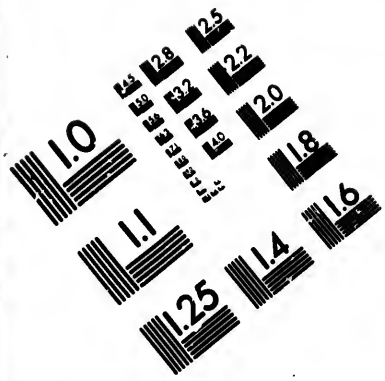


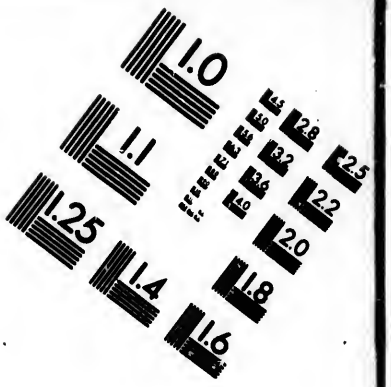
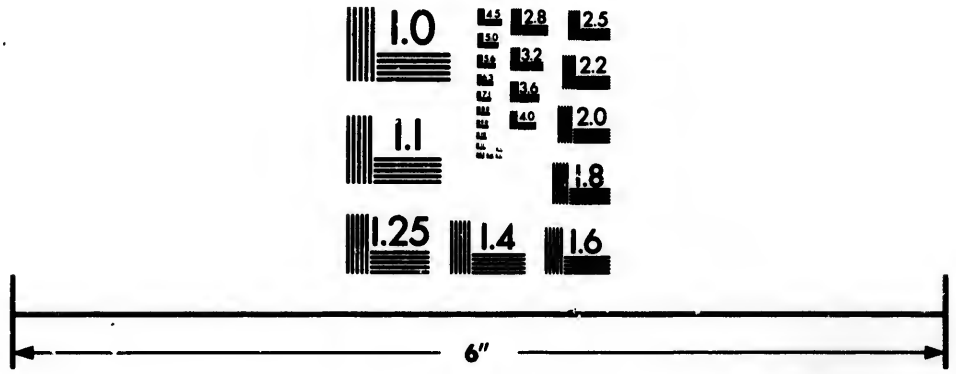


IMAGE EVALUATION TEST TARGET (MT-3)



Photographic Sciences Corporation

23 WEST MAIN STREET
WEBSTER, N.Y. 14580
(716) 872-4503

Technical and Bibliographic Notes/Notes techniques et bibliographiques

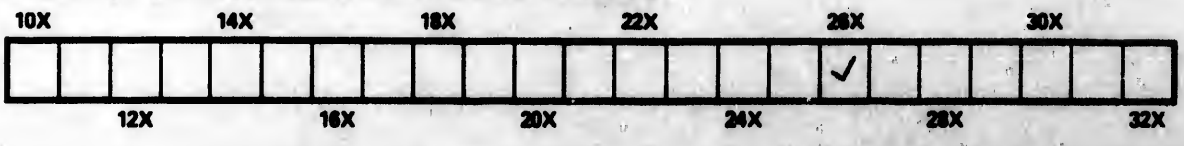
The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming, are checked below.

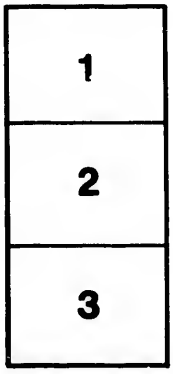
L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

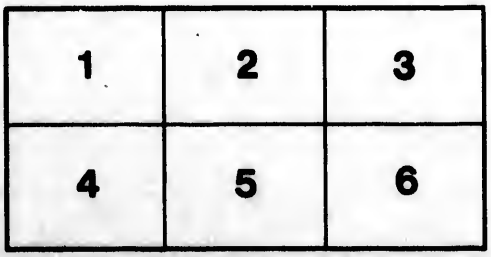
- [x] Coloured covers/ Couverture de couleur
- [ ] Covers damaged/ Couverture endommagée
- [ ] Covers restored and/or laminated/ Couverture restaurée et/ou pelliculée
- [ ] Cover title missing/ Le titre de couverture manque
- [ ] Coloured maps/ Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black)/ Encre de couleur (i.e. autre que bleue ou noire)
- [ ] Coloured plates and/or illustrations/ Planches et/ou illustrations en couleur
- [ ] Bound with other material/ Relié avec d'autres documents
- [ ] Tight binding may cause shadows or distortion along interior margin/ La reliure serrée peut causer de l'ombre ou de la distortion le long de la marge intérieure
- [ ] Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/ Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- [ ] Additional comments:/ Commentaires supplémentaires:

- [ ] Coloured pages/ Pages de couleur
- [ ] Pages damaged/ Pages endommagées
- [x] Pages restored and/or laminated/ Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- [ ] Pages detached/ Pages détachées
- [x] Showthrough/ Transparence
- [ ] Quality of print varies/ Qualité inégale de l'impression
- [ ] Includes supplementary material/ Comprend du matériel supplémentaire
- [ ] Only edition available/ Seule édition disponible
- [ ] Pages wholly or partially obscured by errata slips, tissues, etc., have been refilmed to ensure the best possible image/ Les pages totalement ou partiellement obscurcies par un feuillet d'errata, une pelure, etc., ont été filmées à nouveau de façon à obtenir la meilleure image possible.

This item is filmed at the reduction ratio checked below/
Ce document est filmé au taux de réduction indiqué ci-dessous.







REPORT

ON

THE CANAL NAVIGATION OF THE CANADAS

BY LIEUT.-COLONEL PHILLPOTTS,

ROYAL ENGINEERS.

Forming the Fifth Vol. of Papers on Subjects connected with the Duties of the Corps of Royal Engineers.

REPORT

ON

THE CANAL NAVIGATION OF THE CANADAS.

BY LIEUT.-COLONEL PHILLPOTTS,

ROYAL ENGINEERS.

REPORT ON THE CANAL NAVIGATION OF THE CANADAS.

