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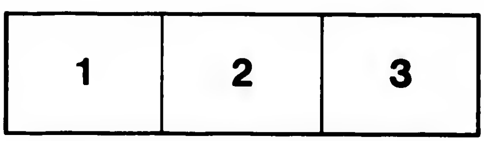
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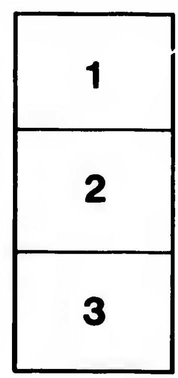
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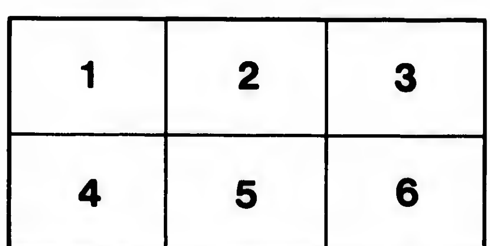
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The Montreal, Ottawa and Georgian Bay Navigation.

REPORT

of T. C. Clarke, Esq., C.E., submitted to the Legislative Assembly, in 1860, together with a

SUPPLEMENTARY REPORT

by Mr. Clarke on the Present Aspects of the Undertaking.

WITH MAPS AND PROFILE.

OTTAWA:
Paynter & Abbott, Printers and Bookbinders, 36 Elgin Street.
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RETURN

To an Address from the Legislative Assembly to His Excellency the Governor General, dated the 5th instant, praying His Excellency to be pleased to cause to be laid before the House, a Return of the recent Survey and Report of the Engineers on the Ottawa Ship Canal.

By Command,

SECRETARY'S OFFICE, Quebec, 19th March, 1860.

C. ALLEYN, *Secretary.*

REPORT.

To THE HONORABLE JOHN ROSE, Commisssoner of Public Works.

Sir,—I have the honor to submit herewith my Report upon the Ottawa navigation, in accordance with instructions received from the Department of Public Works, and hereunto appended.

The questions upon which information is sought, and to answer which the Survey has been carried on during the past year, are as follows:—

I. To determine the practicability of a navigation for vessels of the larger class, between Montreal and Lake Huron by way of the River Ottawa, and its tributary the Mattawan, Lake Nipissingue, and the French River.

II. To ascertain what scale is best suited to the nature of the route.

III. To give a reliable estimate of the cost of the improvement.

In the first place, I have to report that the distance between Montreal and the mouth of French River on Lake Huron (according to the plans furnished me by the Department,) is, following the line of navigation adopted, 430.76 miles.

That of this distance 351.81 miles are already a good natural navigation, and require no improvement, and that it is perfectly practicable so to improve the remaining 78.95 miles, as to convert the whole chain of waters into a first-class navigation for steam vessels, and to reduce the length of canalling to 29.32 miles, or, exclusive of the Lachine Canal, to 20.82 miles.

Secondly—The scale of navigation attainable, and which I would recommend as best suited to the capabilities of this route, is calculated for vessels of one thousand tons burden, and has Locks 250 feet long by 45 feet wide, by twelve depth, on the mitre sills.

Finally—A careful estimate, resulting from a close instrumental survey of all obstructed points, the details of which will be found hereafter, enables me to state that the cost of this improvement, exclusive of interest, legal expenses and land damages none of which I have any means of ascertaining, will not exceed the sum of $12,057,680, distributed as follows:—

Ottawa and French River Navigation.

	Distances.		Levels.		Cost.
	Rivers and Lakes.	Canals.	No. of Locks.	Feet Lockage.	
Lachine Canal		8·50	5	43·75	Not estimated
Lake St. Louis	13·31				do do
St. Annes		1·19	1	1·	409,672
Lake of Two Mountains	24·70				
Carillon to Grenville	7·73	5·	7	58·5	1,640,000
Green Shoals		·10			136,105
Ottawa River	55·07				
Chaudière and des Chênes	3·75	2·61	6	63·00	816,733
Des Chênes Lake	26·00				
Chats	1.70	·06	5	50·	681,932
Chats Lake	19·28				
Snow's to Black Falls	18·32	1·05	11	104·	1,256,840
River and Lake Coulonge	24·93				202,514
Chapeau and l'Islet	4·85	·14	2	18·	243,507
Deep River	33 58				
Joachim's to Mattawan	51·74	2·20	14	148·20	1,757,653
River Mattawan	16·22	1·08	11	144	1,162,154
Summit level and cut	51·15	5·07			2,100,369
French River	47.52	0·82	7	77·	886,117
Add Engineering and Superintendence					574.175
	401.41	29·32	64	603.70	12,057,680

There are, exclusive of the Lachine Canal, 20.82 miles of Canals, costing $12,057,680, which is equal to $579,139 per mile of Canal. But the cost of the whole navigation, from St. Annes to Lake Huron, 408.76 miles, is but a trifle under $29,500 per mile.

Such are the results of the Survey. The manner in which they have been attained will be described under the following general heads.

I.—Physical characteristics of the Ottawa.
II.—Methods of Improvement proposed.
III.—Character of work and material in locks, dams, canals, &c.
IV.—Scale of Navigation.
V.—Special description.
VI.—General Remarks.

I.—PHYSICAL CHARACTERISTICS OF THE OTTAWA.

Before taking up in detail the method of improvement proposed for this chain of waters, I shall sketch briefly the physical geography of the Ottawa Valley, and some of its prominent geological features. Nor is this foreign to an Engineering report, for, in order to clearly understand the matter of the changes proposed, we must first get a correct idea of things as they are.

Rivers have been well defined as the channels by which the water, originally evaporated from the sea, and falling upon the land, is returned to the sea again, and the volume of water discharged is the excess of precipitation over evaporation throughout the valley of any river, varying directly with the area of drainage, the rain-producing character of the atmosphere, and the nature of the soil.

Their position is determined by the laws of gravity, and they always follow, from the interior portions of continents to the sea, the line of quickest descent,—that is, the line of lowest level, whether resulting from upheaval, denudation, or the combined effects of both.

The characteristics of rivers are much modified by the nature of the geological formations through which they pass, and their different powers of resistance to the transporting and eroding effect of the waters.

In a country based upon sedimentary rocks, which are not hard enough to resist the force of the current, and generally do not appear above the surface at all, the formation of river channels is a process similar to that which we see when a shower falls upon a newly cultivated field. The water follows the line of quickest descent, but meeting material of different degrees of hardness, it meanders about from right to left and assumes a sinuous course; its constant tendency being to elongate its channel and consequently diminish its slope These windings are so great in some rivers as to double their length, as in the case of the Mississippi, between the Ohio and the Gulf of Mexico. When the length of the channel has been so much increased as to diminish the slope, and the consequent velocity of the current to such a rate that it will eat into the shores no longer, the regime is said to be established.

But in a formation composed of the harder crystalline rocks which obtrude themselves above the surface, the waters have not the same power to form for themselves channels: and the characteristics of the rivers of such a country are very different from those previously described.

The irregular depressions and clefts in the surface become filled with water, and form Lakes, whose overflow tumbles in cascades and rapids, over the rocky barriers which it cannot destroy, until it finds its way into other Lakes, lying at a lower level and from these to others, until at last it is received in some such arm of the sea as the Gulf of St. Lawrence, or Hudson's Bay.

A glance at the map of our continent will show at once the distinctive peculiarities of the two systems; north of the St. Lawrence, in the region of crystalline rocks, the country is dotted with Lakes and the connecting rivers are generally short. In what may be termed the Mississippi system, there are but few Lakes, and the rivers are long, and marked by a peculiar sinuosity of course.

Owing to the absence of the harder rocks, there are but few cascades and rapids. The currents are strong, but all the tributaries of the Mississippi have at some seasons of the year a natural navigation for boats of light draft of water.

On what we may call the northern river system, the navigation consists of stretches of deep and still water, interrupted by rapids and falls: around which the light canoes of the voyageurs are portaged by hand.

The obstacles to the improvement of these two river systems are of an entirely opposite nature. The problem in the one case is to regulate the natural flow, so as to retain sufficient depth for navigation in summer, and to defend the surrounding country from the disastrous inundations caused by Spring floods, which often rise to a height of fifty or sixty feet above the Summer level, and would probably sweep away any artificial works intended for the improvement of navigation. As the country becomes more widely settled, and a larger area of timbered land is cleared away, the evil increases; for swamps diminish evaporation, and act as natural reservoirs to moderate the violence of torrents.

Our river system, fortunately for us, is furnished with a series of reservoirs, which cannot be destroyed, in the Lakes themselves. These Lakes receive the waters from the melting of the snows in the spring, and hold them stored up against the summer heats. Hence the beautiful uniformity of the flow of our rivers. The St. Lawrence, unless dammed by ice, seldom rises over four or five feet; and the average rise of the Ottawa, where free from obstructions, is about twelve. There are few more beautiful illustrations of that beneficient design, which adapts the physical structure of the earth to the wants of its inhabitants than this; for, from the unretentive nature of the soil, the rain would escape nearly as fast as it fell; and the northern rivers would be torrents at one time, and nearly dry for the rest of the year, were it not for these natural reservoirs in which the surplus waters have been stored up among the hills.

To improve the navigation of such a river system is a comparatively simple matter, for the greater part is already done to our hand, and we have only to devise some means of getting from one Lake to another, and our task is accomplished.

This brief sketch of the more prominent peculiarities of the northern river system of this Continent, will enable us readily to comprehend the physical characteristics of the Ottawa, the largest of the tributaries of the St. Lawrence.

Its total length from its source, near the heads of the Sagueray and St. Maurice according to Sir William Logan, from whence it describes nearly the half of a circle in its course, until it falls into the St. Lawrence at the Island of Montreal, is over seven hundred miles; and it drains an area of not less than eighty thousand square miles.

From the Table of Rivers (see Appendix B) it will be seen that its size is about equal to that of the Rhine, and its great regularity of flow, particularly as compared with such rivers as the Ohio and Rhine, will be evident.

This is principally owing to its numerous lakes, as before mentioned; but in some degree to the fact, that, from the difference of latitude, the snow has melted and passed out of its Southern tributaates, before its "north water," as it is called, comes down.

The two great geological divisions of its rocks are Laurentian and Silurian. The Laurentian rocks are supposed by geologists to have been the surface of the then existing continent, and the floor of the sea upon which the sedimentary Silurian rocks were deposited.

The outlines of the shores of this ancient continent followed the North bank of the St. Lawrence, and thence ran up the Ottawa, skirting its north shore at varying distances. The present Ottawa Valley, as far up as Deep River, seems to have been a bay or inlet of the Silurian Sea; bounded on the North and West by the main continent, and on the South by a peninsula which runs into Northern New York, and forms that wild section of country of which the Adirondack Mountains are the Eastern boundary. The River St. Lawrence has broken through the isthmus which connected this peninsula with the main land, in a great number of channels, forming the celebrated group of the Thousand Islands.

The surface of this Laurentian formation is extremely rugged, and the rocks are contorted in a manner that shows the action of some extraordinary force. There is little level land, and the hollows between the rocky hills are filled with innumerable lakes, whose water is clear and deep. The whole region shews the wearing effect of water, and has evidently been much influenced by glacial action, as may be seen from the grooved appearance of the rocks and the hills, and the huge deposits of boulders that choke up portions of the river beds. The rocks consist chiefly of micaceous and hornblendic gneiss, mica slates, and veins of crystalline limestone.

The Silurian rocks, on the other hand, are sandstones and limestones; lying in regular strata, flat and undisturbed as when deposited on the floor of the ocean.

The truth of the observation of Hugh Miller that the physiognomy of the landscape depends upon its geology, is nowhere more evident than upon the Upper and Lower Ottawa.

From Montreal to Deep River the Ottawa runs in a Silurian valley; although at some points, as the "Rocher Fendu" and the Chats, the crystalline rocks shew themselves in the channel of the river. The general features of the landscape are those of a level country, like that or all limestone formations. Rocky barriers have penned back the waters into long lakes, like the Des Chênes and Chats, whose shores are low and flat, and generally cultivated to the water's edge with fertile farms. The timber is hardwood, principally beech, maple, ash and elm. The width of these sheets of water is from half a mile up to two miles. Along the Northern shore at varying distances, runs the unbroken outline of the Laurentian hills; which, as has been stated, were probably once cliffs against which beat the waves of a Silurian sea.

Above Deep River the character of the landscape changes. We are now entering upon the oldest part of our continent, whose rugged masses and contorted outlines speak of the convulsions of former ages. The hills that had admitted a strip of level country between their bases and the river now crowd close upon its edge, and rise precipitous, in some places to the height of seven or eight hundred feet. The groves of hardwood give place to those vast forests of pine of which the wealth of the Ottawa chiefly consists, and the clearings are few and unimportant.

As we advance, the scenery becomes more wild and rugged, and the picturesque beauty of the cliffs and cascades of the Mattawan, and of the lonely isles of French river, is unrivelled in any part of the continent.

Lake Nipissing is of irregular shape, from forty to fifty miles long and twelve to eighteen wide, and receives the water of seven rivers: two of them, the Sturgeon and Nauwanitigone, of considerable size. The south and west shores are bold, and the depth of water is great. The north and east shores are low and flat, and the water shoals gradually. The western end of the Lake is filled with islands, and the shores are cut up with inlets ending in marshes.

The Mattawa and French Rivers consist of a series of long and narrow lakes, of great depth and sluggish current, the waters escaping from each into the next below over natural dams of rock. Wherever, from greater softness or a more unfavorable disposition of the strata for resistance, *these rocky dams have been much worn down, the current is stronger, and it may be seen from the rounded and wave-worn appearance of the rock-bound shores, that the lake above has once maintained a higher level than it now holds.

On the Ottawa, from the Mattawa to Deep River, there are strong currents, and the character of the water is more river than lake-like.

METHOD OF IMPROVEMENT PROPOSED.

From the preceding sketch, the following conclusions may be deduced:—

That there are two great natural divisions of the Ottawa country; on one of which the banks of the river are low, and the rocks generally soft; while on the other the shores are precipitous and the rocks hard.

That the Ottawa is a river of very even flow, and not subject to sudden rise or destructive freshets.

That the extent of obstructed water requiring improvement is but a small proportion of the whole, and that the greater part is a chain of inland lakes, affording a good natural navigation.

How to correct these unobstructed parts is the question now to be considered.

When a river is obstructed by falls and rapids, there are several methods of making it navigable.

I. We may cut Canals around the rapids, and lock up and down through them, keeping away from the river, and letting it entirely alone.

II. We may throw dams across the channel of the river, and convert the rapids into a series of still lakes, and lock directly from one into another.

III. We may combine these methods by canalling around rapids, and using low dams to give the required depth, and to drown out currents between canals.

Sometimes one of these methods is most applicable to a particular locality, and sometimes another; and the judgment of the engineer is shown by his choosing that which best suits the circumstances of the case.

On the lower Ottawa, where the Lakes are long and deep, and the shores low and highly cultivated, it would be unwise to attempt to alter the existing levels, for we should drown a large extent of country, thereby destroying arable land, and probably rendering what was left unhealthy. Whatever plan is proposed will carefully avoid disturbing the long levels.

But fortunately for the project, on the greater part of the river, where the water is required to be raised, the shores are bold, and the desired lift would overflow but little land. Here we have only to raise the natural dams or reefs of rocks to the desired height, by artificial structures, thus restoring a condition of things which possibly existed before the ceaseless rush of waters, or glacial action had worn the rock dams down to their present state.

Wherever canalling is resorted to, the canal will follow the shore, and be constructed by embankments rather than in excavation, on account of the great saving of expense over thorough cuts in solid rock, of the large dimensions necessary for the navigation.

The whole key to the system of improvement proposed for the Ottawa is comprised in two propositions.

I. Follow the natural bed of the river, and avoid cutting into the rocky shores.

II. Gain the depth required for navigation by raising the surface of the water rather than by submarine rock excavation.

We may lay it down as a general principle that, although on the lower part of the river where the shores are flat and lie upon sedimentary rocks, we could dispense with the use of

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*Note.—When the dip of the strata is in the direction of the current, the water has only an erosive force; but where it is against the current, the strata are undermined, fall from their own weight, and are broken to pieces, and the next flood carries the debris away down the stream.

dams; yet as soon as we enter upon those portions where the river has cut its bed through crystalline rocks, (which is more than half the whole distance from Montreal to Lake Huron), the only mode by which a navigation can be made at all is by raising the water by dams.

There is not now depth enough of water; the currents are too strong to be overcome; and as the shores rise almost perpendicular from the water's edge, there is no room to construct canals; moreover, even if there were room, the length of artificial canal required would be so great as to condemn the project; and there can be no doubt of the superiority of a still deep, lake from two to three hundred yards wide, for purposes of navigation, over a canal of fifty yards in width.

Fortunately every existing condition favors this mode of construction.

The bed of the river consists of hard crystalline rocks, worn smooth and generally free from boulders; and the shores of the same material rise abruptly on either side, diminishing the length of the dam required.

Points can be obtained where the water is shallow, and where there are rocky islands which will act as natural buttresses for the structure. Under these circumstances there is no more danger of a properly constructed flat dam being disturbed than one of the islands themselves.

As has been previously said, the Ottawa is not a river subject to sudden rise or extraordina floods. It never averages over three inches in twenty-four hours for any number of days in succession: its common rise is one inch per day. Its rise to its high water mark, stand, and subsequent fall, occur every year at nearly the same dates, with the utmost regularity. (See appendix for Table "C.")

There is very little shove of ice in the Ottawa, where dams would be required.

So ample is the volume of water, even in the driest time, that notwithstanding leakage and the effect of wind blowing down stream, the dams would be always submerged, with from one to two feet of water running over their crests.

A very important effect of dams upon the Ottawa will be to diminish the variation between high and low water. This is always proved to be the case wherever they are built, for there is a greater area to be filled up by the flood waters before they can rise; and the discharge over the top of a dam is so free that the water can never rise above it to the same extent that it does in a river channel obstructed by islands and sunken rocks.

In designing a system of dams for the Ottawa improvement, we should have the actual volume of water discharged both at the lowest and highest recorded stages. This would require a series of gauges in different parts of the river, taken for a term of years, until the greatest and least flow was ascertained from actual measurement.

As the time of this survey has been limited to one season, I cannot pretend to have attained such accuracy; nor, merely for the purpose of an estimate of cost, is it necessary. It is only requisite, for that purpose, that what is assumed as the greatest and least volume should cover the extreme limits of variation .

The results of several guages give, for the summer volume of discharge, at Portage du Fort, 31,000 cubic feet per second, and that of high water, 127,000 cubic feet per second. From anything on record, it does not appear probable that the least discharge ever falls below 25,000 cubic feet per second, or the greatest over 130,000 These quantities, therefore, have been assumed as a maxim and mimimun (see Appendix, Table "D")

Where the dams themselves act as waste weirs, it has been thought preferable to raise the masonry of the upper or guard lock, and allow the water to rise as high as it would upon the crests of the dams, rather than to attempt to control it by guard gates in the body of the dams, as this would be introducing a perishable material, and mode of construction, into the body of the work.

The height at which the water will stand upon the crests of the dams for different volumes of discharge, has been calculated by the formula for weirs, originally due to the investigations of Du Buat.

Let Q be the number of cubic feet per second, and L the length of the overfall of dam be known and we can obtain :

H. = The height at which the water will stand above the crest of the dam from the simple equation

$$H = \left(\frac{Q}{3.56\,L}\right)^{2/3}$$

By this formula the table of dams (see appendix D) was calculated, and the height of the coping of guard locks established.

It will be seen that these dams will have from 1.34 to 3.51 of water running over them at low water. Yet for purposes of estimating, their crests have been assumed to be as high as the level of water above them, which gives excess of material.

One other point demands notice. We know that by dams we can drown out currents, in these Lakes themselves, strong enough to affect navigation.

The velocity of any current depends directly upon the area of flowage. When that is large in proportion to the volume, the velocity is slow; and as the area diminishes, the velocity increases, in order that equal volumes may pass in equal times. How great this velocity will be at any point is strictly a matter of calculation, founded on well known hydraulic laws. Without here giving details, it is sufficient to state in general terms that the present area of flowage will be so much enlarged by the depth of water thrown on by dams, that no greater velocity of current need be apprehended than three miles an hour, at any point, even during the six or seven weeks of high water; and during the rest of the season the currents will be entirely imperceptible."*

III. METHOD OF IMPROVEMENT PROPOSED.

In accordance with the instructions of the Department, the quality of the works is proposed to be not inferior to the standard of the St. Lawrence Canals; and every thing has been designed as substantial as possible. It is believed that there will be nothing perishable but the lock gates on the whole line.

Dams, where carried above water, will be of rough but strong rubble masonry laid in cement; wherever the water runs constantly over them they will be flat timber dams composed of solid timber laid up crib-fashion, without framing, fastened with ¾ inch square bolts, 20 inches long, at each crossing rock bolts ¾ inch round; to be filled with loose stone, covered with 4 inch plank, well spiked, and staunched with gravel, similar to those usually constructed by the Department in connection with timber slides.

In most places the water can be diverted by a rough coffer dam, and the permanent structure commenced directly upon the flat rock. This operation is much facilitated by the numerous channels into which the river is divided, at the points selected, by large and small islands. The dams can be run from one island to another, and passages left for the discharge of the waters, which can be afterwards closed.

When the water is deep, recourse must be had to the system of sinking cribs. The dam should, where possible, be laid out upon segments of circles arching up stream; at

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*The investigation of the laws that govern the flow of water over wiers is one of the most important branches of hydraulic engineering, and has received the attention of many eminent savants, among whom may be particularly mentioned Du Buat, Castel, Poncelet, Lesbros, Daubuisston, in France; Eytelwein, Weisbach, in Germany; the Rennies, Sir John Leslie, and Thomas E. Blackwell, in England; and James B. Francis, of Lowell, in the United States.

All the rules and formulæ derived from their investigations are founded on that natural law governing the velocity of fluids, known as the theorem of Torricelli, modified by co-efficients obtained by comparing the results derived from it with those furnished by experiment. As these experiments have as yet been made on a comparatively small scale, we cannot apply the rules deduced from them to circumstances widely differing from those under which the experiments were made, without discrepancies more or less great being found in the results.

The case with which we have to deal is fortunately one where we proceed from the greater to the less, so that an error, whatever it is, is diminished instead of being increased. Were we calculating the amount of available waterpower from the height on the crest of our dam, a very small error either in observation or in the co-efficient itself, would give results widely differing from the truth; but where we have already gauged the flow of the stream, and only calculated the height for a given length of dam, we know that the calculated result must, at least, be as close an approximation to mathematical truth as is the quantity expressing the number of cubic feet of water passing a given area in a second, as obtained from our gauges.

Nevertheless it would be very desirable to have a series of experiments made, with special reference to determining the actual longitudinal section of a large river, dammed entirely across, during different volumes of discharge, from extreme high to low water. Such experiments, if properly made, would not only be a very valuable contribution to engineering science, but are almost indispensable to the proper carrying out of a scheme of the magnitude proposed in this Report.

mode of construction in which the greater the pressure the tighter the dam. Every alternate crib should be lowered to its place, sunk, and fastened to the rock with heavy iron bolts.

The key cribs should then be floated in to fill up the spaces, and the whole sheet piled on the up stream side

Upon this level surface the superstructure of the flat dam is carried up in the usual way. Generally the levels can be so arranged as to receive the spill of the dam into deep water; where this could not be done an apron of solid timber has been provided to protect the rock below.

Timber and stone suitable for dams are found abundantly in all parts of the route, and there are no points where their construction offers greater difficulties than have been successfully overcome by the enterprise of the lumbermen on the tributaries of the Ottawa.

