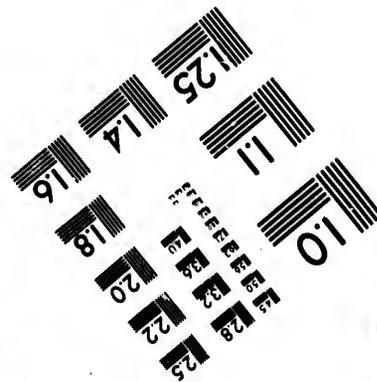
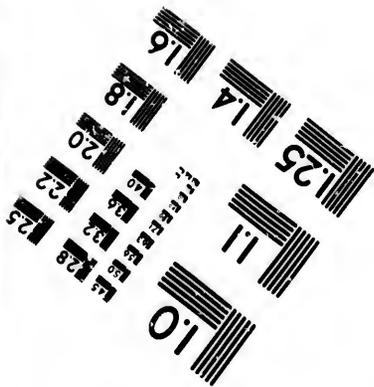
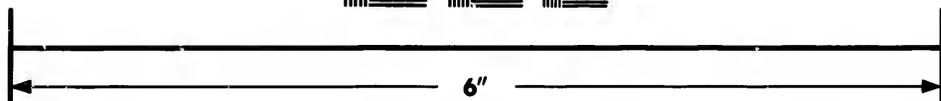
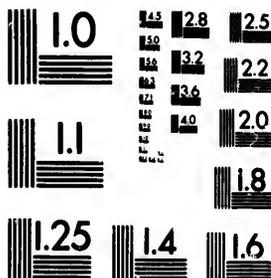
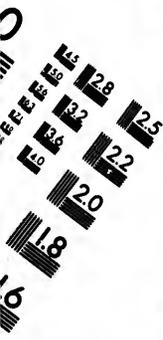


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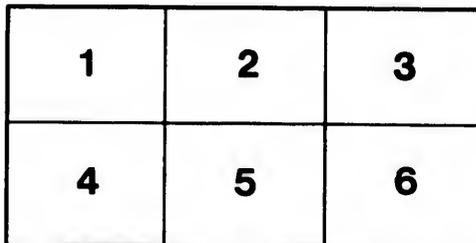
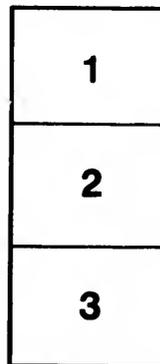
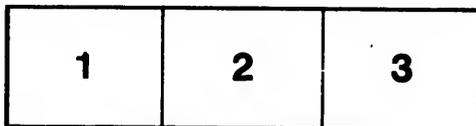
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DOCUMENTS

RELATING TO THE

Deepening of the Ship Channel

THROUGH

LAKE ST. PETER, & C.

**PUBLISHED BY THE HARBOUR COMMISSIONERS,
WITH THE SANCTION OF THE GOVERNMENT.**

FEBRUARY, 1854.

PRINTED BY JAMES POTTS, HERALD OFFICE, MONTREAL.

DOCUMENTS

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REPORT

WALKER & PETERSON

PUBLISHED BY THE HARBOUR COMMISSIONERS
WITH THE SANCTION OF THE GOVERNMENT

FEBRUARY 1883

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DOCUMENTS

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FEBRUARY, 1853.

PRINTED BY JAMES POTTS, HERALD OFFICE, MONTREAL.

P R E F A C E.

THE Harbour Commissioners in presenting the following documents to their fellow-citizens in the form of a pamphlet, are actuated by a desire to make them fully acquainted with all the leading facts and circumstances relating to the important operations carried on under their direction in Lake St. Peter, the Harbour of Montreal, and the Ship-Channel between those points—considering it advisable to do so in order to place within the reach of all such data as will enable them to judge correctly of the manner in which the operations are carried on, and of the advantages which will result to the City of Montreal from having a Ship-Channel to the sea with not less than 16 feet of water in it at all times during the season of Navigation.

HARBOUR OFFICE, }
Montreal, January 21, 1853. }

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MR. GLASS'S LETTER

TO THE

HON'BLE A. N. MORIN,

PROVINCIAL SECRETARY.

Harbour Office,
Montreal, Dec. 27th, 1852

Sir,—I have the honor, by direction of the Montreal Harbour Commissioners, to transmit to you herewith, to be laid before His Excellency the Governor General, along with this communication, the Annual Reports of their Engineer and Superintendent of Works, in relation to the operations carried on in Lake St. Peter, the Channel of the River St. Lawrence, and the Harbour of Montreal, during the past season.

From these Reports, it is hoped His Excellency will observe that the operations have been carried on with energy, economy and success combined. But the Commissioners are desirous of drawing His Excellency's attention more particularly to the following facts in relation thereto:

First,—That the actual cost of the operations, thus far, is considerably within the original estimate.

Second,—That the actual cost of excavation is only 6½d per cubic yard; while the cost of the same description of work, in 1844, '45 and '46, under the superintendence of the Board of Works, was within a fraction of 1s 6d per cubic yard.

Third,—That the Channel, in Lake St. Peter, was deepened to the extent of 2 feet, and made 75 feet wide, in the first season's operations, and a vessel taken through the same, before witness, in the month of November, drawing that extra depth of water.

Fourth,—That in the month of August, in the second season's operations, the Channel—being then made 150 feet wide, and of the depth aforesaid—was declared available for public use for vessels drawing that extra depth of water, viz., 2 feet more than the water on the flats; that it is matter of certainty that vessels drawing that extra depth of water passed through it, and that it was used by all sea-going vessels drawing 10 feet of water and upwards, throughout the fall.

Fifth,—That on the 18th November last, the operations for deepening the Channel to 4 feet more than the depth of water on the flats were completed, and that the Channel will be available for public use on and after the reopening of navigation, for vessels drawing that extra depth of water.

Sixth,—That the aforesaid improvements in the Channel in Lake St. Peter, and at the other points named in the accompanying reports, have been effected at a cost—*independent of outfit*—of £20,077 4s 1d; while, on the other hand, the Board of Works expended £38,267 7s 0c—*independent of outfit*—in excavation that yielded no practical result.

Lastly,—That the channel, according to present appearances, will be completed in November, 1854, from the foot of Lake St. Peter upwards, at

a total cost—including a large and ample allowance for loss upon the expenditure for outfit—of not exceeding £50,000; a sum which the Commissioners believe the public will eventually look upon as of no moment, compared with the important results which will flow from the improvements referred to; results which will be beneficial not only to the city of Montreal, but also to the whole of the Province lying above it.

The Commissioners, however, are not unaware that some of their fellow-citizens consider it questionable whether that expenditure, involving as it does a tonnage duty upon all vessels visiting Montreal drawing 10 feet of water and upwards, is for the advantage of the City or not. Those persons seem disposed to maintain that it would have been better to have allowed the channel to remain in its natural state than to have improved it at such a cost. The Commissioners, I am instructed to say, differ entirely from that conclusion, and beg that they may be allowed to submit their views upon the question for His Excellency's consideration.

