the trust.

We have the honor to be,

Sir,

Your obedient servants,

RIDDELL & STEVENSON,
Auditors.



HARBOUR COMMISSIONERS OF MONTREAL.

ANDREW ROBERTSON, Esq., CHAIRMAN. J. B. ROLLAND, Esq. HUGH McLENNAN, Esq. EDWARD MURPHY, Esq. CHARLES H. GOULD, Esq. HENRY BULMER, Esq. HON. J. L. BEAUDRY, (Mayor). VICTOR HUDON, Esq. ANDREW ALLAN, Esq.

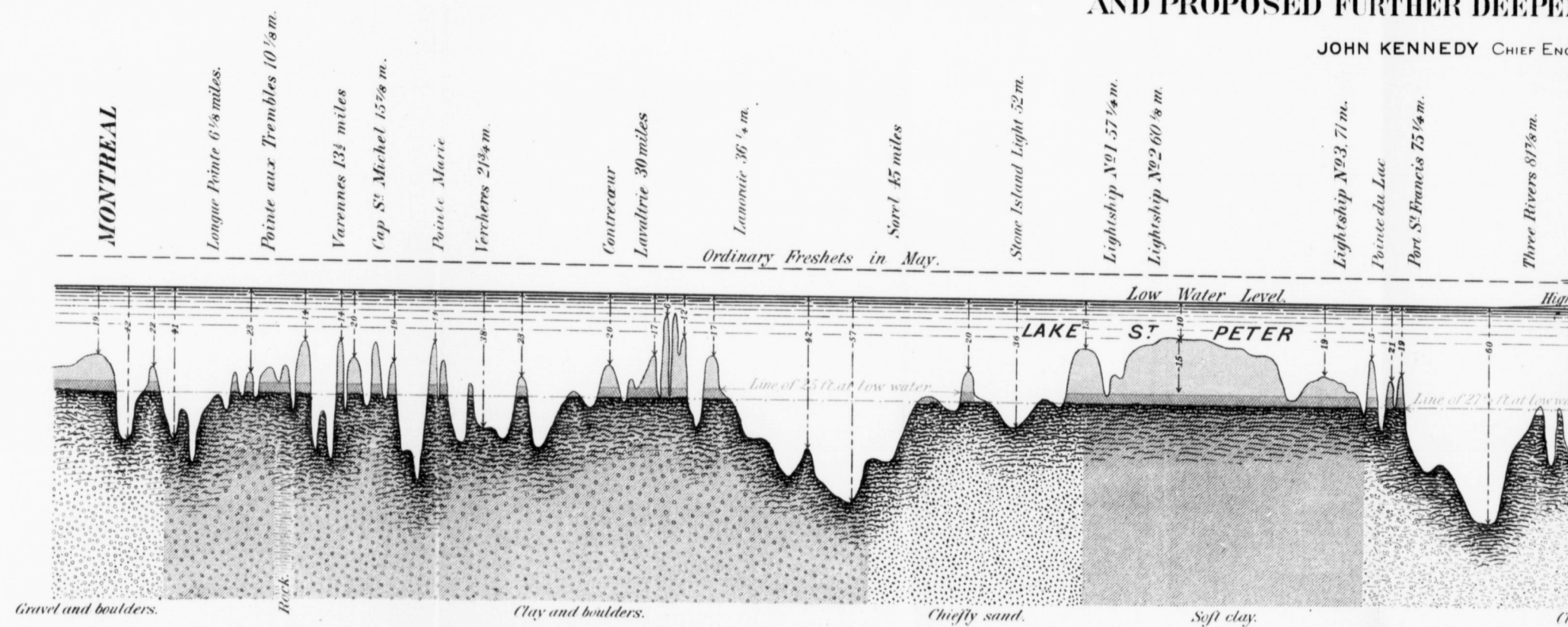
JOHN KENNEDY, M. Inst. C. E., Chief Engineer. THOS. HOWARD, Harbour Master. Capt. THOS. McKENZIE, Superintendent of Dredging. A. B. SAVIGNY, Mechanical Engineer. JOSEPH LEVELLE, Superintendent of Pilots.

H. D. WHITNEY, Secretary and Treasurer

HARBOUR COMMISSIONERS' OFFICES, MONTREAL, FEBRUARY, 1883.

HARBOUR COMMISSIONERS OF MONTREAL. PROFILE OF THE RIVER ST. LAWRENCE BETWEEN MONTREAL AND QUEBEC. SHOWING THE SHIP CHANNEL AS ALREADY DEEPEMED TO 25 FEET AT LOW WATER AND PROPOSED FURTHER DEEPENING TO 27 1/2 FEET.

JOHN KENNEDY CHIEF ENGINEER.