The following Report, called for by the instructions of His Excellency the Earl of Durham, will embrace three distinct lines of communication :

I. The communication from Lake Erie to the sea by the Welland Canal, Lake Ontario, and the River St. Lawrence.

II. The communication from Lake Simcoe to Lake Ontario by the Rice Lakes and River Trent.

III. The communication from Lake Huron by the French River and Lake Nipissing, to the Ottawa River.

I. The first of these being the most important, and my attention having also been more immediately called to it, as well by my instructions as by the directions which I have subsequently received from His Excellency Lieut.-Gen. Sir John Colborne, I proceed to report upon the communication *from Lake Erie to the sea by the Welland Canal, Lake Ontario, and the River St. Lawrence.*

Assuming Port Colborne at Gravelly Bay on Lake Erie as the commencement of this very important communication, (the reasons for which will be given hereafter when I treat more particularly on the Welland Canal,) the distance from Lake Erie to Quebec may be estimated at 587 miles, as follows :

	Canal Navigation.	Lake and River.
	miles.	miles.
From Port Colborne on Lake Erie to Port Dalhousie on Lake Ontario by the Welland Canal	28	..
To Kingston by Lake Ontario	..	180
To Prescott by River St. Lawrence	..	70
To Head of Long Saut Rapid, 38 miles: in which distance the following rapids requiring canals occur, viz.		
The Galoppes Rapids	$0\frac{1}{2}$	
Point Cardinal	$0\frac{5}{16}$	
Rapide Plat	$3\frac{9}{16}$	
Farren's Point	$0\frac{5}{16}$	
	$5\frac{1}{2}$	$32\frac{1}{2}$
To Cornwall by the St. Lawrence Canal	$11\frac{1}{4}$	..
Coteau du Lac by Lake St. Francis	..	35
The Cascades, $14\frac{3}{4}$ miles: in which distance the following rapids requiring canals occur, viz.		
The Rapids at Coteau du Lac	$2\frac{3}{4}$	
Ditto at the Cedars	$1\frac{3}{4}$	
Ditto at the Cascades	$2\frac{1}{4}$	
	$6\frac{3}{4}$	8
To Lachine by the Lake St. Louis	..	21
To Montreal by Canal	9	..
To Quebec by the River St. Lawrence	..	180
	$60\frac{1}{2}$	$526\frac{1}{2}$

Making in all 587 *miles*, as above stated, in which distance it appears that the navigation is naturally good for $526\frac{1}{2}$ miles, and that *only* $60\frac{1}{2}$ *miles of canal are* required altogether to enable large steamers to pass from Quebec to Port Colborne, from whence the navigation is also naturally good for large steamers for a distance of 1000 miles, through Lake Erie, the River Detroit, Lakes St. Clair, Huron, and Michigan, to Chicago; so that, in the whole distance of nearly 1600 miles between Quebec and Chicago, the navigation of $1526\frac{1}{2}$ miles is naturally good for large steamers, and consequently there will only be $60\frac{1}{2}$ miles of canal navigation, of which the Welland Canal comprises 28 miles, and this work is absolutely required under any circumstances in order to afford a water communication between Lake Erie and Lake Ontario. Of the remaining $32\frac{1}{2}$ miles, $11\frac{1}{4}$ have already been nearly completed by the Provincial Government of Upper Canada, in order to overcome the rapids at the Long Saut near Cornwall; 9 miles have been constructed for barges some years since by the Provincial Government of Lower Canada between Lachine and Montreal, which however will require to be *very much* enlarged,

or rather a new canal will be required for steam-boat navigation; and 12¼ miles are necessary to be made in the various short canals required to pass the other rapids of the River St. Lawrence at the Galoppes, Point Cardinal, Rapide Plat, Farren's Point, Coteau du Lac, the Cedars, and the Cascades.

In the above distance there will be 517 feet of lockage, which will require 63 locks, and the total expense of completing this long line of communication on the large scale adopted in the St. Lawrence Canal, near Cornwall, will be £2,228,700 sterling, as shown in the following Table.

	Length in miles.	No. of locks.	Feet of lockage.	Amount of estimated expense.
(Between Lake Erie and Lake Ontario.)				
The Welland Canal	28	35	328½	£1,250,000
(In the River St. Lawrence.)				
The Galoppes Rapids	0½	1	4½	29,500
Point Cardinal	0 3/16	1	2½	25,000
Rapide Plat	3 9/16	2	11½	120,000
Farren's Point	0 8/16	1	4	48,000
Long Saut Rapids	11¼	7	48	57,300
Rapids at Coteau du Lac	2¾	2	17	120,300
Ditto at the Cedars	1¾	4	30¾	125,000
Ditto at the Cascades	2¼	3	25¼	129,000
Lachine Canal	9	7	45	324,600
	60¼	63	517	£2,228,700

Of the above-mentioned works, that part of the St. Lawrence Canal which has been commenced at the Long Saut Rapids near Cornwall, and the Welland Canal, which connects Lake Erie with Lake Ontario, are by far the most important, and they demand immediate attention.

The inland navigation from Quebec to Lake Michigan being alternately through the large lakes of Upper Canada and their connecting rivers, and the portion of this distance which will require canals being altogether so very short, in comparison with the length of the whole route, it is quite evident that large steamers will be much more advantageous under such circumstances than sailing vessels; and accordingly we see that, on Lake Erie and the Upper Lakes, the number of the former is increasing much faster than that of the latter: as there can be no towing on these Upper Lakes, large freight steamers, similar to those now in use on the Mississippi and its branches, will have a most decided advantage over all other modes of conveyance. This is in

some measure proved by the fact that the merchants of the Upper Lakes are now in the habit of ordering their goods, which are sent from New York by the Erie Canal to Buffalo, to be forwarded upwards in steamers in preference to sailing vessels; and therefore it follows that, if we can bring these large freight steamers from these Upper Lakes down to the sea-ports of Quebec and Montreal, all the delay and expense of trans-shipment will be avoided, as well as the long and tedious navigation of the Erie Canal, and consequently one of the great advantages which may most confidently be expected to result from the opening of this communication on the large scale here proposed, will be the inducing of the greatest part of the trade from those States situated to the westward of Buffalo to pass by this route to the Atlantic; and it is believed that this will be effectually secured by affording a continuous uninterrupted steam navigation, without any trans-shipment in the whole distance of nearly 1600 miles; but if the size of the short intermediate canals on this route be reduced to the small scale required for schooner navigation, trans-shipments will be necessary, and thus one of the greatest advantages which the River St. Lawrence naturally enjoys will be thrown away, and this route will in a great measure cease to have such a decided superiority as it may be made to possess over the Erie Canal as well as that which intersects it at Syracuse from Oswego on Lake Ontario.