In the first place, it is well-known that for a long period in the fall of the year, the water on the flats in Lake St. Peter falls to about 11 feet, and seldom rises above 12 to 13 feet till the shipping season is over. It is also known, that a vessel of 500 tons burden (about the smallest vessel that can profitably compete with the class of vessels now employed on other rival routes, and consequently chosen as the fittest example to illustrate the present argument), can carry very little cargo in her when she has to pass through such shallow water. The consequence is, the bulk of her cargo, both inwards and outwards, has to be carried for her in lighters to and from Quebec, entailing a very heavy expense upon the owners, and seriously crippling the natural advantages of this City, arising from its position, in other respects. If, then, this necessity for employing lighters in the fall of the year can be done away with at the cost of a moderate tonnage duty, it seems clear, I am instructed to say, to the Commissioners, that the City of Montreal will be a gainer from it, provided the tonnage duty is less than is usually paid for lighterage; a point which seems to be clearly established by data appended to this communication, under the letter A, to which His Excellency's attention is respectfully invited.

The statement referred to has been made up with great care, after consultation with many persons of high respectability conversant with the subject; and the results shown are that, supposing the channel in Lake St. Peter were not deepened, a vessel of 500 tons burden, laden for Montreal, would be obliged to discharge fully 600 tons of her cargo, with even 12 feet of water on the flats, and that the cost of lightering the

same from Quebec to Montreal, even at the low rates of freight of last season, would be fully £185; while, on the other hand, the tonnage duty on the same vessel, passing through the improved channel with her whole cargo on board, will be only at the present rate of tonnage duty £12 10s, showing a saving on the trip of £152 10s; a saving which seems to be conclusive as respects the question under discussion.

But it may be answered by objectors that the regular trader makes two voyages in the year, pays tonnage duty both voyages, and yet requires to use the improved channel only in the fall of the year. Granting this as true, it still follows that the vessel will be a gainer in the fall of the year, after deducting the dues for both trips, of £130, as shown in detail by the statement already referred to. And in the same manner it might be shown, that the vessel would profit on her outward trips, from the deepening of the Channel; but it is considered unnecessary to multiply proofs where the case is so plain.

It is not, however, to the limited point of view thus far presented, that the Commissioners would wish to confine their examination of this important question. On the contrary, in contemplating the benefits likely to result from deepening the channel, they consider themselves warranted in expecting that vessels of much larger tonnage than those hitherto used in the trade with Montreal, will be employed therein, after the improvements are completed; and it is from this point of view that they draw the most favorable conclusions as to the benefits to be realized, for it seems to them clear that, if vessels of 800 to 1000 tons burthen can be enabled to reach Montreal throughout the season of navigation, without the necessity of employing lighters as auxiliaries, and thus connecting with the large craft now employed in the inland trade with the West, that then the chief desideratum will be attained for enabling Montreal to compete with the most favored seaports elsewhere for the carrying trade, and the commerce of that immense region; and that little else will be required to give permanence to her prosperity, except the allowing the vessels of all nations to resort freely to her wharves in the pursuits of commerce.

With such views, and looking forward confidently to an increase of trade from the causes above referred to, the Commissioners, I am instructed to say, have also thought it their duty to anticipate the actual necessity for increased harbor accommodation; and, accordingly, some months ago, directed their Engineer, C. S. Gzowski, Esq., assisted by T. C. Keefer, Esq., to make a complete survey of the harbor, for the purpose of ascertaining to what extent accommodation could be provided for the water-borne traffic of the city. That survey has been completed, and the Commissioners hope in a short time to receive the report and plans of the Engineers, which they will do themselves the honor of submitting on receipt, for His Excellency's consideration. In the meantime, however, I am directed to remark that the survey has demonstrated that it is practicable to provide accommodation within the harbor for any probable increase of trade, at a cost which may be considered not excessive, when compared with the importance of the interests at stake, and the benefits to result from the expenditure.

I have the honor to be, Sir,

Your most obedient servant,

JNO. GLASS,
Secretary.

Hon. A. N. Morin, M. P.,
Provincial Secretary,
Quebec.

APPENDIX A.

A vessel of 500 tons burthen, loaded with a full cargo for Montreal, will draw on her inward trip generally about 16 feet 9 inches, and will carry, on an average, about 600 tons of dead weight, or 1000 tons composed of weight and measurement goods together.

The same vessel, drawing only 11 feet of water (low water on the flats of Lake St. Peter), would be little more than able to stand upright, and would have very little cargo on board.

The same vessel, drawing 12 feet of water, might have on board, as cargo, 250 tons of dead weight, or 350 to 400 tons of weight and measurement goods together.

These facts have been ascertained from merchants well acquainted with the subject, and form what may be considered the general ruler of the case.

Reasoning, then, from the foregoing data, it follows that, supposing the channel in Lake St. Peter were not improved, the generality of 500 ton vessels, loaded in full for Montreal, would have to lighter up in the fall of the year, with even 12 feet of water in the Lake (a foot more than often prevails), fully 600 tons of cargo, composed of weight and measurement goods together; and the cost of doing so—ascertained from merchants and others engaged in the business—would be from 5s to 6s per ton all round, independent of the towage of the vessel.

Assuming, then, the cost of freight at the average rate of 5s 6d per ton, all round, the charge for lightering 600 tons of cargo would be £165; while, on the other hand, the tonnage duty upon the same vessel, passing through the improved Channel in the Lake, with a full cargo on board, would be at the present rate of duty only £12 10s—showing a net gain to the vessel from deepening the Channel of £152 10s on the inward fall trip. But further; supposing the vessel to be a regular trader, making two voyages in the year, and deducting from the said gain the tonnage duty paid upon the spring inward trip also, the vessel would still be a gainer on the two trips of £130, from the substitution of tonnage duty for lighterage.

The above, however, is not the only saving to the vessel; for to it must be added, a reasonable allowance for damage done to cargo in the operation of transhipping—also the cost of transhipping—and the expence arising from the vessel's being delayed by it; all which would involve, in the case supposed, a very considerable expenditure.

The saving effected by a vessel on her outward trips might also be shown in detail; but it is considered unnecessary to enlarge upon so self-evident a point.

(Reports referred to in Mr. Glass's letter.)

REPORT OF C. S. GZOWSKI, ESQUIRE, RESPECTING WORKS CARRIED ON IN LAKE ST. PETER, THE CHANNEL OF THE RIVER ST. LAWRENCE, AND THE HARBOUR OF MONTREAL, FOR THE SEASON 1852.

MONTREAL, 18th December, 1852.

Sir,—On the withdrawal of the vessels engaged in the work of improving the channel through Lake St. Peter and their removal to winter quarters, I have the pleasure of submitting, for the information of the Harbour Commissioners, a brief report of the operations during the last season, and of the results attained.

The operations on the Lake were commenced in the latter part of May, and prosecuted with

the utmost energy, during the entire season, until the 18th day of November last. In addition to improving the channel in the Lake, several other obstructions existing in the navigable channel between the Lake and Montreal have been removed, and a great improvement effected within the limits of the Harbour. For the detailed data as to the exact period at which the works were commenced and suspended, as well as to the kind of vessels employed at the different localities, I respectfully refer to a very satisfactory report of Capt. Bell, the Superintendent, which is hereto appended.