The locks are intended to be built of sound and durable stone, laid in hydraulic cement, with fine bushed face, cut to quarter inch joints, backing of rectangular stone, with parallel beds laid to one inch joint, and well bound to face work. The rock is generally assumed to be sound, but a tight timber foundation, laid in concrete, is provided for under the recesses.

The gates are designed of solid timber, in the style now used on the St. Lawrence Canals. Each gate will have two sluices 10′ 6″ x 2′ 6″, and culverts around the hollow quoins to be used in case of accident to the sluices, or together with them if required.—The arrangement for opening and shutting gates should be of the most approved kind; and it is believed that a lockage need not take over ten minutes, the average time on those locks of the St. Lawrence Canals, where the latest improvements in machinery and gates are used.

In arranging the lockage it has not been found necessary to place more than two locks in combination, except at the Talon Chute, where three have been combined, the contour of the ground prohibiting any other arrangement.

The cost of the execution of this work will depend, more than anything else, upon the character of the rock, its hardness in excavation, and its suitableness for purposes of construction. As has been before stated, the two great divisions of the Ottawa rocks are Laurentian and Silurian. The former are very hard, difficult to work, and too brittle for the face stone of locks; while, on the other hand, the Silurian lime and sandstones are easily excavated, and, from the upper beds of the limestone known as the Trenton group, we can procure a building material excellent in every respect, both as regards ease of workmanship, strength and durability. From some of the Argillaceous beds a good hydraulic cement can be obtained, such as is now made at Hull, opposite Ottawa City.

We know, then, that from Montreal to Deep River, building stone lies all around us, but from that point to Lake Huron, it was much to be feared that the stone of the country, although good enough for backing lock walls, filling lock dams, and rough masonry in general, could not be depended on for face work. Luckily, however, this is not true of the whole of that extent of country. A bed of yellow weathering, fossiliferous limestone, on the North-east shore of the river, a little above the Deux Riviéres Rapids, will afford good stone for the structures in that district and on the lower Mattawan.

At Talon Chûte there is a vast mass of crystalline limestone, described in the Geological Report, which is a fine grained and tolerably tough stone, and appears to be good enough for face work. The locks at that point have been estimated to be built of it.

The face work of the remainder of the locks upon the lower Mattawan is designed to be built from a quarry of gray granite (probably an intrusive dyke) on the north side, about half a mile from the river, below Paresseux Chûte.

For the structures on French River, the face stone must come from the beds of Niagara limestone, on the Manitoulin Islands of Lake Huron. This will much increase the cost of that portion of the work, and render its construction necessarily gradual.

IV. SCALE OF NAVIGATION.

The first point to consider is, whether we are designing a local or a through Navigation. This would be decided by the general depth of the chain of waters, the difficulties of overcoming the summit, the supply of water, and other points, more or less closely connected with the preceding.

To these my intention was first directed, and after careful personal examinations of the whole route, aided by the graphic report of Mr. Shanly and the result of such Surveys as were at the time made, I was able definitely to decide, that, whatever scale was fixed on should be with the view of completing, at some future day, the through line of Navigation.

It must be borne in mind that this is exclusively a steam navigation ; sails, although useful auxiliaries, would never alone enable vessels to pass through this route, with any saving of time over that by the Welland Canal*

The next point is, whether we shall build locks fitted for large vessels ; or whether, preserving the dimensions suited to an inland and Local Navigation, we shall cause a transhipment to take place at the mouth of French River, which is about half way between Chicago and Montreal by this route.

This question is determined by the length of Canal (or what is equivalent in delay to an artificial cut) on the route where a large proportion of the distance is canal. I should then recommend transhipment : for I believe the unwieldness of large vessels, on account of their top hamper being acted on by the wind,—the risk of damage to the vessels and to the works in the narrow channel of the Canal, and the delay arising from these causes, would more than balance the cost and trouble of transhipment into steam barges better suited for Canal navigation.†

As soon as I had ascertained that the length of Canal on the whole route, including Lachine, would not exceed 29·32 miles and that the remaining 401·44 miles could be made a navigation allowing of as rapid a transit as the great Lakes themselves ; and indeed more so, so far as freedom from head winds and storms is concerned ; I was then prepared to recommend the larger scale, and an unbroken line of Navigation.

It only remains to decide how large. When crops are good, and full freights offer, it is an admitted axiom, that, the larger the vessels the cheaper the cost of transport. It is a fortunate pecularity of this route that vessels can always depend upon making up full freights of sawed lumber from the inexhaustable pine forests of the Ottawa, manufactured at every dam on the river.

It requires then, I think, no argument to prove that we cannot err in providing to let down to Montreal the largest class of Propellers, now confined to the Upper Lakes by the limited size of the Welland Canal.

From these data, and after consultation with various persons experienced in the Lake Trade, I have fixed upon the dimensions given, as follows:—

The length proposed by Mr. Shanly, and suggested in the instructions of the Department, 250 feet, is long enough for vessels of the desired tonage. It does not, however, seem desirable to exceed the breadth of the St. Lawrence Canals, 45 feet ; because this is in itself wide enough ; and because it makes the enlargement of the Lachine Canal attainable, without pulling down the present lock walls.

The depth has been fixed at 12 feet, which is absolutely necessary if we wish to admit vessels of over six hundred tons, as will be seen from the table of large Propellers (given in Appendix E.) for which I am indebted to the kindness of Capt. D. B Dobbins, Secretary of the Board of Lake Underwriters, Buffalo, N. Y.

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*When the question of the enlargement of the Erie Canal came up some years ago, this point was discussed very thoroughly, and the opinion of forwarders was that, if the Erie Canal were large enough to admit vessels of 1,000 tons, they would still prefer to tranship at Buffalo.

† In this I am supported by the opinion of Mr. Shanly, who has in his report so well expressed the character of this route, that I shall make no apology for quoting it here.

" It is as a Steam Navigation, and more especially for that denomination of Steamers known as "Propellers," that I believe the Ottawa and French River route is destined to hold a first place as a Channel of Trade. For vessels of that description the character of the waters, and of the region on either side of them, is peculiarly fitted. Land locked for the greater portion of the way, the route will not in that respect be as advantageous for Sailing Craft as that by the great Lakes, but the inexhaustible supplies of wood at all points along it, and the facilities for taking their fuel on board at frequent intervals, will forever render the cost of working Steam Vessels lower on this than on any equal length of Navigation on the continent. Here, too, the Propeller can keep the even tenor of its way heedless of the storms which, sweeping across the Lakes in the Autumn of each year, cause such immense destruction of life and property."

Although, through the heavy cuttings, as where the distance is short, I have followed the width recommended by the Department, 100 feet on the bottom, I have not hesitated to increase the prism of the Canal generally to 146 feet on bottom ; as I believe that is not more than is required for vessels to pass with speed and safety. The depth has been fixed at one foot more than the locks—say 13 feet ; and in Lakes and Rivers will be 15 feet, and generally average 20 feet.

V.—SPECIAL DESCRIPTION.

Commencing at the City of Montreal, we have the Lachine Canal common to both the St. Lawrence and Ottawa routes. It is 8.5 miles long ; has five locks, 200 ft. x 45 x 9, with a total lockage of 43.75 feet. The prism of the Canal is 80 feet on the bottom, 120 at water surface, and averages 10 feet deep. This would have to be deepened, and the locks lengthened to admit vessels of the same tonnage as could pass the proposed Ottawa Canals.

As neither the time nor means at my disposal have enabled me to make a survey of this, I have not included it in my estimate. The enlargement involves no serious obstacles, and will, probably, be made whether the Ottawa Navigation is opened or not.

A map of Lake St. Louis, made for the Commissioners of the St. Lawrence improvement, in 1842, by A. LaRue, P. L. S., shows a channel depth, somewhat circuitous, of not less than 15 feet from Lachine to Isle Perrôt. For reasons given above. I have not made any survey here, but am informed by pilots that there are 15 feet, and over, along the North Shore of Isle Perrot, up to the foot of the present St. Annes Lock. I have myself, taken soundings for half a mile below the lock, and over that distance can corroborate the truth of their statement ; but it is much to be desired that there should be a new survey with soundings carefully made from St. Annes Lock to Lachine.

SAINT ANNES.

Length of Canal, 1.19 miles.
1 Lock, 1 ft. lift, L.W. ; 3.5 ft., H.W.
Canal above, 125 ft. wide by 5000 ft. long.
Guard pier below, 1000 feet long.
Estimated cost, $469,672.

I propose to enlarge the present lock to the requisite dimensions, as it occupies the best point that can be selected. In order to do this it will be necessary to put in a coffer dam and pump it dry, take down the east wall, and get the pit sunk to the proper depth, as early in the spring as the weather will admit of laying stone. Then by working night and pay. it would be possible to complete the new lock without delaying the opening of the navigation for more than three or four weeks.

I will be necessary to build a guard pier 1000 feet long below the lock, on the side next the rapid, to cut off the current, which, at high water, is strong enough to incommode vessels very much. This will be an ordinary crib-pier filled with stone.

Above the lock, the river bed is Potsdam Sandstone, in strata of from five to eighteen inches thick, somewhat tilted upon one another, and covered with boulders from the Laurentian rocks. The average depth, from the head of the lock to a point where the water suddenly deepens to eighteen feet, is eight feet, and the distance 5000 feet.

I propose to make a double line of timber piers, 15 feet wide and 125 feet apart, for the whole distance. Half of the width of each pier to be filled with earth lining and sheetpiled, and the enclosed area divided into sections by water-tight bulk heaks. The rock is seamy and would leak a good deal but by puttiug in powerful steam pumps and shortening the length of the section to be laid dry in proportion to the leakage, it would be perfectly practicable to keep down the water until the excavation was made to the required depth of five feet. The stone would be used to fill the outside compartments of the piers, and the excess deposited outside of that. The bulkheads would be removed, and the whole thing would be an artificial canal 125 feet wide, and 13 feet deep, in the bed of the river, while the piers would serve as guides to keep vessels from straying out of the channel. I have been particular to describe this in detail, as a simlar method will be proposed for submarine rock excavation wherever it may occur.

The face and backing of locks is estimated to come from the neighboring quarries of Chazy limestone at Point Claire of which the piers of the Victoria Bridge are built; filling of cribs out of the excavation.

This is unquestionably the best way to make the improvement, for were the proposed canal located on the shores of the Island of Montreal, as has been sometimes proposed, the amount of under water rock excavation required to reach 15 feet of water from the shore, both above and below, would actually exceed that on the line I propose, and we should have, in addition, an enormous amount of excavation on land, and an expensive bridge to build for the Grand Trunk Railway.

LAKE OF TWO MOUNTAINS.

The head of the Saint Annes Cana would be 23 miles from Montreal. From the 23rd to 24th mile, according to the surveys of W. B. Gallwey, C. E., placed in my hands by the department, it has a depth of from 20 to 30 feet. From the 24th to the 26½th mile, the low water depth does not exceed 13 to 14 feet, and I am unable to say whether the bottom is rock or some material that could, if required, be dredged. From the 26½th mile to the foot of the Carillon rapids at the 47¾th mile, the channel is 30 feet and the navigation is straight and unimpeded.

Carillon.

Length of Canal 0.5 miles.

2 locks, 12 and 5 feet lift; passing basin, 2000 ft. long.

Rolling Dam, 1700 ft. overfall; lift of water, 6.25 feet.

Estimated cost, $307,742.

At Carillon the river is obstructed for 1·3 miles by a reef of calciferous sandstone with only two or three feet of water running over it, except in the "Sickle" channel, about 150 ft. wide and 9 or 10 deep, and, as its name implies, very crooked. The fall, at the stage of water when we levelled it, was 8.75 feet.

This has been overcome by the military canal, built by the Imperial Government, 2 09 miles long; locks up, 23 feet, by two locks 128 x 32.5 x 5.5, and down again 13 to 15 feet by one lock of the same size, and is fed from the North river. The prism of the canal is very irregular, being from 18 to 40 feet wide on bottom, and 50 to 80 at surface, say 5.5 deep in the centre, gradually shoaling to each side. It runs from 5 to 16 feet cutting to water surface, principally rock.

The locks are in a very ruinous state, and cannot last many years longer in their present condition.

The great amount of rock excavation necessary to enlarge this canal to the new scale, its twelve to fifteen feet of unnecessary lockage, and bad location of the lower lock, forbid us attempting to improve the present work.

I have located the new canal on the south shore of the river. The water is 25 to 30 feet deep up to the lower lock, which is at the foot of the current, near the house of the late Judge Macdonald, Point Fortune. The passing basin is defended from the river by a wall of stone laid in cement battering 2" in 12", backed by a bank of loose rock out of the excavation, sloping 1½ to 1 towards the river, and the whole paved with stone set on edge. The rolling dam stands on flat rock, free from boulders, and except in the channel, the depth of water is not over two feet. It will have a slide for timber, and the height of water above its crest will range from 2.57 to 8.11 feet.

By removing some fifty thousand cubic yards of rock between the upper lock and the head of the rapid, this dam across the river could be dispensed with. On referring to the map it will be seen that the proposed canal occupies the place of the side dam just constructed. To gather enough depth of water to run deal and timber cribs, as we are obliged to destroy this channel, we must provide a new one; and there is no way so practicable as to raise the water by a dam, which shall contain a broad and short slide leading directly into deep water below.

The lock stone will come either from the Pointe Claire quarries, or those of Isle Bizard. The loose stone for dam filling, out of the excavations, and the stone for the wall, to be laid in cement, can be got out of the bed of the river in such size and shape as will enable it to be laid up into a wall with scarcely any dressing. On this account I have considered that $3 25 yer cubic yard would be sufficient; which price implies that but little labor is required.

CHUTE A BLONDEAU.

Length of canal, 0.07 miles.
One lock, ten feet lift.
Rolling dam, over fall, 1750 ft., lift 12 ft.
Light dam, cement masonry, 1550 ft. long.
Estimated cost, $144,315.

A stretch of five miles of still water over 30 ft deep, brings us to this rapid, about 900 ft. long, and falling 4 ft. The Military Canal is here formed by cutting off a point of rock, and has one lock of the same size as at Carillon. The canal is forty feet wide. and cut through rock, about the same depth.

We place the new lock in a channel between the island and the present lock, and follow the line of reef with one dam, the depth, except in channel, not being over two or three feet. This dam has a slide for timber similar to Carillon.

The object of raising the water 12 ft. by this dam is as follows:—The lower end of the present Grenville Canal is through rock cutting. By raising the water at the Chute a Blondeau, we can follow the river for 1.1 miles above the present lower lock of the Grenville Canal, shortening the new one by so much; and saving a large amount of rock cutting.*

The lock stone is estimated to come from the same point as Carillon. Stone for dams can be procured on the spot.

GRENVILLE.

Length of canal, 4.43 miles
One pair of combined locks, 12 ft. lift each.
Passing basin, 400 ft. long.
One lock 6½ feet lift; prism of canal 150 ft. at surface, 146 on bottom and 13 deep; at head for 2000 ft., 100 ft. wide on bottom.
Guard lock, 1 to 15 ft. lift.
Estimated cost, $1,197,852.

The bed of the Ottawa, at the foot of the Long Sault, which is an almost continuous rapid for five miles, with a fall of forty-five feet, consists of calciferous sandstone, covered with boulders from the Laurentian crystalline rocks. These are worn smooth and polished by the water, are of all sizes, and in many places entirely conceal the rock in position. This makes so bad a foundation for artificial structures, that we are driven perforce out of the bed of the river, and can do nothing but enlarge the present Grenville Canal, which is generally well located on a strip of flat land lying between the high bank and the margin of the river.

As has been stated, we leave the river 1.1 miles above Greece's Point, and lock up at once to the Grenville level, in order to raise the bottom of the canal out of cutting. The new line joins the old one in about a mile, follows it for about a mile and a half, and then, to avoid rock cuttings, runs along the river's edge, which forms one bank, while the other is formed by a stone wall laid in cement, backed by a bank of loose rock out of the excavation of the head, and sloped 1½ to 1 toward the river, and paved. The new canal follows the old line, cutting through the neck of land upon which the Village of Grenville stands. Here, for 2000 feet, the width has been estimated to be 100 feet, with sides nearly vertical. The embankments (not river wall) are formed by dry battered wall, backed with earth filling.

If, instead of using these stone walls, laid on dry land, and in cement in river wall, the embankments were dressed to a slope of 1½ to 1 and paved, the estimated cost of this section could be reduced about $300,000.

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*The Chute a Blondeau is one of the few points on the Ottawa where the phenomenon of "ice-packing" takes place.

The floating ice which has come down the Long Sault, is arrested by the sheet of still water below this rapid, jammed under it and "packed," until an ice-dam is formed, raising the river some 25 to 30 feet above its summer level.

The effect of the proposed dam would be to form a still lake for some three miles above it, which would be frozen over wtth a thick sheet of ice, and the "packing" if it took place at all, would be removed some three miles up the river, above the point fixed for the lower entrance of the Grenville Canal.

The lock-stone can be brought from below by the present canals; all the other stone can be got out of the river, or near by; and, as at Carillon, will require but little labor to lay it into a good wall. All the rock from Carillion to Grenville is soft, lies in thin strata, and can be easily got out. I have considered $1 per cubic yard as an ample allowance, except at Chute a Blondeau, where the rock is harder and there is less of it, and I have called it $1.25 per yard. The lock-stone is easily dressed and can be carried from the quarries, to where it is wanted, in scows: distance 25 to 35 miles. I have considered that $12 for face and $6 for packing, averaging $8 would be sufficient.

At the head of the Long Sault is a great sand-shoal, partly dry at low water: but following close to the north shore we have 24 to 30 feet. From Grenville to Ottawa, the river runs in a level valley, with low shores of blue tertiary clays; a considerable extent is overflowed by high water, and covered with sand deposited by the river.

The width is from one to two thousand feet, and the channel depth 30 feet, until we get to the "Green Shoal," some 8 or 9 miles below Ottawa City. Here a calciferous sandstone reef runs clear across the river, diminishing the depth at low water to eight feet for a length of five hundred feet.

It will be necessary to pursue the same course here, that has been recommended at St. Annes, and remove the stone by a coffer dam, the sides of which should be left for guide piers to indicate the channel. Betwen this place and Ottawa City, there are some sand shoals that must be dredged, but no more rock.

The sum estimated for the improvement of this section is $136,105.

The plans of this part ot the river furnished me by the Department from the surveys of Mr. Gallwey being unfinished, I have obtained the distance from Grenville to Ottawa City through the kindness of Sir William Logan, who calculates it at 55.25 miles in a straight line. Allowing for the bends of the river, I have called it 56.07.

CHAUDIERE AND DES CHENES.

Length of Canals: Chaudiere, 2 miles; Des Chênes, 0.61. Total, 2.61.

Slides channel; pair of combined locks 11½ feet lift each; passing basin 600 feet long; pair of combined locks, 11½ feet lift each; water surface above raised 3.7 feet by prolongation of present dam from head of mill flume, across islands to Sparks' Point.

Sparks' Point; 1 lock, 8½ feet lift; stone side dam. 1700 feet long; rolling dam at head at little Chaudière, 2000 feet over-fall; lift of water four feet, drowns out Remoux.

Remoux; coffer dam and rock excavation.

Des Chênes: 1 lock, 8½ feet lift; canal banks battered wall of stone in cement, backed with stone filling, and paved. Estimated cost, $816.733.

At Ottawa City the river is interrupted by rapids and falls for 6.36 miles, having a decent between Ottawa harbor and Des Chênes Lake of about 60 feet, *36 of which are taken up by the Chaudière, a magnificent fall which affords one of the finest water powers on the continent.

Several lines had been previously surveyed for this Canal, but I have preferred to follow the river, shortening the length of Canal required, and much diminishing the amount of rock-cutting, and consequent expense. But little land is overflowed, and that chiefly swamp. Two mills would be destroyed, (Sparks, and the Britannia,) but the new privileges would be better than those now existing.

Stones for the dams can be got out of the excavation, and excellent lock stone from the Trenton group of limestones, abounds close at hand.

Lake Des Chênes, or as it is sometimes called, Chaudière Lake, is 26.69 miles long, and varies from half a mile to two miles in width; and according to Mr. Gallwey, its general channel depth is from 20 to 30 feet of water.

Below the river Quio the channel is crooked for a short distance, the depth 14, 16 and 18 feet, and some points might have to be taken off. From there to the foot of the Chats there is 25 to 30 feet.

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* At the time we took our levels, the fall between Des Chênes Lake and Ottawa harbor was 59.5 feet but the difference between the recorded levels of low water is 63 feet. If this is correct, of which I have some doubts, it is owing to the greater evaporation on the longer level below. It has been thought prudent to provide for sixty-three feet of lockage.

Below, the river rises more than at any other point, some 20 to 24 feet. This is attributed to the fact that the Gatineau, a very large river, comes in a little below at right angles to the main river, and draws back its waters.

CHATS.

Length of Canal, 0.6 miles.

Chats Island: 1 pair of combined locks, 12 feet lift each; passing basin, 400 feet long; clay embankment paved; 1 pair of combined locks, 12 and 6 feet lift; rolling dam 3700 feet over-fall; tight dam, 300 feet; lift of surface 4 feet. Chats Rapids: 1 lock, eight feet lift; rolling dam, 2100 feet spil; tight dams, 1000 feet long; lift of surface, eight feet, up to low water level of Chats Lake.

Head of Rapids; coffer dam and rock excavation. Estimated cost, $681,932.

This, it will be observed, differs entirely from the old route of the Chats Canal. A considerable proportion of the excavation necessary to finish that work to the scale originally contemplated (60 feet wide, and 7 deep,) has been done. but it forms a very insignificant amount of that required for the new scale. The canal ends below in Big Bay, a sheet of water about a mile long, quite shallow, and with a bottom of gneiss rock.

The depth at low water for 700 feet is not over 5.5; for 1000 feet not over 8 5; and for 1600 feet, at the entrance, not over 6 or 7 feet, although most of this is probably clay, and could be dredged.

The only way a sufficient depth can be got except at a ruinous expense, is to throw a dam across the mouth of Big Bay, and raise the surface, placing a lock on what is called Hudson's Point.

My estimate for the completion of the present Chats Canal on this plan, to a scale uniform with the rest of the river, is $1,465,439. [See appendix]

There being some difficulties in ascertaining the amount of work done, I have credited the work with the whole amount expended, as per last report of Department of Public Works, amounting to $ 324,000, leaving a balance to be yet expended of $1,141,439.

My estimate for the new work has been stated at $681,932, showing that it would be a saving to the Province of $459,507 to abandon the work already done on the old route and take the new.

The length of Canal on the old route is three miles, and is quite crooked; on the new route we have only $\frac{6}{10}$ of a mile, being the locks and passing basin. The rest of it will be as good navigation as any part of the river. I have no hesitation in recommending the adoption of the new route.

We cross the Chats Island with four locks, as stated above and run a low dam along the line of reefs at the head of the main fall, raising the surface enough to drown out currents up to our upper lock. The water does not exceed three feet in depth on the line of dam, except in the channels, and there are so many islands to work from, that the difficulty of building a dam here is not so great as at first sight would appear.

The depth of water will not be less than from 20 to 25 feet from this point to the upper lock and dam. This brings us to the level of Chats Lake, and we have 18 to 30 feet depth as far as the reef at the present head of the rapids. At what is called the canoe channel, there is now a depth of ten feet, but it is narrow and crooked. It slopes above into 13 feet of water in about 300 feet, and, below, pitches off at once into 18 feet of water. After the dam has been built below, and water stilled, it will be necessary to put in a coffer dam here, and remove some rock, which is chiefly crystalline limestone, leaving the sides of the dam for guides, as at Green Shoal.