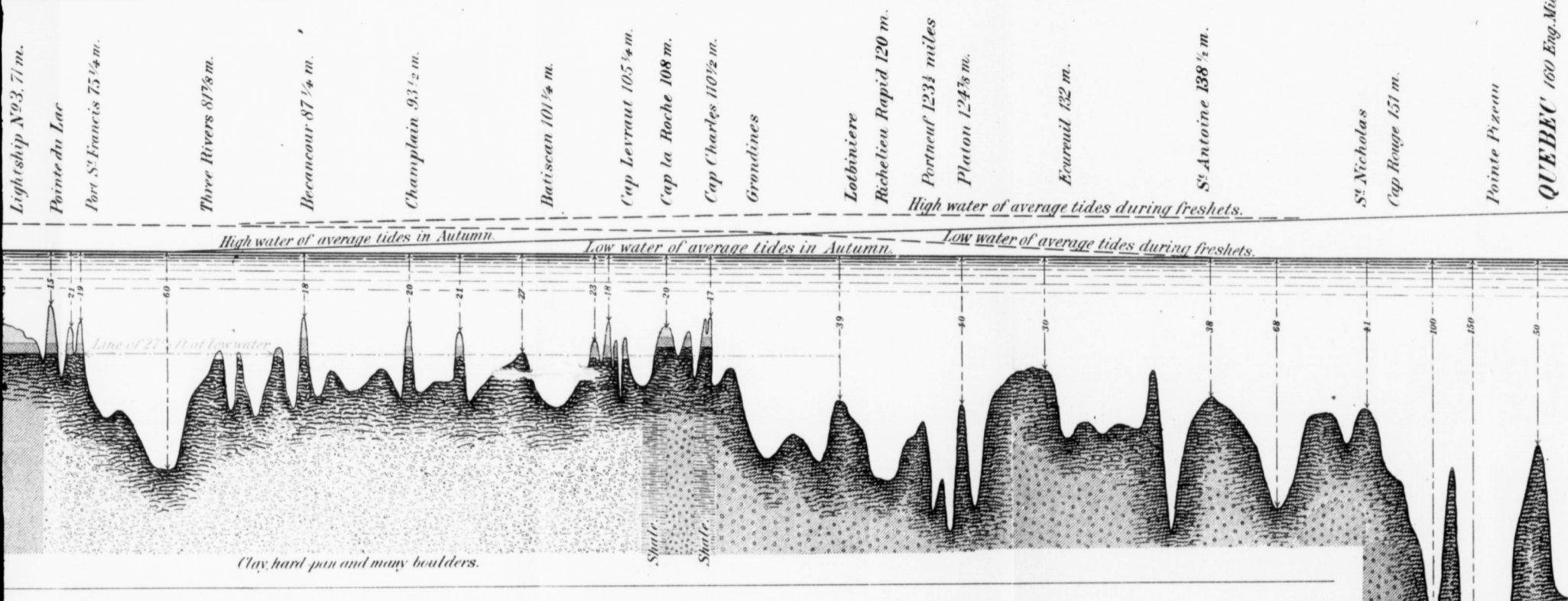


Length of Dredging in Lake St. Peter, 17 1/2 Statute Miles. Quantity for 25 feet depth, 8,000,000 cubic yards.

SCALES. Vertical, 30 feet to an inch. Horizontal, 6 miles to an inch.

COMMISSIONERS OF MONTREAL. PROFILE OF THE RIVER ST. LAWRENCE BETWEEN MONTREAL AND QUEBEC. SHOWING THE SHIP CHANNEL AS ALREADY DEEPEMED TO 25 FEET AT LOW WATER AND PROPOSED FURTHER DEEPENING TO 27 1/2 FEET.

JOHN KENNEDY CHIEF ENGINEER.



SCALES. Vertical, 30 feet to an inch. Horizontal, 6 miles to an inch. Dredging done to 25 ft. depth at low water shown thus. Do. yet to be done to 27 1/2 ft. depth.

SHIP CHANNEL DREDGING.

Table with 2 columns: Description of dredging work, and Amount in English Statute Miles. Includes entries for distance from Montreal to Quebec, depth of channel, and expenditure.

PLACES AT WHICH DREDGING HAS BEEN DONE.

Table with 3 columns: Location, Nature of Material, and Length of Dredging in Miles. Lists various locations along the river and the types of material encountered.

Total for 25 feet Channel, 34.25. Total length Dredged, 39.25. In the straight parts of the Channel, between No. 1 Lightship and the White Buoy, Lake St. Peter, the dredging is 325 feet wide; in the straight parts elsewhere it is generally 300 feet, but in bays and all important places it is widened out to 450 feet or more.

PLANT EMPLOYED.

- Eight Elevator Dredges (single set of buckets, endless chains). Two Spoon Dredges (employed part of time). Two Boulder Grappling Barges. Nine Tug Boats. Five Coal Tenders. Nineteen Hopper Scaws, 80 to 90 cubic yards capacity. Four Hopper Scaws, 150 cubic yards capacity. Daily capacity of Dredges varies with the nature of work, from 150 cubic yards Shale to 4,000 cubic yards soft Clay.