The result of the operations up to the close of the season shows that a channel of 4 feet in depth and 150 feet in width, has been made through the flats of Lake St. Peter, which extends from the lower floating light to the lower buoy, and of 130 feet in width from the buoy to a point about two miles below it, embracing in all, a distance of about six miles, and admitting now of a passage through the Lake for a vessel drawing four feet more water than the depth of water on the flats.

In addition to this, the bar which existed above the upper light, and which formed a barrier at the entrance of the channel, has been removed, and a passage made through it 200 feet wide, and corresponding in depth with that in the channel through the Lake.

The shoals at "Isle Platte" have also been removed to an extent affording now a channel through both the upper and lower bars, of the same depth with that in the Lake, and of not less width than 250 feet on the lower, and 150 feet on the upper bar.

A shoal, found to exist at "Isle DeLorier," has also been removed, and a channel made through it 250 feet wide, and 16 feet deep at low water. In addition to this, much serviceable dredging has been done in the Montreal Harbour, and the entrance to it so far improved, that, with but little more work, next season an uninterrupted channel will be secured through the harbour, admitting of vessels drawing 16 feet at low water.

The aggregate quantity of material removed at the different points, exclusive of that in the Montreal Harbour, is equal to 740,892 cubic yards.

The total amount expended since the commencement of the works, including preliminary survey and all the outfit, is £42,110 10s. 3d. The amount expended in actual operations, exclusive of the outfit, is £20,077 4s. 1d.

By a reference to the report made to the Harbour Commissioners by Engineers appointed by them to examine and report on the improvements to the navigation through Lake St. Peter, and the selection of a proper channel, it will be found that the cost of making a channel through the Lake, between the lower light and below the lower buoy, 150 feet wide and 15 feet deep at low water, that is 4 feet deeper than the depth of water on the flats, was estimated at £22,313 5s. 6d.

The actual cost of operations being £20,077 4s. 1d. shows the work to have been done within the estimates, and to a much greater extent than is even apparent in the mere difference between the amount estimated and expended, as the sum paid for operations covers the expenditures at "Isle Platte," "Isle DeLorier," and in the Harbour of Montreal, while the estimate was made for the work in the channel through the Lake exclusively.

I attribute the result of having done the work so much within the estimated cost, to a due regard to economy in all arrangements, and to the active and vigilant supervision of the daily operations of vessels and machinery.

To show how the present expenditures and amount of work done compare with that made in

the straight channel, under the department of Public Works, I will draw your attention to the following extract from the report of Mr. Rubidge, Engineer in the service of the department, dated the 31st May, 1847, addressed to the Commissioners of Public Works, showing the result of the operations in the straight channel during the seasons of 1844, 1845, and 1846.

The report shows that the quantity of work done in the straight channel during those 3 seasons is 520,963 cubic yards, that the amount expended for outfit, adding depreciation for 3 years service, is.....£31,606 0 3

And the actual cost of dredging 20,963 cubic yards is.....£38,267 7 0
Making the total expenditure up to that period.....£69,877 16 3
Or a cost per each yard of earth dredged equal to 1s 5½d, nearly.

The operations up to the close of the present (second)* season, under the Harbour Commissioners, shows the quantity removed by dredging and rake to be 746,892 cubic yards, and the actual cost of doing that work to be £20,077 4s 1d, making the cost per yard 6½d, currency, or a fraction over one-third what it cost to do the work in the straight channel under the supervision of the Board of Works.

It is but right to observe also, that the future entire cost of the work will be proportionately less per yard, the outfit being now, I may say, almost complete, and all in good working order; its cost will bear a less proportion to the actual quantity of material moved, when the channel is made to its full width and depth, than when it is, as now, only one-third done.

Another point, which, without assuming more than the result of the season's work entitles us to, is, that the work has been tested and made use of, and that it has been most clearly and undeniably shown that vessels have passed through the new channel in the Lake this season, drawing more water than what they have ever been known before to do. The width of the channel being only 150 feet, is not yet quite sufficient to allow vessels much lee-way, while passing through it, but as long as vessels kept within its bounds, they could pass through it drawing 2 feet more water up to the 17th November, and 4 feet more of water since that date.

The result of the operations of the two past seasons, as to quantity of work done, and the expense incurred, with the certainty that now exists, that a Channel of 300 feet in width and 16 feet in depth, at low water, will be secured at the end of two seasons more, are, in my opinion, additional evidences that the Channel selected is the proper one, and that the final results will be fraught with very great advantages to the trade.

I have the honor to be,
Sir,
Your obedient servant,
(Signed) C. S. GZOWSKI,
Engineer.

John Glass, Esq., Secretary
Harbour Commissioners.

(COPY).

REPORT OF CAPT. JOHN BELL, SUPERINTENDENT OF WORKS IN LAKE SAINT PETER, &c. &c. FOR THE SEASON, 1852.

To the Montreal Harbour Commissioners:

GENTLEMEN,—As our operations for the season of 1852 are now closed, it becomes my duty to

*The operations of the first season were not commenced until the month of July,

lay before you a statement of the amount of work done and the good effected.

In the first place, the dredges were taken into the Lake on the 19th May, but owing to the new boat not being ready one of them only was kept at work until the 12th June, when the new boat started. From this until the 19th of the same month, they were both wrought without intermission. On this day the main shaft of the new boat broke, which we could not get effectually repaired till the 30th July. The "Albion" was chartered in her place, but owing to her want of power, and the time she was absent with a broken bridge tree she did not work more than half the time we had her. I mention these things to point out to you the great detention and delay from unforeseen accidents, which we had to contend with in the commencement of our operations this season; but, notwithstanding these delays, the two dredges have up to the 18th November, or in 120 working days, removed 498,820 cubic yards, thereby forming a channel, about four miles long, from a little above the lower light vessel to the iron buoy, of 150 feet in width, and thence to deep water, about two miles long, of 130 feet in width, with 4 feet more water in it throughout, than the water on the flats.

The bar above the upper light-vessel has also, this summer, been sufficiently removed to allow vessels to pass drawing 12 feet at low water. This improvement was effected by means of the "North America" and "Harrow." This vessel commenced on the 4th May, and finished on the 18th June, making the channel about 200 feet wide, and removing in that time about 44,000 cubic yards. When finished here, her crew was for some time employed in laying down the buoys on the side of the channel, placing 27 on the south side of the channel through the flats, and 3 on the south side of the channel through the upper bar.

Dredge No. 1 was also very much detained by the breaking of some parts of her machinery; but, notwithstanding this, I commenced operations with her at Isle "Platte", on the 14th June, improving the channel which she made there last year, by deepening it 2 feet, and increasing its width to 250 feet through the lower Bar, and 150 feet through the upper Bar. To effect this, she had to remove 15,000 cubic yards, and it was finished on the 28th August. From this place I sent the vessel up to Isle "De Lorier", where she cut a channel through the Bar there of 250 feet wide and 16 feet deep, at low water, removing, in that operation, 1,400 cubic yards, and finishing on the 8th September. She was then removed up to the Harbour of Montreal, where she continued to work until the close of the navigation, improving the channel entering the Harbour, which she has not yet finished.

I may remark here, that the improvements made upon the machinery and mode of working this Dredge last spring, have enabled her to do double the amount of work in much less time than she took last year. I should recommend you to make still further improvements upon this vessel, with the view of adapting her for lifting large boulders, of which there are many yet in the Harbour to be removed: a description of which improvements I will lay before you at any time you may require it.