The lock stone for this work should come from the quarries of Black River limestone on Des Chênes Lake. Stone for dams can be got in the neighbourhood. I have estimated the face stone at $12, and the backing at $6.50 per cubic yard, or an average of $8.25.

Up to this place whatever rock excavation has been necessary. was through Silurian lime and sandstones of soft texture. But this rocky barrier, over which the river tumbles in some thirty different chutes, is one of the Laurentian series, and consists of hornblendic gneiss, mica slates, and crystalline limestone. The strata are considerably inclined, dip in the direction of the current, and the "strike" is generally at right angles to the direction of the stream, as may be plainly seen from the course of the reef.

These rocks are all hard to work. The crystalline limestone is much the easiest, and I have allowed $1.50 per cubic yard for it. The mica slates, and particularly the hornblendic gneiss of a greasy texture, and greenish red color, such as is found at the lower end of the canal excavations, are hard to drill, and require much power to break them up. The price which I have allowed, and which is proportioned to the rock prices over the rest of the river, is $2.50 per cubic yard.

The Chats Lake is a fine sheet of water 18 miles long, and from half a mile to three miles wide, with a channel depth of from 25 to 30 feet.

From the head of this Lake to the head of the Calumet Island, a distance of 31.07 miles by the North or Calumet Channel, and 24.79 miles by the South or "Rocher Fendu" channel, the river has a total fall of 102.48 feet, and is much obstructed by rapids and shoals. On the north channel more than half the fall is concentrated at one point, the Grand Calumet Falls, and there are longer stretches of still water. The south channel is a continuous rapid for much of the distance.

In deciding between these two channels, several things were apparent without further instrumental survey :

I. The Calumet was 6.28 miles longer than the other

II. From the head of the Calumet Falls to La Passer 17 miles, the bed of the river is cut through sandy alluvial soil, is very crooked, and is filled with shifting sand-bars and shoals, that would have to be dredged, not only once, to open the navigation but continually to keep it open.

III. The timber slides now occupy the Calumet channel, and as there is not room for both timber and vessles, if we take this channel new slides must be built on the Rocher Fendu.

IV. The nature of the ground at the Calumet Falls would require three locks in combination.

The very important question of cost could not be determined without making location of locks and dams on both channels, and estimating on each.

The Lock at the Snows is common to both routes ; the lift at the upper one at Portage du Fort, and the height of dam, would have to be increased six feet. Two locks and a dam, and 0.28 miles of canal at the "Mountain" chute, and five locks and a dam at the "Grand Calumet." raising the water to the level of the river at the head of the island.

Here the only possible location for the canal s on the site of the present slides. A ravine to the left of the fall was surveyed in 1857. But even by combining all the five locks at the lower en l, there would be fifty feet cutting for one mile, which, even for a canal of a hundred feet wide, would require the removal of nearly a million yards of rock.—This is, of course, impracticable.

In comparing the cost of the two routes, the lockage is the same ; and the difference of dams is not enough to affect the estimate materially. But the "Calumet" route would have in excess,

167,500 cubic yards rock cutting, at $1,50 - - - - -	$251,250
1,000,000 " dredging, at 35c - - - - - - -	350,000
Shewing a difference of cost of - - - - - -	$601,250

over the Rocher Fendu route.

Taking all these things into account, I have no hesitation in recommending the Rocher Fendu for improvement, and shall describe how it can be done.

CHENAUX OR "SNOWS."

Total length of Canal, 0.2 miles.
1 lock, 6 feet lift.
Dam 1,267 feet.
Estimated cost, $133,356.
The rapids of the Ottawa are caused by reefs.

These are the remains, more or less worn away of the rocky barriers which once separated the different lakes In the limestone formations; the whole bar has generally been washed away, leaving an entirely submerged reef. But among the Laurentian rocks, the river cuts channels through the softer veins, leaving the harder rocks protruding above water in the form of islands. The "Snows" is a place where even the reefs between the islands have been worn away, so that it is now merely a contraction in the channel, forming what hydraulic writers call a "discontinuous weir."

In summer the volume of water is only sufficient to dam itself up some six or eight inches,* forming a slight ripple; but in floods the water above rises from three to four feet, making a rapid too strong for steamboats to ascend.

Three methods of improvement have been suggested:—To raise the Chats Lake and drown out the rapid;—To remove the islands which obstruct the channel;—To put a lock in one of the channels.

When a river channel is contracted, the water dams itself up until it has attained a head sufficient to give itself velocity enough to pass through a narrow passage. Raising the water below will not prevent this from taking place, unless it is raised enough to give it an area of flowage equal to that of the average channel of the river. To do this here would require a lift of the Chats Lake so great as to be inadvisable.

To enlarge the area from 8,400 to 20,000 square feet, by removing obstructions, would require too much rock excavation.

We are, therefore, reduced to the third plan, as recommended by T. E. Norman, C. E., in his report to the department last year, and must put a lock in one of the channels. The Canoe Channel has been selected as the best; and the Steamboat Channel will be left open for the decending trade; but all the others will be closed by low dams. This will raise the water six feet † above its present level. In the spring the high water will pour over these dams.

I have gone somewhat more into detail in describing this place than its importance would seem to warrant; because, from its being the line of the present steamboat navigation, it has been much discussed, and many plans suggested for its improvement, both by professional and amateur engineers.

The lock stone should come from the superior quarries at the lower end of Chats Lake.

PORTAGE DU FORT.

Length of canal, 0.24 miles.
1 lock 12 feet lift, passing basin 400 feet long
1 lock 8 feet lift. Rolling dam, 2,664 feet long.
Tight dam, of masonry, 1,360 feet; lift of surface, 10.5.
Estimated cost, $287,396.

Here we have a multitude of islands and channels, but the reefs between are not worn down more than two or three feet below the surface of the water, with one exception a narrow channel called the "Devil's Elbow," which is over twelve feet deep. The locks will be placed at the head of the island to which runs the dam of Usborne's Mills. From the locks to the north shore the dam is a tight one, with a flume to admit water and logs to the mills. The remainder is a rolling dam, giving free discharge to the flood waters. The timber slides will not be disturbed, except to lengthen them for the increased fall.

The locks may be built of a crystalline limestone, known as Portage du Fort marble, and the dams of the same.

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*The cross section of this point gives an area equal to that of a channel 420 feet wide, by 20 feet deep. The river above averages 1000 feet wide, by 20 feet deep. By the formula for discontinuous weirs, where

b = breadth of channel .... = 420 feet.
d = depth .... = 20 feet.
h = height to which it is dammed .... = 6.10 of a foot.
q = quantity of discharge in cubic feet per second, $= 9b\sqrt{2gh}\,(\quad + d) = 32{,}254$ cubic feet.

The quantity was guaged at same time, and a mile above was 30,913.

At high water d becomes 28
h " 4
q " 127,000

agreeing very nearly with other observations of H. W. discharge.

† Call q = 32,254 cubic feet, per second.
d = 20 feet
h = 6 feet, height required,
And b = breadth required.
The formula,

$$b = \frac{q}{9(\frac{2}{3}h + a)\sqrt{2gh}} = 105\tfrac{3}{8} \text{ feet}$$

which is about the breadth of the present steamboat channel, which may be left alone. And by closing the others, the water will be dammed up six feet.

Rocher Fendu.

Length of Canal, 0.61 miles.
8 locks and 5 dams, as follows:—

Rocher-Fendu Chute Canal, 0.07 miles.
1 lock ten feet lift; dam 450 feet long.
Lift of surface 13 feet.
Long Rapids Canal, 0.12 miles.
Pair of combined locks, 14 and 6 feet lift; rolling dam 600 feet; tight dam 500 feet; lift 17 feet.
Lafontaine's Rapids, length 0.23 miles.
1 lock 12 feet lift; basin 400 feet long; 1 lock 12 feet lift; dam 350 feet long; lift 17 feet.
Norman's Rapids, length 0.12 miles.
Pair combined locks 12 feet each; dam 350 feet flat, 100 feet tight; lift 23 feet.
Black Falls, length 0.7 miles.
Guard lock, 2 to 4 feet lift; tight stone dam 1100 feet long; low water lift 2.4 feet.
Estimated cost, $836,088.

The dam at Portage du Fort will drown out the small rapids known as the "Split Rock and Tables," and give sufficient depth of water as far as the Rocher-Fendu Lake which, according to the surveys of T. E. Norman, Esq., is 30 to 60 feet in depth. The distance from Portage du Fort to the head of this lake, where we have a lock and dam is 7.35 miles. A distance of 1.61 miles takes us to Long Rapids, where are two locks and a dam. The lift of water, 17 feet, drowns out La Barrière, Muskrat, and Mice Rapids, all of which have channels worn through the reefs, so that there will be no necessity for submarine rock excavation, while the shores are bold and high enough to prevent much land from being overflowed. We are now at the foot of what is called Lafontaine Island, and here the river is divided into three channels. It is proposed to follow the south channel, and by building a tight stone dam above Black's Falls at the head of the island, to shut out the flood water and drive it down the other two channels, only admitting enough for navigation. Otherwise, the amount of water discharged in flood it so great in proportion to the contracted size of the channel, that it would be difficult either to build structures, or use them after they were done. By availing ourselves of the existence of these other channels to take off the surplus water, we can lay our work without coffer dams, and regulate force of currents as we please. Five locks and three dams take us to the head.

Some of the crystalline limestone is good enough for locks, some stone will come from the quarries on Allumettes Island above, and perhaps some from Portage du Fort or Chats Lake.

The rock on this part of the river, although of the Laurentian series will not be so hard as that at the Chats, owing to the greater amount of crystalline limestone, and to the preponderance of felspar in the gneiss, which is easily acted on by the weather, and causes the gneiss to crumble, and become broken up. I have estimated the rock excavation at $1.50 per cubic yard. Stone for dams can be got in the locality.

From the head of the Calumet Island to the foot of the Allumettes Island, the river expands into what is known as Lake Coulonge. At its foot the river is divided into several channels and islands. The main body of water passes on the west side, and has not been sounded until this year. The other channels are quite shallow, but this has 20 feet and over, except at one point, where, for five hundred feet in length, there is not over ten feet at low water.

Through the remainder of Lake Coulonge according to plans made under the direction of Mr. Shanly, and furnished me by the department, there is 25 to 30 feet in depth of water.

The river is again divided into two channels by the Allumettes Island; the Northern of which, known as the Culbute, is much the better suited for navigation.

This Channel is narrow with bold shores, and the fall 18.26 feet, is concentrated into rapids at the head, the Culbute and l'Islet. For nine miles from the foot of the island, up to a slight rapid of five or six inches fall, known as the Chapeau, and caused by a contraction of the channel, we must follow the natural bed of the river, which is somewhat crooked, and will require a considerable amount of dredging, particularly at the mouth of Black River, a turbulent stream which brings down much sand during spring freshets.

It is probable that there will be some boulders, and points of reef below water, to be removed. For the improvement of this section there has been estimated the sum of $262,514.

Chapeau and L'Islet.

Length of canal, 0.14 miles.

Chapeau: 1 lock, 12 feet lift, and rolling dam 500 feet long; tight dam, 240 feet; lift of surface, 11.5 feet.——

L'Islet: 1 lock, 6 feet lift, L. W.; 12 feet, H. W.: tight dam, 700 feet long; lift of surface 9.5 feet. Estimated cost, $243,507.

The lift of 11.5 feet at the Chapeau, gives good navigation for 5.85 miles to the foot of l'Islet. Here a tight dam of masonry in cement, as at Black's Falls, will keep out the flood waters, and drive them down the broad Pembroke channel, and the lock is located in the channel between the island and the north shore.

This raises the surface of the water above l'Islet to the level of the river at Fort William, and drowns out the Culbute, which rapid darts through a narrow gorge in the rock, not over eighty feet wide, with high perpendicular cliffs on either hand. It will be necessary to take three or four feet off the top of the reef for about fifty feet in length. This can be done by putting in a short temporary dam at the head, after the water is raised and made still by the dam below. Then, on opening the gates of the lower dam. the bed of the river will be laid dry at this point, and the rock can be removed, after which the coffer dam above must be taken out.

The lock stone for these works is estimated to come from the quarries on Allumettes Island, four or five miles from the work. Stone for dam can be got near by.

Although it does not properly fall within the limits of this report, yet I shall take the liberty of calling the attention of the commissioners to the fact that the expenditure of the above named sum of $243,507, would extend the present steamboat navigation from Des Joachims to the head of Calumet Falls, a distance of 75 miles. From thence the macadamized road just finished by the department, would avoid the 8.41 miles of obstructed navigation, between the steamboat landing above the Calumet and Portage du Fort, the present head of navigation on Chats Lake; avoiding the expensive and tedious detour of Muskrat Lake. An additional expenditure of $80,000 would build the lock at the Snows. The dam would not be required at present.

I know no point above the City of Ottawa where so little expenditure would do so much for the local traffic, as at these places.

From the head of Culbute to Fort William, 5.3 miles, the river is much broken up by rocky islands, but according to the soundings laid down on the plans of Mr. Shanly, there is a deep, although somewhat tortuous channel.

From Fort William to the Rapid des Joachims, we have the fine stretch of water known as Deep River; this is very straight, one to two thousand feet wide, and 27.6 miles long. The depth is very great, and said to be over 100 fathoms in some places; the shores are very bold, and the general character of the scenery resembles that of the Saguenay on a small scale,

Des Joachims

Total length of canal 0.57 miles.

Pair combined locks, 13 feet lift each. Passing basin 2000 feet long. Embanked by material taken from the excavation and sides of river. Slopes paved. One single lock, 12 feet lift. Dam, 1,272 feet long; length of overfall, 1, 148 feet; lift of surface, 17.8 feet.

Estimated cost, $327,774

This rapid is 1.64 miles long and falls 26.4 feet. It comes nearly at right angles to the general course of the river, which, if prolonged, would run through a series of lakes, and strike the river again about three miles above. A line of levels were taken by Mr. G. H. Perry, to see whether this chain of lakes might be followed and a canal cut through the ridge, dividing them from the river. Although the distance is less than a mile, the cutting even with proposed dam at head of Des Joachims, would average 20 feet, which would require the removal of over 400,000 cubic yards, principally rock. Hence we prefer to follow the north shore of the river itself. The rock occupies the place of the slides, which will have to be removed to the south side of the island, where there is a very good place for them.

Face stone of locks is estimated to come from Pembroke quarries. All other stone can be obtained in the neighbourhood.

McSorley's

Length of canal, 0. 13 miles; 1 lock ten feet lift.. Length of dam, 1,383 feet; length of overfall 1,041 feet; lift of surface, 16.5 feet. Estimated cost, $169,375.

From the upper lock at Des Joachims, a distance of 13.68 miles brings us to a series of small rapids of 3 feet fall, where we put in a lock on the south side of the river, and a dam. It is necessary to raise the water eleven feet on the foot of the Rocher Capitaine; and to avoid making the dam at the Joachims so high, this intermediate dam at McSorley's is designed.

The face stone of the lock must come from the Pembroke quarries. Backing, and other stone, adjacent to the works.

Rocher Capitaine.

Total length of canal, 0.65 miles.

Single lock, 13 feet lift; passing basin, 1,000 feet long. Material for bank, taken from excavation; slopes paved.

Single lock six feet lift, L. W., 12 feet H. W. Dam, 1,005 feet; lift of surface, 22.4 feet; pool, 0. 70 miles long. Pair of combined locks, 13 and 6 feet lift; dam 1,702 feet long; overfall, 1,400 feet; lift of surface, 21.5. feet.

Estimated cost, $533,544.

The Rocher Capitaine, which it is proposed to overcome in the above manner, is one of the largest rapids on the Ottawa, falling 40.9 feet in a distance or 1.35 miles. The locks are located on the north side of the river. The bank is composed of an immense mass of boulders of all sizes worn smooth by the water. It covers a space of about two square miles, and rises some sixty feet above the water. Fortunately, between these boulders and the river there is a strip of solid rock in position, upon which we place the locks and canals. The bottom of the river is smooth rock, the depth where the dams run is not great, and, except that the upper dam must be long, there is no special difficulty in overcoming this rapid.

The face stone of locks is estimated to be got from the Pembroke quarries; but the expense would be less, if the canal, hereafter described at the Deux Rivières, were built first, as the stone would then come from the quarries above it, without transhipment. The rest of the materials can be got near the work.

Deux Rivières.

Length of canal, 0.46 miles.

Pair of combined locks, 12 feet lift each; passing basin, 500 feet long. Material of bank from excavation; slopes paved; single lock, 12 feet lift, passing basin, 500 feet long; single lock, 6 feet lift; upper locks, on timber foundations. Dam, total length, 1,292 feet; overfall, 938 feet, lift of surface 33.9. feet.

Estimated cost, $419,942.

The rapids, known as Deux Rivières, Trou and La Veillée, occupy 3.15 miles, and fall 31.1 feet. The fall in the river, from their head, to Johnson's Rapids, a distance of 17.85 miles, is 9.7 feet, most of which occurs in the rapids, at the Rocky Farm, which occupy 4.75 miles. It was thought best to put in a high dam at the Deux Rivières and then back the waters to Johnson's Rapids, as the facilities were greater for that mode of construction, than for putting in another dam and lock between the two, and the amount of land overflowed is quite insignificant.

The locks are situated on the south side of the river, on a flat piece of land, well suited for their location; the lock stone will come from beds of a yellow or buff colored fossiliferous limestone, which appears on the north side of the river, about three miles above, and promises to afford a good building stone. Other stone can be got near at hand.

JOHNSON'S RAPIDS.

Length of canal, 0.45 miles. Single lock 12 feet lift; passing basin 1900 feet long; raised with earth and stone from cutting; slopes paved; single lock on timber foundation, 8.2 feet lift at L. W. up to 13 feet at H. W.: dam 2626 feet long: overfall 2000 feet: lift of surface 21 feet,

The locks and canal are on the north side of the river on a strip of flat land. The dam stands in $4\frac{1}{2}$ feet of water at L. W.

The lock stone will come from quarries below, other stone near by.

This dam drains the rapids just below the mouth of the Mattawan, and the currents in that river, and throws 13 feet of water upon the foot of the Plein Chants rapids, 3.40 miles above.

MATTAWAN RIVER.

At Fort Mattawan 308 miles from Montreal, we leave the Ottawa which turns to the northward, and is still a large river, the amount of water passing in summer being but little less than that running over the Chaudière at Ottawa. This is owing to the fact that as we descend, the river expands into wide lakes, and loses by evaporation nearly as much as it receives from its tributaries.

From this point to French River, I cannot do better than to quote from the report of my principle assistant, Mr. E. R. Blackwell:—

"On commencing examinations for a work of the contemplated character and magnitude of the improvement of the Ottawa and French River waters, the first thing presenting itself as indispensibly necessary, was to obtain a reliable section of French River, Lake Nipissing, and the summit or height of land between Nipissing and Trout Lakes. The examinations were commenced at the principal mouth of the middle outlets of French River on the 20th November 1858.

"This debouchment of French River is entirely land locked. To the west lie a large group of islands known as the "Bustard Islands," which completely shelter the mouth of the river from the westerly and the southwesterly winds of Georgian Bay. The main land affords protection from the northerly winds.

"The channel to the entrance of French River lies at the northerly extremity, and close under these islands. There appear to be several deep and broad channels divided by sunken reefs, and I am confident that a spacious entrance can be marked out, free from these treacherous sunken rocks which mark the whole coast of Georgian Bay.*

"From the mouth of French River, for the distance of 2.74 miles, the river is straight, broad, and deep; the banks bold, and the gray crystalline gneiss rocks rise perpendicular out of the water, and make it resemble more the deep bays of the lake, than the mouth of a river.

"At this distance from the bay, the river makes a turn nearly at right angles to the right, and becomes quite narrow; and here "Les Petites Dalles Rapids," form a barrier to navigation; the fall at this point is six feet. The rapids are about ninety feet in width, and it is about 1160 feet from deep water below to deep water above. The rock on the north rises nearly perpendicular to the height of ninety feet, and on the south side, with a gentle slope. to the height of twenty feet, in a distance of one hundred and twenty feet, and then rises abruptly into broken cliffs.

"From "Les Petites Dalles" we continue our course nearly east for the distance of one and a quarter miles; here we find two large channels, one continuing directly on the

*The mouth of French River is a deep fissure or cleft in the rock, extending from the lake into the land Its course is about north-east and south-west, which is that of the "strike" of the strata in that locality, and consequently of the ridges on land and the reefs in the water. Thus, although the navigation is dangerous to those who are coasting, and have to pass over the ends of the reefs ,there can always be found a direct entrance between them, unobstructed by shoals or sunken rocks. I have myself sounded from the foot of the Petites Dalles, out into the open lake, and found a gradual increase of 6,7,8, 9 and 10 fathoms, where my soundings ceased, about half a mile from the point where the river may be said to end.—T. C. C..

course we have been traversing, and the other nearly at right angles to the north.

"We pursued our examination up the latter for the distance of three miles to 'Lac de Bœuf,' a body up water about three miles long by one mile in width, thickly studded with islands; here we enter on our easterly direction for Lake Nipissing.

"At the distance of 10.17 miles from "Les Petites Dalles," we find a small rapid of two feet fall, about 200 feet wide, and the water from 6 to 8 feet deep at a low stage.

"At a further distance of 3.82 miles, another small rapid of seven-tenths of a foot fall, is encountered. 1.08 miles further, we reach "Le Grand Récollet Rapids, with a fall of 6.80 feet. The width of the river at this point is two hundred and fifty feet. The bank on the north side rises nearly perpendicular to the height of one hundred and fifty feet above the water. On the south side there is a table scarcely sufficient in length and breadth for the lock. The rest of the bank rises perpendicularly eighty or ninety feet.

"After leaving 'Le Grand Récollet' we have a reach of 17.02 miles to the 'Rapide de Parisien,' where there is a fall of 1.20 feet. In the next 4.10 miles, we pass the 'Petite Fancelle Rapid,' fall 4.4 feet, 'Rapide du Buison,' fall 3.3 feet, 'Grand Faucelle Rapid,' fall 5.6 feet, and 'Rapide du Pin,' fall 2.6 feet. In tracing the distance we change our course from east to north. At the head of the 'Rapide du Pin,' the course again becomes easterly, and continues so to the foot of the 'Chaudière Rapids,' a distance of 7.57 miles.

"The fall between the foot of Lake Nipissing and the still water in French River below the rapids, is divided into fine cascades and rapids. The total fall is 26 feet in a distance of 1.61 miles. The banks at the water's edge of the rapids are mostly low; rising gradually for the distance of sixty to one hundred feet back; then they rise abrupt into high rocky cliffs.

"From the mouth of French River on the Georgian Bay, to its source at the outlet of Lake Nipissing, the distance is 47.52 miles; the ascent at low water is 60.3 feet, making the elevation at Lake Nipissing 634.3 feet, above tide water.

"The distance through Lake Nipissing is 30.44 miles. Between Nipissing and Trout Lakes two routes were carefully examined.

"The first, by the valley of the 'Rivière des Vases,' 6.69 miles in length.

"The second, by the valley of the 'Ojibwaysippi,' 4.19 miles in length, with an ascent between Nipissing and Trout Lakes of twenty-four and a-half feet. The water-heads of the Mattawan are 658.8 feet above tide water.

"In comparative cost these two routes have no relative merits. By the 'Vases' route, there are four miles of cutting, any one of which would cost more than the whole line of the 'Ojibwaysippi' route.

"Here we pass the watershed between the waters of the Ottawa and French Rivers.

