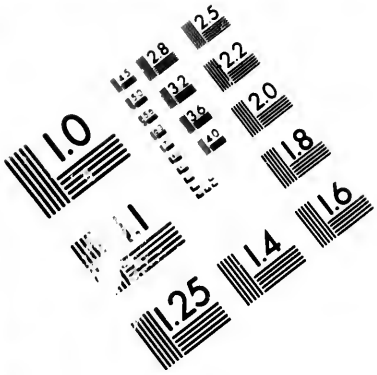

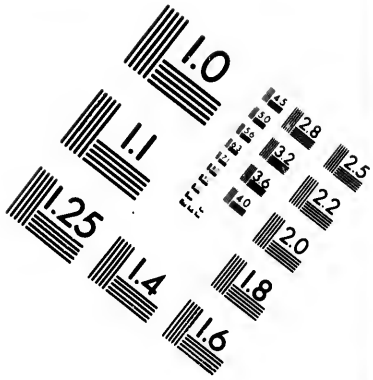

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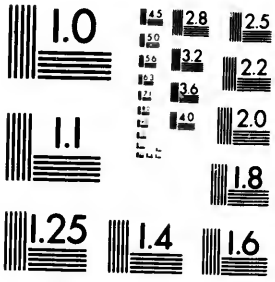

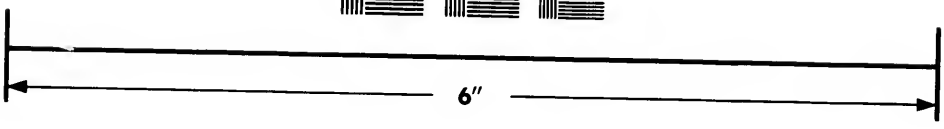

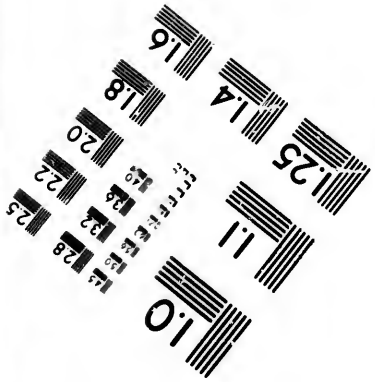

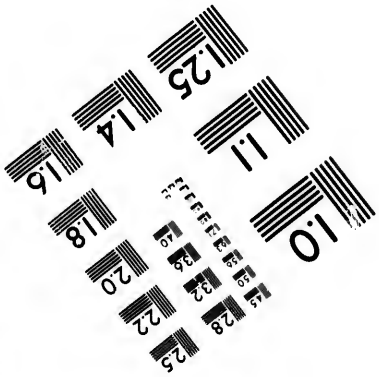

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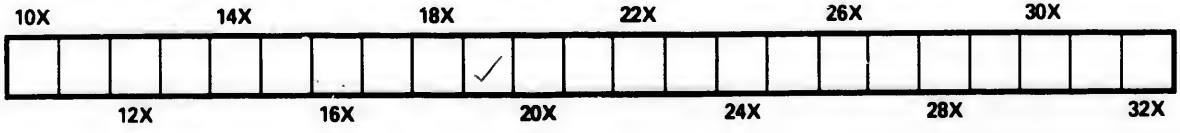

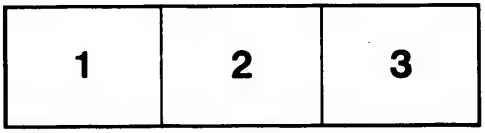

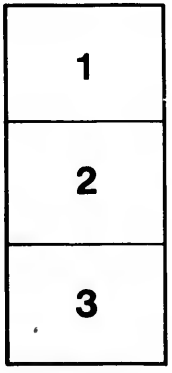

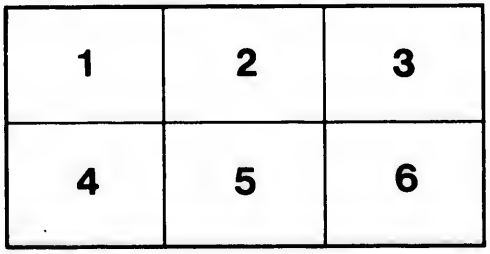

REPORT

ON

The Montreal, Ottawa and Georgian Bay Canal,

BY

MARCUS SMITH, M. INST. C.E.

OCTOBER 1st, 1895.

"The Ottawa Ship Canal and the Pacific Railway must be constructed, and no voice would be raised against the great national work, which would open the Western States and Colonies to the Seaboard."

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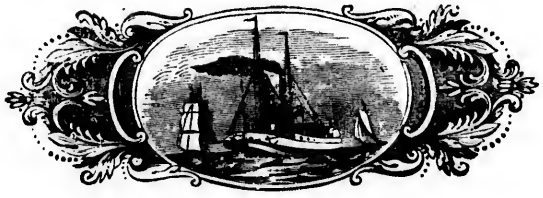

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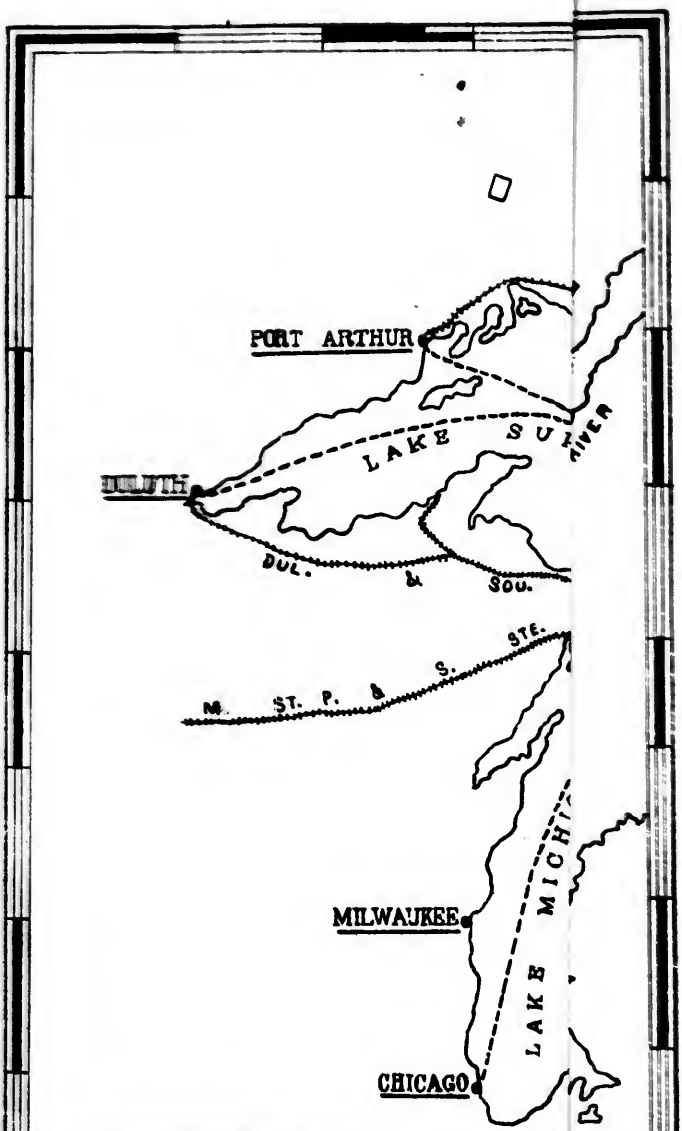


DISTANCES — CHICAGO TO NEW YO

	Lake and River	Canal	To
(1) via Ottawa Route	1228	120	IC
(2) " Erie Canal	1065	350	N
(3) " St Lawrence	1441	169	

The Montreal, Ottawa and Georgian Bay Canal and River Navigation.