From a slight inspection of the map of this part of North America, it will be quite evident that the surplus produce of all that part of this continent which is situated to the westward of the Falls of Niagara, including the States of Ohio, Kentucky, Tenessee, Indiana, Michigan, Illinois, a part of Missouri, Mississippi, and Alabama, together with the territories of Wisconsin, Missouri, and Iowa, must find its way to the ports of the Atlantic by one of the following routes, viz.,

1st. By the Mississippi to New Orleans.

2nd. By the Ohio and Chesapeake Canal to Baltimore.

3rd. By the Ohio and Pennsylvania Canal to Philadelphia.

4th. By the Ohio, Kanawha, and James River, to Richmond, Virginia.

5th. By the Erie Canal from Buffalo, or by the Welland Canal and Lake Ontario *via* Oswego to New York.

6th. By the Welland Canal and River St. Lawrence to Montreal and Quebec.

1st. With regard to New Orleans, the climate is an insuperable obstacle to any regular commercial intercourse, being one which no art of man can overcome · the consequence of which is, that the Erie Canal from Buffalo already draws off a great part of the transport from the Mississippi; and it is said that a very large portion of the merchandize intended for Tenessee, and even for Florence, in the state of Alabama, now passes by this route from New York.

2nd, 3rd, and 4th. With regard to Baltimore, Philadelphia, and Richmond, it is true that a quantity of produce and merchandize will generally be enabled to pass, through the canals and railroads, to and from these ports before the Erie Canal is free from ice, and therefore during two or three weeks in the former and latter part of the season these routes may possibly be sometimes preferred; but as they are all of them much longer, and, on account of the numerous trans-shipments, far less commodious than the Erie Canal, the latter must at all other times have the preference.

5th. It is probable that New York will always offer a more steady and certain market than either Baltimore, Philadelphia, or Richmond; and after the navigation has once fairly opened for the season, the Erie will be a far more commodious and cheap communication than either of the Ohio Canals, as it is much shorter, and very much less impeded by lockage.

6th. The communication, which it is proposed in this Report to open between the Upper Lakes and Montreal and Quebec, is however much shorter and more commodious than either of these routes; it is also much less impeded by lockage, and far less by canal navigation, as it enjoys the great advantage of having the River St. Lawrence through nearly its whole extent.

It has been objected to Montreal and Quebec, that they do not afford so good a market for produce as New York, and that they are easily overstocked; but there can be no doubt that when once the inland navigation has been so far improved as to render it possible to bring the trade of the western country by this route, mercantile establishments of sufficient extent will soon spring up to receive the produce of that fertile region, and forward it to the West Indies or Great Britain, as may be required, and thus insure to the western merchant and farmer as good a market at Montreal and Quebec as he would obtain at New York or elsewhere.

It has also been objected to this route, that the ports of Montreal and Quebec are usually blocked up by ice during several months of the year,

while New York is open all the year round; but when we take into consideration the fact that the Erie Canal is also rendered impassable by the same cause for a longer period, this objection ceases to be of any importance, and as this route will, when completed according to the plan here proposed, be a much more convenient and cheap route to the Atlantic than any other, (and by some alterations in the Trade Act such decided advantages may easily be given to the ports of the St. Lawrence as will render these markets far preferable to New York or any others on this continent,) there can be no doubt that a very large portion of the vast trade referred to, as well as the whole of that from Upper Canada, will pass this way, and that Montreal and Quebec will become two of the greatest emporiums in North America.

From the above statement there can be no doubt that this vast and important trade may be secured to Quebec and Montreal, if the canals required to pass the rapids, &c. of the St. Lawrence be made on the enlarged scale now proposed; and therefore I proceed to report fully and in detail upon each portion, beginning with the Welland Canal.

WELLAND CANAL.

Before the last war with the United States, and indeed until the opening of the Erie Canal in 1825, the whole of the trade of the country bordering on the River St. Lawrence, Lake Ontario, and the Upper Lakes, found its way to the ocean *via* Montreal and Quebec, and it is probable that it would have continued to do so to this day, had it not been for the construction of the New York and Erie Canal, which, by affording a safe and commodious inland water communication from Buffalo, at the foot of Lake Erie, to New York, has secured to our neighbours on that side of the boundary line the transport of nearly all the products of the western country, thus depriving the inhabitants of Canada of the advantage they had previously anticipated of becoming the carriers of all produce of the extensive countries west of the Falls of Niagara, and diverting much of their own produce to the New York market.

This was soon foreseen, as the natural result of the completion of that canal, by a few enterprising individuals of Upper Canada, who, fearing the consequence to the trade of these provinces, began a survey of the country as early as 1818, between the Chippawa or Welland River, which discharges

itself into the Niagara River about 2 miles above the Falls, and the Twelve-mile Creek, which discharges itself into Lake Ontario at Port Dalhousie.

In consequence of the active exertions of the individuals above alluded to, the Legislature of Upper Canada passed an Act in the year 1824, incorporating the Welland Canal Company with a capital of £40,000, which sum was considered sufficient to make a canal with locks only 7 feet wide for boat navigation, commencing at the Welland River, about 9 miles from its mouth, where the village of Port Robinson now stands, and entering Lake Ontario at the mouth of the Twelve-mile Creek where the harbour, now called Port Dalhousie, has been formed; but before any progress was made in this design, the importance of the work began to be more fully discussed, and in the following year (1825) the plan was enlarged for schooner navigation, and the capital of the Company was increased to £200,000.