The Spoon-dredge has not done so well as I expected her to do, principally owing to parts of her machinery being too slight for the hard excavation we had to contend with in the Harbour. This I propose to remedy, with your permission, this winter, by making certain improvements in her construction. She has, however, effected some improvements in the Harbour, more particularly

in the Creek-corner, the King's Basin, the Sydenham Basin, and the upper side of the Island Wharf, which could not have been effected by any other means.

In my letter to you, dated the 11th December, 1851, I stated that, by following certain plans, a channel of 15 feet at low water could be had by the end of the season of 1852; I am now happy to be able to state that such a channel actually exists, with the exception of one small bar opposite the Victoria Pier, entering the Harbour of Montreal, on which there is about 8 inches less of water than we now have in the channel through the Lake. This can be removed by Dredge No. 1, when the channel from the Harbour to the foot of Lake St. Peter will be complete, and safe for vessels to navigate drawing 4 feet more than the water on the flats. But as this fact appears to be by many doubted, I respectfully request that you will appoint some qualified person to sound and examine the channel in Lake St. Peter, and report thereon. This can be done effectively on the ice, as soon as the Lake is frozen over, and the length and width of the channel at the same time accurately ascertained.

The plan for future operations in Lake Saint Peter will greatly depend upon the width you intend to make it. For my part, I should prefer a deep channel 300 feet wide to a wider one containing merely sufficient water to float the vessel.

A channel of 300 feet wide and 10 feet deep, at low water, can be effected by our present means in two years.

A channel 400 feet wide and 15 feet deep, at low water, can be effected in the same time. To obtain the first mentioned, I should in the Spring, when the water is high, commence the widening of the present channel, and as soon as the water fell sufficiently to admit of our working in the present channel, I should begin to make it a foot deeper. A great portion of it could be put down to this extra depth before the Fall vessels would begin to arrive, and they would thereby obtain the advantage of it.

But if the channel of 400 feet wide were preferred, there would be nothing to do but to commence the widening of the present channel, and continue it till finished.

As respects the channel from the Lake to Montreal, it will be necessary, some time next Summer, again to place Dredge No. 1 at Isle Platte to widen the channel 100 feet through the upper Bar, and deepen the whole of it one foot more. But on the opening of the Navigation, I would recommend you again to place her in the Harbour, as there are many places about the lower wharves where deepening is much required, and where she could work to advantage while the water is high, and as the water falls she could commence and finish the improvement of the channel entering the harbor.

I may add, in conclusion, that the amount of material to be lifted by calculation to make the channel what it is now represented to be, and the amount lifted by account, agree within a very few yards, which proves that our method of working the dredges is perfect; that is to say, that they leave nothing behind them which can cause obstruction.

I am, Gentlemen,

Your most obdt. serv't,

(Signed)

JNO. BELL.

(Copy.)

MONTREAL, 22nd October, 1850.

GENTLEMEN,—Some five years ago, it was determined by the Provincial Government of Canada, to improve the navigation of the St. Law-

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MONTREAL, 31st October, 1850.

To The Hon. The Board of Harbor Commissioners of Montreal.

GENTLEMEN,—Having accepted the responsible trust confided to us, as your Board of Engineers, we, on the receipt of your instructions of the 22nd instant, proceeded to the discharge of the duties devolved on us, as specified in those instructions.

Accompanied by your President and Secretary, experienced Pilots provided, in fact with every facility essential to the speedy and accurate attainment of our object, we embarked in the steamer Richelieu that afternoon for Sorel—where we had the pleasure to be joined by Mr. Logan and Captain Armstrong, and early the next day, (Wednesday, 23rd,) reached our main field of operations Lake St. Peter.

Under favorable auspices, the calmness and clearness of the weather, and consequently, smoothness of the Lake, we commenced soundings with a pole graduated to feet and inches, and making such other surveys, examinations and observations, as, in our judgment, would suffice to disclose with sufficient minuteness, all the facts, to enable us as you desire, “to arrive at a comprehensive result, and to give you such a report, with reasons for our opinions, as shall have weight with those, who may desire to be convinced of their correctness, before advancing the necessary funds to complete the work.”

1st.—To ascertain the nature and character of the materials forming the Bars and Flats which obstruct the navigation of the River and Lake, frequent borings were made, and specimens preserved for analysis by Mr. Logan, to whose communication on the subject (hereto appended) we would respectfully refer you; and from the tenor of which it may be confidently assumed, that the flats of the Lake are an alluvial deposit of a very fine clay, lightly intermixed with sand, formed by the river drifts of the St. Lawrence, and its subsidiary arms, which meander through the islands and debouche, at the head of the Lake, together with the lateral tributaries, the Rivers Yamaska, St. Francis, and others of less capacity.

It may be inferred, as experience has proven, that material of such description is easily excavated by dredging and the use of the barrow; and yet its consistency is such, that it does not seem from previous excavations, to have silted up; obvious, however, would be the necessity of concentrating the several currents, as far as practicable, into one Channel, thereby materially aiding further excavations, and as a permanent security against a re-deposit of obstructions once removed.

2nd.—We proceed to state the direction and character of existing Channels, comparing the soundings and the velocities of currents, of the Old and New Channels with each other as determined by ourselves, and also by Captain Bayfield, R. N., and others.

The facts under this head are summarily exhibited in the following Table:—

rence between Quebec and Montreal, so that a vessel drawing 16 feet of water, should be able to sail, up or down, in any stage of the water. Mr. Atherton, in 1844, then in the employ of the Provincial Board of Works, surveyed Lake St. Peter and reported in favour of deepening the present natural channel. This was opposed by the President of the Board, Mr. Killaly, who advised the cutting of a new and straight channel. This plan being adopted, the work was placed under the superintendence of Mr. David Vaughan.—While this work was going on, a strong party sprung up, who opposed the construction of this straight channel, which they stated would be unsuccessful, and that at least 600 feet of a breadth, at its upper end, would be required—that for the purposes of the trade, its very straightness was an objection, &c. An outlay of some \$320,000 had been made in this new channel, when the Government, on the Reports of a Committee from the House of Assembly, stopped the work in 1846. We would refer you to the Reports of Mr. Atherton, Mr. Young, the Committee of the House of Assembly, Captain Bayfield, and Captain Boxer, R. N.

The deepening of Lake St. Peter, and the improvement of the navigation, between this City and Quebec, is now placed under our control, and we have called on you, as gentlemen of experience in your profession, to examine fully, into the whole matter, and report to us, the best means, of effectually opening a channel, of 16 feet in low water, between this place and Quebec, as well as the cost of opening a channel of 13 feet, 14 feet, and 15 feet.

We have placed at your disposal, two Branch Pilots, Messrs. David Bouillie, Branch Pilot, No. 2, Zephirin Mayrand, do. do., on whose statements you can rely, and who are practically acquainted with the towing of vessels, and the various channels and places which require dredging. A steamer is placed at your disposal, and you will be supplied with boats, or whatever else you may require in the survey.

The forgoing remarks we believe embrace the plain facts, and as you are now acting as our Board of Engineers, without and entirely unconnected, with local interests or prejudices, we believe you will be enabled to arrive, at a comprehensive result, and give us such a report, with your reasons for your opinions, as shall have weight with those who may desire to be convinced of their correctness, before advancing the necessary funds to complete the work: this latter remark, is the more necessary, from the conflicting views which exist on the subject.