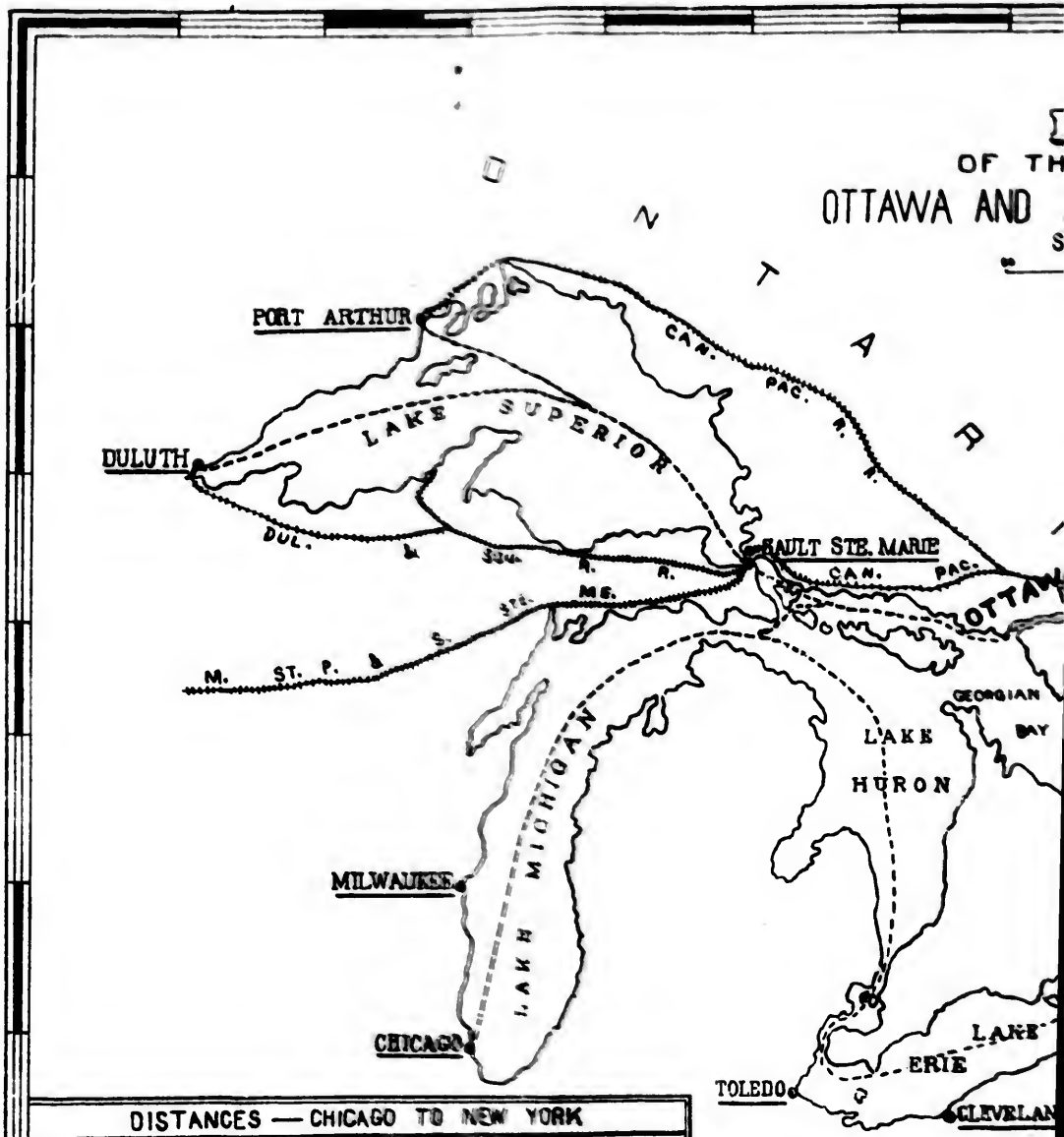
I have carefully examined the scheme for forming a line of river and canal navigation for steamboats of 1,000 tons burden, limited to a draft of ten or eleven feet ; from Montreal by the Ottawa, Matawan and French Rivers, to Georgian Bay, Lake Huron.

The subject is of great interest to the whole Dominion and of paramount importance, not only to the district traversed by the route, but more especially to the great domain extending westward to the Rocky Mountains ; for the route will be much shorter than the present line by the St. Lawrence and Welland Canals, or by any other practicable route of navigation for transporting the products of the mines and forests of the lake regions and the vast agricultural lands of the North-west Provinces and Territories, as well as those of the adjacent United States, to the head of ocean navigation at Montreal.

The line could be extended to New York by the construction of what has been called the Caughnawaga Canal, from Lake St. Louis, at the mouth of the Ottawa River, to St. John, or other convenient point on the Richelieu, Lake Champlain and Hudson River line of navigation; the improvement of which would doubtless be readily undertaken by American merchants and capitalists.