It was originally intended to make the Welland River the summit level, and to pass up the River Niagara from the village of Chippawa to Lake Erie; but the high ridge of land which crosses the country between Port Robinson and Allanburgh, and rises to the height of 56½ feet above the surface of the Welland, proved a most formidable obstacle to the pursuance of this plan, to accomplish which, that part, commonly called "The Deep Cut," was undertaken, requiring an excavation of from 30 to 56½ feet in depth for a distance of nearly 2 miles.

The removal of this formidable obstacle was very nearly completed, and there was every prospect that this first and most important section of the work, commencing at Port Dalhousie and ascending from Lake Ontario through the Deep Cut to the Welland River, would soon be opened for navigation, when, in the autumn of 1828, these high banks slipped down in many places, and filled up the bottom of the canal.

This disastrous occurrence caused a very great additional expense, and it became a serious question with the Company whether it would be expedient, with their limited means, to persist in the excavation of the Deep Cut, and continue the work on the original plan, or to raise the summit level, and abandon the idea of clearing out this channel to so great a depth. It is much to be regretted that the resources of the Company were not sufficient to enable them to persist in the original plan with a reasonable probability of success; the ultimate expense of which it now became very difficult to estimate with any certainty, in consequence of the quicksand on which these high banks

were found to stand; and as their prospects of obtaining funds for the final completion of the work depended upon the communication being soon opened, the Company were reluctantly obliged to embrace the latter alternative; and by throwing a dam across the Grand River at Dunville, and cutting a small canal as a feeder from thence, they have brought the water of that river over the Welland by means of an aqueduct, at a level about 15½ feet above its surface; and therefore vessels are now enabled to pass through the Deep Cut over the obstacles caused by the slides above mentioned.

Although the completion of the Deep Cut would have given a safe water communication for vessels round the Falls, by sailing up the Niagara River from the mouth of the Welland to Lake Erie, yet it would have been a very imperfect one, because there is a very strong current below Fort Erie, which can only be ascended by sailing vessels when the wind blows strongly from the eastward, and it would also have been a very circuitous one; it was therefore subsequently intended to follow the Welland to Fort Creek, which is situated about 11 miles above Port Robinson, and by a cut of about 14 miles in length through a flat swampy country to enter the Grand River, the mouth of which is capable of being made a very excellent and safe harbour for any number of vessels that may navigate Lake Erie, and this Lake would thus have been rendered the summit level and feeder of the Welland Canal throughout its whole extent.

The alterations of the plan, however, in consequence of the slides at the Deep Cut, rendered an aqueduct necessary across the Welland, and therefore the navigation of that river, which, for a distance of upwards of 20 miles resembles a canal more than a running stream, (having scarcely any perceptible current, and being sufficiently deep for any vessel that can navigate the Lake,) has been impeded.

It has also been necessary, in order to raise the water of the Grand River to the summit level required, to erect a dam where the village of Dunville is now situated, about 5 miles from its mouth, and the water is brought from thence by a feeder 20¾ miles in length; but the canal, instead of being carried to the Grand River, has been taken by a shorter cut of only 7¾ miles to Gravelly Bay on Lake Erie, where the harbour of Port Colborne has been formed; and thus the entire communication between Lakes Erie and Ontario has been completed without entering the River Niagara at all. The advantages of this alteration are very important; for besides avoiding the great

impediment to the navigation caused by the strong current in that river at Fort Erie, a great reduction of the distance[1] in lake sailing has been effected, an additional harbour has been formed on Lake Erie, and the canal is now generally open for navigation much earlier than the Niagara River, which, owing to the large quantity of ice that accumulates every spring at the foot of the lake, is generally closed for three or four weeks after the ice has disappeared above.

These alterations and additions to the original plan, however, have necessarily added much to the expense of the work. In the year 1833 the Legislature of Upper Canada appointed three commissioners to superintend the expenditure of a certain sum of money on this canal, and to appoint an engineer to examine it, and make an estimate of the expense of finishing it. In consequence of which, Benjamin Wright, Esq., an experienced engineer from the United States, was employed for this purpose, who made a full Report upon the work, and suggested several improvements, some of which were adopted; and now the expenditure from first to last has been altogether not much less than £500,000, of which upwards of £200,000 have been expended on the Deep Cut alone.

Although the canal was opened for schooners in 1830, the locks were not put into an efficient state till 1835, since which time it has continued navigable with little interruption. From the return of tolls collected (see Appendix), it is evident that the traffic on it is fast increasing, and that it is already drawing a great portion of the trade of the western country by this route; and when the contemplated improvements on the River St. Lawrence are completed between Prescott and Montreal, it cannot fail to answer the expectations of its original projectors, who deserve great credit for the activity and zeal with which they have prosecuted the work, under a series of discouragements that would have induced many persons of less perseverance and energy to abandon it in despair.

[1]

From Port Robinson to the mouth of the Welland	9¼	miles.
Thence to Fort Erie	18	,,
To Port Colborne	22	,,
Total	49¼	,,
From Port Robinson to Port Colborne, by canal	12	,,
Saving of distance	37¼	miles.

This canal, as now constructed from Port Colborne on Lake Erie to Port Dalhousie on Lake Ontario, is rather more than 28 miles in length: it may be divided into four great sections, viz., the *first*, from Port Colborne to the aqueduct, 7¾ miles in length; the *second*, from the aqueduct to Port Robinson, 4¼ miles; the *third*, from Port Robinson to Thorold, 6¼ miles; and the *fourth*, from Thorold to Port Dalhousie, nearly 10 miles.

The first section passes through a low flat country, the surface of which is about 8 feet above the level of Lake Erie. For a distance of about half a mile near the lake the excavation for the canal passes through a bed of limestone, commencing about 4 feet under the surface; the remainder, through marsh resting on clay, which can be easily removed.

The second section, after crossing the Welland River by means of a very good aqueduct, formed of wood, runs along the left bank of that river, which, being composed of good stiff clay, affords the means of forming the canal without difficulty.