"After entering 'Trout Lake' our course bore south of east. The length of this lake is 8.43 miles, and average width one mile. At the foot of this occurs a narrow ridge of rocks which divides it from Turtle Lake. The fall is nine-tenths of a foot. The rapid is about ten feet wide, and not over eighteen inches in depth. We then pass 3.28 miles through Turtle Lake, nearly on a due east course. This lake averages about half a mile in width.' Passing down the outlet of Turtle Lake, we change our course to the north in the first two miles; thence eastwardly, and at the distance of 3.74 miles, we enter Lac Talon The descent between these two last-named lakes is 29.9 feet, giving Lac Talon an elevation of 628 feet above tide water. The outlet has a succession of small rapids with deep still ponds between them.

"The course through Lac Talon lies about south-east, and is 7.63 miles in length, with an average width of one mile. Lac Talon discharges through a flume-like chute of 21 feet in width, with three beautiful cascades before reaching the level below, The total fall is 42.7 feet. Each side of the chute is bounded by high and barren syenite cliffs.

"From the foot of Talon Chute, the course of the waters changes to the north, until they reach the foot of the Paresseux Chute, 2.28 miles; in this distance there is a series of ponds, or basins and rapids, making a descent to the head of the Paresseux Chute of 21 feet. At the Paresseux Rapids and Chute there is 33.8 ft. fall in a beautiful cascade.

"After passing the Paresseux Chute, the river passes between bold cliffs of syenite, which present the appearance of rough and massive masonry, towering about 150 feet above the surface of water. The river is narrow and deep between these iron bound barriers, in places only 105 feet wide. It soon widens to 250 and 300 feet in width.

"From Lake Talon to the river below Talon Chute, a route was examined, leaving Talon Lake about one and a half miles above its foot. At the distance of 1500 feet from Lake Talon, we encountered a summit of fifty feet in height above the lake, and about 2000 feet in length; after passing this summit, we dropped down into a chain of small ponds running nearly east, and emptying into the Mattawan about one half of a mile below Paressenx Chute. The length of this line is 4.15 miles, and more direct than the channel of the river, and well adapted for the line of improvement, were it not for the heavy cutting at the summit. The examinations, estimates, and plans of this route were made with the same care and attention as marked those of the main route.

"The river route is 1.06 miles longer, but is estimated to cost $564,000 less, and is recommended.

"From the foot of the Parasseux Chute to the mouth of the Mattawan, the course is direct and nearly due east. At 2.64 miles we reach the 'Rapide des Aiguilles,' with a fall of four-tenths of a foot; 0.71 miles further east is the 'Rapide des Rochers,' with a descent of 4.8 feet. At this rapid the land on each side is low and swampy for the distance of six to eight hundred feet back. Passing down with a strong current for 1.20 miles, we reach the 'Rapide de la Rose,' fall 5.6 feet. At the further distance of seven-tenths of a mile is the 'Rapide des Epines' fall 5.6 feet.

"From the foot of the 'Rapide des Epines,' we find a broad and deep stretch of river 5.5 miles in length, with the same rugged, syenite cliff-like banks; at the foot of this fine stretch of water, we reach the 'Lac Plein Chants Rapids and Chute,' with a fall of 16.9 feet, in the distance of four-tenths of a mile. At the further distance of 2.40 miles, the Mattawan enters the Ottawa waters. In this distance we find three small rapids with a fall of 5.4 feet; making the total descent of the Mattawan 169.8 feet in the distance of 39.79 miles, and the low water surface at the mouth 489 feet above tide.

"A tabular statement of the low water section of these rivers. &c., is annexed.

"The characteristics of the French River and Mattawan waters are similar, each being a succession of pools of wide, deep and still water, separated by short falls and rapids; in many of these pools there is no perceptible difference of level.

"The shores are principally lined with the ever-prevailing syenite and gneiss, rising abruptly out of the water into bold precipitous cliffs, covered with a dwarf growth of timber.

"By the mode of improvement proposed, that is by locks and dams, which is the only feasible plan of work to render these rivers navigable for any class of vessels that may navigate the western lakes; the characteristics of these rivers will, in a great degree, remain the same as now, after the completion of the improvement.

"My early attention was called to the question of supply of water, 'upon which the success of the whole project depends,' and more particularly directed to the practicability of the plan of elevating Lake Nipissing to the summit level, as proposed by Mr. Shanly, both by the general instructions of the board of Public Works, and by your letter of instructions.

"Mr. Shanly, in his report on the 'Ottawa Survey,' says 'It may at once be stated that the summit does not furnish water sufficient to meet the demands of even a far inferior scale of navigation to that which the general character of the route would warrant us in looking forward to.'

"To this opinion of Mr. Shanly's, respecting the supply of water from the summit, that is from Trout and Turtle Lakés, I agree; and after a careful examination of the whole subject, I would recommend the following plan for

SUPPLY.

"For the supply of water it is proposed to raise Lake Nipissing 9.46 feet above high water, and lower Trout Lake 7.85 feet, and Turtle Lake 6.95 feet, and Turtle Lake outlet to the same level, and to raise Lac Talon 20.95 feet, which brings it up to the same height, making a summit level for navigation of 57.12 miles in length, with an area of watershed of 3165 square miles, and a reception basin of eighty miles in length, and varying from one-half of a mile to 12 miles in width, giving a surface of about three hundred and thirty square miles. By this arrangement it does not become necessary to make any provision for a storage reservoir. The waters of Lake Nipissing are sufficient for any scale of navigation, and for all time to come.

"Although the quantity of water required to maintain a steady flow of any given depth through open sluices of regular width, may be calculated with a considerable degree of accuracy; yet, in the case of an open river of uneven bottom and irregular width and declivity, like that of the French river, it cannot be expected that anything more than a rough approximation can be obtained; uncertainly must attend the measurements, and consequently the results founded thereon.

"Fortunately for us in this case, the quantity of water discharged from Lake Nipissing through the French River is so large that any error of this kind could not affect the question of supply for any scale of navigation that may be adopted.

"The quantity of water found, by careful gauging, to be flowing in French River at a low stage, was nine thousand five hundred (9,500) cubic feet per second, or eight hundred and twenty millions eight hundred thousand (820,800,000) cubic feet in twenty-four hours. Assuming the locks to be 250 x 50 x 12, and that fifty lockages are made each way in twenty-four hours, it would require fifteen million cubic feet of water, or less than one-fiftieth part of the supply. The whole amount of water flowing is equivalent to 5,472 lockages each twenty-four hours. This, at once, sets at rest any idea of the necessity of a storage reservoir.

"There are but few objectionable features to this mode of supplying the necessary water for navigation, and of raising Lake Nipissing to the height above stated. The first, and almost the only one, is the overflowing of the lands bordering on the Lakes.

"The entire southern shore of Lake Nipissing, east of the Chaudière Portage, is bounded by high barren rocky cliffs, with a scanty growth of evergreens covering the whole, except a strip on the east end of the lake, about eight miles long, and varying from one tenth to one-fourth of a mile in width, one-half of which is annually inundated by the Spring freshets. The shore of the East Bay and the east end of the Lake, for the distance of ten miles, will be overflowed; a large portion of this tract is annually submerged by the freshets, and nearly the whole is one extended Tamarac swamp, or an Alder marsh. The north shore, for two-thirds of its le[illegible] is high, and out of the reach of this height of water.

"In the vicinity of the Hudson's Bay Post, at the mouth of the Sturgeon River, the largest tract on the borders of the Lake will be submerged, say from ten to twelve miles in length, and from two to three miles in width; one-third of the tract is low open marsh, about one-third swamp annually overflowed, and the remaining third tolerably fair land for agricultural purposes.

"In the Western Bay there is an occasional narrow strip that will be drowned out. Taking the whole land that will be drowned by the raising of Lake Nipissing, it will be inconsiderable when compared with the length of shore, and that but of small value for agricultural purposes.

"Raising Lake Nipissing to the height of Trout Lake, would lessen the cost of construction about one million dollars, and reduce the length of canal on the summit to less than one and three-quarter miles, would increase the lockage 15 6 feet, and overflow three times as much land as the plan proposed.

"The land, being in a district uninhabited, except by a few Indians and the servants of the Hudson's Bay Company, cannot be looked upon as claiming much consideration, in deciding upon such an important question. The objectionable features in elevating the water of Lake Nipissing to the level of Trout Lake, are:—

"First, the low banks along the southerly shore, west of the Chaudière Portage, and also for two miles to the east of the Portage; Second, the large fissures and crevices in the rocks, affording an opportunity for the escape of water, scarcely to be estimated: in fact this might prove so large as to cause any attempt to meet such an emergency entirely abortive, and without a more careful and minute instrumental examination of the entire southern shore west of the Portage, than my limited time would permit me. I should be unwilling to recommend the raising of Lake Nipissing higher than contemplated in the plan proposed.

"The raising of Lake Talon can be accomplished without overflowing the adjacent land to any considerable extent.

LOCKAGE.

"The arrangement of Locks and Dams connected will be as follows :—

"At Les Petites Dalles, on lock, fourteen feet lift, on the south side of the river.

"To establish the level above the Petites Dalles, it would be necessary to construct seven Dams across the several outlets of the French River.

"Total length of Dams, 1,535 feet.
Aggregate Spill, 1,595 feet.
Crest of Dam, 8.50 feet above low water.

"These Dams throw the water up to "Le Grand Recollet Rapids," fifteen and one-tenth miles, drowning out two small rapids, so that no excavation will be necessary to give the requisite depth of water.

"At 'Le Grand Recollet,' one lock of 13 feet lift on the south side of the river.

"Two Dams will be necessary, one across each channel of the river.
Total length of Dams, 566 feet.
Aggregate Spill, 406 feet.
Crest of Dam, 11.30 feet above low water.

"The length of the next reach is 16.95 miles, extending to the 'Rapide de Parisien,' where we have one lock of ten feet lift, on the north side of the river.
Total length of Dam, 599 feet.
Length of Spill, 445 feet.
Crest of Dam, 21 feet above low water.

"The next reach is only 2.23 miles to the 'Rapide du Buisson,' drowning out the Petite Faucelle Rapid," so that no excavation will be necessary for the requisite depth of water. At this poiht there is one lock of ten feet lift on the north side of the river. Here the river is divided by a large island into two channels ; it will be necessary to dam each of them, and also to dam the north channel of the east, in making these dams.
Total length of dams, 1,070 feet.
Aggregate Spill, 1,055 feet.
Crest of Dam on Main Channel, 19.5 feet above low water ; Crest of Dam in the North Channel of the East, 10.8 feet above low water.

"From the head of the Lock at the 'Rapide du Buisson', the level extends to the foot of the Chaudière Portage, ten and one half miles, drowning the 'Grande Faucelle,' and 'Rapide du Pin.' A small island one hundred feet long by twenty-five feet wide, will have to be excavated to the depth of five feet from its present surface.

"At the Chaudière Portage there will be three Locks of ten feet lift each, the first single, and the second and third combined ; located on the south side of the river. By combining all these Locks, a saving of about $80,000 could be made.

"Four Dams across the outlets of Nipissing will be necessary.
Total length of Dams, 1,134 feet.
Aggregate Spill, 1,310 feet.
Crest of Dams, 16.7 feet above low water.

"The next or summit level extends to the foot of Lac Talon, a distance of 57.12 miles with a guard Lock in the Canal between Nipissing and Trout Lakes, to control the waters in times of high wind.

"At the foot of Talon Lake, there is one lock of eleven and a half feet on the north side of the outlet.
Total length of Dam, 500 feet.
Length of Spill, 472 feet,
Crest of Dams, 23.7 feet above the low water mark.

"The next three Locks occur 0.43 miles below the last-mentioned Lock, and on the south side of the river at Talon Chute, all in combination, each fourteen and a half feet lift.
Total length of Dam, 382 feet.
Length of Spill, 332 feet.
Crest of Dam, 12.3 feet above low water.

"Two combined locks of eleven feet lift each next occur at the 'Petit Paresseux Rapid'; length of level 2.13 miles. The locks are located on the north side of the river. This level drowns out several small rapids, so that but trifling excavation will be required to make the necessary depth of water.

Total length of Dam, 1,128 feet.
Length of Spill, 1,128 feet.
Crest of Dam, 22.8 feet above low water.

"At "Paresseux Chute." 0.35 miles below are two locks in combination, each fourteen feet lift, located on the south side of the river."

Total length of Dams, 872 feet.
Length of spill, 872 feet.
Crest of Dam 10.4 feet above low water.

"A level of 4.62 miles extends to the "Rapide de la Rose." There we have one lock thirteen feet lift on the south side of the river. This level completely drowns out the "Rapide des Aiguilles," and "des Rochers."

Total length of Dam, 812 feet.
Length of spill, 812 feet.
Crest of dam 21.2 feet above low water.

The next level of 6.29 miles reaches the last locks in this division at "Lac Plein Chants Rapide and Chute," where there are two locks in combination, of thirteen feet lift each, on the north side of the river.

Total length of Dam, 664 feet.
Length of spill, 388 feet.
Crest of Dam, 18.8 feet above low water.

"A short reach of 2.40 miles carries us to the mouth of the Mattawan, the eastern end of the western or Nipissing division."

"The question of cost will be greatly enhanced by the difficulttes to be encountered in procuring the materials neçessary for the construction."

"The face coping and culvert stone for all the Locks west of the Summit, will have to be procured from the great Manitoulin Island, in Lake Huron, which lies to the west ward about fifty miles, directly facing the mouth of French River. The stone for the lock at Les Petites Dalles can be landed at the work, and that for the Rapide de Parisien will be attended with the additional cost of two short portages. For the lock at "Du Buisson." three short portages will be necessary, and for the locks at the Chaudière Portage, two short portages, and two miles of land carriage will have to be encountered. All foreign materials for these locks will be subject to similar expense of Transit.

"The stone for the backing and interior of all the Locks of this division, will be obtained from the excavation for locks, and from the banks adjacent to the works.

"Large quantities of rectangular blocks are found upon the banks of the river, often with parallel beds and joints more perfect than it would be possible to quarry them from limestone quarries, and in size well adapted to the character of the work. The stone for rubble masonry will be procured in the same manner as the backing. Loose stone for filling the Dams, will be obtained from the excavation, and picked up from the river banks.

"The timber for the Locks and Dams is in all cases convenient; in no instance do I think it will be necessary to haul over two miles. In some instances it will be found cheaper to cut the timber on the banks above the work, and float it down rather than haul it.

"The work west of the summit requires no special description; there are no difficulties to be encountered in the construction, of an unusual character.

"The two first miles of Canal, on the summit, between Nipissing and Trout Lakes, are wholly of earth, cutting through an open marsh, easily drained. This work has been estimated at thirty-five cents per cubic yard.

"For the remainder of the Canal, the material has been all estimated as rock. The excavation will all be disposed of with a short haulage. In this portion of the Canal there are several deep ponds, which can be easily drained without machinery, as the work progresses. The rock excavation has been estimated at two dollars per cubic yard. Twenty-two hundred feet of this cut have been estimated with a width of 100 feet on the bottom.

"For the excavation of the bars in Trout and Turtle Lakes, it is contemplated to commence the work at the foot of the Turtle Lake outlet, carrying it up to Turtle Lake, the water of the Lake will then pass off through the cut, and leave the rocks to be excavated out of water, and easy of access. Then, by cutting through the barrier between

Turtle and Trout Lakes, which is only three hundred feet long, the work in Trout Lake will be drained, and will be as easily accomplished as any on the whole length of the improvement, except that in some places boats will have to be used to pass to and from the work; a liberal allowance has been made for such contingencies.

"The greater portion of the work to be done in Trout Lake, is the removal of round boulders, varying in size from one fourth of a cubic yard, to six and eight cubic yards.

"That in Turtle Lake is the excavation of rocks and reefs, mostly in the pinnacle form. As they stand up with bold slopes and deep soundings near them, they can be readily excavated at less than the usual expense of rock excavation. Anticipating that this character of work would be looked upon as a hazardous undertaking and expensive, I have given it a price of two dollars and twenty-five cents per cubic yard; a far larger price than that for which I think it can be safely executed.

"For the Locks at the foot of 'Lac Talon,' and 'Talon Chute,' an abundance of crystalline limestone is found at those points, and from the examination made of this material, it is presumed that it will make suitable masonry for Lock walls. The excavation for these Locks is chiefly in this kind of limestone.

"For Locks at 'Petite Paresseux,' and 'Paresseux Chute,' the face stone will have to be hauled about two miles from a fine Quarry of grey granite. A liberal estimate has been made for the expensive dressing of this character of stone.

"The face stone for the Locks at the 'Rapide de la Rose,' and at 'Plein Chants Chute,' it is proposed to obtain from the same Quarry."

VI. GENERAL REMARKS.

In the preceding pages it has been attempted to show that the Ottawa waters may be improved for vessels of one thousand tons burden, for a sum not exceeding $12,026,351.

The discussion of the important questions of the present or prospective need of such improvement; its effect, if constructed, on the course of Western Trade, and its relative merits to other routes already existing, formed no part of my instructions, and will not be taken up here.

I shall take the liberty, however, to recommend, that whatever new work may be hereafter constructed upon this line of waters, may not be of less dimensions than those which I have stated as necessary for the through line of navigation, as the difference in cost between a Canal on a small scale like those already built, and such a one as has been recommended, would not amount to so much as, in my judgment, would warrant the construction of work which might hereafter have to be enlarged.

I cannot conclude this report without expressing how much we have been indebted to the labors of the Geological Survey, and its accomplished director, Sir William Logan. Their plans of French River, Lake Nipissing, and the Mattawan, were so complete, and after a close test, proved so accurate, that they left nothing further to be desired towards a general map of that section ot the waters. Had they not been in existence, this Report could not have been made without another season's field work.

Had maps of the Ottawa River, of a similar character to those of French River, been accessible, a large part of the expense of the Ottawa Survey might have been saved to the province. I mention these facts both as an act of justice, and because I wish to record distinctly my appreciation of the Geographical results of the Geological Survey, in regard to which my past year's labors have qualified me to speak,

The labors of my predecessors, Messrs. Stewart, Perry, and Gallwey, have been made use of to determine the lengths and depths of the unobstructed, or rather still water portions of the river.

The plans and sections of the "Rocher Fendu" Channel, and Chats Rapids, made for the Department by Mr. Thomas E. Norman, have been adopted in full.

Mr. Slater's levels and bench marks, from Fort William to the head of the Chats Channel, have been followed; everything else upon which this Report and estimate of cost is based, has been derived from actual survey, carried on under my own supervision, and for the correctness of which I am responsible.

In accordance with the instructions of the Department, the plans and estimates "give in detail the dimensions and quantities of each section of work, and the structures pertaining thereto." This has required a much more careful survey than is usual on a preliminary examinition, and has involved a large amount of labor. It has been necessary to make a continuous section of 198.73 miles of river, and to make detailed surveys and cross sections of the location of every Lock, Canal and Dam on the whole line. Plans on a large scale, have been constructed from these surveys, and the estimates and quantities taken out in detail with great care.

This could not have been accomplished in the limited time allowed, if I had not been so fortunate as to have had very energetic as well as carefull assistants.

To Mr. E. R. Blackwell, whose reputation, as an experienced Hydraulic Engineer, stands high in the United States, I owe the labor of conducting the surveys from Des Joachims to Lake Huron, and taking out the quantities upon the whole line. By his judgment I have been much guided in arranging plans and determining prices.

To my other assistants, Messrs. T. E. Norman, C. H. Irvin and Mr. H. Civer, I am much indebted for executing quickly and accurately, whatever fell to their duty to perform.

I have also been assisted by the judgment and experience of Mr. Horace Merrill, Superintendent of Ottawa Timber Slides, to whom is due the plan of Timber Dams. His report upon the effect of the proposed improvements upon the timber navigation, and the arrangement and cost of new Slides will soon be handed in.

I must also state that all our work on the river has been facilitated by the courtesy of the officers of the Hon. Hudson Bay Company, among whom I may particularly mention George McTavish, Esq., C. T. Fort William.

All of which is respectfully submitted by

(Signed) THOS. C. CLARKE,

Engineer, Ottawa Survey.

January 2nd, 1860.

APPENDIX.

TABLE OF CONTENTS.

A

Extracts from Instructions to the Engineers entrusted with the Ottawa Survey.

The Survey is to be prosecuted with a view of ascertaining the praticability of opening a ship communication between the St. Lawrence and Lake Huron, through the Ottawa waters ; and not for the purpose of making a minute and highly accurate hydrographic chart of the river, except so far as the same may be subservient to the first named purpose.

The Engineer in charge of each section of the Survey is to examine, in that section, the nature of the difficulties, and the quantity of the canalling required to be done, and to state the cost of such canalling ; giving in detail the dimensions and quantities of each section of work, and the structures pertaining thereto, and the prices which appear to him sufficient to their execution ; in order that the data, upon which his estimates are based, may be open to the inspection of this Department.

The Scale of Navigation upon which his estimates are to be based, will be that proposed by Mr. Shanly, *i. e.*. dimensions of locks 250x50x10 feet.

Canals one hundred feet wide at bottom, depth ten to eleven feet. Should he, however, see any reason which appears to him sufficient for modifying any of these dimensions, he will make a separate estimate upon such portions, giving his reasons for the change.

The quality of the works proposed should not be inferior to the standard of the St. Lawrence Canals.

He will be expected to report generally upon the method proposed for executing the works, and to designate the points from which meterials are to be obtained ; and should any special difficulties of construction occur on his section, he should show how he proposes to overcome them.

With his Report he will furnish a seperate plan and section of each piece of Canal, carefully noting upon the sections, the difference of level between extreme high and low water.

As the question of supply, upon which the success of the above project depends, is to be determined upon your section. you will give particular attention to that point, and to the praticability of the plan of elevating Lake Nipissing to the summit level, as proposed by Mr. Shanly. The question of a terminal harbor on Lake Huron should receive your careful consideration, and the proper site for the lighthouses and piers should be pointed out.

(Signed,) L. V. SICOTTE,
Chief Commissioner.

Toronto, 15th Nov., 1858.

B.

TABLE OF RIVERS.

NAMES.	Area of drainage in square miles.	Length in miles.	Discharge in cubic feet per second. Low Water.	Mean.	High water	Authority.
Amazon........	2,400,000	4,000	... .	....	1,700,000	Encyclopaedia Britannica
Mississippi	1,226,000	4,400	447,200	....	1,270,000	C. Ellet, Junior.
Saint Lawrence	565,000	2,600	. ...	900,000	....	A. J. Russell, Esq.
Niagara.........	237,300	.....	370,589	389,000	406,000	N. Y. State Reports
Ganges	432,000	1,680	36.300	207,000	294,200	Sir C. Lyell
Nile	520,200	2,240	23,100	220,000	....	Encyclopaedia Britannica
Ohio, at Wheeling...	25,000	...	1,400	....	260,277	C. Ellet, Junior.
Thames............	5,000	215	1,330	....	7,900	Encyclopaedia Britannica
Rhone..............	38,000	560	7,000	21,000	204,000	D. Aubuisson
Rhine.	88,000	700	13,400	33,700	164,000	do
*Ottawa (Grenville)...	80,000	700	35,000	85,000	150,000	Ottawa Survey.
French River........	4,700	....	9,500	....	....	do

* See Tables C. and D.

(Signed) THOS. C. CLARKE,
Engineer, Ottawa Survey.

January 2nd, 1860.

C.

TABLE OF HEIGHTS OF WATER—UPPER Lock, Grenville, year 1859.