We are happy to say that W. E. Logan, Esq., Provincial Geologist, a gentleman of great eminence in his profession, will accompany you, in the hope that he may be of service in determining the character and age of the deposit in Lake St. Peter.

We are, Gentlemen, yours very respectfully,

(Signed) JOHN TRAY, *Chairman.*

JOHN YOUNG.

LOUIS MARCHAND.

To General McNeil, Captain Child, }
and C. S. Gzowski, Esq. }

Board of Engineers to Examine and Survey Lake St. Peter.

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TABLE 1st.

Shewing the Soundings taken in the Straight Channel, in the years 1846, 1847, 1848 and 1850; also those in the Old Ship Channel, all reduced to low water of 11 feet on the Flats, the results being the mean depth in cross sections of 150 feet in width, commencing at the head of the cut for the New Channel and at the Upper Bar of the Old.

Soundings.	1846.		1846.	1847.	1848.	1850.	Soundings of Old Ship Channel by Board of Engineers.			
	By Mr. Keefer and Cap. Vaughan		By Cap. Bayfield, R. N.	By Cap. McKim.	By Mr. Rubidge.	Board of En- gineers, 23rd, 24th and 25th October.				
1	15	0	Captain Bayfield reports on the 17th September, the depth to be at least as much as previously reported, if anything increased. Again that there is no perceptible change in the relative depths of the two Channels, for 16 years, or since his survey of the Lake, in 1830, except at the head of the new Channel, where a considerable portion of the former shallow bank has been cut away by the action of the current, as shewn by the red dotted line on the Chart.	14	7½	15	0	14	2	On the Upper Bar 1st mile, average 15 feet, 12½ feet minimum. Thence a deep Channel for 3 miles.
2	11	9½		13	8½	15	0½	13	10	
3	12	2		13	10½	13	7	13	2	
4	12	5½		11	3	11	11	13	3	Thence for 2 miles on the 5th and 6th miles, 11 feet 8½ inches.
5	12	5½		11	6½	12	10½	13	10	
6	12	5½		12	8½	13	6½	13	10	
7	12	9½		12	9½	13	9	Thence for 1-2 or to the 8½th mile, 11 feet 9½ inches.
8	13	3		13	5½	12	3½	13	2	
9	12	11½		12	6½	13	2	13	9	Thence for 1-2 mile, or to the 10th mile, 12 feet 8½ inch, on 10th mile, 13 feet, 9½ inches, 10½ miles, 13 feet 3 inches.
10	12	5½								
11	11	10		12	9½	12	10½	13	7	

The average depth of water in the Straight Channel, for a distance of 2½ miles from the point to which dredging operations were carried, is 12 feet 9 inches.

The "position of Soundings" by Messrs. Keefer, Vaughan, McKim and Rubidge, is more particularly stated by localities named by them, answering, however, very approximately to the distances assumed above by us.

From the foregoing it appears that for a period of five years, from 1846 to 1850, inclusive, the New Channel has, to say the least, generally maintained the depth to which it had been dredged. In fact, it has increased in depth even beyond that represented by the soundings of Mr. Rubidge in 1848, excepting for a short distance at the head of the Channel, where he reports 10 inches to 1 foot more water than we do. This, however, we do not deem material, as we think it easily accounted for from the fact that the excavated sand of which that portion of the cut is formed, although displaced in tempestuous weather and by the currents, was yet too heavy to be far removed, and by its gravity was soon deposited where it now is. This seems the more probable, because of the generally increased depth of the Channel below, where the bottom consists, as hereinbefore stated, of a very fine clay, which, when disturbed, does not readily subside, but mingles with the waters, and is carried off by the current; in which supposition we are fully supported by the Report of Mr. Logan, which determined the light and flocculent character of this clay, and which, in our opinion fully proves, that with proper concentration of currents and the application of mechanical means, in the first instance, to disturb and remove the material, permanency in the depth of any adopted Channel will be secured.

It may be satisfactory to append, in connection with the foregoing, the following extract from the Report of Captain Bayfield:

"Although the first cut is incomplete, and has not been carried much below the 6th Buoy, a current of considerable strength has already been established, fully equalling, if not exceeding in rate, that which obtains in corresponding points of the Old Channel, for instance, at the 2nd Buoy of the New Channel, the rate was 1½ Knots, while, at the Upper Light, it was 1½ Knots; at the 7th Buoy, ¾ Knots, and at the Lower Light Vessel, ½ a Knot. These facts show that there is no tendency in the New Channel to fill up which is ascribed to the direction of the resultant of the currents of the Main Streams which unite a short distance below Stone Island, and also to the strong current setting to the Southwest past the point of the Marshes that extend from Monk Island, and lastly, by the action of the current, in cutting away the banks between the red dotted line and the first Buoy, which southerly direction is deemed very important.

"But with reference to the improvement of the Old Channel, it would be unsafe to leave the New Channel open, because the very considerable water now passing through it would lessen the chance of any cut that might be made through it remaining open."

We concur with the above-named justly distinguished authority as to the existence of a current of considerable strength through the straight Channel, and its probable increase, and that there is no tendency to fill up; but we differ with Captain Bayfield in the fact as stated by him, that a greater velocity of current exists in the New than in the Old Channel. We find it otherwise, as stated in the following table, from the obvious

1848 and 1850 ;
Flats, the results
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fact that from the direction of the waters of the St. Lawrence, whether by the Main Stream, or through subsidiary Channels among the Islands, and the inclination not Southward but Northward at the head of the Lake, and after it has passed the marshes extending below Flat Island, that the greater volume of water would seek an outlet by the Old Channel, and the same cause does ope-

rate in favor of the velocity, of current, in the Old Channel throughout, until when, from the influence of currents from the subsidiary Channels entering the Lake, North of the Main Channel, a Southern inclination from the Lower Light obtains to the junction of the two Channels opposite the River Machiche.

TABLE No. 2.

Exhibits the comparative velocities of the currents in the Old and New Channels 7/8 mile, 7/8 hour.

OLD CHANNEL.	NEW CHANNEL.
Below the Upper Buoy, 1:58 7/8 mile, 7/8 hour.	At the head of New Cut 1:45
Half way between the Lower Light & Buoy, 0:67	Lower end 0:59
At Lower Buoy, 0:81	One mile above Lower end of Cut... .. 0:64

The velocity of the current at end of Stone Island in the Main Channel, 1:58 per mile, per hour.

We also agree with Captain Bayfield, that it would be unsafe to leave the New Channel open, in the event of improving the Old one, while the same course of reasoning, will, in our opinion, justly apply to prove the necessity of stopping the Old Channel, should the improvement of the New Channel be decided upon.

In addition to the foregoing considerations, it is proper, before entering upon the estimates of the costs, to announce this principle of concentration of water into our Channel, as the indispensable guide to a conclusion, upon which, we can ourselves rely, and by which, the objects as stated in our instructions, viz.: "The best means of effectually opening a Channel of 16 feet depth in low water, through Lake St. Peter, as well as the cost of the same, and also the cost of opening a Channel of 13, 14 or 15 feet," can be effectually and satisfactorily secured.