The third section, soon after leaving the Welland River at Port Robinson, passes through the high ridge of land before alluded to, which crosses the country on the north side of the Welland, and through which that part of the canal called "the Deep Cut" has been excavated; it then passes by Allanburgh across the mountain ridge to Thorold.

The excavation of the Deep Cut is through stiff clay resting on quicksand, the banks of which, though far too steep, stood very well until the excavation reached the quicksand, when the slides above mentioned took place, which caused the abandonment of the original magnificent plan of carrying the water of Lake Erie through to Lake Ontario. Between the Deep Cut and Thorold the soil is generally clay, and easily excavated, excepting through "the little Deep Cut," which passes through a ridge of clay 20 feet high, resting on a bed of limestone, in which the excavation has in one part been sunk to the depth of 8 feet.

The fourth section, soon after leaving the village of Thorold, descends the mountain by a deep ravine into the bed of the Twelve-mile Creek to St. Catherine's, and terminates at the mouth of this creek at Port Dalhousie, where it enters Lake Ontario. In descending the mountain the excavation runs generally through a mixture of limestone and clay till it passes into the valley of the Twelve-mile Creek, where the soil is chiefly clay, and where, indeed, little excavation is required.

The difference of level between the two lakes is 328 feet 8 inches, to which must be added the rise of the feeder from the Grand River above the level of Lake Erie, which is 5 feet at the aqueduct.

The number of locks at present is forty, including one near Port Colborne, descending from the level of the feeder from the Grand River into Lake Erie; two at Port Robinson, descending into the Welland River; and two at Allanburgh, descending into the canal below the Deep Cut. These five extra locks have all been rendered necessary in consequence of the alteration of the summit level. The locks below St. Catherine's are 32 feet wide, and 130 feet long; the lock at Port Colborne is 24 feet wide, and 130 feet long; all the others were originally 22 feet wide, and 110 feet long; but some of them have settled inwards so much that they do not now exceed 20 feet 6 inches in width.

The canal generally, according to the original plan, was intended to be 26 feet wide on the bottom, with slopes of 2 feet base to 1 foot perpendicular; and having 8 feet water, it would consequently be 58 feet wide on the top water line.

The locks having been mostly built of wood, more than twelve years ago, are now generally in a very decayed state, and in order to keep the canal open they require frequent repairs.

By constant watching and superintendence this canal has been kept in such a state of repair that no accident of any great consequence has lately occurred, until this summer, to interrupt the navigation for any length of time; but it was necessary during the past season to close it on two occasions, for about ten days each time, while some of the locks were undergoing repair; and I feel it proper to remark, in the strongest manner, that it is quite impossible, in the present state of the work, to insure the navigation being kept open much longer unless the whole canal be immediately put into an efficient and permanent state of repair. For, besides the dilapidated state of the locks, the banks in many places require to be strengthened, and altogether the whole work is at the present moment in a most precarious state; so much so, that if permanent and efficient measures be not adopted without delay, there is great danger that this highly important communication will soon become impassable. I am therefore of opinion, and I feel that I cannot state it too strongly, that no further delay should take place in finally deciding upon the plan which is to be adopted for completing it, and carrying it into execution as soon as possible.

The Welland Canal Company have been fully aware of this for some time past, and they have used every exertion in their power to carry this desirable object into effect, in which most probably they would ere now have made much progress had not the present financial difficulties of this province rendered it impossible to procure the necessary funds for this purpose.

In the year 1837, Messrs. Baird and Killaly, two experienced civil engineers, were employed by the Company to examine the canal, and make a full Report upon it, which they have done in a very able and satisfactory manner.

In deciding upon the route which they have recommended for the canal, they appear to have been governed by the principle of availing themselves as much as possible of the outlay already incurred, and of making the most of the works as they found them; but they were particularly directed by their instructions "to interrupt the navigation as little as possible," and also to "report fully upon the propriety or necessity, as regards the public interest only, of altering the present route or any part thereof."

After thoroughly examining the subject in all its bearings, which they have fully stated in their Report, they have recommended that Port Colborne should still be retained as the point of departure from Lake Erie, and Port Dalhousie the point of entrance into Lake Ontario; but that both of these harbours should be much enlarged and improved, and that the feeder from the Grand River should be widened and deepened in several places in order to afford the additional quantity of water that will be required. They have also recommended that the old line should be adopted throughout, except in the descent of the mountain between Thorold and St. Catherine's; and they have recommended some improvements between St. Catherine's and Port Dalhousie.

In the size of the locks, which are proposed to be built of stone, they were limited by their instructions to 110 feet in length and 24 feet in width, for schooner navigation.

The canal is intended to be 36 feet broad at the bottom, which is to be 6 inches below the mitre-sills of the locks, to have 8 feet of water on the mitre-sills, and consequently 8 feet 6 inches in the other parts, with slopes generally of 2 feet base to 1 foot perpendicular. Their estimate amounts to the sum of £300,304. 2*s*. 3*d*., of which £65,189. 16*s*. 10*d*. is proposed to be expended in the improvement of the harbours of Port Colborne and Port Dalhousie, and £13,156. 11*s*. in building a junction and graving lock at Dunville.

They conclude their Report by expressing their fears that the scale above alluded to will not be found sufficient for the prospective wants of the country, even in a commercial point of view, and therefore they suggest that it should be enlarged to such dimensions as will suit the steamers navigating the lakes: with this view they propose that the locks should be made 45 feet wide and 180 feet long, which alteration may in their opinion be effected by an increased expenditure of £250,000, making in all £550,304. 2*s*. 3*d*. Halifax currency. The Welland Canal Company, however, have not felt themselves warranted; with their limited means, in adopting the suggestions of Messrs. Baird and Killaly in this respect, and therefore they are about to proceed upon the small scale for schooner navigation only.

In referring to this Report, and the plan on which it is at present proposed to proceed, I felt it my duty, as soon as I received directions to make a Report on the subject, to request that their operations might be suspended until I had an opportunity of inspecting the canal, as their work would be all thrown away if it should hereafter be determined by Her Majesty's Government to take it out of their hands, and to enlarge the plan to the scale which I am about to propose for consideration.