January.	Height of Water on Sill.	February.	Height of Water on Sill.	March.	Height of Water on Sill.	April.	Height of Water on Sill.	May.	Height of Water on Sill.	June.	Height of Water on Sill.
1	6 3	1	5 4	1	5 1	1	10 10	1	11 11	1	13 9
2	6 3	2	5 4	2	5 1	2	10 10	2	12 3	2	13 8
3	6 2	3	5 4	3	5 1	3	10 10	3	12 6	3	13 7
4	6 1	4	5 4	4	5 1	4	10 10	4	12 9	4	13 6
5	6 1	5	5 4	5	5 1	5	10 11	5	13 0	5	13 6
6	6 1	6	5 4	6	5 1	6	10 10	6	14 2	6	13 6
7	6 0	7	5 4	7	5 1	7	10 9	7	14 5	7	13 5
8	5 11	8	5 4	8	5 1	8	10 7	8	14 7	8	13 7
9	5 10	9	5 4	9	5 1	9	10 4	9	14 10	9	13 6
10	5 10	10	5 4	10	5 0	10	10 2	10	14 10	10	13 5
11	5 9	11	5 4	11	5 0	11	10 0	11	14 11	11	13 3
12	5 9	12	5 4	12	5 0	12	9 11	12	14 11	12	13 1
13	5 8	13	5 4	13	5 0	13	9 10	13	15 0	13	12 0
14	5 7	14	5 4	14	5 2	14	9 9	14	15 10	14	12 10
15	5 7	15	5 3	15	5 3	15	9 9	15	15 10	15	12 9
16	5 7	16	5 3	16	5 6	16	9 9	16	15 10	16	12 8
17	5 7	17	5 3	17	6 0	17	9 9	17	15 9	17	12 7
18	5 8	18	5 3	18	7 0	18	9 9	18	15 8	18	12 7
19	5 6	19	5 3	19	7 8	19	9 9	19	15 8	19	12 6
20	5 6	20	5 3	20	8 1	20	9 9	20	14 7	20	12 6
21	5 5	21	5 3	21	8 6	21	9 9	21	14 6	21	12 6½
22	5 5	22	5 3	22	9 0	22	9 9	22	14 11	22	12 7
23	5 5	23	5 3	23	9 5	23	9 10	23	14 11	23	12 6½
24	5 5	24	5 2	24	9 7	24	11 2	24	14 10	24	12 6½
25	5 5	25	5 2	25	9 8	25	11 3	25	14 10	25	12 6
26	5 5	26	5 2	26	9 11	26	11 5	26	14 9	26	12 5
27	5 5	27	5 2	27	10 0	27	11 7	27	14 9	27	12 4
28	5 5	28	5 1	28	10 3	28	11 9	28	14 8	28	12 3
29	5 5			29	10 5	29	11 10	29	13 11	29	12 2
30	5 4			30	10 6	30	11 11	30	13 10	30	12 1
31	5 4			31	10 8			31	13 10		

July.	Height of Water on Sill.	August.	Height of Water on Sill.	September.	Height of Water on Sill.	October.	Height of Water on Sill.	November.	Height of Water on Sill.	December.	Height of Water on Sill.
1	12 0	1	8 7	1	6 7	1	8 1	1	7 10	1	10 0
2	11 11	2	8 7	2	6 7	2	8 3	2	7 11	2	10 0
3	11 10	3	8 6	3	6 6	3	8 5	3	7 11	3	10 9
4	11 9	4	8 6	4	6 5	4	8 6	4	7 10	4	10 7
5	11 8	5	8 5½	5	6 5	5	8 7	5	7 9	5	10 7
6	11 7	6	8 5	6	6 5	6	8 8	6	7 9	6	10 8
7	11 6	7	8 5	7	6 4	7	8 9	7	7 9	7	10 8
8	11 5	8	8 4	8	6 4	8	8 9	8	7 9	8	10 8
9	11 3	9	8 3	9	6 4	9	8 9	9	7 10	9	10 7
10	11 2	10	8 2	10	6 3	10	8 8	10	7 10	10	10 6
11	11 0	11	8 1	11	6 6	11	8 7	11	7 10	11	10 5
12	10 10	12	8 0	12	6 10	12	8 6	12	7 10	12	10 4
13	10 8	13	8 0	13	6 10	13	8 6	13	8 0	13	10 3
14	10 6	14	7 11	14	7 2	14	8 5	14	8 6	14	10 1
15	10 5	15	7 10	15	6 10	15	8 5	15	9 3	15	10 0
16	10 3	16	7 9	16	6 8	16	8 4	16	9 4	16	9 11
17	10 1	17	7 9	17	6 7	17	8 2	17	9 5	17	9 10
18	10 0	18	7 8	18	6 7	18	8 0	18	9 6	18	9 9
19	9 10	19	7 6	19	6 7	19	8 1	19	9 6½	19	9 8
20	9 8	20	7 5	20	6 8	20	8 2	20	11 4	20	9 8
21	9 6	21	7 4	21	6 9	21	8 1	21	11 8	21	9 7
22	9 3	22	7 3	22	6 9	22	8 0	22	12 1	22	9 6
23	9 1	23	7 2	23	7 0	23	8 1	23	11 11	23	9 6
24	9 0	24	7 1	24	7 3	24	8 4	24	11 10	24	9 5
25	8 11	25	7 0	25	7 4	25	8 2	25	11 9	25	9 3
26	8 10	26	6 11	26	7 5	26	8 3	26	11 8	26	9 1
27	8 10	27	6 10½	27	7 6	27	8 2	27	10 11	27	8 10
28	8 10	28	6 10	28	7 8	28	8 1	28	10 10	28	8 8
29	8 9	29	6 9	29	7 9	29	8 0	29	10 10	29	8 7
30	8 8	30	6 8	30	7 11	30	8 0	30	10 9	30	8 5
31	8 8	31	6 7			31	7 11			31	8 3

(Signed) THOMAS C. CLARKE,
Engineer Ottawa Survey.

January 2nd, 1860.

D

TABLE OF DAMS.—Shewing the depth of water on their crests at high and low water.

NAME.	L. Length of overfall in feet.	Low Water.		High Water.		Difference between high and low water.	Remarks.
		Q. Cubic feet per second.	H. Height in feet.	Q. Cubic feet per second.	H. Height in feet.		
Carillon	1700	35000	3 20	150000	8 48	5 28	
Chute a Blondeau	1750	"	3 15	"	8 32	5 17	
Little Chaudière	2000	25000	2 31	130000	6 93	4 62	
Chats	2100	"	2 80	"	8 40	5 60	
Portage du Fort	2400	"	2 08	"	6 08	4 00	
Rocher Fendu	400	15000	4 64	70000	13	8 36	Rocher Fen-
Long Rapids	600	"	3 67	"	10 07	6 40	du Channel
Joachims	1150	25000	3 33	125000	9 76	6 43	
McSorley's	1040	"	3 55	"	10 43	6 88	
Rocher Capitaine	1050	"	3 51	"	10 36	6 85	
Do. do.	1400	"	2 92	"	8 54	5 62	
Deux Rivières	938	"	3 82	"	11 20	7 38	
Johnson's Rapids	2000	"	2 29	"	6 73	4 44	
Paresseux Chute	920	5000	1 34	7800	1 63	0 29	Mattawan*

The heights H. and H. in columns 4 and 6 were calculated by the formula $H = \left(\frac{Q}{3.56L}\right)^{\frac{2}{3}}$

The quantities Q and Q are assumed to be the least and greatest volumes of water, respectively, which will pass over the Dams.

(Signed) THOMAS C. CLARKE,

Engineer, Ottawa Survey.

January 2nd, 1860.

*These quantities include the supply drawn from Lake Nipissing in addition to the present discharge of the Mattawan.

E.

Table of Large Propellers.

600 tons and over.

Year.	NAME.	Port of Hail.	Tonnage.	Over all. Length.	Over all. Beam.	Draft when loaded
1856	Acme	Buffalo	762	190-6	33-3	10-0
do	Alleghany	"	583	172-0	28-7	10-9
do	Adriatic	Detroit	663	178-0	31-6	10 0
1855	Chicago	Buffalo	758	....	....	....
1856	Cuyahoga	Cleveland	601	....	....	....
1857	Comet	Buffalo	622	181-3	29-0	11-6
do	Dacotah	Cleveland	698	193-4	30-4	11-0
do	Equinox	Buffalo	620	185-0	30-0	10-0
do	Eclipse	"	620	185-0	30-0	10-0
do	Equator	"	620	185-0	30 0	10-0
1856	Evergreen City	Sheboygan	624	192-6	27-9	10-6
1857	Free State	Buffalo	768	196-0	31-6	10-6
do	Fountain City	Cleveland	820	210-0	30-3	12-0
do	Galena	"	690	193-0	30 4	10-6
do	Hunter	Buffalo	680	200-0	30-0	10-6
1856	Iron City	Cleveland	607	184-2	29 4	9-6
......	Iowa	Buffalo	981	247-0	31-0	11-6
1855	Jersey City	Dunkirk	633	182-0	29-5	10-6
1856	Kenosha	Cleveland	645	194-7	27-10	10-0
do	Montgomery	Detroit	879	204-0	33-5	11 0
do	Mohawk	Buffalo	789	200-6	31-2	11-6
1857	Mendota	Cleveland	709	193-9	30-7	11-0
......	Milwaukee	......	650	200-0	28-0	10-0
......	May Flower	......	623	185-0	28-0	11-0
......	Nile	......	700	188-0	28 6	11-0
1856	Neptune	Buffalo	675	181-0	30-2	10-6
do	New York	Dunkirk	665	182-1	32 0	10-6
1858	Northern Light	Cleveland	716	207-0	30-0	10-6
......	Oriental	......	850	234-0	34-0	10-6
......	Plymouth	Buffalo	846	212-0	32-0	11-0
1856	Pittsburg	"	606	185-0	28-0	10-6
1855	Potomac	"	818	209-0	33-0	11-0
1856	Racine	"	715	196-0	30-0	10-8
do	Rocket	"	611	181-1	29-3	11-6
do	Tonawanda	"	922	......	......	.....
1857	Wenona	Cleveland	688	193-0	30-6	11-0

(Signed) THOMAS C. CLARKE,
Engineer Ottawa Survey.

January 2nd, 1860.

F.

OTTAWA WATERS UNIMPROVED.—Table of Distances and Levels.

	Names of Rivers, Lakes, Rapids, &c.	Distances.			Levels.			
		Miles from Montreal.	Length of Open Navigation.	Length of obstructed Navigation.	Rise, Low Water Section.	Elevation above Tide, low water.	Elevation above Tide, high water.	Difference.
	Tidewater, Three Rivers....	....	....	....	....	0.00	....	......
	Montreal Harbour...........	0'00	.. ..	....	12·75	12.75	....	......
	Lachine	8'50	......	8·50	43·75	56.50	62.50	6.00
	Lower St. Annes	22'00	13·50	....	·50	57.00	63.50	6.50
	Upper St. Annes	22'10	....	·10	1·00	58.00	67.00	9.00
	Carillion Rapids..............	47'70	25·60	....	1·00	59.00	71.00	12.00
	Above do	49'00	....	1·30	8·75	67.75	77.75	10.00
	Chute à Blondeau Rapids	53'00	4·00	..... .	·05	67.80	79.80	12.00
	Above do	53'10	..... .	·10	4·00	71.80	87.00	15.20
	Foot of Long Sault Rapids..........	54.50	1·40	..... .	·10	71.90	88.30	16.40
	Grenville.....................	60·43	... ...	5·93	45·80	117.70	132.50	14.80
	Ottawa Harbour	116·50	56·07	.. ..	*2·30	120.00	140.00	20.00
	Above Chaudière Falls....	... .	....	....	42·30	162.30	170.30	8.00
	Above Little do	118·50	....	....	8·10	170.40	177.40	7.00
	Above Remoux Rapids............	....	... .	... .	2·80	173.20	181.20	8.00
	Des Chênes Lake.....	122·86	... .	6·36	9·80	183.00	191.80	8.00
	Foot of Chats Falls..............	149·55	26·69	... .. .	·30	183.30	193.30	10.00
	Above Chats....................	150·05	. ....	....	38·00	221.30	225.30	4.00
	Chats Lake.....................	153·16	....	3·61	11·80	233.10	240.10	7.00
	Foot of Snows Rapid	171·13	17·97	....	·20	233.30	240.30	7.00
	Head of do	171·33	....	·20	·60	233.90	243.00	10.00
Calumet Channel.	Portage du Fort Rapid.........	175·73	4·40	.. ..	1·90	235.80	245.80	10.00
	Head of do	... ...	....	......	13·00	248.80	257.80	9.00
	Mountain Rapid........	181·33	....	....	6·20	255.00	265.00	10.00
	Head of do	......		....	13·29	268.29	281.29	13.00
	Head of Dargies Rapid.........	....	....	....	1·76	270.05	278.05	8.00
	Foot of Calumet.............	....	....	....	5·65	275.70	285.70	10.00
	Head of do	184·14	....	....	55·67	331.37	340.37	9.00
	La Passe	202·20	..... .	....	4·21	335.58	345.58	10.00
Rocher Fendu Channel.	Portage du Fort Rapid.........	175·73	....	....	....	248.80	. ...	......
	Rocher Fendu Falls..........	183·00	....	....	·50	249.30	259.30	10.00
	Foot of Long Rapids...........	184·50	....	....	6·40	255.70	264.70	9.00
	Foot of La Barrière..........	186·00	. .....	....	16·30	272.00	284.00	12.00
	Muskrat	187·00	....	....	3·30	275.30	284.30	9.00
	Mice......................	188·00	....	....	6·80	282.10	291.10	9.00
	La Fontaine's Lake............	188·50	....	....	3·30	285.40	293.40	8.00
	Black Rapids.	189·50	.. ....	....	18·70	304.10	314.10	10.00
	Black Falls.................	190·30	......	....	17·80	321.90	331.90	10.00
	Flat Rapids.......	192·00	. .. .	16·27	12·00	333.90	343.90	10.00
	La Passe.....	195·92	......	.. .. .	1·68	335.58	345.58	10.00
	Foot of Allumette Island	206.60	. ....	.. ..	2·58	338.16	349.16	11.00
	Foot of Chapeau............	215·43	23·43	....	·76	338.92	349.92	11.00
	Head of do	215·50	. . ..	..... .	·60	339.52	250.52	11.00
	Foot of L'Islet..................	220·35	. .. .	....	·57	340.09	350.59	10.50
	Head of Culbute	221·10	.. ....	5·69	17·09	357.18	364.18	7.00
	Fort William....	226·40	......	....	·32	357.50	[illegible]	[illegible]
	Head of Deep River...............	254·00	32·90	....	1·30	358.80	[illegible]	[illegible]
	Head of Des Joachims Rapids...... .	255·64	....	1.64	26·40	385.20	[illegible]	17.00
	Mouth of Des Moines River.........	263·30	7·66	....	1·00	386.20	403.90	17.70
	Foot of McSorley's Rapids.	268·25	......	4·95	3·00	389.20	....	......
	Head of do do	269·00	....	·75	3·00	392.20	....	......
	Foot of Rocher Capitaine Rapids.....	272·50	3.50	......	2·90	395.10	....	.....

* Estimated at 2.30

F.—*Continued.*

Names of Rivers, Lakes, Rapids, &c.	Distances.			Levels.			
	Miles from Montreal.	Length of open Navigation.	Length of obstructed Navigation.	Rise, Low water Section.	Elevation above Tide, low water.	Elevation, above Tide, high water.	Difference.
Head of Rocher Capitaine Rapids	273.85	....	1.35	40.90	436.00	450.00	14.00
Foot of Deux Rivières Rapids	285.55	11.70	....	4.30	440.30	455.90	15.60
Head of do do	286.01	....	.46	12.60	452.90	....	......
Foot of Trou Rapids	286.70	....	.60	.80	453.70	....	.....
Head of Trou Rapids (at Mic Macs)	287.15	....	0.45	7.40	461.10	478.50	17.40
Foot of La Veillée	288.10	....	0.95	2.80	463.00	.....	......
Head of do	288.70	....	0.60	7.50	471.40	......	....
Foot of Rocky Farm Rapids	296.75	8.05	....	0.40	471.80	......	.....
Head of do do	301.50	....	4.75	8.50	480.30	......	.....
Foot of Johnson's Rapids	306.55	5.05	....	.80	481.10	....	......
Head of do	307.00	....	0.45	4.90	486.00	....	...
Foot of Mattawan Rapids	307.60	.60	....	.10	486.10	.....	......
Head of do	308.00	....	0.40	2.90	489.00	503.30	14.30
Mouth of Mattawan River	308.00	....	......	......	489.00	....	......
		242.52	65.48				

Mattawan and French River Waters Unimproved.

Names of Rivers, Lakes, Rapids, &c.	Miles from Montreal.	Length of open Navigation.	Length of obstructed Navigation.	Rise, Low water Section.	Elevation above Tide, low water.	Elevation, above Tide, high water.	Difference.
Mouth of the Mattawan	308.00	242.52	65.48	....	489.00	....	.....
Foot of Lac Plein Chants Rapids and Chute	310.40	2.00	0.40	5.40	494.40	....	......
Foot of Lac Plein Chants	310.80	....	0.40	16.90	511.30	....	....
Foot of Des Epines Rapids	316.25	5.45	....	0.20	511.50	....	.....
Head of do do	316.30	....	0.05	5.60	517.10	....	......
Foot of Rapide de la Rose	316.85	0.55	....	0.20	517.30	....	......
Head of do do	317.00	....	0.15	5.60	522.90	....	......
Foot of Rapide des Rochers	318.20	1.20	.....	1.40	524.30	....	......
Head of do do	318.30	....	0.10	4.80	529.10	....	......
Foot of Rapide des Aiguilles	319.00	0.70	....	0.10	529.20	....	......
Head of do do	319.01	....	0.01	0.40	529.60	....	......
Foot of Chutes des Paresseux	321.65	2.64	....	....	529.60	....	.....
Head of do do	321.85	....	0.20	33.80	563.40	....	....
Foot of Petite Paresseux Rapides	322.20	0.35	......	....	563.40	....	......
Head of do do	322.35	....	0.15	8.20	571.60	....	......
Foot of Lac Pimisi	323.38	....	1.03	12.80	584.40	....	......
Foot of Talon Chute	324.53	1.15	....	....	584.40	....	......
Head of do	324.71	....	0.18	42.70	627.10	....	......
Rapid below Lake Talon	325.18	0.47	....	....	627.10	....	.....
Foot of Lake Talon	325.33	....	0.15	0.90	628.00	633.10	5.10
Head of do	332.34	7.01	....	....	628.00	....	.....
Foot of Turtle Lake	336.08	....	3.74	29.90	657.90	659.70	1.80
Foot of Trout Lake	339.36	3.28	....	0.90	658.80	....	...
Head of do	347.79	8.43	....	....	658.80	661.60	2.80
				Fall.			
East shore of Lake Nipissing	351.98	....	4.19	24.50	634.30	....	.....
Head of Chaudière Portage	382.42	30.44	....	.....	634.30	641.60	7.30
Foot of do	382.72	....	0.30	25.30	609.00	.....	.....
Foot of Chaudière Rapids	384.03	....	1.31	0.70	608.30	612.00	3.70
Head of Rapide du Pin	391.60	7.57	....	....	608.30	611.90	3.30
Foot of do do	391.69	....	0.09	2.60	605.70	....	.....

F.—*Continued.*

Names of Rivers, Lakes, Rapids, &c.	Distances. Miles from Montreal.	Length of open Navigation.	Length of obstructed Navigation.	Levels. Rise Low water Section.	Elevation above Tide, low water.	Elevation above Tide, high water.	Difference.
Head of Grande Faucelle Rapid......	392.45	0.76	....	0.10	605.60	609.00	3.40
Foot of do do	392.53	....	0.08	5.60	600.00	....	......
Head of Rapid du Buisson	393.22	0.69	....	0.40	599.60	....	......
Foot of do	393.32	......	0.10	3.30	596.30	....	......
Head of Petite Faucelle Rapid......	393.78	0.46	....	....	596.30	....	.....
Foot of do	394.00	....	0.22	4.40	591.90	598.30	6.40
Head of Rapide de Parisien..........	395.49	1.49	....	0.80	591.10	....	......
Foot of do	395.70	....	0.21	1.20	589.90	593.70	3.80
Head of Grand Récollet Rapids	412.72	17.02	....	0.30	589.60	....	......
Foot of do do	412.74	....	0.02	6.80	582.80	....	......
Head of Small Rapid................	413.74	1.00	....	0.10	582.70	....	......
Foot of do	413.82	......	0.08	0.70	582.00	....	......
Head of Small Rapid................	417.54	3.72	....	.....	582.00	....	......
Foot of do	417.64	......	0.10	2.00	580.00	583.90	3.00
Head of Petites Dalles Rapid.	427.81	10.17	....	....	580.00	....	......
Foot of do	428.02	....	0.21	6.00	574.00	....	......
Mouth of French River..............	430.76	2.74	....	....	574.00	....	......
		351.81	78.95				
		430.76					

(Signed) THOMAS C. CLARKE,

Engineer, Ottawa Survey.

January 2nd, 1860.

"G."

OTTAWA WATERS IMPROVED.—Table of Distances and Levels.

Names	Distances.			Levels.				
	Miles from Montreal.	Length of Rivers and Lakes.	Length of Canals.	Elevations above tide.	Number of Locks.	Lockage.	Total number of Locks	Total Lockage.
Montreal	0'00			12.75		43.75		
Lachine	8.50		8.50	56.50				
			8.50					
St. Annes	21.81	13.31		57.10				
Canal	23.00		1.19	58.	1	1.00		
		13.31	1.19				1	1.00
Lake of Two Mountains	47.70	24.70		59.				
Carillon Canal	48.20		.50	71.	1	12.00		
					1	5.00		
Chute à Blondeau	53.00	4.80		76.				
Lock and Dam	53.07		.07	86.	1	10.00		
Foot of Grenville Canal	56.00	2.93		116.50	1	12.00		
Head do	60.43		4.43	117.50	1	12.00		
					1	6.50		
					1	1.00		
		7.73	5.00				7	58.50
Green Shoals			.10					
Ottawa Harbour	116.50	55.97		120.				
					1	11 50		
					1	11.50		
Below Sparks' Mill	118.50			166.	1	11.50		
Lock and Dam			2.00	174.50	1	11.50		
Foot of Des Chênes Rapid	122.25	3.75			1	8.50		
Canal	122.86		.61	183.	1	8.50		
		3.75	2.61				6	63.00
Head of Des Chênes Lake	149.55	26.69		183.30				
Chats Canal	150.05		.50	225.30	1	12.00		
					1	12.00		
					1	12.00		
					1	6.00		
Lock and Dam	151.75	1.70			1	8.00		
Chats Lake	151.85		.10	233.00				
		1.70	.60				5	50.00
Foot of Snows	171.13	19.28		233.30				
Lock and Dam	171.33		.20	239.30	1	6.00		
Portage du Fort Rapids	175.73	4.00						
Locks and Dam	175.97		.24	259.30	1	12.00		
					1	8.00		
Rocher Fendu Chute	183.32	7.35						
Locks and Dam	183.39		.07	269.30	1	10.00		
Long Rapids	185.00	1.61						
Lock and Dam	185.12		.12	289.30	1	14.00		
					1	6.00		
Lalontaine Rapids	188.63	3.51		313.30	1	12.00		
Locks and Dam	188.86				1	12.00		
Norman's Rapids	189.18	.32	.23	337.30				

"G"

OTTAWA WATERS IMPROVED.—Table of Distances and Levels.—(*Continued.*)

Names	Distances.			Levels.				
	Miles from Montreal.	Length of Rivers and Lakes.	Length of Canals.	Elevation above tide.	Number of Locks.	Lockage.	Total number of Locks.	Total lockage.
Locks and Dam	189.30	....	.12	.... ..	1 1	12.00 12.00	....	......
Black Falls	190.43	1.13	....	339.30	....	....	....	......
Lock and Dam	190.50	....	.07	....	1	2.00	....	......
		18.32	1.05				11	104.00
Lake Coulonge	....	......	....	339.30	....	....	....	......
Foot of Chapeau	215.43	24.93	......	339.30	....	....	....	......
Lock and Dam	215.50	....	.07	351.30	1	12.00	....	......
L'Islet	220.35	4.85	....	....	....	....	....	......
Lock and Dam	220.42	....	.07	357.20	1	6.00		
		4.85	.14				2	18.00
							32	294.50
Fort William	226.40	....	....	357.50	....	....	....	......
Foot of des Joachims	254.00	33.58	....	358.50	....	....	....	......
		33.58		....	....	....	....	.... .
Foot of des Joachims Rapids	254.00	....	....	358.80	....	....	....	......
Lock and Canal	254.57	....	0.57	396.80	1 1 1	13.00 13.00 12.00	....	......
Foot of McSorley's Rapids	268.25	13.68	....	....	....	....	....	......
Lock and approaches	268.38	....	0.13	406.80	1	10.00	....	......
Foot of Rocher Capitaine	272.50	4.12	....	....	....	....	....	......
Locks and Canal	272.95	....	0.45	425.80	1 1	13.00 6.00	....	......
River to head of Rocher Capitaine	273.65	0.70	....	....	....	....	....	......
Locks at head of Rocher Capitaine	273.85	....	0.20	444.80	1 1	13.00 6.00	....	......
Foot of Deux Rivieres	288.55	11.70	....	....	....	....	....	......
Locks and Canal	286.01	....	0.46	486.80	1 1 1 1	12.00 12.00 12.00 6.00	....	......
Foot of Johnson's Rapids	306.55	20.54	....	....	....	....	....	......
Locks and Canal	307.00	....	0.45	507.00	1 1	12.00 8.00	....	......
							14	148.20
Mouth of Mattawa River	308.00	1.00	....	....	....	....	....	......
		51.74	2.26					

"G."