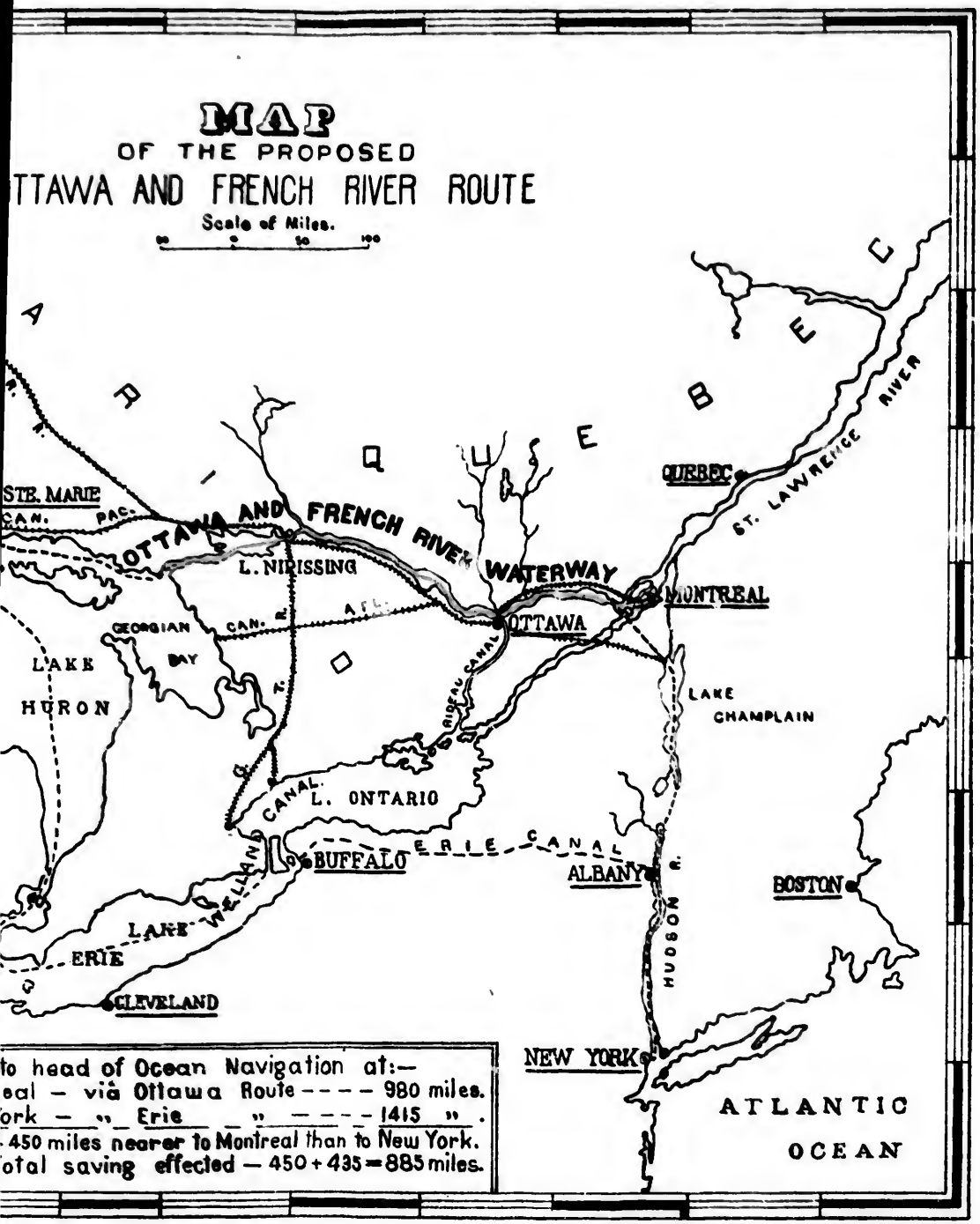
The advantages of this route attracted the attention of the Canadian Government at an early period in the history of canal navigation on this continent.

In July, 1856, Mr. Walter Shanly, the well-known Civil Engineer, was engaged by the Commissioners of Public Works to make a survey of the route. He made a personal examination of the route from the Georgian Bay to the City of Ottawa by canoe. The surveys were commenced in August and continued through the winter, with an energetic staff of assistants. Some of the most difficult portions of the work were



DISTANCES — CHICAGO TO NEW YORK			
	Lake and River	Canal	Total Miles
(1) via Ottawa Route	1228	120	1348
(2) „ Erie Canal	1065	350	1415
(3) „ St Lawrence	1441	163	1604

Chicago to head of Ocean
(1) Montreal — via Ottaw
(2) New York — „ Erie
Liverpool — 450 miles nearer t
Total saving effe


MAP
OF THE PROPOSED
TTAWA AND FRENCH RIVER ROUTE
Scale of Miles.
50
100
A
R
Q
U
E
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C
STE. MARIE
CAN.
PAC.
OTTAWA AND FRENCH RIVER WATERWAY
L. NIPISSING
GEORGIAN
BAY
CAN.
LAKE
HURON
OTTAWA
RIDEAU CANAL
QUEBEC
ST. LAWRENCE RIVER
MONTREAL
LAKE
CHAMPLAIN
L. ONTARIO
WELLAND CANAL
BUFFALO
ERIE CANAL
ALBANY
BOSTON
HUDSON R.
LAKE
ERIE
CLEVELAND
NEW YORK
ATLANTIC
OCEAN
to head of Ocean Navigation at:—
eal — via Ottawa Route - - - - 980 miles.
ork — " Erie " - - - - 1415 " .
450 miles nearer to Montreal than to New York.
otal saving effected — 450 + 435 = 885 miles.

completed in a most thorough manner ; when in the following May the surveys on that division between the confluence of the Ottawa and Matawan Rivers and the Georgian Bay was suspended by official instructions, they had reached Lake Nipissing. They were continued on the Ottawa River till near the end of January, 1858, when by Order-in-Council all further operations were discontinued for the present, and Mr. Shanly made his report dated 22nd March, 1858.

On the 16th November of the same year Mr. Thomas C. Clarke, C. E., was engaged to continue the surveys, which he completed at the close of 1859, and he made his report dated 2nd January, 1860 ; in which he gives quantities of the several classes of works and rates for executing the same, from which an approximate estimate of the total cost is made.

In my explorations of the country for the Canadian Pacific Railway I made a close examination of a harbour in the Georgian Bay, at the mouth of French River, and,in a canoe,examined the main channels of French River up to the Falls, where it issues out of Lake Nipissing, also all around the shores of that lake and eastward up to the waters of the Matawan River at Trout Lake, on the summit of the dividing ridge between the tributaries of the Ottawa and those of French River

With the information obtained from these and other sources I shall endeavor to give a fair presentation of the prominent features of the route, an approximate estimate of the cost of constructing the works, and its capacity for safe and rapid transportation of freight at a minimum cost as compared with other routes.

The general course from the mouth of French River to Montreal, considering the great length of 430 miles, varies but little from a direct line, a little south of east, and about half the length of the route is on the north side, the other on the south side, of the 46th parallel of latitude.

It follows a depression that may once have been the main channel, certainly a most important channel for the outlet of the surplus waters of the great lakes—Superior, Michigan and Huron. That there has been an upheaval of the country nowf orming the barrier between the Georgian Bay and the Ottawa River is clearly apparent from the surveys.

Mr. Shanly gives the altitude of the Georgian Bay, at the mouth of French River, 572 feet above sea level, and Lake Nipissing, out of

which that river issues, 632 feet. Trout Lake, on the summit of the dividing ridge between Lake Nipissing and Ottawa waters, is 655 feet above sea level. In this lake he made soundings of sixty, one hundred and two hundred feet, thus reaching more than one hundred feet below the surface level of the Georgian Bay. At the confluence of the Mata-wan and Ottawa River the altitude is nearly one hundred feet below the level of the Georgian Bay. All the rocks in the vicinity of these lakes are of granite or kindred crystalline rocks, such as syenite, gneiss, etc.

The harbour on the Georgian Bay, at the mouth of French River, is capacious, of ample depth and well protected. There are some rocks at the entrance which may have to be removed, which can be done at moderate cost.