In fact no one can doubt that much water now flows through both Channels, diminishing the supply in each separately, and as a consequence, if either were closed, the current through, and depth of the other, would be proportionally increased.

In connection then with cost of excavations to deepen either Channel within prescribed limits, we must look to the practicability and cost of effecting such a concentration.

For instance, if we would effectually improve the New Channel, we must direct the waters flowing through the subsidiary Channels into the main Channel of the St. Lawrence, and by the construction of dams and jetties, direct the accumulated body of water fairly into it, and also close the Old Channel.

If, on the other hand, the improvement of the Old Channel is to be effected, the same principle of concentration applies; we have but to allow the waters of subsidiary Channels to flow on naturally, for they chiefly come down in the desired direction, and to complete the work of diverting the whole of the main current of the St. Lawrence to throw a groin in a north easterly direction from the Flats of Monk Island, and thence by a dam across the New Channel, to the Bar, North of it.

With these considerations we have the means of instituting a comparison of the two Channels—or, rather, to determine in what direction it may be advisable in our opinion to make a Channel, answering the conditions specified in our instructions; for, independent of all pre-conceived opinions and local prejudices, we regard either Channel, or both, as but natural features to be

availed of, so far only as they may not impair or conflict with the main object—which object is the making of the best practicable Channel, through Lake St. Peter. Unquestionably, one or the other, the Old, or the New Channel, indicates where the Channel in view should be, and to determine which shall be adopted, we proceed to compare them.

It will be shewn that at each and all of the several widths and depths assumed, the Old Channel has greatly the advantage in point of cost; nor does it appear unfavorably on comparison of the soundings or the velocity of currents.

The New Channel being straight throughout, is about three quarters of a mile shorter than the Old, which is termed crooked by comparison; but which, nevertheless is not, from all that we can learn, inconveniently so, as to cause us to attach as much weight to the objection, as obtained in the opinion of many others of high authority. In other words, we are satisfied that were it of the desired depth and width for large vessels throughout, the inconvenience alleged would not be experienced. Certainly a New Channel would not be sought as a remedy for obstructions caused by River drift, which may be removed as easily from the one as the other.

In viewing this case *de novo*, we cannot but observe that nature should be aided by artificial means, and not forced from her ordinary course, and with high respect for the opinions of others we must take her suggestions from the present, rather than a very remote past period of time.

Although the Main Channel through the Lake may have once been in the direction of the New cut, yet the interposition by nature herself of the extensive St. Francis bank has for an indefinite period effectually and permanently modified her own work, and produced the present Old Channel, which we think may now be justly called the Natural Channel, it being the deepest, most central through the Lake, and drawing without artificial assistance vastly the larger portion of all the waters of the St. Lawrence River.

Again, the risk of vessels coming in collision at the curves of the Old Channel, or within the New Channel, in consequence of its straightness, seems to us to have been unreasonably magnified.

No Channel can be safely navigated without care, and we know from daily experience that where accidents are most apprehended, they least often occur. It is clear also, that great width of Channel, with moderate crooks, is better, the depth being the same, than a straight and narrow one, as in the present instance. But any improved

Channel, however narrow or crooked (far more so than either of these,) may be rendered safe by such regulations as may be established by the constituted authorities—in illustration of which, the River Clyde in Scotland, furnishes a prominent example. Furthermore, the adoption and perfection of the New Channel involves the stoppage of the old one, and thereby, will force the whole trade of the River through the New Channel, thus rendering its enlargement at once to a width of 100 fathoms, absolutely necessary, while the character of the entire bottom of the Old Channel, shewn by Mr. Logan to be lime clay, easily removed by harrowing, relieves that Channel from the difficulties stated, as apprehended by Mr. Killaly from the entanglement of the passing vessels with the buoys, boats and rigging employed on the work. Nine tenths, however, of the bottom of the New Channel, is of the same material as that of the old, and as easily removed by similar means, while the cut through the St. Francis bank, is chiefly coarse and fine sand, which must be taken out by dredging. When thus fully excavated throughout to 100 fathoms in width, and the principal part of the St. Lawrence waters turned therein, the New Channel would doubtless have a slightly stronger current, and be more acceptable to all concerned than the old one. But the other considerations viewed in connection with the estimates will shew if the advantages of straightness, and consequent reduced length will compensate for the greater cost—for from our premises it follows that this difference of cost may be so great as to more than counterbalance the slight curves of the Old Channel. The results of these estimates are as follows in tabular statement:

TABLE OF COSTS.

WIDTH 150 FEET.						Depth.
Old Channel Cost.		New Channel Cost.		Difference.		
£	s.	d.	£	s.	d.	Feet.
9720	19	0	13665	13	4	3035 14 4 13
16621	16	3	21709	8	6	5087 12 3 14
22303	5	6	30659	14	0	14356 8 6 15
28201	3	10	47898	8	4	19697 4 6 16

WIDTH 300 FEET.						Depth.
Old Channel Cost.		New Channel Cost.		Difference.		
£	s.	d.	£	s.	d.	Feet.
16253	1	4	26457	13	6	10204 12 2 13
25859	18	9	46040	17	1	20180 18 4 14
37225	11	2	70851	0	3	33625 9 1 15
49624	18	10	88205	17	3	38580 18 5 16

WIDTH 450 FEET.						Depth.
Old Channel Cost.		New Channel Cost.		Difference.		
£	s.	d.	£	s.	d.	Feet.
10481	12	1	36166	15	8	14685 3 7 13
32340	11	9	67275	6	10	34934 15 1 14
48104	8	10	97854	17	7	49750 8 9 15
65040	7	0	123852	8	1	58812 1 1 16

Estimates as much in detail as our time will admit, are hereto annexed, and marked A. and B.

These results show that at 13 feet depth of channel and of the respective widths of 150, 300, 450 feet the differences in favor of the Old Channel are £3,935 14 4, £10,204 12 2, and £14,685 3 7. At 14 feet depth £1,087 12 3, £20,180 18 4, and £34,934 15 1. At 15 feet depth, £14,356 8 6, £33,625 9 1, and £49,750 8 5. And at 16 feet depth, £19,697 4 6, £38,580 18 5, and 58,812 1 1. Or the cost by the Old Channel at 16 feet in depth and 300 feet in width is but £1,722 10 6 more than the New of half that width; and at the same depth and a width of 450 feet the cost of the New, (£123,852 8 1,) would be double that by the Old, (£65,040 7 0.) In fact any available amount of money will furnish more improved accommodation by the Old than by the New Channel.

Viewing therefore in any aspect of width and depth, we think that the greatly diminished cost of improving the Old Channel more than compensates for its few curves and slightly increased distance.

There are two other considerations worthy of note, one is, that in addition to the diminished cost, a greater volume of water can be diverted into the Old than into the New Channel, and with a far less risk to the stability of the works required to be constructed for that purpose.

2nd.—It has not heretofore been contemplated to dispense with the Old Channel, on the contrary, at the greatest width heretofore proposed for the New Channel, to wit, 300 feet, "that breadth being sufficient for the special and principal purpose of enabling ships of heavy draft in tow of steamers to pass the Lake." Rafts are to be forbidden its use, "lest they should injure the buoys, or get in the way of vessels;" neither is it to be used by night, "the present ship Channel remaining sufficient for the general purposes of trade."