Ottawa Waters Improved,—Table of Distances and Levels,—(*Concluded.*)

	Names.	Distances. Miles from Montreal.	Distances. Length of Rivers and Lakes.	Distances. Length of Canal.	Levels. Elevation above tide.	Levels. Number of Locks.	Levels. Lockage.	Levels. Total number of Locks.	Levels. Total Lockage.
Mattawan River.	Mouth of Mattawan River..	308.00							
	Foot of Lac Plein Chants... Rapids and Chute	310.40	2.40		507.00				
	Locks and Dam	310.56		0.16	533.00	1 1	13.00 13.00		
	Foot of Rapide de la Rose..	316.85	6.29						
	Lock and approaches	317.03		0.18	546.00	1	13.00		
	Foot of Paresseux Chute	321.65	4.62						
	Lock and approaches..	321.85		0.20	574.00	1 1	14.00 14.00		
	Foot of Petit Paresseux Rapid	322.20	0.35						
	Lock and approaches.	322.40		0.20	596.00	1 1	11.00 11.00		
	Foot of Talon Chute	324.53	2.13						
	Lock and approaches	324.75		0.22	639.50	1 1 1	14.50 14.50 14.50		
	Foot of Lake Talon	325.18	0.43						
	Lock and approaches	325.30		0.12		1	11.50		
			16.22	1.08				11	144.00
Summit Level.	Talon Lake	334.30	9.00		651.00				
	Turtle Lake Outlet	336.08		1.78					
	Trout and Turtle Lakes	347.79	11.71						
	Summit Cut	351.98		4.19					
	Lake Nipissing	382.42	30.44		651.00				
			51.15	5.97					
French River.	Head of Chaudiere Portage Lake Nipissing.	382.42			651.00				
	Locks and Basin	382.72		0.30	621.00	1 1 1	10.00 10.00 10.00		
	Head of Rapide du Buisson	393.22	10.50						
	Lock and approaches	393.38		0.16	611.00	1	10.00		
	Rapide de Parisien	395.61	2.23						
	Lock and approaches	395.70		0.09	601.00	1	10.00		
	Grand Recollet Rapids	412.65	16.95						
	Lock and approaches	412.74		0.09	588.00	1	13.00		
	Petites Dalles Rapid	427.84	15.10						
	Lock and Canal	428.02		0.18	574.00	1	14.00		
	Mouth of French River Georgian Bay	430.76	2.74						
			47.52	0.82				7	77.00
	Totals		401.44	29.32				64	663.70

January 2nd, 1860.

(Signed,)

THOS. C. CLARKE,
Engineer Ottawa Survey.

H.

Abstracts of Estimates.

	$	$
Saint Annes		469672
Carillon	307741 80	
Chute à Blondeau	144315 25	
Grenville	1197852 30	
		1649909
Green Shoals		136105
Chaudiere and Des Chênes		816733
Chats		681932
Snows	133356 50	
Portage du Fort	287396 10	
Rocher Fendu	836088 00	
		1256840
Lake Coulonge		262514
Chapeau, l'Islet, &c.		243507
Des Joachims	327773 62	
McSorley's	169375 15	
Rocher Capitaine	553543 70	
Deux Rivières	419941 40	
Johnson's	287019 20	
		1757653
Plein Chants	215744 35	
De la Rose	123573 20	
Paresseux	242096 20	
Petite Paresseux	212116 45	
Talon Chute	270105 05	
Talon Lake	98518 65	
		1162154
Summit Cutting		2160369
Chaudière of French River	368925 02	
Rapide du Buisson	132612 50	
Parisien Rapid	108358 90	
Grand Recollet	136349 20	
Petites Dalles	139870 90	
		886117
	$	11483505
Add 5 per cent. for Engineering and Superintendence		574175
	$	12057680

(Signed) THOMAS C. CLARKE,
Engineer, Ottawa Survey.

January 2nd, 1860.

I

ITEMS.	Quantities.	Price.	Amount.	Total.
WORK AT SAINT ANNE'S				
		$ cts.	$ cts.	$ cts.
Lock No. 1.				
Removing old Lock Walls.......... Cubic yds.	2900	0 75	2175 00	....
Excavation, including pumping, &c... do	134800	1 50	202200 00	....
Embankment.................... do	4060	0 25	1015 00	....
				205390 00
Masonry in Lock Walls, face and coping do	2055	12 00	24660 00	....
do do do Culverts...... do	148	16 00	2368 00	....
do do do Backing...... do	4509	8 00	36072 00	....
Rubble Masonry in Cement.......... do	....	....	....	....
Concrete Masonry.................. do	68	6 00	408 00	....
Timber in foundations.............. Linl. feet.	2020	0 18	363 60	....
Wrought Iron in foundations..............Lbs.	4500	0 15	675 00	....
Cast Iron ....do	5780	0 10	578 00	....
Mitre Sills, complete.....................	....	....	625 00	....
Culvert Gates, complete...................	....	....	5000 00	....
Lock Gates, complete......................	....	....	650 00	....
				71399 60
Piers.				
Pine Timber......................Linl. feet.	858400	0 16	137344 00	....
Wrought Iron.............................Lbs.	147600	0 10	14760 00	....
Battered Wall in Cement............Cubic yds.	494	4 00	1976 00	....
Stone filling.......................... do	78980	0 25	19745 00	....
Lining with earth, &c.................. do	36400	0 35	12740 00	....
				186565 00
Coffer Dams to be removed.				
Pine Timber.......................Linl. feet.	15750	0 22	3465 00	....
Lining with earth, &c.............. Cubic yds.	680	0 60	408 00	....
Plank................................. do	94000	26 00	2444 00	....
				6317 00
WORK AT CARILLON.				
				$469671 60
Locks No. 2 and 3.				
		$ cts.	$ cts.	$ cts.
Excavation of Rock.................Cubic yds.	30000	1 00	30000 00	....
Removal of Crib Work.................. do	10000	0 50	5000 00	....
Embankment............................ do	51135	0 25	12783 75	....
				47783 75
Masonry in lock walls, face and coping. do	4082	12 00	48984 00	....
do do Culverts......... do	296	16 00	4736 00	....
do do Backing........ do	9038	6 00	54228 00	....
Rubble Masonry in Cement.......... do	3783	4 50	17023 50	....
Concrete Masonry.................. do	136	6 00	816 00	....
Timber in foundations..............Linl. feet.	4040	0 18	686 80	....
Wrought Iron, in do ....Lbs.	9010	0 15	1351 50	....
Cast Iron............................... do	11560	0 10	1156 00	....
Mitre sills, complete.....................	....	....	1250 00	....
Lock gates, complete......................	....	....	12550 00	....
Culvert gates, complete	....	....	1300 00	....
				144081 80
Dam.				
Pine Timber.......................Linl. feet.	213000	0 16	34080 00	....
Plank including Spike............. F. B. M.	342000	22 00	7524 00	....
Wrought Iron .... Lbs.	46000	0 10	4600 00	....
Stone filling......................Cubic yds.	47000	0 50	23500 00	....
Slope or pavement wall................ do	4850	1 50	7275 00	....
Battered wall......................... do	9413	3 25	30592 25	....
				107571 25
Coffer Dams to be removed.				
Pine Timber.......................Linl. feet.	31500	0 22	6930 00	....
Stone filling......................Cubic yds.	3700	0 75	2775 00	....
Lining with earth, &c .... do	2000	0 30	600 00	....
				10305 00
				$309741 80

I.—*Continued.*

ITEMS.	Quant	Price.	Amount.	Total.
WORK AT CHUTE A BLONDEAU.				
Lock No. 4.				
		$ cts.	$ cts.	$ cts.
Excavation of Rock.................. C. yds.	3475	1 25	4343 75	....
Embankment..... .... do	10585	0 25	2646 25	....
				6990 00
Masonry in Lock walls, face and coping... do	2699	12 00	32388 00	....
do do Culverts. do	148	16 00	2368 00	....
do do Backing.. do	5685	6 00	34110 00	....
Rubble Masonry in Cement.... .... do	298	4 50	447 00	....
Concrete Masonry..................... do	68	6 00	408 00	....
Timber in foundations........ ....Linl. ft.	2020	0 18	363 60	....
Wrought Iron in do. .... Lbs.	4500	0 15	675 00	....
Cast Iron........................ .... do	5780	0 10	578 00	....
Mitre Sills, complete....	....	....	625 00	....
Lock Gates, complete.	....	....	5800 00	....
Culvert Gates, complete	....	....	650 00	....
				78412 60
Dam.				
Pine Timber...........................Linl. ft.	88350	0 16	14136 00	....
Plank, including Spike...............F. B. M.	327000	22 00	7194 00	....
Wrought Iron .... .Lbs.	43900	0 10	4390 00	....
Stone filling............... ....C. yds.	19434	0 60	11660 40	....
Slope or pavement wall........... ..... do	2129	1 50	3193 50	....
Battered wall in Cement .... do	3437	3 75	12885 75	....
				53462 65
Coffer Dam to be removed.				
Timber..... .. ..Linl. ft.	15200	0 22	3344 00	.. ..
Stone filling......... ....C. yds.	1800	1 00	1800 00	....
Lining with earth, &c........... . .... do	1020	0 30	306 00	....
				5450 00
WORK AT GRENVILLE.				$144315 25
Locks No. 5, 6, 7 and 8.				
		$ cts.	$ cts.	$ cts.
Excavation of Earth...................C. yds.	361000	30	108300 00	....
do Loose Rock.. .... do	25200	60	15120 00	....
do Solid do .... do	366300	1 00	366300 00	....
				489720 00
Masonry in Lock Walls, face and coping .. do	7662	12 00	91944 00	....
do do Culverts...... .. do	522	16 00	8352 00	....
do do Backing........ do	16925	6 00	101550 00	....
Rubble Masonry in Cement.............. do	410	4 50	1845 00	....
Concrete. .... do	844	6 00	5064 00	....
Timber in foundations.................Linl. ft.	15210	18	2737 80	....
Wrought Iron............ .... Lbs.	11980	15	1797 00	... .
Cast Iron.............. .... do	20230	10	2023 00	....
Mitre Sills, complete.......	....	....	2190 00	....
Lock Gates, complete.....	....	....	18230 00	....
Culvert Gates, complete.....................	.. ..	....	2275 00	.. ..
				238007 80
Canal Banks.				
Stone filling made from Cuts..... ....C. yds.	85730	25	21432 50	....
Plank, including Spike.............F. B. M.	....	....	... .	.....
Slope or pavement wall ....C. yds.	27197	1 50	40795 50	....
Battered wall dry...................... do	77380	2 75	212795 00	....
do do in cement......... ...... do	57566	3 25	187089 50	....
				....
				462112 50

I—*Continued.*)

ITEMS.	Quantities.	Price.	Amount.	Total.
Coffer Dams to be removed.		$ cts.	$ cts.	$ cts.
Timber .... Linl. ft.	27800	22	6116 00	....
Stone filling .... C. yds.	2500	60	1500 00	....
Lining with earth, &c .... do	1320	30	396 00	....
				8012 00
				$1197852 30
WORK AT GREEN SHOALS, and dredging of the river between Green Shoals and Ottawa.				
		$ cts.	$ cts.	$ cts.
Excavation of rock within coffer dam .... C. yds.	9402	2 50	23505 00	....
Dredging of Channel	200000	0 30	60000 00	....
				83505 00
PIERS.				
Pine timber .... Linl. ft.	166510	0 16	26641 60	....
Stone filling .... C. yds.	17210	0 75	12975 00	....
Wrought Iron .... Lbs.	11756	0 10	1175 60	....
Lining with earth, &c .... C. yds.	3700	0 30	1110 00	....
				41902 20
COFFER DAMS TO BE REMOVED.				
Pine timber .... Linl. ft.	30030	0 25	7507 50	....
Stone filling .... C. yds.	2470	1 00	2470 00	....
Lining with earth, &c	1200	0 60	720 00	....
				10697 50
				$136104 70
WORK AT OTTAWA CITY, including all to the head of the Du Chênes Rapids.				
Locks N. 9, 10, 11, 12, 13 and 14.		$ cts.	$ cts.	$ cts.
Excavation of Rock .... Cubic yards	243760	0 90	219384 00	....
Excavation of Rock at foot of locks within coffer dams, including pumping. do	8333	1 50	12499 50	....
Excavation of Rock at the Remoux within coffer dams, including pumping. do	16000	2 00	32000 00	....
Removal of old cribs .... do	6166	0 30	1849 80	....
Removal of bridge piers .... do	107	0 50	53 50	....
Embankment .... do	34370	0 25	8592 50	....
				274379 30
Masonry in lock walls, face and coping do	12673	10 00	126730 00	....
do do Culverts ...... do	748	16 00	11968 00	....
do do Backing ...... do	32166	5 00	160830 00	....
Coursed rubble masonry at head of lock 12 .... do	3562	6 50	23153 00	....
Rubble masonry in cement .... do	813	4 50	3658 50	....
Concrete .... do	307	6 00	1842 00	....
Timber in foundations .... Linl. ft.	9110	0 18	1639 80	....
Wrought Iron in foundations ...... Lbs.	31120	0 15	3168 00	....
Cast Iron .... do	29120	0 10	2912 00	....
Mitre sills, complete	....	....	3125 00	....
Lock gates, complete	....	....	29300 00	....
Culvert Gates, complete	....	....	3250 00	....
Swing Bridge	....	....	7000 00	....
				378576 30

I—*Continued.*

ITEMS.	Quantities.	Price.	Amount.	Total.
Dams and Canal Banks.				
Pine Timber........................Linl. ft.	166200	0 16	26592 00	....
Plank, including spike...............F. B. M.	310400	22 00	6828 80	....
Wrought Iron........... ....Lbs.	91690	0 10	9169 00	....
Stone filling......................Cubic yds.	14540	0 75	10905 00	....
Slope or Pavement wall............ do	6500	1 50	9750 00	....
Battered wall, laid dry .... do	2830	3 00	8490 00	....
Battered wall in cement............ do	10224	3 50	35784 00	....
Puddle wall...................... do	3560	0 45	1602 00	....
Lining with chip stone and gravel..... do	2770	0 30	831 00	....
				109951 80
Coffer Dams, ½ to be removed.				
Pine Timber..... .... Linl. ft.	156260	0 20	31852 00	....
Stone filling......................Cubic yds.	18799	1 00	18799 00	....
Wrought Iron.............. .... Lbs.	15249	0 10	1524 00	....
Lining with earth, &c..............Cubic yds.	5500	0 30	1650 00	....
				53825 90
				$816733 30
WORKS AT THE CHATS RAPIDS.				
Locks Nos. 15, 16, 17, 18 and 19.		$ cts.	$ cts.	$ cts.
Excavation of earth.................Cubic yds.	32500	0 25	8125 00	....
do of rock..... .... do	77645	2 50	194112 50	....
do of do within coffer dam including pumping.......... do	4444	3 50	15554 00	....
Embankment..... .... do	74323	0 15	11148 45	....
				228939 95
Masonry, lock walls, facing and coping do	9187	12 00	110224 00	....
do do culverts......... do	600	16 00	9600 00	....
do do backing........ do	27726	6 50	134719 00	....
Rubble masonry in cement.......... do	433	4 50	1948 50	....
Concrete. .... do	1808	6 00	10848 00	....
Timber in foundation.... .... Linl. ft.	23300	0 16	3728 00	....
Wrought iron in do . ... Lbs	10856	0 15	1628 40	....
Cast Iron.. .... do	23340	0 10	2334 00	....
Plank, including spike .. ..F. B. M.	89400	20 00	1788 00	....
Mitre sills, complete..............................	....	....	2500 00	....
Lock gates, complete..............................	....	....	20750 00	....
Culvert gates complete............................	....	....	2600 00	....
				302687 80
Dams and Piers.				
Excavation............... ....Cubic yds.	400	2 50	1000 00	....
Pine timber.........................Linl. ft.	298402	0 15	44760 30	....
Plank, including spike...............F. B. M.	407500	20 00	9950 00	....
Wrought Iron...................... .... Lbs.	87470	0 10	8747 00	....
Stone filling .... Cubic yds.	45555	0 80	36444 00	....
Slope or pavement wall............. do	2734	1 50	4101 00	....
Battered wall in cement.... .... do	2940	4 00	11760 00	....
Lining with chip stone and gravel..... do	3310	0 40	1324 00	....
				118086 30
Coffer Dams—one half to be removed.				
Pine timber ....Linl. ft.	95530	0 20	19106 00	....
Stone filling..... ....Cubic yds.	10014	1 20	12016 80	....
Lining with earth, &c .. .. do	2190	0 50	1095 00	....
				32217 80
WORK AT THE SNOWS, OR CHENAUX RAPIDS				
				$ 681931 95
Lock No. 20.		$ cts.	$ cts.	$ cts.
Excavation of rock.......... .....Cubic yds.	16600	1 75	29050 00	....
Embankment.......... .... do	17100	0 20	3420 00	....
				32470 00

I.—*Continued.*

ITEMS.		Quantities.	Price.	Amount.	Total.
Masonry in Lock walls, face and coping	Cubic yds.	2248	14 00	31472 00	....
do do Culverts	do	148	18 00	35133 75	....
do do Backing	do	5205	6 75	2664 00	....
Rubble Masonry in cement	do	398	4 50	1791 00	....
Concrete Masonry	do	77	6 00	462 00	....
Timber in foundations	Linl. ft.	2020	0 17	343 00	....
Wrought iron in do	lbs.	4500	0 15	337 50	....
Cast iron in do	lbs.	5780	0 10	578 00	....
Mitre Sills complete		....	....	625 00	....
Lock gates complete		....	....	5650 00	....
Culvert gates complete		....	....	650 00	....
					79706 65
Dams and Piers.					
Excavation	Cubic yds.	160	2 00	320 00	....
Pine Timber	Linl. ft.	30249	0 15	4537 35	....
Plank including Spike	F.B.M.	31700	20 00	634 00	....
Wrought iron	lbs.	8000	0 10	800 00	....
Stone filling	Cubic yds.	3330	1 00	3330 00	....
Battered walls in cement	do	1875	3 50	6562 50	....
Lined with Chip Stone, Gravel, etc	do	450	0 50	225 00	....
					16408 85
Coffer Dam to be removed.					
Pine Timber	Linl. ft.	14330	0 20	2866 00	....
Stone filling	Cubic yds.	1460	1 25	1825 00	....
Lining with earth, etc	do	160	0 50	80 00	....
					4771 00
					$133356 50

Work at Portage du Fort Rapids.