From every inquiry which I have been able to make on the subject, I am of opinion that it will be very inexpedient for Her Majesty's Government to follow the limited plan of the Welland Canal Company, as I feel quite satisfied that before the canal could be completed according to that plan, the necessity of making the locks large enough for steam navigation would become evident even for commercial purposes; but in the event of its being required for military operations, in which point of view it must be more especially regarded if assumed by the Government, there cannot be a question on the subject. I have, therefore, as directed by my instructions, drawn up my Report with this view, it being most important that, in the event of any misunderstanding with the United States, our vessels of war on Lake Ontario (which can be fitted out at Kingston without difficulty and to any extent) should be able to pass up to Lake Erie, where we have no naval establishment of any kind for this purpose.

Before I enter upon the plan which it is my intention to propose for the enlargement and completion of this highly important work, it may be proper for me to point out the different routes by which the communication from Lake Erie to Lake Ontario by the Welland Canal may be effected.

It would naturally have been expected that this would have been done by assuming Lake Erie as the summit level, and cutting a canal from the mouth of the Grand River, or from Gravelly Bay, to the River Welland, and thereby taking the water of the Welland down through the canal by the vale of the Twelve-mile Creek to Lake Ontario.

Although a most formidable obstacle existed to the accomplishment of this plan, which, as has been already stated, rendered an excavation from 30 to 56½ feet deep necessary for a distance of nearly 2 miles, yet this bold project was, as we have already seen, undertaken by the Welland Canal Company, who were only prevented by their limited means, and the want of adequate support and encouragement in the accomplishment of this object, from carrying it into effect.

It has been already shown that the slipping-in of the sides of the Deep Cut, when nearly completed, induced the Company to abandon this part of their plan, and to raise the summit level to the height of 8 feet above Lake Erie, by means of a dam across the Grand River, the water of which is now brought through the townships of Moulton and Wainfleet to the Welland, and carried by an aqueduct over that river 15 feet 6 inches above its level; and by this means vessels are enabled to pass over all the obstacles occasioned by the Deep Cut above alluded to.

This having been effected, it becomes a matter of comparative expense whether this important navigation shall continue to receive its supply of water from the above source,—whether the original plan of locking down from the level of Lake Erie into the Welland River shall not be resumed and carried on to completion, or whether the supply of water may not at any rate be obtained direct from Lake Erie, without obliging vessels coming up from below to rise, as they now do, 5 feet above that lake, and then descend into it at Port Colborne.

I. If this canal continue to receive its supply from the Grand River, and the summit level be kept, as at present, 5 feet above Lake Erie, four modes present themselves for our consideration.

1st. By following the present route from Allanburgh to Port Colborne, and receiving the water by the feeder from the Grand River, according to the plan now adopted by the Welland Canal Company.

2nd. By following the present route to Port Robinson, and then locking down into the Welland, and following that river 4 miles to Hellem's Creek,

immediately below the aqueduct; then rising by a single lock of 10½ feet to the level of Lake Erie, and passing on straight to Port Colborne, or rising by a double lock of 15½ feet at Hellem's Creek to the level of the feeder, and descending by a single lock of 5 feet into Lake Erie at Port Colborne.

3rd. By following the present route to the aqueduct, and then descending by a double lock of 15½ feet into the Welland River, and proceeding up that river 6½ miles to Fork Creek; then by a double lock of 15½ feet ascending to the present level, and entering the feeder at Marshville, 4 miles distant from the Welland, and following the feeder 9 miles to Broad Creek, which may be entered by a single lock of 7 feet fall about 1¼ mile from the Grand River, which it joins 2 miles from its mouth on the level of Lake Erie.

4th. By supplying the Deep Cut from the Grand River by means of a tunnel or inverted syphon under the Welland, instead of an aqueduct over it, and locking down into the Welland by a double lock of 15½ feet at Port Robinson, following the Welland 10½ miles to Fork Creek, and proceeding from thence, as described above (No. 3), by Marshville and the feeder into Broad Creek, and thence to Port Maitland at the mouth of the Grand River.

II. If the original plan of conveying the water of the Welland River through the Deep Cut be resumed and carried on to completion, only two modes present themselves; to accomplish either of which it will be necessary to sink the Deep Cut 15½ feet more than will be required by the present plan of feeding it from the Grand River, and 10½ feet more than would be required if it were supplied with water from Lake Erie. The average depth of water now in the Deep Cut is about 8 feet, and therefore an increased depth of only 2 feet will be sufficient, on the present plan, to give 10 feet of water; and if Lake Erie be made the summit level, an increased depth of 7 feet will be sufficient for this purpose; but if it be supplied with water from the Welland, it will be necessary to sink it 17½ feet lower than it is at present.

Having sunk the Deep Cut to the level of the Welland, the only remaining point to determine would be whether the canal should enter Lake Erie at Port Colborne in Gravelly Bay, or Port Maitland at the mouth of the Grand River.

1st. In the former case a lock of 10½ feet lift will bring a vessel to Lake Erie level at Hellem's Creek, near the aqueduct, and a canal of less than 8 miles will bring it from thence to Port Colborne, where a regulating lock will be required.

2nd. In the latter case a lock of 10½ feet lift will also be sufficient to bring a vessel to the level of Lake Erie, between Marshville and Fork Creek, which, for a distance of 1½ mile, may easily be made navigable; and by cutting half a mile across a point to Misener's Saw Mill, 1½ mile of easy excavation will bring it to Marshville, from whence the present feeder, being enlarged for a distance of 9 miles, will bring it to Broad Creek, within 1¼ mile of the Grand River, which it will enter about 2 miles above its mouth.

By the former route a canal of less than 8 miles in length will take a vessel from the Welland into Lake Erie at Port Colborne, where it will be 18 miles distant from Port Maitland, at the mouth of the Grand River, which is the only naval depôt on Lake Erie.