If then as we have asserted, as much water as can be practically and with ease accumulated should be thrown into our Channel, and hence the propriety of closing the other; and 300 feet width be not sufficient for the general purposes of the vast trade destined to seek the St. Lawrence as its favored avenue, it follows that a wider Channel is advisable; and we on mature deliberation recommend 450 feet as the proper width of the contemplated Channel to be excavated to the depth of 16 feet.

Such dimensions naturally point to the Old Channel, which for a distance of about five miles, presents a superabundant width and depth of water, and for the remainder of its extent is as easily to be widened and deepened as the corresponding part of the New Channel; and for this and other reasons stated, we are of opinion that you should adopt the Old Channel for improvement and shut up and abandon the New. We cannot perceive any agency in the argument that more money should be spent to attain an object for which much has already been ineffectually expended, when, as in the present instance, a less sum applied in another direction will attain that object.

We estimate that three steamers of 150 horse power each, with properly constructed harrows as large and heavy as can be drawn five to six miles the hour will produce 13 feet depth of water in the Old Channel 450 feet wide, throughout, in one season's work, from the opening to the close of the navigation,—also that 14 feet depth will require the same power two seasons; 15 feet depth three seasons, and 16 feet depth four years.

The same ultimate effect could not be produced in the New Channel in a less period than six years.

The improvements of the navigation below Lake St. Peter, namely, on the *Pouliet* and English Bars require for the present, in our opinions, no further expenditure than the placing of buoys designating the position of the Bars, but it may be advisable, at some future period, to make a wide passage through the English Bar, which will admit of vessels taking a direct course.

At Isle Platte there are two Bars—one extending for a distance of 343 feet—the other for a distance of 1666 feet.

The proper way of permanently improving the navigation at those points, is to dredge a channel of 600 feet in width, to a depth of 16 feet, the estimated cost of such a work will be £2075.

The material to be removed on these Bars, consists of soft clay and sand, and at a short depth below the surface, the clay is of the same description as that found in Lake St. Peter, and may be removed by Harrows.

The economy and success of hydraulic works, such as form the subject of this investigation, especially require the superintending care of a scientific and experienced Engineer, and as it is far cheaper in the end to employ skill already acquired, rather than incur the mistakes and current losses, of teaching, we recommend that these improvements, when resumed, be placed in charge of a competent Civil engineer and an experienced Assistant, the latter of whom shall reside constantly on the work.

Having been informed that considerable piling had been done North of Flat Island, to divert water into the New Channel, we were led to look into the condition of the work constructed, and its effect upon the current, but found that nearly the whole had been destroyed—probably by the ice; we therefore present the annexed section and plan of a Piled Dam, such as we believe will be both cheap and durable.

The Piles being deeply driven into the bottom of the Channel, and sunk at least two feet under the surface of low water, and supported by banks of earth and stone (as represented in the section,) thereby giving the ice room to form, and pass over the Dam.

In conclusion, although it does not come within our Province as Engineers, yet we cannot, in connection with the subject, but naturally advert to the immense and growing interests to be accommodated and promoted by any and every improvement of the St. Lawrence, nor do we know of any more important than that which you now contemplate.

The St. Lawrence—the natural outlet of the great Lakes—and they connected by Railroads and Canals with the Ohio and the “Mother of waters, the Mississippi,” the great, the “far West,” is directly and largely interested in its unobstructed navigation, and to an extent that must insure, at an early period, its safe, unobstructed and free passage.

To this condition it will, ere long, come, for it does not consist with right or reason, or the enlightened spirit of the age, that obstacles be permitted to exist against the will and interests of the Commercial world.

We have the honor,
Gentlemen,

With the highest respect, to remain,
Your obedient servants,

WM. GRIBBS MACNEIL,
JOHN CHILD,
C. S. GZOWSKI.

(Copy.)

STEAMER “RICHELIEU,” ST. LAWRENCE RIVER,
October 21st, 1850.

To W. E. Loyal, Esq., F. G. S., Provincial
Geologist.

SIR,—Having accompanied us during the past week in our examination of Lake St. Peter, for the purpose of determining the best mode of deepening the Ship Channel through said Lake, and having witnessed the measurements, water soundings and bottom borings in the two principal channels and elsewhere, we shall now be glad to receive from you, in writing, such information as you can readily give on the following points.

1st—The Analyses of the following specimens obtained, namely, one from Isle Platte, and two from the New Channel, being one from the head, and one from a mile above lower end; three from the Old Channel, namely, from Upper Bar, Lower Light and Buoy, and one from the English Bar near Pointe du Lac.

2nd—The nature or origin of the formation from which these specimens have been taken.

3rd—Your opinion relative to the effect of the present or moderately increased current upon the materials constituting the Flats, Bars and Channels of the Lake.

With the highest respect,

We are,

Your most obedient servants,

(Signed)

WM. MACNEIL,
JOHN CHILD,
C. S. GZOWSKI.

Board of Engineers appointed by the Montreal Harbour Commissioners for the examination of Lake St. Peter.

MONTREAL, 30th October, 1850.

GENTLEMEN,—In compliance with the wish expressed in your communication of the 28th inst., I beg to state the results of such mechanical analyses as the time has permitted, of the specimens to which you allude, obtained in your borings in the bed of Lake St. Peter, and neighboring parts of the St. Lawrence.

1. From the Bar of Isle Platte. The bottom of the River in this part appears to consist of clay with a thin and probably partial coating of silicious gravel occasionally mingled with sand.—The augur was with difficulty made to bore 3 feet of the clay, and the specimen obtained gives, after drying, 3 per cent of sand, the remainder being nearly pure clay.

2. From the Upper Bar in the Old Channel.—The bed of Lake St. Peter is here a soft, argillaceous mud, through which the augur was pressed without difficulty to the depth of 12 feet. The material is a blue nearly pure clay. The depth of water was here 14 feet—the rate of current in miles and decimal parts 1.51.

3. From the Lower Light Ship. The bottom in this part is exactly the same as in the previous instance. The augur was without exertion pressed through 14 feet, and the material is a nearly pure clay.—The depth of water was 13 ft. 2 in. the rate of current 0.91m.

4. From the Lower Buoy. The bottom here much resembles that in the last two instances.—The weight of one man was sufficient to press the augur through 13½ feet of the deposit, of which the first six inches appeared to be rather tougher than the remainder. The material in the lower part is a nearly pure clay. A specimen taken midway between the Lower Light Ship and the Buoy, another two miles below the Buoy, and a third four miles further down give nearly the

same results. In the three cases the augur with little pressure sank over 13 feet in the mud.—The depth of the water in the Lower Buoy, was 14 feet; the rate of current 0.81m.

5. From the head of the New Channel. In this place the bottom consists of sand; the augur was with difficulty worked through 5½ feet, the top of which holds 48 per cent. of clay, the bottom 17 per cent. of the same, the remainder in each case being coarse sand. The larger quantity of argillaceous material at the top appears to arise from the presence of a thin stratum of clay overlaying the sand. The depth of water was 15ft. 3in.—the rate of current 1.45m.