			$ cts.	$ cts.	$ cts.
Locks Nos. 21 and 22.					
Excavation of Rock	Cubic yds.	47200	1 40	66080 00	....
Embankment	do	14056	0 20	2811 20	....
					68891 20
Masonry in Lock Walls, face and coping	do	4016	14 00	56224 00	....
do Culvert	do	296	18 00	5328 00	....
do Backing	do	8799	6 75	59393 25	....
Rubble Masonry in Cement	do	370	4 50	1665 00	....
Concrete do	do	136	6 00	816 00	....
Timber in foundations	Linl ft.	4040	0 17	686 00	....
Wrought iron in foundations	lbs.	9000	0 15	1350 00	....
Cast Iron	lbs.	11560	0 10	1156 00	....
Mitre Sills complete		....	....	1250 00	....
Lock Gates complete		....	....	10700 00	....
Culvert Gates complete		....	....	1300 00	....
					139868 25
Dam.					
Pine Timber	Linl. ft.	134150	0 15	21342 00	....
Plank, including Spike	F.B.M.	330700	20 00	6674 00	....
Wrought Iron	lbs.	44875	0 10	4487 50	....
Battered Walls in Cement	Cubic yds.	8685	3 75	32568 75	....
Stone filling	do	13784	0 60	8270 40	....
Lining with Chip Stone, Gravel, etc	do	2190	0 50	1095 00	....
					74437 65
Coffer Dam—one-third to be removed.					
Timber	Linl. ft.	34110	0 20	2682 00	....
Stone filling	Cubic yds.	1440	1 00	1440 00	....
Lining with Earth, &c	do	154	0 50	77 00	....
					4199 00
					$287396 10

I.—(*Continued.*)

ITEMS.	Quantities.	Prices.	Amount.	Total.
WORK AT ROCHER FENDU CHANNEL.				
Locks Nos. 23, 24, 25, 26, 27, 28, 29 *and* 30.		$ cts.	$ cts.	$ cts.
Excavation of Solid Rock..............C. yards.	66020	1 50	99030 00	....
Excavation of Loose Rock.... .. .. do	3200	0 60	1920 00	....
Embankment...................... ... do	41645	0 30	12493 50	....
				113443 50
Masonry in Lock-walls, face and coping... do	15948	14 00	223272 00	....
do do Culverts......... do	1044	18 00	18792 00	....
do do Backing.......... do	36780	6 75	248265 00	....
Rubble Masonry in Cement...... .. do	2174	4 75	10326 50	....
Concrete Masonry..................... do	444	6 50	2886 00	....
Timber in foundations...............Lineal feet.	16680	0 17	2835 60	....
Wrought Iron in foundations ....lbs.	30120	0 15	4518 00	....
Cast Iron..................................lbs.	40680	0 10	4068 00	....
Mitre Sills, complete........................	....	....	4575 00	....
Lock Gates, complete..............	....	....	38100 00	....
Culvert Gates, complete............	....	....	4550 00	....
				562188 10
Dams.				
Pine Timber. ....Lineal feet.	274970	0 15	41245 50	....
Plank, including Spike ....F. B. M.	385500	20 00	7710 00	....
Wrought Iron.... ....lbs.	71550	0 10	7155 00	....
Stone filling.......... .... .Cubic yards.	37948	1 00	37948 00	....
Battered wall in Cement................. do	12874	4 00	51496 00	....
Lining with Chip Stone, Gravel, &c....... do	2222	0 50	1111 00	....
				146665 50
Coffer Dams.				
Pine Timber...................... Lineal feet.	31245	0 20	6249 00	....
Stone filling. .... Cubic yds.	3450	1 25	4312 50	....
Lining with earth, etc..... .... do	410	0 50	205 00	....
				10766 50
Waste Weir.				
Oak Timber.......... ....Cubic feet.	540	0 25	135 00	....
Oak Planks........ ....F. B. M.	3920	25 00	98 00	....
Wrought Iron........... .... lbs.	1176	0 15	176 40	....
Rubble Masonry.............. .... Cubic yds.	355	5 00	1775 00	....
Masonry in Arches................. do	60	14 00	840 00	....
				3024 40
				$836088 00
WORK AT LAKE COULONGE AND CULBUTE CHANNEL.				
		$ cts.	$ cts.	$ cts.
Dredging. ....Cubic yds.	424500	0 30	127350 00	....
Excavation of Rock................. do	43330	2 00	86660 00	....
				214010 00
Piers and Coffer Dam.				
Pine Timber................................	214050	0 16	34248 00	....
Stone Filling.....	18610	0 60	11166 00	....
Lining with earth, etc.	10300	0 30	3090 00	....
				48504 00
				$262514 00

I.—(*Continued*,)

ITEMS.	Quantities.	Prices.	Amount.	Total.
WORK AT CHAPEAU, L'ISLET, AND CULBUTE RAPIDS.				
Locks Nos. 31 and 32.		$ cts.	$ cts.	$ cts.
Excavation of Rock, Chapeau and L'Islet..C. yds.	22100	1 40	30940 00	....
Excavation of Rock, Culbute .... do	2000	2 00	4000 00	....
Embankment..................... .... do	12190	0 30	3657 00	....
				38597 00
Masonry in Lock-walls, face and coping... do	4312	14 00	60368 00	....
do do Culverts......... do	296	18 00	5328 00	....
do do Backing. .... do	11844	6 75	79947 00	....
Rubble Masonry in Cement.. .. .. do	186	4 75	883 50	....
Concrete Masonry.......... .... do	136	6 50	884 00	....
Timber in foundations.................Linl. ft.	4040	0 17	686 80	....
Wrought Iron in do ....Lbs.	9000	0 15	1350 00	....
Cast Iron............ .... do	11560	0 10	1156 00	....
Mitre Sills complete..............................	....	....	1250 00	....
Lock Gates complete............	....	....	10400 00	....
Culvert Gates complete......	....	....	100 00	....
				163553 30
Dams.				
Pine Timber. ....Linl. ft.	33240	0 15	4986 00	....
Plank, including Spike... ....F. B. M.	60170	20 00	1203 40	....
Wrought Iron. .. ..Lbs.	13520	0 10	1352 00	....
Battered Wall in Cement .... C. yds.	2776	4 00	11104 00	....
Stone filling..... .... do	4283	0 70	2998 10	....
Lining with Chip stone, gravel, &c........ do	726	0 50	368 00	....
				22006 50
Coffer Dam to be removed.				
Pine Timber .... Linl. ft.	51092	0 20	10218 40	....
Stone filling. .. ..C. yds.	5710	1 00	5710 00	....
Lining with earth, &c...... .... do	1740	0 50	870 00	....
				16798 40
Waste Weir.				
Oak Timber........ ....C. feet.	527	0 25	131 75	....
Oak Plank..... .... F. B. M.	3920	25 00	98 00	....
Wrought Iron........... ....Lbs.	1176	0 15	176 40	....
Rubble Masonry ....C. yds.	260	4 50	1170 00	....
Arch do .... do	61	16 00	976 00	....
				2552 15
				$243507 35
WORK AT DES JOACHIMS RAPIDS.				
Locks No. 33, 34, 35.		$ cts.	$ cts.	$ cts.
Excavation of Rock........ ....C. yds.	19700	1 75	34475 00	....
Embankment........................... do	51500	0 25	12875 00	....
Removal of Peirs, Cribs, &c.... .... do	4930	0 20	986 00	....
				48336 00

I.—(*Continued.*)

ITEMS.	Quantities.	Prices.	Amount.	Total.
		$ cts.	$ cts.	$ cts.
Masonry in Lock-walls, face and coping .C. yds.	6727	13 00	87451 00	....
do do Culverts .... do	374	17 00	6358 00	....
do do Backing.......... do	15191	6 75	102539 25	....
Rubble Masonry in Cement............ do	830	4 75	3942 50	....
Concrete Masonry.................... do	154	6 50	1001 00	....
Battered Wall in Cement............... do	1320	4 00	5280 00	....
Timber in foundations.................Linl. ft.	4556	0 17	774 52	....
Wrought Iron, in do ....Lbs.	10559	0 15	1583 85	....
Cast Iron............................ do	14560	0 10	1456 00	....
Mitre Sills complete..................	....	....	1565 00	....
Lock Gates complete..................	....	....	11375 00	....
Culvert Gates complete...............	....	....	4625 00	....
				227951 12
Dams, Cribs, and Canal Bank.				
Excavation............................C. yds.	857	1 25	1071 25	....
Pine Timber...........................Linl. ft.	113340	0 15	17001 00	....
Plank, including Spike ....F. B. M.	246800	20 00	4936 00	....
Wrought Iron..........................Lbs.	40200	0 10	4020 00	....
Stone filling.........................C. yds.	19280	0 50	9640 00	....
Battered Wall in Cement .... do	53	4 00	212 00	....
Slope or Pavement wall............... do	4179	1 75	7313 25	....
Lining with Chip stone, &c............ do	700	0 50	350 00	....
				44543 50
Coffer Dam, to be removed.				
Pine Timber.......................... Linl. ft.	20910	0 20	4182 00	....
Stone filling.........................C. yds.	2320	1 00	2320 00	....
Lining, with earth, &c................ do	1260	0 35	441 00	....
				6943 00
				$327773 62
WORK AT MCSORLEY'S RAPIDS.				
Lock No. 36.		$ cts.	$ cts.	$ cts.
Excavation of Rock....................C. yds.	10420	2 00	20840 00	....
do Earth.................... do	9130	9 25	2282 50	....
Embankment .... do	8640	0 25	2160 00	....
				25282 50
Masonry in Lock-walls, face and coping... do	2475	15 50	38362 50	....
do do Culverts......... do	148	19 09	2812 00	....
do do Backing......... do	5649	7 25	40962 75	....
Rubble Masonry in Cement............. do	325	4 90	1592 50	....
Concrete Masonry .... do	68	6 75	450 00	....
Timber in foundation..................Linl. ft.	2020	0 17	343 40	....
Wrought Iron in do ....Lbs.	4500	0 15	675 00	....
Cast Iron .... do	5780	0 10	578 00	....
Mitre Sills complete..................	....	....	625 00	....
Lock Gates complete..................	....	....	6200 00	....
Culvert Gates complete...............	....	....	550 00	....
				93260 15

I.—(*Continued.*)

ITEMS.		Quantities.	Prices.	Amount.	Total.
Dam and Crib.			$ cts.	$ cts.	$ cts.
Excavation of Earth	C. yds.	2000	0 25	500 00	....
Pine Timber	Linl. ft.	121820	0 15	18273 00	....
Plank, including Spike	F. B. M.	185200	0 20	3904 00	....
Stone filling	C. yds.	39020	0 10	3902 00	....
Battered Wall in Cement	do	19420	0 70	13594 00	....
Lining with Chip stone, gravel, etc.	do	1920	4 30	8256 00	....
	do	617	0 50	308 50	....
					48737 50
Coffer Dam to be removed.					
Pine timber	Linl. ft.	7380	0 20	1476 00	....
Stone filling	C. yds.	520	1 00	520 00	....
Lining with earth, &c	do	330	0 30	99 00	....
					2095 00
					$169375 15
WORK AT ROCHER CAPITAINE RAPIDS.					
Locks No. 37, 38 39, and 40.					
Excavation of Rock	C. yds.	50113	1 75	87697 75	....
do Earth	do	54525	25	13631 25	....
Embankment	do	32454	10	3445 40	....
					104574 40
Masonry in Lock walls, face and coping	do	8145	16 50	134392 50	....
do Culverts	do	522	20 00	10440 00	....
do Backing	do	18194	7 00	127358 00	....
Rubble Masonry in Cement	do	1551	5 00	7775 00	....
Concrete Masonry	do	221	6 90	1524 90	....
Battered Wall in Cement	do	1132	4 50	5094 00	....
Timber in Foundations	Linl. ft.	6570	17	1116 90	....
Wrought Iron in do	Lbs.	15060	15	2259 00	....
Cast Iron	do	20340	10	2034 00	....
Mitre Sills complete		....	....	2190 00	....
Lock gates complete		....	....	10175 00	....
Culvert gates complete		....	....	2275 00	....
					315634 30
Dam and Canal Banks.					
Excavation of Earth	C. yds.	2696	25	674 00	....
Embankment	do	860	25	215 00	....
Pine Timber	Linl. ft.	312410	15	46861 50	....
Plank, including Spike	F. B. M.	482800	20 00	9656 00	....
Wrought Iron	Lbs.	151510	10	15151 00	....
Stone filling	C. yds.	50310	1 00	50310 00	....
Battered Wall in Cement	do	236	4 50	1062 00	....
Slope or Pavement wall	do	4340	2 00	8680 00	....
Lining with chip stone, gravel, &c	do	1451	50	725 50	....
					133335 00
WORK AT DEUX RIVIÈRES.					$553543 70
Locks Nos. 41, 42, 43 and 44.					
Excavation of rock	C. yds.	3540	1 90	6726 00	....
do Earth	do	50900	25	12725 00	....
Embankment	do	20610	15	3091 50	....
					22542 00

I—(*Continued.*)

ITEMS.	Quantities.	Price.	Amount.	Total.
		$ cts.	$ cts.	$ cts.
Masonry in Lock Walls, face and coping. C. yds.	7860	13 50	106110 00	....
do Culverts.................. do	522	18 00	9396 00	....
do Backing.................... do	18230	6 75	123052 50	....
Rubble Masonry in cement............. do	580	5 00	2900 00	....
Concrete masonry....................... do	2408	7 00	16856 00	....
Timber in foundations...............Linl. ft.	32900	17	5593 00	....
Plank in do ....F. B. M.	146200	20 00	2924 00	....
Wrought Iron in do .... Lbs.	3100	15	466 50	....
Cast Iron.............................. do	20340	10	2034 00	....
Mitre Sills complete.........................	....	....	2190 00	....
Lock gates complete..........................	....	....	18650 00	....
Culvert gates complete.......................	....	....	2275 00	....
				292447 00
Dam and Canal Banks.				
Excavation .... C. yds.	720	1 00	720 00	....
Embankment............................ do	22130	15	3319 50	....
Pine Timber........................ Linl. ft.	176250	15	26437 50	....
Plank, including Spike................ F. B. M.	198600	20 00	3972 00	....
Wrought Iron. .... Lbs.	72630	10	7263 00	....
Stone filling.........................C. yds.	38538	80	30830 40	....
Battered Wall in Cement................ do	3272	4 00	13088 00	....
Slope or Pavement Wall................ do	5969	2 00	11938 00	....
Lining with chip stone, gravel, &c .... do	555	10	277 50	....
				97845 90
Coffer Dam.				
Pine Timber............................ Linl.ft.	18430	20	3686 00	....
Stone filling..........................C. yds.	3000	1 00	3000 00	....
Lining with Earth, &c.................. do	1200	35	420 00	....
				7106 00
				$419941 40
WORK AT JOHNSTON'S RAPIDS.				
Locks No. 45 and 46.				
Excavation of Rock...................C. yds.	5605	2 00	11120 00	....
do Earth....................... do	57150	30	17145 00	....
Embankment............................ do	10964	15	1644 60	....
				29909 60
Masonry in Lock walls, face and coping... do	4201	15 00	63150 00	....
do do Culverts. .... do	296	20 00	5920 00	....
do do Backing.......... do	9448	7 25	68498 00	....
Rubble Masonry in Cement........... do	590	5 25	3097 50	....
Concrete Masonry..................... do	750	7 20	5300 00	....
Timber in foundations...............Linl. ft.	11530	16	1844 80	....
Plank do ...................F.B.M.	43400	20 00	868 00	....
Wrought Iron in Foundations...........Lbs.	4800	15	720 00	....
Cast Iron do .... do	11560	10	1156 00	....
Mitre Sills, complete..........................	....	....	1250 00	....
Lock Gates do	....	....	11000 00	....
Culvert Gates do	....	....	1300 00	....
				164104 30
Dam and Canal Banks.				
Exeavation.............................. C. yds.	1790	75	1342 50	....
Embankment.............................. do	26280	15	3942 00	....
Pine Timber.........................Linl. ft.	175640	14	24589 60	....
Plank, including Spil e................F.N.M.	465600	20 00	9312 00	....

I.—(*Continued.*)

ITEMS.	Quantities.	Prices.	Amount.	Total.
		$ cts.	$ cts.	$ cts.
Wrought Iron.................. ....Lbs.	77720	11	8549 20	....
Stone Filling.......... .... C. yds.	28340	75	21255 00	....
Battered Wall in Cement................ do	190	4 75	902 50	....
Slope or Pavement Wall........... ..... do	8282	2 00	16564 00	....
Lining with Chip Stone, Gravel, &c....... do	1185	50	592 50	....
Coffer Dam.				87049 30
Pine Timber............... ....Linl. ft.	17800	20	3560 00	....
Stone Filling.......................C. yds.	2000	1 00	2000 00	....
Lining with Earth, etc .... do	1320	30	396 00	....
				5956 00
WORK AT PLEIN CHANTS CHUTE.				$ 287019 20
Locks Nos. 47 and 48.				
Excavation of Rock.....................C. yds.	17614	1 75	36824 50	....
Embankment............................ do	9200	30	2760 00	....
				33584 50
Masonry in Lock walls, face and coping... do	3995	19 00	75905 00	....
do do Culverts.... ..... do	226	23 00	5198 00	....
do do Backing.......... do	9366	7 30	68371 80	....
Rubble Masonry in Cement....... . do	135	6 00	810 00	....
Concrete do .... do	85	8 25	701 25	....
Timber in Foundations..............Lineal feet.	2540	17	431 80	....
Wrought Iron in Foundations.. ....Lbs.	6050	15	907 50	....
Cast Iron do ....Lbs.	8780	10	878 00	....
Mitre Sills, complete..........................	....	....	940 00	....
Lock Gates, complete...........................	....	....	8475 00	....
Culvert Gates, complete........................	....	....	975 00	....
Dam.				163593 35
Excavation...........................C. yds.	530	50	265 00	....
Pine Timber.........................Linl. ft.	66250	15	9937 50	....
Plank, including Spike ....F. B. M.	188500	20 00	3770 00	....
Wrought Iron...........................Lbs.	31700	10	3170 00	....
Stone filling.......... .... .C. yds.	1590	40	636 00	....
Battered Wall in Cement................ do	120	4 90	588 00	....
Lining with Chip Stone, Gravel, &c ..... do	400	50	200 00	....
				18566 50
				$215744 35
WORK AT RAPIDE DE LA ROSE.				
Lock No. 49.				
Excavation of Rock.................. C. yds.	2650	1 75	4637 50	....
Embankment......................... do	8420	30	2526 00	....
				7163 50
Masonry in Lock walls, face and coping. do	2200	18 00	39600 00	....
do do Culverts.......... do	148	22 00	3256 00	....
do do Backing.......... do	5096	7 15	36436 30	....
Rubble Masonry in Cement............. do	280	5 75	1610 00	....
Concrete Masonry do .... do	70	8 00	560 00	....
Timber in Foundations.......... ......Linl. ft.	2020	17	343 40	....
Wrought Iron do ....Lbs.	4500	15	675 00	....
Cast Iron.............................. do	5780	10	578 00	....

I.—(*Continued*,)

ITEMS.		Quantities.	Prices.	Amount.	Total.
			$ cts.	$ cts.	$ cts.
Mitre sills, complete				625 00	
Lock gates do				5050 00	
Culvert gates do				650 00	
					89983 70
Dam.					
Excavation	C. yds.	370	50	185 00	
Pine Timber	Linl. ft.	61980	15	9297 00	
Plank, including Spike	F. B. M.	181000	20 00	3620 00	
Wrought Iron	Lbs.	28660	10	2866 00	
Stone Filling	C. yds	8370	1 00	8370 00	
Rubble Masonry	do	388	4 75	1843 00	
Lining with Chip Stone, Gravel, &c.	do	490	50	245 00	
					26426 00
					$123573 20
WORK AT PARESSEUX CHUTE.					
Locks Nos 50 and 51.					
Excavation of Rock	C. yds.	33128	2 25	74564 00	
Embankment	do	8100	25	2025 00	
					76589 00
Masonry in Lock walls, face and copidg	do	4125	17 00	70125 00	
do do Culverts	do	226	21 00	4746 00	
do do Backing	do	9815	7 00	68705 00	
Rubble Masonry in Cement	do	200	5 50	1100 00	
Concrete Masonry in Cement	do	86	7 90	679 40	
Timber in Foundations	Linl. ft.	2540	17	431 80	
Wrought Iron in Foundations	Lbs.	6050	15	907 50	
Cast Iron	do	8780	10	878 00	
Mitre Sills, complete				940 00	
Lock Gates, do				8700 00	
Culvert Gates do				975 00	
					158187 70
Dam.					
Excavation	C. yds.	330	50	165 00	
Pine Timber	Linl. ft.	15120	15	2268 00	
Plank, including Spike	F. B. M.	96000	20 00	1920 00	
Wrought Iron	Lbs.	9140	10	914 00	
Stone Filling	C. yds	160	50	80 00	
Battered Wall in Cement	do	150	4 75	712 50	
Lining with Chip Stone, Gravel, &c.	do	2520	50	1260 00	
					7319 50
					$242096 20
WORK AT PETIT PARESSEUX RAPIDS.					
Locks Nos 52 and 53.					
Excavation of Rock	C. yds.	20675	1 75	36181 25	
Embankment	do	8760	25	2190 00	
					38371 25
Masonry in Lock walls, face and coping	do	3727	17 00	63359 00	
do do Culverts	do	226	21 00	4746 00	
do do Backing	do	8464	7 00	59248 00	
Rubble Masonry in Cement	do	310	5 50	1705 00	
Concrete Masonry	do	86	7 90	679 40	

I—(*Continued.*)

ITEMS.	Quantities.	Prices.	Amount.	Total.
		$ cts.	$ cts.	$ cts.
Timber in foundations. .... Linl. ft.	2540	17	431 80	
Wrought Iron in do .... Lbs.	6050	15	907 50	
Cast Iron .... do	8780	10	878 00	
Mitre Sills, complete.			940 00	
Lock Gates, complete.			8025 00	
Culvert Gates, complete..........			975 00	
Dam.				141894 70
Excavation.......... Cubic yds.	645	50	322 50	
Pine Timber.......... Linl. ft.	110900	15	16635 00	
Plank, including Spike .... F. B. M.	310700	20 00	6214 00	
Wrought Iron .... Lbs.	51750	10	5175 00	
Stone filling.......... C. yds.	7440	40	2976 00	
Battered wall in Cement.......... do	40	4 75	190 00	
Lining with Chip stone, gravel, &c.. .... do	676	50	338 00	
				31850 50
WORK AT TALON CHUTE.				$212116 45
Locks Nos. 54, 55 and 56.				
Excavation of Rock.......... C. yds.	27800	1 75	48650 00	
Embankment .... do	29100	30	8730 00	
				57380 00
Masonry in Lock Walls, face and coping.. do	6082	13 50	82107 00	
do do Culverts.......... do	304	17 50	5320 00	
do do Backing.......... do	14631	6 75	98759 25	
Rubble Masonry in Cement.......... do	980	5 25	5145 00	
Concrete .... do	86	7 75	666 50	
Flagging .... do	358	1 75	626 50	
Timber in foundations.......... Linl. ft.	2540	17	431 80	
Wrought Iron.......... Lbs.	6050	15	907 50	
Cast Iron.......... do	11770	10	1177 00	
Mitre Sills, complete..........			1250 00	
Lock Gates, complete..........			11670 00	
Culvert Gates, complete..........			1300 00	
Dam.				209360 55
Excavation .... C. yds.	65	1 00	65 00	
Pine Timber.......... Linl ft.	9700	15	1455 00	
Plank, including Spike.......... F. B. M.	33800	20 00	676 00	
Wrought Iron .... Lbs.	5400	10	540 00	
Stone filling.......... C. yds.	760	40	304 00	
Battered Wall in Cement.......... do	47	4 50	211 50	
Lining with Chip stone, &c.......... do	226	50	113 00	
				3364 50
WORK AT TALON LAKE.				$270105 05
Lock No. 57.				
Excavation of Rock.......... C. yds.	9200	2 00	18400 00	
Embankment.......... do	6600	25	1650 00	
				20050 00
Masonry in Lock walls, face and coping... do	2097	13 50	28209 50	
do do Culverts.......... do	148	17 50	2590 00	
do do Backing.......... do	4740	6 75	31995 00	
Rubble Masonry in Cement.......... do	116	5 25	609 00	
Concrete Masonry.......... do	68	7 75	527 00	

I.—(*Continued.*)

ITEMS.	Quantities.	Prices.	Amount.	Total.
		$ cts.	$ cts.	$ cts.
Timber in foundations..........Linl. ft.	2020	17	343 40	....
Wrought Iron in do ....Lbs.	4500	15	675 00	....
Cast Iron.. ....do	5780	10	578 00	....
Mitre Sills, complete..........................	....	....	625 00	....
Lock Gates complete	....	....	5500 00	....
Culvert Gates complete..........................	....	....	650 00	....
				72301 90
Dam.				
Excavation.............................Cubic yds.	215	1 00	215 00	....
Pine Timber..........................Linl. ft.	17200	15	2580 00	....
Plank, including Spike ....F. B. M.	72300	20 00	1446 00	....
Wrought Iron..........................Lbs.	9030	10	903 00	....
Stone filling...........................C. yds.	1880	30	564 00	....
Battered wall in cement.................do	65	4 75	308 75	....
Lining with Chip Stone, Gravel, etc......do	300	50	150 00	....
				6166 75
				$98518 65
WORK ON SUMMIT LEVEL.				
Summit cut between Nipissing and Trout Lakes.				
Excavation of Earth.................. C. yds.	483470	35	169214 50	....
do of Rock..........................do	355260	2 00	710520 00	....
				879734 50
Excavation of Rock in Trout Lake........do	175740	2 25	395415 00	....
do do Turtle do ....do	84840	2 25	190890 00	....
do do Turtle outlet.....do	321100	1 75	561925 00	....
do Earth in Turtle Outlet ....do	1456	25	364 00	....
Guard Lock between Nipissing and Trout Lakes.				1148594 00
Excavation of Rock....................C. yds.	33830	2 00	67660 00	....
Embankment.............................do	1960	30	588 00	....
				68248 00
Masonry in Lock Walls, face and coping . do	1665	16 50	27472 50	....
do do Backing. ....do	3004	7 75	23281 00	....
Concrete Masonry........................do	136	7 50	1020 00	....
Timber in foundations..............Linl. feet.	4040	17	686 80	....
Wrought Iron in foundations..............Lbs.	9000	15	1350 00	....
Cast Iron...............................do	8780	10	878 00	....
Mitre Sills, complete..........................	....	....	1250 00	....
Lock Gates, complete..........................	....	....	7855 00	....
				63793 30
				$2160369 80
WORK AT THE CHAUDIERE PORTAGE AND AT THE OUTLETS OF LAKE NIPISSING.				
Locks Nos. 58, 59 and 60.				
Excavation of Rock....................C. yds.	48550	2 25	110237 50	....
Embankment...........................do	41500	30	12450 00	....
				122687 50
Masonry in Lock Walls, face and coping .. do	5586	17 50	97755 00	....
do do Culverts........do	374	21 50	8041 00	....
do do Backing. ......do	12392	7 50	92670 00	....