By the latter a canal of 14 miles will be necessary, but though so much longer than the former, the excavation on this route will be comparatively easy, and therefore this part will not be very much more expensive; and this route has the decided advantage of being 6 miles shorter to the naval establishment on the Grand River than the other, and also of communicating with that important station without any exposure whatever to the lake; and in addition to its being 18 miles higher up the lake, the mouth of the Grand River is always free from ice in the spring before Port Colborne, and it is altogether a more commodious situation for military purposes.

III. If the canal receive its supply of water from Lake Erie, two modes present themselves for consideration.

1st. By bringing the Lake Erie level from Port Colborne to the Welland, and building a large aqueduct across that river, then proceeding by the present line, 5 feet below the present level, through the Deep Cut to Allanburgh.

2nd. By erecting a dam across the Welland, near Port Robinson, and thus raising that river 10½ feet to the level of Lake Erie, and proceeding from Hellem's Creek, near the aqueduct, to Port Colborne, as before described (I. 2); or passing up the Welland to Fork Creek, and proceeding from thence by Marshville and Broad Creek to the Grand River, as described (I. 3). This plan will also lower the surface through the Deep Cut 5 feet, and of course increase the excavation to that extent.

Taking all the circumstances into consideration, I believe that the first mentioned plan will be the cheapest; but as there is reason to doubt whether the supply of water from the Grand River will always be found sufficient when the locks are enlarged, and as the last mentioned plan will be in every respect

by far the most commodious and secure when complete, I am induced to recommend its adoption, and I believe that the difference of expense will not exceed £ 50,000 sterling, the rough estimate for the former being about £ 1,200,000, and that for the latter £ 1,250,000 sterling, if the canal be taken from Hellem's Creek to Port Colborne; but if it be taken from Fork Creek to the Grand River the expense will exceed this sum, and therefore I have for the present estimated for the route to Port Colborne only, the detailed expense of which will be given in a future Report, accompanied by an estimate showing the extra expense to the Grand River, which will certainly be at all times the more commodious of the two for naval and military purposes. From the Deep Cut the old line may be enlarged to Thorold, from whence it will be desirable to deviate from the present course, and to follow a deep ravine or branch of the Ten-mile Creek for some distance; it may then cross over to a branch of the Twelve-mile Creek which joins the old line a little more than a mile above the village of St. Catherine.

From Port Dalhousie to Kingston, a distance of about 180 miles, the navigation by Lake Ontario is very good for steamers of any size, and so indeed is that of the River St. Lawrence, as far as the town of Prescott; but between Prescott and Montreal there are numerous rapids, in consequence of which, and particularly of that of the Long Saut, near Cornwall, the difficulty and danger of conveying heavy stores and merchandize is very great. This was found such a serious inconvenience during the last war with the United States, that a short time after the peace of 1815, Major-Gen. Nicolls, then Commanding Royal Engineer in the Canadas, was directed to send an officer to explore the country between Kingston and the Ottawa River, in order to ascertain whether it would not be practicable to form a secure and commodious water communication by an inland route, which being remote from the frontier, and therefore beyond the reach of an enemy, would be at all times available for military purposes.

Captain Jebb, Royal Engineers, who was employed on this duty, reported in favour of the practicability of forming this communication; but nothing was done respecting it for many years afterwards.

In 1821 the Legislature of Upper Canada passed an Act "to make provision for the improvement of the internal navigation of the province," and appointed commissioners to report on the subject; and in 1824 they sent in estimates for connecting Lake Ontario with the Ottawa River by the Rideau.

They also sent in an estimate for the improvement of the St. Lawrence, particularly at the Long Saut, which was considered more immediately necessary in consequence of the recent cession by the British Government of Barnhart's Island to the Government of the United States.

Nothing further appears to have been done on this subject, however, until 1826, when the British Government, seeing the absolute necessity of opening a secure water communication between the lakes and Lower Canada, in the event of another war with the United States, determined on forming the communication by the Rideau, and sent out Lieut.-Col. By, Royal Engineers, for this purpose. Under his superintendence this canal was formed, at the sole expense of the Home Government, and opened for public use in 1832.

About the same time canals were also formed by the Royal Staff Corps at Grenville, at the Chute à Blondeau, and at Carrillon on the Ottawa River, which, in connexion with the canal about to be formed next year by the Provincial Government at St. Ann's, and the Lachine Canal, which has long been open to the public, will complete the line of water communication between Montreal and the lakes.

Although this is a very tedious and circuitous route, the question will at first sight naturally be asked by all persons not well acquainted with the subject, why the above mentioned canals, which now afford a safe communication to Kingston, and to which the British Government have already so largely contributed, will not answer every purpose? and why therefore they should be called upon to assist in completing the works on the St. Lawrence?

To which it may be answered, that although the Ottawa and Rideau Canals are most useful in a military point of view, and in the event of a war with the United States they would be invaluable, yet they are so circuitous, and so much impeded by lockage,[2] that they will not answer for commercial purposes; at least they never can compete with the American canals for the trade of the Western States. Some of the locks on the Ottawa Canals are at present too small for steamers; and even if they were enlarged to the size of the Rideau locks, they would be altogether too small for the steamers which

[2] Vessels passing from Lake Ontario by this route rise 165 feet 4 inches to the summit level at the Rideau Lake, and then descend 292 feet 3 inches to the Ottawa, from whence the lockage to Lachine is 82 feet; making altogether 539½ feet of lockage. By the St. Lawrence it is only 209 feet from Kingston to Lachine. The distance by the latter route also is only 190 miles; by the former it is 237 miles.

navigate Lake Ontario and the Upper Lakes, and therefore a trans-shipment at Kingston would be necessary: consequently a canal on that scale, even if it were made along the line of the St. Lawrence would never draw off the trade of the Western States to the sea-ports of Lower Canada to the extent that it may be made to do if completed on the scale here proposed. For unless we open an uninterrupted navigation for *large freight steamers*, capable of conveying a cargo of at least 300 tons, *without any trans-shipment* before they arrive at Montreal or Quebec, we have no chance whatever of securing any great portion of that vast and important trade which must ere long be carried on between the Western States and the Atlantic Ocean, a very large proportion of which may, if properly encouraged, be most undoubtedly induced to come by this route, and thus confer incalculable advantages on the inhabitants both of Upper and Lower Canada; for besides the benefits which will ultimately result to these provinces from these works, when completed, they will derive the greatest possible advantage from them during their progress in many ways, and particularly in the very favourable opportunity they will afford of encouraging emigration from Great Britain to almost any extent, and on such a plan as will soon insure to these provinces a large numerical majority of good and loyal subjects. And I fully believe that nothing would tend so much to quiet the different parties in both provinces, and to produce contentment in the minds of all the well affected portion of the population, as the speedy completion of this very important communication, of which I now proceed to enter upon the details.