There is also a good harbour at Cantin's Bay, about 25 miles up the French River. It is about five miles long and a quarter of a mile wide; it was selected for the terminus of the Georgian Bay branch of the Canadian Pacific Railway, to be operated in connection with the navi-gation of the lakes; there would be one lock between it and Georgian Bay.

French River enters the Georgian Bay by several arms, but as we ascend it consists mainly of two very irregular channels, with many small bays or spurs. It is a series of still water stretches or narrow and deep lakes, separated by short rapids or falls; the first of these is about a mile from the mouth of the river called the Petites Dalles; about 16 miles further up is Le Grand Recollect, a rise of about 7 feet; then a stretch of 18 miles more of deep water, interrupted by one short rapid; the foot of the "Rapids de Parisien" is reached, the first of a series of four falls, extending about as many miles. The last is the "Chaudière Falls," one of the outlets of Lake Nipissing, in which the ascent to the level of that lake is nearly twenty-six feet; the distance from the Georgian Bay nearly fifty miles; total ascent about 60 feet, making the level of Lake Nipissing above the sea 632 feet.

Lake Nipissing is a very irregular sheet of water, about forty miles in length and twelve to eighteen extreme breadth; its principal feeders are the Sturgeon and Nawwanitigone Rivers, both of considerable volume, and the depth of the lake is great.

The south and west shores are bold, but the north and east are low and flat. There are several islands in the lake.

From the east end of Lake Nipissing by the small stream called La Vase, and a short portage the distance to Trout Lake is about five miles; but by another stream further north the distance is only about four miles or a little over, and the ground lower, being at the summit very little above the level of Trout Lake. This lake is on the summit level, being part of the Matawan River which flows eastward into the Ottawa, its altitude is 655 feet above sea level and 23 feet higher than Lake Nipissing.

The table below will show at a glance the character of the navigation from the Georgian Bay up to this point.

	Natural Navigation.	Canal Navigation.	Total Distance.	Height to be Overcome	No. of Locks.	No. of Dams.
	Miles.	Miles.	Miles.	Feet.		
French River	49	1	50	67	8	8
Lake Nipissing	30	..	30	..	..	3
Summit Barrier	..	5	5	16	2	..
	79	6	85	83	10	11

This table is made out to raise Lake Nipissing seven feet by dams at its outlet; further on he proposes to raise it to the level of Trout Lake twenty-three feet—which is now impracticable as it would submerge many miles of the Canadian Pacific Railway and the town of North Bay.

This is the greatest difficulty encountered, for, as Mr. Shanly states, the supply of water to Trout Lake is not sufficient to meet the demands of even a far inferior scale of navigation to that which the general character of the route will warrant.

Mr. Clarke proposed to raise Lake Nipissing sixteen feet and lower Trout and Turtle Lakes to that level; this is also now impracticable.

I think it may be safely assumed that Lake Nipissing may be raised five feet without doing any damage to adjoining property that cannot be compensated at moderate cost. Then the rise to Trout Lake would be eighteen feet. This lift could be effected by hydraulic

methods with a much less quantity of water than is required for ordinary locks; but, if practicable without excessive cost, the better method would be to lower the lakes. This can be discussed more clearly with the aid of the tabulated section of the Matawan River from Mr. Shanly's Report.

Table of the Matawan Rapids.

Section of River.	Natural Navigation.	Canal Navigation.	Total Distance.	Falls to be Locked.	No. of Locks.	No. of Dams.
	Miles.	Miles.	Miles.	Feet.		
Trout and Turtle Lakes.....	12·70	0·05	12 75	.....	.....	.....
Turtle Rapids	.....	4 20	4·20	32·75	3	3
Lac Talon.....	7·00	.....	7·00	.....	.....	.....
Talon Chute.....	.....	0·22	0·22	42·75	4	1
Eel Lake	1·20	.....	1·20	.....	.....	.....
Series of rapids and ponds	.....	1·48	1·48	21·15	2	2
Chutes des Paresseux	.....	0·23	0·23	34 12	3	1
Lac des Aiguilles	3 15	.....	3·15	.....	.....	.....
Rapids des Aiguilles, La Rose, les Epines.....	.....	2 14	2·14	18·54	3	3
Lac Plein Chant.	5·40	.....	5 40	.....	.....	.....
Plein Chant and other rapids to mouth	1.21	1·44	2·65	20·69	3	3
	30·66	9·76	40·42	170·00	18	13

The end of the Plein Chant is within two and a-half miles of the confluence of the Matawan and Ottawa Rivers.

The distance from Lake Nipissing to Trout Lake by the little River Ojibwaysippi is a little over four miles, of which for over three miles, the land is little, if any, higher than near the shore of Lake Nipissing; then for continuing the canal on the same level as Lake Nipissing when raised five feet, and for giving a clear depth of water of at least ten feet as proposed by Mr. Shanly, the depth of cutting for probably three and a half miles in length would average twelve feet. On the next half or three-quarters of a mile to Trout Lake the land rises to very little above the level of that lake, and is marshy, the maximum depth of cutting

would be about thirty feet, the major part of which would most probably be in crystalline rock.

Trout Lake is eight and a half miles long, and a short distance from the shore the water is of great depth, so that lowering it eighteen feet will not affect its navigation.

Immediately below, and separated from it by a rocky bar of four hundred feet in length, is Turtle Lake--only one foot lower than Trout Lake—it is four and a quarter miles in length, and in it there are some detached shoals extending in all over a length of about fifteen hundred feet, and chiefly composed of needle rocks having seldom less than eight feet of water over them. With these exceptions the depth throughout is rarely less than eighteen feet, and generally over thirty feet. The average width of these lakes is about one mile.

The outlet from Turtle Lake is through a rocky river generally shallow and rapid with occasional ponds of deep and level water. The length of this neck is a little over four miles, when it falls into another basin, Lake Talon; the fall from Turtle Lake being about thirty-two feet.

Lake Talon is seven miles long and thirty-three feet lower than Turtle Lake, and as the latter is to be lowered seventeen feet, if Lake Talon were raised sixteen feet it would bring all these lakes to the same level as Lake Nipissing—when it is raised five feet. Thus giving a continuous summit level for a length of fully fifty-five miles with an inexhaustible supply of water from Lake Nipissing.

In addition to the excavations between Lakes Nipissing and Trout there would be the following approximate depths of cuttings.

1. The rocky bar between Trout and Turtle Lakes, 400 feet long, 28 feet deep.

2. The upper part of Turtle Lake needle rocks scattered over a length of 1,500 feet, tops about eight feet below the present level of the lake, cuttings 20 feet deep.

3. About one-third of the length of Turtle Lake would, by the raising of Lake Talon, be flooded to a sufficient depth, the excavation in the balance (two-thirds of the whole length) would be from nothing to twenty-seven feet—average fourteen feet.

The cost of these excavations cannot be closely estimated without

further surveys, much of it being under water, but if the excavations are to be made the full width of one hundred feet at the bottom, a roughly approximate estimate may be made for comparing the cost with that of raising Lake Nipissing twenty-three feet by dams, to the present level of Trout Lake, requiring two locks of eighteen feet lift, not needed by the new method of lowering the summit lakes.