I.—(*Continued.*)

ITEMS.	Quantities.	Prices.	Amount.	Total.
		$ cts.	$ cts.	$ cts.
Rubble Masonry in Cement ....C. yds.	173	6 00	1038 00	....
Concrete Masonry .... do	136	7 25	986 00	....
Timber in Foundations.... .. ..Linl. ft.	4556	17	774 52	....
Wrought Iron, in do .... Lbs.	10560	15	1584 00	....
Cast Iron .... do	14450	10	1445 00	....
Mitre Sills, complete..........................	....	....	1565 00	....
Lock Gates, complete	....	....	13000 00	....
Culvert Gates, complete..........................	....	....	1625 00	....
				220483 52
Dams.				
Excavation. ....Cubic yds.	400	1 00	400 00	....
Pine Timber.............. .... Linl. ft.	39600	15	5940 00	....
Plank, including Spike. ....F. B. M.	115800	20 00	2316 00	....
Wrought Iron..................... Lbs.	23100	10	2310 00	....
Stone Filling........... ....Cubic yds.	5140	1 25	6425 00	....
Battered Wall in Cement .... do	1568	4 75	7448 00	....
Lining with Chip Stone, Gravel, &c... do	1830	50	915 00	....
				25754 00
				$368925 02
WORK AT THE RAPIDE DU BUISSON.				
Lock No. 61.				
Excavation of Rock................Cubic yds.	10400	2 00	20800 00	....
Embankment..................... do	2700	25	675 00	....
				21475 00
Masonry in Lock Walls, face and coping... do	1995	16 00	31920 00	....
do do Culverts .... do	148	20 00	2960 00	....
do do Backing . ... do	4380	7 25	31755 00	....
Rubble Masonry in Cement...... .... do	96	5 75	552 00	....
Concrete Masonry.. .... do	70	7 00	490 00	....
Timber in Foundations................Linl. ft.	2020	17	343 40	....
Wroughtiron in do ....Lbs.	4500	15	675 00	....
Cast Iron .... do	5780	10	578 00	....
Mitre Sills complete	....	....	625 00	....
Lock Gates complete............................	....	....	5200 00	....
Culvert Gates complete......	....	....	650 00	....
				75748 40
Dam and Piers.				
Excavation.......... ....Cubic yds.	1130	1 00	1130 00	....
Pine Timber ....Linl. ft.	89410	15	13411 50	....
Plank, including Spike..................F.B.M	164400	20 00	3288 00	....
Wrought iron..........................Lbs.	32410	10	3241 00	....
Stone Filling ....Cubic yds.	13214	1 00	13214 00	....
Battered Walls in Cement........ .... do	76	4 60	349 60	....
Lining with Chip Stone, Gravel, etc.... do	1510	50	755 00	....
				35389 10
WORK AT RAPIDE DE PARISIEN.				$132612 50
Lock No. 62.				
Excavation of Rock...................C. yds.	8050	2 00	16100 00	....
Embankment......................... do	6700	30	2010 00	....
				18110 00

I—(*Continued.*)

ITEMS.	Quantities.	Prices.	Amount.	Total.
		$ cts.	$ cts.	$ cts.
Masonry in Lock Walls, face and coping Cubic yds.	1995	15 25	30423 75	....
do Culvert .... do	148	19 25	2849 00	....
do Backing .... do	4382	7 25	31769 50	....
Rubble Masonry in Cement .... do	177	5 75	1017 75	....
Concrete do .... do	70	6 80	476 00	....
Timber in Foundations .... Linl. ft.	2020	17	343 40	....
Wrought Iron in Foundations .... lbs.	4500	15	675 00	....
Cast Iron .... lbs.	5780	10	578 00	....
Mitre Sills complete	....	....	625 00	....
Lock Gates complete	....	....	5200 00	....
Culvert Gates complete	....	....	650 00	....
				74607 40
Dams and Piers.				
Excavation of Rock ....Cubic yds.	270	75	202 50	......
Pine Timber ....Linl. ft.	43040	15	6456 00	....
Plank, including Spike .................F.B.M.	95000	20 00	1900 00	....
Wrought Iron ....Lbs.	16160	10	1616 00	....
Stone Filling ....Cubic yds.	5990	65	3893 50	....
Battered Wall in Cement .... do	320	4 50	1440 00	....
Lining with Chip Stone, Gravel, etc.... do	267	50	133 50	....
				15641 50
				$108358 90
WORK AT LE GRAND RECOLLET AND PETIT RECOLLET.				
Lock No. 63.				
Excavation of Rock ....Cubic yds.	16950	2 00	33900 00	....
Embankment .... do	5000	25	1250 00	....
				35150 00
Masonry in Lock walls, face and coping do	2320	14 75	34220 00	....
do do Culverts .... do	148	18 75	2775 00	....
do do Backing .... do	5095	7 00	35655 00	....
Rubble Masonry in Cement .... do	950	5 60	5320 00	....
Concrete Masonry .... do	35	6 60	231 00	....
Timber in Foundations ....Linl. ft.	1010	17	171 70	....
Wrought Iron in Foundations ....lbs.	2250	15	337 50	....
Cast Iron in do .... do.	5780	10	578 00	....
Mitre Sills complete	....	....	625 00	....
Lock Gates complete	....	....	5650 00	....
Culvert Gates complete	....	....	650 00	....
Loose Stone Paved ....Cubic yds.	150	1 50	225 00	....
				86448 20
Dams and Piers.				
Excavation of Rock ....Cubic yds.	60	1 50	90 00	....
Pine Timber ....Linl. ft.	47650	15	7147 50	....
Plank including Spike ....F.B M.	84200	20 00	1684 00	....
Wrought Iron ....Lbs.	13630	10	1363 00	....
Stone Filling ....Cubic yds.	5815	40	2326 00	....
Battered Wall in Cement .... do	18	4 25	70 50	....
Lining with Chip Stone, Gravel, etc... do	240	50	120 00	....
				12807 00
Coffer Dam to be removed.				
Pine Timber .... Linl. ft.	6540	20	1308 00	....
Stone Filling ....Cubic yds.	800	60	480 00	....
Lining with earth, etc. .... do	260	60	156 00	....
				1944 00
				$136349 20

I.—(*Continued.*)

ITEMS.	Quantities.	Price.	Amount.	Total.
WORKS AT LES PETITES DALLES, AND OTHER OUTLETS.				
Lock No. 64.		$ cts.	$ cts.	$ cts.
Excavation of Rock .... Cubic yds.	19240	2 00	38480 00	....
Embankment .... do	3000	25	750 00	....
				39230 00
Masonry, Lock walls, face and coping .. do	2268	14 00	31752 00	....
do do culverts .... do	148	18 00	2664 00	....
do do Backing .... do	5331	7 00	37317 00	....
Rubble Masonry in cement .... do	147	5 50	808 50	....
Concrete Masonry .... do	70	6 50	455 00	....
Timber in foundations .... Linl. ft.	2020	17	343 40	....
Wrought iron in do .... lbs.	4500	15	675 00	....
Cast iron in do .... lbs.	5780	10	578 00	....
Mitre Sills complete	....	....	625 00	....
Lock gates complete	....	....	5800 00	....
Culvert gates complete	....	....	650 00	....
				81667 90
Dams and Piers.				
Excavation .... Cubic yds.	100	1 25	125 00	
Pine Timber .... Linl. ft.	29300	15	4395 00	....
Plank including Spike .... F.B.M.	73300	20 00	1466 00	....
Wrought iron .... lbs.	11300	10	1130 00	....
Stone filling .... Cubic yds.	2110	60	1266 00	....
Battered walls in cement .... do	780	4 25	3315 00	....
Lining with Chip Stone, Gravel, etc.... do	540	50	270 00	....
				11967 00
Coffer Dam to be removed.				
Pine Timber .... Linl. ft.	20910	20	4182 00	....
Stone filling .... Cubic yds.	2620	1 00	2320 00	....
Lining with Chip Stone, Gravel, etc.... do	1260	40	504 00	....
				7006 00
				$139870 90

J.

Chats Canal Old Line.

ITEMS.	Quantities.	Prices.	Amount.	Total.
Locks Nos. 1, 2, 3, 4, 5 *and Guard Lock.*		$ cts.	$ cts.	$ cts.
Excavation of Earth .... Cubic yds.	93700	25	23425 00	....
do Gneiss Rock .... do	321270	2 50	803175 00	....
do Limestone Rock .... do	155420	1 50	233130 00	....
Embankment .... do	36810	30	11043 00	....
				1070773 00
Masonry in Lock Walls, face and coping do	10444	12 00	125328 00	....
do do Culverts ...... do	748	16 00	11968 00	....
do do Backing ...... do	24077	6 50	156500 50	....
Rubble Masonry in Cement .... do	690	4 50	3105 00	....
Concrete Masonry .... do	1200	6 00	7200 00	....
Timber in foundations .... Linl. ft.	24459	16	3913 44	....
Wrought Iron in foundations .... Lbs.	16915	15	2537 25	....
Cast Iron .... do	29220	10	2922 00	....
Plank in foundations .... F. B. M.	57300	20 00	1146 00	....
Mitre Sills, complete	....	....	3125 00	....
Lock Gates, complete	....	....	25435 00	....
Culvert Gates, complete	....	....	3250 00	....
				346430 19
Dam and Cribs, Hudson's Point.				
Pine Timber .... Linl. ft.	92300	15	13845 00	....
Plank including spike .... F. B. M.	191500	20 00	3830 00	....
Wrought Iron .... lbs.	28750	10	2875 00	....
Stone filling .... Cubic yds.	14201	80	11360 80	....
Battered Wall in Cement .... do	1515	4 00	6060 00	....
Slope or pavement Wall .... do	3796	1 50	5694 00	....
Lining with Chip Stone, Gravel, &c. .. do	600	40	240 00	....
				43904 80
Coffer dam to be removed.				
Pine Timber	11880	26	2376 00	....
Stone Filling	1389	1 20	1666 80	....
Lining with earth, etc.	576	50	288 00	....
				4330 80
				$1465438 79

January 2nd, 1860. (Signed,) THOS. C. CLARKE,
Engineer Ottawa Survey.

McLeod Stewart, Esq.,

Montreal Ottawa & Georgian Bay Canal Co., Ottawa, Canada.

DEAR SIR:—

I have the honor to submit the following Report, bringing down to the present date the matters treated upon in my Report of 1860.

Great changes have taken place since that Report demonstrated the feasibility of improving the Ottawa and French Rivers into one of the greatest channels of commerce. What was then only a scientific discussion has now become a matter of great importance to two nations.

Including together the present exports from the basin of the Great Lakes, both in the United States and Canada, there is enough traffic in sight to warrant a large expenditure in opening a new route, if the conditions are such that the cost of transportation between the Lakes and the Ocean can be diminished. Canada alone does not at present furnish enough traffic The Ottawa route must be treated as an international one.

Two remarkable changes have taken place during the last ten years, which have each resulted in greatly lessening the cost of water transportation; one, upon the Lakes and the other between the North Atlantic ports of the United States.

The construction of the locks at the outlet of Lake Superior has devoloped a traffic vast in size, and differing from all others in the world, in that it enables vessels to get full cargoes in both directions during the whole season of open navigation.

The U. S. lake ports will all be deepened to 20 feet very soon. Steamers now carry cargoes of 6,000 tons of grain and iron ore eastward to South Chicago, Cleveland and Buffalo, and take back cargoes of coal to upper Lake ports. It is a well-known axiom that the larger the vessel the cheaper it can handle freight. These 6,000 ton steamers have carried grain from Chicago to Buffalo for 1$\frac{36}{100}$ cts. per bushel, which is less than one half of one mill per ton-mile. Hence there has arisen a popular demand for ship canals of 20 or even 25 feet deep, from the Lakes to the Ocean. Even if such canals were built and could be used free of tolls, no such economy of transpoitation by large steamers could take place as in the open lakes.

The rate of speed of thirteen miles an hour would be reduced to five, as in the Suez Canal. Canal traffic would not give full cargoes in both directions, and more detention in port would be necessary than at Cleveland or Duluth where whole cargoes of 6,000 tons of coal or ore have been handled by machinery in less than one day. The large steamer is a very expensive machine, and if she were not able to make as many trips per season as she now does, much of her economy would be lost.

It does not now seem possible, except at a prohibitory cost, to deepen the Ottawa navigation to 20 feet, and fortunately it is not necessary.

The second change, which has resulted in lessening the cost of transportation between Atlantic ports, suggests the true method of improving the Ottawa.

Some ten years since all coal was carried between the shipping ports of Philadelphia and New York to other Atlantic ports, chiefly of New England, in single collier steamers, at a cost of $1.50 to $1.75 per ton.

Now it is carried in tows of three or four large barges drawing from 16 to 18 feet of water, towed by a single powerful tug boat, This tug does not wait in port for coal to be loaded or unloaded. but each tug has many barges, and she picks up her tow of full or empty barges without detention, as a locomotive does cars. In this way many trips are made per season. The distance between Philadelphia and Boston and return is about 800 miles, and coal is now carried for an average of 75 cents per ton, which is nine-tenths of a mill per ton-mile.

This economy of transportation has increased the coal traffic to some twenty-five million of tons annually, which is as great as the tonnage annually passing through the Detroit River. The use of these tows of barges is fast increasing upon the Upper Lakes.

All these facts have been clearly set forth by Maj. T. W. Symons, U. S. Engineer Corps, in his admirable and exhaustive report to the U. S. Congress in 1897. He shows that if the Erie Canal were deepened to 11 feet and grain were carried in tows of barges of 1500 tons capacity, it could be carried from Chicago to New York, including reason-able transhipment charges at Buffalo from large steamers into canal boats, for less than steamers of 20 feet draft conld carry it through the Erie Canal if that could possibly be deepened to over 20 feet, and steamers run continuously from Chicago to New York. In both cases tolls are not taken into account.

The estimated cost of the 11 ft. canal is 50 million dollars and of the 20 ft. 200 millions.

The great value of the Ottawa navigation is thls: Out of 975 miles between Chicago and Montreal 591 miles is an inland or perfectly protected navigation, leaving but 384 miles of open lake. In open lake a speed of 4½ miies an hour can be made by tows of barges. In the protected portion an average speed of ten miles an hour can be made. The cost of insurance by this route would be much less than by any other.

By the Welland and St. Lawrence route, there are 991 miles of open lake navigation, and but 267 of inland or protected navigation, The depth of the Welland and St. Lawrence canals would limit the draft of barges to 13½ ft. which is too shallow for navigation in lakes such as Erie, subject to sudden violent storms. The rates of insurance would be greater, and a longer time required, owing to greater length, and slower movement through the unprotected parts, would more than make up for the 22 days of longer open navigation by the Welland route.

I recommend that the scale of the Ottawa navigation be fixed as follows:—Locks 300 ft. long x 45 ft. wide x 14 ft. deep, capable of passing steel barges 280 ft. long, 42ft. beam and carrying 3,100 tons net on 13½ ft. draft of water.

The excavated channels should be fifteen feet deep and have five times the area of the vessel, with sufficient room for two vessels to pass each other, which would give a width of 160 ft. on the bottom and 170 ft. at low water level.

The cost of carrying grain from one of the Lake ports, say Chicago, to Montreal by the Ottawa route would be as follows:—

CAPACITY.

A tow would consist of three steel barges, each 280 x 42 x 20 feet, moulded depth, carrying, on 13½ feet draft, 3,100 net tons. These would be towed by a powerful tug steamer capable of towing the barges at the rate of four and one-half miles per hour in open lake, and ten miles per hour through the sheltered lakes and rivers of the Ottawa navigation. The tug steamer would be capable of carrying a cargo of 1,200 tons, making a total capacity of 10,500 tons.

TIME.

Open Lake—		
Chicago to a point near the mouth of St. Mary's River—380 miles at 4½ miles per hour		72.2 hours.
Inland Lakes and Rivers—		
St. Mary's River to French River, 160 miles		
Ottawa navigation	401 "	
	561 " at 10	56.1 hours.
Canals	29.3 miles at 2.9	10. hours.
Lockages 1½ minutes per foot		
for each vessel	$\frac{1\frac{1}{2} \times 4 = 6 \times 682 \text{ ft.}}{60 \text{ min.}}$	68.2 hours.
	Total	206.5 hours.

206.5 x 2 = 413 hours.
In port 91 hours.

504 hours, or 21 days round trip.

The open season of navigation on this route, is limited by the closing of Lake Nipissing and gives an open season of 213 days, or *ten* round trips.

COST.

1 tug........................	$125,000	
4 barges (1 extra) at $75,000....	300,000	
	$425,000 interest and depreciation at 5 per cent.............	$21,250
Insurance on hulls, 2 per cent		8,500
" on cargo		
Going East 10 x 10,500.........	105,000 Tons.	
" West ⅓................	35,000 "	
	140,000 Tons at $20. $2,800,000 at 25c. per 100.............	7,000
Expenses of tug—full subsistence, wages and small repairs, $100 per day for 213 days.................		21.300
4 barges at $7.50 per day—30 x 213..............................		6,390
Profits 10 per cent............		6,440
		$70,880

which divided by 140,000 Tons gives as the cost about 50c. per ton, or 1½ cts. per bushel.

It is absolutely essential to the success of this project that there should be ample elevator facilities at the port of Montreal, so that ocean steamers should suffers no detention. With such an elevator of the capacity of one million bushels as lately has been built by the Great Northern Railway at Buffalo,the whole cost of elevating and storage should uot exceed three quarters of a cent, making the total cost per bushel two and one quarter cents, which is far below the cost by any existing route, or than can be obtained on the Welland and St. Lawrence route when the canals are completed.

This extremely low cost is based on the assumption of full cargoes going East, and one third full going West. The larger the amount of business done, the more nearly will this be realised, and the financial success of the scheme would be enhanced, if the Ottawa navigation could be extended upon the same scale, through Lake Champlain to New York, the feasibility of which the U. S. Deep Water Ways Commission are now, it is believed, investigating. By this route the distance from Chicago to New-York, would be about 1353 miles, of which 380 miles would be open lakes, 847 miles inland navigation, and 126 miles of canals.

By similar calculations to those above given, eight trips could be made in an open season of 235 days, and the cost would be 2 cts. per bushel, to which should be added the present elevator and other charges at the port of N. Y , which are very high, amounting to 1½ cts. per bushel, or a total of 3½ cents per bushel. Maj. Symons estimates that when the Erie canal is deepened to nine feet and the locks lenghtened, wheat can be carried from Chicago to N. Y., for 3.67 cts., to which add N. Y., terminal charge, 1.50 cts., a total of 5.17 cts ; showing the superiority of the Ottawa route.

The cost of interest, maintenance and repairs, lock tending, electric lighting, etc., on the Ottawa route, would be borne by moderate tolls, and leases of water power, described hereafter.

As compared with the estimated cost of the Ottawa navigation in 1860, there will be an increase of quantities and a diminution of cost in item prices.

The increase of the size of the locks from 250 x 45 x 12 to 300 x 45 x 14, will increase quantities. Also the enlargement of the prism of the excavated canal from 146 x 13 to 160 x 15, will increase quantities.

The locks at Grenville and Carillon, will have to be enlarged, The Lachine locks will also have to be lengthened unless it is decided not to use the present crowded Lachine Canal, and improve one of the branches of the Ottawa north of the Island of Montreal.

Another increase of cost is due to the fact that Lake Nipissing cannot now be raised by damming its outlets, as was proposed in 1860.

The country around the summit lakes is now well settled and has many cultivated farms, The town of North Bay, which would have to be moved back to prevent overflow, as some 2500 inhabitants. Thirty miles of the Canadian Pacific Railway would have to be moved or raised.

The level of Lake Nipissing must still be maintained from French River to the Mattawan, 57 miles. This means lowering the level of Trout and Turtle Lakes to coincide with that of Nipissing, which can be done. This is the only way in which sufficient water for lockages can be obtained. The total lockage will be reduced from 715 to 682 feet.

The amount of excavation will be increased, but it is believed that the extra cost of this will not exceed what would have to be paid for damages if Lake Nipissing were raised.

The plan of 1860, which raised existing levels by dams on the French and Matawan Rivers and on the Ottawa as far east as Chats Lake, can still be followed, as the shores are steep and rocky, and but little land will be overflowed There are a few places where sites of locks and dams may have to be changed, but not at an increased cost.

In 1860 the whole Upper Ottawa was a wilderness. All materials and supplies above Deep River must then have been transported partly by teams and partly in batteaux towed by horses, or poled by men. Now, the Canadian Pacific Railway can deliver materials, supplies and men all along the route, and at far less cost.

Several locks of low lift can now be concentrated into one, as in accordance with the best modern practice. This will reduce cost.

I am in favour of locating locks so that a duplicate lock can be built hereafter alongside of the one first to be built.

I now advise constructing the locks of concrete (made from the stone near by) and Portland cement. The lock walls can be protected by waling pieces of steel and oak, thus saving much costly cut stone masonry.

The most important item of economy comes from the fact that the cost of the rock excavation, which is the largest item of cost, can be greatly reduced by the improvements which have been made during the past few years in the use of power drills, high explosives, and better kinds of machinery for handling materials.

The air compressors and other machinery can in many cases be driven by electric power derived from the river. The latest price paid for rock excavation on the Chicago Drainage Canal was 59c. per cubic yard, while the average price estimated for the Ottawa improvements in 1860 was generally from $1.50 to $2.00 per yard.

I am not now prepared to revise the figures of cost made in 1860, as this cannot be done without further examinations and surveys, which will take several months to properly carry out.

There are several very important economies in construction that can now be made available, which could not in 1860.

It is proper to point out that the most important change in the situation since 1860 has come from the development of electrical transmission of power. The dams which were designed by me in 1860 were then, and are now, absolutely necessary to give sufficient depth for navigation. These dams will also be the means of developing and controlling water power for electric appliances.

I can state unreservedly that I know of no other place in any manufacturing country, Niagara Falls not excepted, where there is such an amout of water power as this scheme can make available, both for manufacturing purposes and possibly for moving vessels rapidly through the locks.

It is proposed to construct 20 dams on the Ottawa with an average of 20 feet fall each. The low water discharge of the Ottawa never falls below 1,500,000 cubic feet per minute, of which one third should be allowed to run over the crests of the dams to prevent decay, leaving 1,000,000 cubic feet per minute to run through flumes and do effective work. By the usual formula

Dams cu. ft. per min. fall.

$$\frac{20 \times 1{,}000{,}000 \times 62\tfrac{1}{2} \text{ lbs.} \times 20}{44{,}000.}$$ we have 566,360 horse power.

Adding that available on the Mattawan and French Rivers there will probably be, at minimum, not less than 700,000 horse power.

The *average* discharge of the weirs would give not less than *four* times this amount.

All this can be made available, by the comparatively small expenditure necessary for flumes and the foundations of penstocks and turbines. The cost of the installation of electric plant would vary greatly with the situation.

All of which is respectfully submitted by

(Sgd.) THOMAS C. CLARKE,

Consulting Engineer Montreal,
Ottawa & Georgian Bay Navigation.
Member Institution of Civil Engineers,
and of the American Society of
Civil Engineers.

New York, Feb. 16, 1898.