6. From a point about a mile and a half above the lower end of the New Channel. The bottom here is nearly the same as in the instance of No. 4. The borer sank with little pressure through 11 feet. The first six inches were rather tougher than the remainder; they gave a clay with 8 per cent of sand; the remainder is a nearly pure clay.

A specimen taken a little higher up in the New Channel, and another from the lower end, give nearly the same results. At the lower end of the New Channel the depth of water was 14ft. 4in.—the current 0.59m. per hour.

7. From the Upper or *Poulier* Bar near Pointe du Lac. The bottom here consists of tough clay, through which the borer was with difficulty worked 2½ feet. The Lower or English Bar near Pointe du Lac has a covering of gravel on which the borer had no effect; but from its proximity to the Upper Bar, it seems probable that this gravel is underlaid by a similar clay, and that a partial coating of gravel will be found to invest the Upper Bar. On the *Poulier* Bar the depth of water was 18 feet,—the rate of current 1.17m. On the English Bar the water was 15½ feet—the rate of current 0.99m.

On desiccation, the nearly pure clays (which still hold a minute portion of fine sand not separable by any ordinary process of washing) have the aspect of pottery clay, or fuller's earth, and when rubbed with the nail or cut with a knife show a glossy surface, unctuous to the touch. In the deposits they are in a condition of very minute division; in those instances in which the augur sank with facility to the various depths mentioned, there is of course a large portion of water associated with the clays. In this state they are by agitation regularly mingled with an increased amount of the liquid; and on experiment an ounce of the clay, thus mixed with about thirty times its bulk of water, and left to subside in a vessel in which the mixture occupied a height of 8 inches, (and in which the clay, if pressed into a solid mass, would not present a thickness of more than a quarter of an inch.) after resting twenty-four hours, still remains suspended to the height of three inches in so very light and flocculent a condition, with two and a half inches of opaque, turbid water over it, and half an inch of clearer liquid above, that the most gentle current would be sufficient to float it away.

The argillaceous deposits of the Lake, notwithstanding their softness, are in most places, and in the New Channel more than the Old, covered with a skin holding a small and varying amount of sand which gives it a sufficient degree of tenacity to resist the wear of the present currents, and it seems to me probable that once brought to a quiescent state, and thus protected, the deposits would resist even moderately increased currents, where the bottom is free from abrupt inequalities of surface in their direction, but that the skin broken and the deposits by any

means disturbed and agitated, so as to bring them into suspension, such currents would be sufficient to carry the great bulk of the material to considerable distances. According to the best authorities, a velocity of three inches per second or 900 feet per hour at the bottom will just begin to work upon fine clay fit for pottery, and however firm and compact it may be, it will eat away the surface; and yet no beds are more stable than those clays when the velocities do not exceed the rate indicated, for the water soon takes away the impalpable particles of the superficial clay, leaving the particles of fine sand, usually associated with it, sticking by their lower half in the rest of the clay, which they now protect, making a very permanent bottom, if the stream does not bring down gravel or coarse sand, which will rub off this very thin crust and allow another layer to be worn away. A velocity of six inches per second will lift fine sand; eight inches will carry off sand as coarse as linseed; twelve inches will displace fine gravel, and twenty-four will roll along rounded pebbles, of an inch diameter; to carry away angular fragments of stone as large as a hen's egg requires a rate of three feet per second.

With the exception of the various Islands and their reed—producing prolongations, constituting the delta at the head of the Lake, several of which appear to be composed of sand, it is very probable nearly the whole bed of the lake will be found to consist of the soft argillaceous mud which has been described. In some of the borings in this, fragments of one or two species of shells, at present inhabiting the river, were met with near the surface, and at depths of seven and eight feet, shewing that the deposit is the drift of the river. The argillaceous mud was met with also in some of the numerous Channels which intersect the sandy Islands, leading to the inference, which, however, requires confirmation, that the clay may extend under the sand. Fragments of river shells were found associated with the sand also, so that whether it be over or under the clay, it is alluvial; and it would thus appear that no parts of the deposits of Lake St. Peter and its Islands are the remains *in situ* of those clays and sands of ancient marine origin, which form a large portion of the immediate valley of the St. Lawrence, and through which the main river, and many of its tributaries have cut their way for considerable distances. It is from the ruins of these marine beds however of the post tertiary period, brought down by the tributaries and the main river, that the alluvial deposits of the Lake are supplied. To pursue the material carried from each or any individual tributary, and point out its distribution, and the effect it may have on the waters of the main stream, would require a much more extended investigation than the present: but it does not appear to me to follow as a matter of course, that because a deposit is near the mouth of a tributary, it is of necessity derived from it. To ascertain, for example, whether the material of the sand bank out in front of the mouths of the Rivers Yamaska and St. Francis, is supplied by them, would require an examination into the nature and quantity of the sediment brought by them during freshets, and under other circumstances; and the force and direction of the currents then, and at other times prevailing. This bank is a subaqueous continuation of Monk Island, the whole of which Island is above the mouths of those streams, and cannot therefore be derived from them; and though it is not an

improbable supposition that they may have contributed to the material of the subaqueous part, it is not impossible, also, that it may be due to a continuation of the supply, which formed the Island higher up. But whenever the sand is derived, there seems little doubt that the St. Lawrence current in the Ship Channel on the one side, and the currents of the tributaries on the other, have arranged and modified the form of the bank, and that this has reacted on the currents. It is probable that what is called the Ship Channel once ran from Monk Island straight through the Lake, as it appears from Bayfield's soundings in 1831 there were then traces of it lower down; but the transverse action of the tributaries has so modified the distribution of the material as to produce a deflection of the St. Lawrence current in the Channel in question, and carry it into what is called the Old Channel.

In respect to the soft argillaceous deposits, all the rates of current ascertained being greater than that sufficient to give to the bottom current the velocity required to remove fine clay, it may be asked by what cause such a retardation of the rate has at any time been effected, as to permit the clay to come to a state of rest. According to what has been stated, the clay would fall at this velocity under three inches per second; this is understood to be French measure. A bottom current of three inches per second, would represent a surface velocity of 7,463 inches French per second or expressed in English miles and decimal parts, 0.47 per hour. The lowest rate of current ascertained was 0.54 at a mile and

a half above the lower end of the New Channel. But in the Old Channel, midway between the Lower light and Buoy, two trials were made in one spot on different days. In the first instance the rate was 0.37, and we were informed by the light-man that the water was at the time six inches higher than it had been some hours before, in consequence of the effect of tide. In the second instance, the rate was 0.73, when we were informed it was low water, the light-man's gauge showing six inches less than on the previous trial. That the lower rate with the higher water was a tidal result, is evident from the fact that if the water had risen from increased supply, the current should rather have been stronger than weaker, unless the Channel at the entrance should not carry off the increased supply so fast as the Channels at the head gave it, which does not appear probable. If 0.70 be taken as the current when the slope of the river is unaffected by the tide, the retardation produced by an ordinary tide would appear to be between 4 and 5 per cent., and perhaps it is not assuming too much to suppose that some occasional combinations of tidal and effluvia conditions, such as extraordinary high tides and general low water in the river, with the temporary influence of wind, may effect a retardation of a quarter of a mile per hour, which is about the amount that is required.

I have the honor to be,
With much respect,
Your most obedient servant,

(Signed, W. E. LOGAN.