The difference would probably be not less than a million dollars, but as a set-off there is the saving of a very large tract of land, and the absolute certainty of a plentiful supply of water for all time to come.

It is probable that the small stream feeding Trout Lake may fail altogether to supply the waste by evaporation, as it is well known that the rivers are constantly shrinking as the forests are being cleared.

Trout Lake may be supplied by a small canal (or wide trench) to divert part of Sturgeon River to it, the distance may be about thirty miles. This could be done at probably one-fifth the cost of lowering Trout and Turtle Lakes, but the latter is by far the best scheme.

The Ottawa River Section.

From its confluence with the Matawan down to the City of Ottawa, about one hundred and ninety miles, the Ottawa is a broad and deep river with a gentle current, broken at intervals by rapids or falls, and expanding into broad, still water stretches and lakes.

Quoting from Mr. Shanly's report, he states that that portion of the river from the Matawan down to the foot of Deep River was not submitted to actual survey ; that for the fall of the river at the various rapids above Les Deux Joachims he was partly indebted to the maps of the geological survey by Sir William Logan ; that he made a careful examination of the river throughout, and he estimated the distance between the rapids by the time occupied in the canoe journey. This is a method frequently adopted to save time, it does not affect the works, if any error in distance is made it is in that of natural navigation.

"The altitude at the confluence of the Matawan and Ottawa Rivers is estimated 485 feet above sea level.

Immediately below this there is a rapid of about five feet fall and would require a lock and side cut about a mile in length.

For seventeen miles below these the Ottawa continues very direct and deep with a decided current, the banks for the most part are bold, precipitous and rocky ; the scenery very grand.

"At nineteen miles is the head of a series of three great rapids occupying a length of three miles, 'La Veille, Le Trou and Les Deux Rivières.' The pitch is 32 feet, the facilities for locking and canalling highly favorable.

From the foot of these are ten miles of broad and deep water, to the head of the "Rocher-Capitaine," the most magnificent of the rapids of the Ottawa. The fall is forty-five feet. On the north side of the river is a flat table land but little elevated above the water at the head of the rapid.

From these there is sixteen miles of open navigation uninterrupted save by some strong currents to "Les Rapides, Des Deux Joachims," where in two miles there is a fall of twenty-eight feet.

The descent at "Les Deux Joachims" brings us into "Deep River," a stretch of twenty eight miles of apparently motionless water, very wide and deep.

On the south side of this superb piece of water the general conformation of the country is that of an elevated and comparatively level plateau, the prevailing character of the soil being dry and sandy ; the forest nearly all of red and white pine. On the north side very bold mountainous scenery prevails.

The Deep River may be said to terminate a little below the Hudson Bay Company's post, Fort William, where a group of islands multiply the channels, and for less than a quarter of a mile renders the navigation intricate.

The altitude of Deep River is estimated 351 feet above sea level.

This is estimated about eighty miles from the confluence with the Matawan, below which to the City of Ottawa the surveys were completed.

The most striking feature of this part of the Ottawa is its severance, as it were, into two distinct rivers. The "Allumettes" Island, com-

mencing six miles below Fort William, has a length of six miles, with an average width of four miles. To the south of this the main river passes by the Pembroke channel and the Allumettes Lake, presenting long stretches of rapids and much shallow water; the fall of the river in this length being about nineteen feet.

The northerly channel, about one-fifth of a mile in breadth, concentrates nearly the whole fall into two cascades at the head of the island—the "Culbute" and "L'Islet" rapids.

At the foot of the Allumette Island the two arms of the river come together, forming "Lac Coulonge," across which we have eleven miles of wide water. The section of this part of the river is more clearly shown in tabulated form:

	Fall.	Distance.
	Feet.	Miles.
Culbute and L'Islet, six miles below Fort William.....	18	
Length to be canalled at these rapids.....	.....	2
Fall of river, foot of L'Islet to Grand Calumet Falls....	7	42
Grand Calumet Fall.....	56	.....
Dargis, Mountain, Sable and other rapids.....	37	.....
Grand Calumet to Portage du Fort, smooth water.....	.....	5
" " rapid water.....	.....	5
Total fall and distance.....	118	54

"The rapids below the main chute at the Calumet, five in number, are situated at average distances of more than a mile apart. In the reaches between them where not of sufficient depth for navigation, this can be obtained by throwing dams across above the locks.

The last of the above series of rapids is at the village of Portage du Fort, situated on a deep bay at the head of "Lac des Chats," a stretch of eighteen miles of navigable water terminating at the Chats Rapids, where a canal connecting with the next lake below has already been commenced. The length of the Chats Rapids is about three miles, with a total fall of fifty feet, into the head of "Lac des Chenes." The length of this lake is twenty-eight miles, to the head of the Chaudière Rapids, which have a length of two miles, and a fall of sixty-seven feet, to the harbour of the City of Ottawa.

TABLE SHOWING SECTION OF THE RIVER MATAWAN TO OTTAWA.

Name of Rapids, &c.	Distances. River & Lake Navigation.	Distances. Canal Navigation.	Fall of River.	Elevation above the sea.
	Miles.	Miles.	Feet.	Feet.
Junction of Matawan and Ottawa	0	0	0	485
Matawan Rapids.....	1	1	5	... .
Matawan to La Veille Rapids.....	17	0	9	.....
La Veille, Grou and Deux Rivierès ...	0	3	32	.....
Deux Rivierès to Rocher Capitaine	10	0	5	.....
Rocher Capitaine and Grand Maribout Rapids.....	0	2	45	.....
Rocher Capitaine to Deux Joachims ...	16	0	8	.....
Deux Joachim Rapids	0	2	28	.....
Deep River to head of Culbute	34	0	3	350
Culbute to L'Islet Rapids	0	2	18	.....
L'Islet to Grand Calumet Falls	42	0	7	.....
Grand Calumet and other rapids	5	5	93	.....
Lac des Chats..	18	0	1	231
Chats Rapids	0	3	50	.....
Lac des Chenes.....	28	0	0	181
Chaudière Rapids	2	4	67	... .
Ottawa Harbour	0	0	0	114
	173	22	371	

By later surveys, the distance from the mouth of the Matawan to the City of Ottawa is fully 190 miles; ~~the error~~ in the table (~~173~~ 195 miles) is accumulative in estimating the length of open navigation by the rate of travel by canoe.

the small excess

Ottawa to Montreal.

Mr. Shanly's survey did not extend below the City of Ottawa, but from some other sources he gives the following :

Ottawa to Grenville, still water navigation	54	miles
Grenville to Carillon, " "	4	miles
" " Canal, still water navigation .	8	"
	12	"
Lake of the Two Mountains, Carillon to St. Ann	20	"

St. Ann Rapids	½	miles
Lake St. Louis—St. Ann to Lachine	15	"
Lachine Canal—Lachine to Montreal	8½	"
Total distance, Ottawa to Montreal	110	"

The required lockage is :

Grenville to Carillon, Long Sault, Chute au Bloudeau and Carillon Rapids	54	feet.
St. Ann Rapids	3	"
Sault St. Louis, Lachine Canal	44	"
Total lockage	101	"

Mr. Clarke differs a little from this ; he gives :

Ottawa to Grenville, distance	56	miles
Grenville to Montreal	60.43	"
Total distance	116.43	"
Fall of River, Grenville to Lake St. Louis	61	feet
St. Louis Rapids—Lachine Canal	43'75	"
Total fall	104.75	feet

MR. SHANLY'S RECAPITULATION.

River and lake navigation	372	miles
Canal navigation (including the Lachine)	58	"
Total distance Lake Huron to Montreal	430	"
Rise—Lake Huron to the summit	83	feet.
Reduced by lowering summit lakes to	65	"
Fall—summit to Montreal	642	"
Reduced to	624	"

Capacity.

After obtaining full information respecting the character and dimensions of the vessels navigating the upper lakes, Mr. Shanly gives his views as follows :

" It is a stream navigation, and more especially for the denomin-

ation of steamer known as the "propellor" 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 regions on either side of them, is peculiarly fitted. Land-locked for the greater portion of the way, the route in that respect will not be as advantageous for sailing craft as that by the great lakes, but the inexhaustible supplies of wood at all points along it will forever render the cost of working steam vessels lower on this than on any equal length of navigation on the continent."

From Mr. J. B. Jarvis' report on the projected Caughnawaga Canal he obtained a list of forty-eight propellors with their principal dimensions. Only eleven of those could pass the Welland Canal (as constructed at that date). There are but two of them under 300 tons burden, the largest 850 tons. The greater portion range from 400 to 600 tons. The greatest length, the "Iowa," is 234 feet, and her actual tonnage is 720, draws 11½ feet when loaded. Most of them are employed in the navigation of the upper lakes.

"The two most important lake ports for outward bound tonnage are Chicago and Toledo; the entrance into the former was kept open by excavation for vessels drawing ten feet of water; in the latter, nine feet of water is as much as usually can be depended on.

"That the harbours on the lake ports are not as a general thing adapted for ten feet draft of water I was well aware, and it must be obvious to anyone who has at all studied the subject, that the vessel which can at any stage of the lakes obtain or deliver her cargo in the greatest number of the principal ports must be a more profitable one to employ than the larger craft, which, from her excessive draught, must limit her intercourse to one or two of the deeper harbours, or more unprofitable still make her trips with lighter loads. I am not one of those who believe that sea-going vessels will ever be freighted to any considerable extent in our lake ports.

"The Ottawa route possesses distinctive features which entitle it to other considerations than those incident to a mere channel for merchandise. Penetrating the heart of our country it can boast of magnificent scenery, which, when it becomes accessible and known, cannot fail to attract the tourist, as well European as American. To prohibit the use on Ottawa waters of the paddle-wheel steamer, with her

commodious upper cabin and promenade deck would be a mistake. I propose, therefore, to fix the dimensions for the Ottawa locks so that they will admit the passage of vessels of that denomination. The size of the St. Lawrence locks is 200 feet long by 45 feet wide, the depth of water on the mitre sills is nine feet."

Considering all the data above stated he recommends the following dimensions :

LOCKS.

Clear length between the mitre sills	250 feet.
Clear width between the gate quoins	50 "
Depth of water on the mitre sills	10 "
Width of canal at bottom—long lengths	100 "
" " " —short lengths	60 "

Estimate of Cost of Construction.

Mr. Shanly's estimate of constructing the works on the whole route on the scale laid down is twenty-four millions of dollars.

He explains in relation to this : " The proportion of canalling on the route is not large, being about twenty per cent. less (Lachine Cana- included) than on the Welland and St. Lawrence line of navigation. The quantities of material to be excavated will also average less per mile, but the difficulties to be encountered on this work are : The hard and unyielding nature of the materials to be worked upon, the granite rocks, chiefly syenite, gneissoid and gneiss ; the distance which materials for building the locks would have to be carried ; the great cost of transporting these materials, plant and supplies, to a large portion of the route, without roads, in a wilderness without inhabitants. He therefore places very high rates on the works to be executed.

He states that the St. Lawrence and Welland Canals cost not far from $150,000 per mile, and he estimates that the 58 miles of the Ottawa & Georgian Bay Canal (the enlargement of the Lachine included) will cost upward of $370,000 per mile.

Now, as the Lachine Canal is, or will be, completed by the Dominion Government, there will be only fifty miles to construct, at $370,000 per mile..... $18,500,000

Deduct for improved facilities by the construction of the Canadian Pacific Railway, and improvements in machinery, etc., 20%	3,700,000
	$14,800,000

This might even include the extra work of lowering Trout and Turtle lakes and making the canal from Lake Nipissing to Trout Lake, say in round numbers fifteen million dollars.

MR. THOMAS C. CLARKE'S SURVEY.

Mr. Clarke completed the surveys in 1859, and his report is dated January 2nd, 1860.

Scale of Navigation.

In deciding this question Mr. Clarke explains:

"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 connected with the preceding.

"To these my attention was first directed, and after a careful personal examination of the whole route, aided by the graphic report of Mr. Shanly and the results 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. 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 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.....

"As soon as I had ascertained that the length of canal on the whole route would not exceed 29.32 miles, and that the remaining

401.44 miles could be made a navigation allowing of as rapid 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 axiom that the larger the vessel the cheaper the cost of transport. It is a fortunate peculiarity of this route that vessels can always depend upon making up full freights of sawed lumber from the inexhaustible pine forests of the Ottawa, manufactured at every dam on the river."

Appendix E is a table of propellers of 600 tons and over with their drafts when loaded; the drafts vary from ten feet to eleven feet eight inches.

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

Length of lock.....	250 feet
Clear breadth.....	45 "
Depth on sill.....	12 "

"Although through heavy cuttings and where the distance is short, I have followed the width recommended by the Department, 100 feet on bottom, I have not hesitated to increase the prism of the canal generally to 146 feet on the bottom, as I believe that it 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 generally 15 feet and over."

Mr. Clarke has reduced the length of canalling and the number of locks by dams, raising the river to overcome many of the rapids. In Appendix E he gives a tabulated statement of distances and levels of the natural section of the river, and in Appendix G he gives another table of lengths and heights of canal and river with number of locks as improved, and in Appendix I the quantities, rates and amount of each work is given in detail.

The total estimate exclusive of Lachine Canal is $12,058,680, which is equal to $579,134 per mile of canal constructed.

I think some of the prices were too low at that date, but with the present improved facilities, if the quantities can be relied on, the esti-

mate cannot be far out. I should, however, add for contingencies, such as that which prevents the raising of Lake Nipissing and other unforseen difficulties, not less than twenty per cent., making the estimate in round numbers fourteen million five hundred dollars.

Comparison with other Routes.

The St. Lawrence and Welland canals were completed in 1846, but in the next decade the traffic had so increased that improved means of transport were already being discussed, and Mr. Shanly states :—

"To meet the coming exigencies of that commerce, public attention had already been directed to three great projects, viz. :

1st. The enlargement of the Welland Canal.

2nd. The construction of the Toronto and Georgian Bay Canal.

3rd. The establishment of the French River and Ottawa navigation.

The term navigation is used rather than canal, in relation to the last named scheme, because it consists of an uninterrupted chain of waters—river and lake—demanding certain detached sections of canal to render the navigation continuous. Its advantages will be seen from the tabular comparisons, viz. :

No.	Name of Route.	Distances—Chicago to Montreal.				Lockage.		
		Lake.	River.	Canal.	Total.	Up.	Down	Total.
		Miles.	Miles.	Miles.	Miles.	Feet.	Feet.	Feet.
1	Welland Canal.....	1,145	132	71	1,348	.....	535	535
2	Toronto and Georgian Bay	775	155	120	1,050	130	675	805
3	French River and Ottawa.....	575	347	58	980	83	615	698

These figures show the superiority of the French and Ottawa

Rivers route not only by the difference in the whole length of the route, but in the large proportion of open, yet sheltered water in the latter.

Chicago to New York and Liverpool.

1. Chicago to Buffalo by Lakes	920	miles
Buffalo to Albany by Erie Canal	350	"
Albany to New York by Hudson River	145	"
To New York	1,415	"
New York to Liverpool	3,080	"
Total to Liverpool	4,495	"
2. Chicago to Montreal via Welland & St. Lawrence Canals and River	1,348	miles
Montreal to Liverpool	2,800	"
Total	4,148	"
3. Via French River and Ottawa route—		
Chicago to Montreal	980	miles
Montreal to Liverpool	2,800	"
Total	3,780	"

Over 700 miles less via the French and Ottawa Rivers route than by way of Buffalo and Erie route.

Rate of Travel.

The difference in distance is practically increased by the comparative length of canal to open water on each route, the rate of speed being estimated at four miles per hour for canal, and ten miles for open river and lake, and allowance for lockage one and a half minutes per foot. With these conditions the time estimated taking Mr. Clarke's plan which gives 29.32 miles of canal to be constructed, add 4.18 miles canal between Lakes Nipissing and Trout, making a total length of canal 33½ miles, and of open water 946½ miles, lockage 700 feet, we have :

1. Welland Canal and St. Lawrence route.—

	h.	min.
1277 miles lake and river navigation	127	42

	h.	min.
71 miles canal navigation	17	45
535 feet lockage	13	22
Chicago to Montreal	158	49

2. Toronto and Georgian Bay route—

	h.	min.
930 miles lake and river navigation	93	00
120 " canal navigation	30	00
805 feet lockage	20	07
Chicago to Montreal	143	07

3. French River and Ottawa route.—

	h.	min.
938 miles lake and river navigation	93	48
42 " canal navigation	10	30
700 feet lockage	17	30
Chicago to Montreal	121	48
Or, by lowering Trout and Turtle Lakes	120	54

4. Via the Erie Canal to New York.—

	h.	min.
1,064 miles lake and river navigation	106	24
351 " canal navigation	87	45
655 feet lockage	16	22
Chicago to New York	210	31

Both the reduction in the length of the route and the time of navigating it make a reduction in the cost of transporting freight. Mr. Shanly estimated the cost of transporting a ton of freight from Chicago to Caughnawaga (where the two routes meet)

By the Welland and St. Lawrence route	$3 20
By the French River and Ottawa route	2 82
Difference per ton	0 38

At the present time making all due allowance for lack of return freights at the outset, it is calculated that wheat should be laid down at Montreal by the Ottawa route at a cost of transportation from Chicago

not to exceed three cents per bushel; or about one-half the lowest prevailing rates.

The Safest Route.

From the mouth of Lake Michigan vessels will pass under the shelter of Manitoulin Island to the mouth of French River, avoiding all the dangers of southern Lake Huron, the shallow and dangerous Lake Erie. From Sault Ste. Marie, with the exception of a few miles on Georgian Bay, the route will be on land-locked waters continuously to Montreal. Grain will not only be insured at minimum rates on this route, but passing through the cool deep waters of the Ottawa in so much shorter time will reach market in better condition than by any other route.

The Scheme Generally Approved.

The advantages of the project were fully recognized when the surveys were completed in 1859, but the time was not auspicious, it was premature. Canada at that date consisted of Upper and Lower Canada, extending from the Detroit River to the Gulf of St. Lawrence. The bulk of the population west of Montreal occupied a narrow belt, extending northward from the St. Lawrence and Lake Ontario, and from Lake Erie to the eastern shore of Lake Huron. Up the Ottawa, Renfrew was the last post of surveyed settlement, and there were a few settlements on the southern shore of Georgian Bay. All the country north of Georgian Bay, Lakes Huron and Superior, was an unbroken wilderness, the hunting ground of the Indian without a white settler. The country was believed to be worthless except for the timber that grew on it, and entirely unfit for settlement.

We had not then any Manitoba or North-West Territory, and even the adjacent United States were but sparsely settled; commerce was then chiefly with south-western and southern states entering in Toledo and Chicago. I have no statistics of the tonnage passing between these points and eastern lake ports, but, in 1856, when Mr. Shanly commenced the surveys for the French River and Ottawa navigation, the registered tonnage using the Sault Ste. Marie Canal was only 101,458 tons. Now over twenty million tons pass Detroit annually, a large proportion of which passes through the Sault Ste. Marie Canal.

The Great Western and Grand Trunk Railways had recently been

completed to Detroit, connecting with railways of the western states, the public was elated with the impulse they gave to commerce and loudly proclaimed that the days of canals were passed. All these unfavourable circumstances contributed, not to the abandonment, but the postponement of the project till the proper time arrived.

At the present day a very different picture is presented. Canada is now a great Dominion extending from the Atlantic to the Pacific Ocean ; a railway has been constructed extending over the whole length uniting all the provinces into a concrete whole. This passes over our heretofore despised wilderness, and it is found that, besides the forests, there are tracts of rich land in the valleys, and underneath the surface it teems with the precious metals and abounds in those minerals which are applied to the arts and manufactures. While the vast extent of the rich agricultural and pasture lands of Manitoba and the North-West Territories are being settled and developed, and the settlers are eagerly demanding that the best possible means of transportation to the Atlantic seaboard be provided, so that they may send their produce, at the smallest cost, to compete in British markets with that from Russia, Egypt, India and South America.

How essential this is for the rapid settlement of this grand inheritance may be gathered from what has taken place alongside of us, as related by a gentleman of large experience and keen observation. He states :

"The question of a navigable waterway connecting Lake Huron with ocean navigation at Montreal, by way of Lake Nipissing and the Ottawa River, is one in which I have long taken great interest. The prosperity of the American Northwest, no less than of the Canadian Northwest, will be promoted to a greater degree by increased facilities for transportation to the seaboard, than by anything else which can be imagined. The settlement of the American Northwest did not fairly begin until it was settled that a lock and canal was to be constructed to surmount the rapids in St. Mary's River at the outlet of Lake Superior. Another great wave of settlement began when the new lock was opened in 1881, and there is every reason to expect that a similar movement will follow the opening of the still greater locks now approaching completion on both the American and Canadian sides of the St. Mary's River."

" The route from Lake Superior to Montreal, by way of the Ottawa River, is more nearly an air line than any other stretch of inland navigation *which can be found in all the world*, and presents, beside, physical conditions which will enable it to be improved for the passage of the largest vessels for a less cost than any other which can be found.

"The Canadian Pacific Railway, lying close to the whole route,will afford facilities which will materially lessen the cost of construction. In this connection I wish to emphasize the fact, that while the cost of water transportation is very much less than that of transportation by rail, and waterways are the most effective regulators of railway rates,yet, instead of injuring railways, they are of the greatest possible benefit to them. This opinion is not based on theory, but upon the facts which I have been for many years collecting from all parts of the world. I have scores of illustrations of the beneficial effect in the enormous increase of railway business which has followed the construction or improvement of waterways directly alongside of the railways, and I have been utterly unable in all my researches to find a single case in which the result of the railway has been anything else than highly beneficial.

"The Pennsylvania Central Railway owns and operates 900 miles of canal.

"When the Baltimore and Potomac Canal was almost utterly destroyed by floods a few years ago, the funds for its reconstruction were supplied by the Baltimore & Ohio Railway Company, which railway parallels this canal all the way from the City of Washington to the heart of the Alleghany Mountains.

"The underlying fact is, that it is better for the community, and hence for the railways which serve the community, *to turn over to the waterway the transportation of bulky raw material, in which the weight is very large in proportion to the value ; and in the transportation of which speed is not essential.*"

Water Power and Electricity.

But, in my view, the most important event that has occurred to stimulate the carrying out of this project is the complete success in using electricity as a motive power ; this will make a complete revolution in transportation, whether by rail or canal.

The characteristics of the waters by which it is proposed to form a continuous line of navigation from the Georgian Bay—Lake Huron to the head of ocean navigation at Montreal—are such as to afford very great facilities for generating electricity ; for, when improved by dams, they will at convenient distances give hydraulic power, in the aggregate probably not less than that of Niagara, but more serviceable by being distributed over the whole route, not in dribblets, but from Lake Nipissing westward to Georgian Bay, and eastward by the Matawan and Ottawa Rivers to Montreal, continually increasing in volume, none being wasted, but passing on from dam to dam, doing duty at each, extending a length of 430 miles.

There can be no doubt, if this project is carried out, that electricity will be used not only for lighting towns and driving manufacturing machinery, but also for operating the Canadian Pacific and Parry Sound Railways with their branches that will be made to mines and for lumbering purposes.

It is estimated that the Canadian Pacific Railway could be operated on this route by electricity at thirty per cent. less cost than by steam, and as there are rivers of sufficient volume and water falls for generating electricity at convenient distances apart, westward from Lake Nipissing, it is probable that within a short time the Canadian Pacific Railway would be operated by electricity to Fort William, or even to Winnipeg. Propellers will also be driven by the same power when that power can be carried with them.

The leasing of this water power should yield a large revenue to the Canal Company.

But what a transformation will take place in the aspect of the country, all up the Ottawa Valley extending to the Georgian Bay will be a hive of manufacturing industry, and what this will be for the Cities of Ottawa and Montreal it needs no prophet to foretell.

MARCUS SMITH.
M. Inst., C. E.

Deep Water-way from the Atlantic Ocean to the Great Lakes

The project of a deep water-way for ocean steamers to reach Lakes Huron, Michigan and Superior has recently been discussed both in conventions of "The International Deep Water-way Association" and in engineering journals ; the discussion being generally limited to two routes :

1. By the Erie Canal and Hudson River to New York.

2. By the Welland Canal and St. Lawrence Rivers to Montreal ; with extension from Lake St. Francis to Lake Champlain, thence by canal and Hudson River to New York.

The depth of water to be not less than twenty feet ; and even this is considered insufficient for the larger class of steamers by which freight could be carried at the least cost.

The cost of constructing such a work to Montreal would be very great, and to New York enormous, even if sufficient water could be obtained on this route. To construct a canal of this depth to be fed by water from Lake Erie has been estimated by an American engineer to cost one hundred and fifty million dollars.

That portion of the route between Sault Ste. Marie and Lake Erie being on the boundary line would be an international work, but from Lake Erie by the Welland Canal and St. Lawrence River to Lake Francis is entirely within Dominion territory, and if carried thence to Montreal and also to New York, the Dominion Government would be required to bear a large proportion of the cost.

No one expects that any interest on the large capital would accrue from the tolls, if indeed they should pay working expenses ; some of the promoters want no tolls.

The scheme would be chiefly for the reduction of the cost of "through" freight from the Western States to the seaboard, for exportation to Europe, and in a less degree, from the Northwest Territories of the Dominion ; for few of the lake harbours on the route will admit vessels of twenty feet draught, and they could only be deepened and kept open at great expense.

The general or prevailing result of these discussions has been to discredit the scheme.

At the convention recently held at Cleveland, Mr. T. C. Clarke, M. Am. Sec. C. E., submitted an elaborate paper from carefully collected statistics of operations and cost of transportation of freight on the Erie Canal, from which he concludes, that to reduce the cost to a minimum on that route, the canal should have a depth of nine feet, to be navigated by a fleet of one tug boat with four steel barges, loaded to a depth of seven and a half feet draught—capacity 2,400 tons.

But as the length of canal to be constructed on the Georgian Bay and Ottawa River route bears a very small proportion to the length of open water navigation, and the depth of the rivers being favourable, a canal of the depth of ten to twelve feet, with suitable propellers and barges as suggested in the reports of Mr. Walter Shanly and Mr. T E. Clarke, already quoted, would be the most economical for carrying freight.

After duly considering these several schemes in all their bearings, I believe it indisputable that the Montreal, Ottawa and Georgian Bay scheme has very great advantages over all the others :

1. It is the shortest practicable route that can be found from Chicago or any point on Lake Superior, being 368 miles shorter to Montreal than by the Welland and St. Lawrence route and 435 miles shorter to Montreal than it is to New York by the Erie Canal and Hudson River,

2. It is the safest, being for the greater portion of its length sheltered in rivers and narrow lakes.

3. It is the quickest, not only for its shortness, but from its proportion of open water, on which steamers can make greater speed.

4. It is by far the least costly to construct.

5. Having all these advantages, the transportation of freight can be done at the least cost.

In addition to these, it will have very great local importance from a Canadian point of view. The water power that will be provided by the proposed dams for over-coming rapids will be used for generating electricity for driving manufacturing machinery, branch railways, lighting towns, etc., so that will materially assist in developing the mineral and other resources of the country, and it will thus have a large local as well as through traffic.

MARCUS SMITH,
M. Inst. C. E.