THE RIVER ST. LAWRENCE.

The River St. Lawrence, which conveys the waters of Lake Ontario to the Atlantic, has always been navigable for the largest steamers without interruption from Kingston to Prescott, a distance of about 70 miles, and this latter port was for some time considered the termination of steam navigation; but of late years steamers of great power and small draught of water, carrying passengers and light freight, have passed daily to Dickenson's Landing, which is situated at the head of the Long Saut Rapid, and about 38 miles below Prescott: from Dickenson's Landing to Cornwall, a distance of about 12 miles, this river is only navigable for boats and large barges.

At Chimney Island, about 4 miles below Prescott, there is a shoal which makes the channel very narrow, and the navigation rather intricate; but in ordinary seasons, when the river is not unusually low, vessels not drawing more than 9 feet of water may pass through it, and in all other parts of the river above the Long Saut there is a sufficient depth of water.[3]

In the year 1833 the Legislature of Upper Canada passed an Act "for the improvement of the navigation of the River St. Lawrence," and appointed commissioners to make the necessary arrangement for this purpose. They employed Mr. Wright and Mr. Mills, two civil engineers from the United States, who made a report and estimate of the expense required for improving this part of the river between Prescott and Cornwall, and who subsequently laid out the canal at the Long Saut, which was required by the Act to be commenced and finished before any other part was undertaken.

It appears by their Report, that between Prescott and Dickenson's Landing there are four rapids, which will require improvement before this part of the river can be made navigable for steamers carrying merchandize and heavy freight, &c., viz.

The Galoppes Rapids, the Rapid at *Point Cardinal*, *the Rapide Plat*, and *Farren's Point*. The plan they have suggested of passing these by short canals is a very good one, but I am of opinion that it will cost much more than the sum they have mentioned in their estimate.

The Galoppes Rapids are situated about 7½ miles below Prescott; here a lock of 4½ feet lift will be necessary, and a canal about 2400 feet in length, which, as descending vessels will pass down by the river, need not be more than 50 feet broad at the bottom. The expense of this point is estimated by Mr. Wright at £15,848. 10*s*. 6*d*. Halifax currency; but I am of opinion that it will amount to £29,500 sterling.

The rapid at *Point Cardinal* is situated about 1½ mile below the Galoppes Rapids, and here a lock of 2½ feet lift will be required, with a canal about 1500 feet in length; the expense of which has been estimated by Mr. Wright

[3] In the chart published at the Hydrographical Office of the Admiralty in 1828, from the survey made by Captain W. F. W. Owen, R. N., in 1826, the soundings here are marked 12 to 15 feet, and I found about the same depth when I sounded here in July last; but I had not the means of ascertaining the exact nature and position of the shoal above alluded to, as the current is very strong in this part of the river: it is therefore very desirable that the officer commanding on the lakes should be requested to have it properly examined as soon as possible.

at £13,484. 18*s*. 6*d*. Halifax currency; but I am of opinion that it will amount to £25,000 sterling.

From Point Cardinal to the head of the Rapide Plat the distance is about 10 miles, in which there is a good channel for vessels drawing 9 feet of water: there are, however, three rapids in this part of the river, which it may be proper to notice, though they may be passed by steamers without much difficulty.

Opposite Presqu'île, for about 1500 feet, the current runs at the rate of nearly 5 miles an hour. At Point Iroquois, for a distance of about 2710 feet, it runs at the rate of 5½ miles an hour; and at Pine Tree Point at the rate of 6 miles an hour. At the two latter points the St. Lawrence is very narrow, not exceeding 430 yards in breadth at the former, and 390 yards at the latter.

At the *Rapide Plat* three different routes have been suggested, by Mr. Clowes in 1826, Mr. Barrett in 1830, and Messrs. Wright and Mills in 1833. The first passes up Sawyer's Creek for about half a mile, then runs along a little in rear of Maria Town, and enters the river again near the mouth of Campbell's Creek. The second passes up Sawyer's Creek for about a mile, and running much more inland than the former, comes out at the bay near Broffle's Storehouse. The third runs along the side of the river from the mouth of Sawyer's Creek to the bay near Broffle's Storehouse.

I agree in opinion with the latter gentlemen, that the third is by far the cheapest route, and therefore to be preferred. The fall here being 11½ feet, two locks will be necessary, with a canal $3\frac{9}{10}$ miles in length; the expense of which, for one lock only, is estimated by Mr. Wright at £51,451. 8*s*. 9*d*. Halifax currency; but I think it will amount to £120,000 sterling

Farren's Point is situated about 10¾ miles below the foot of the Rapide Plat, and here a lock of 4 feet lift will be necessary, with a canal about 4000 feet in length; the expense of which is estimated by Mr. Wright at £26,485. 3*s*. Halifax currency; but I think it will amount to £48,000 sterling.

The *Long Saut Rapid* begins a little below Dickenson's Landing, and about 5 miles below Farren's Point, where the river ceases to be navigable for any thing but boats and large barges as far as Cornwall, and consequently a continuous canal of $1\frac{1}{4}$ miles in length was commenced here in 1834 by Messrs. Wright and Mills, whose estimate for this work was £216,342. 1*s*. 2*d*. Halifax currency; but owing to the sudden and very unprecedented rise in the price

of provisions and labour in 1835 and 1836, the contractors were quite unable to procure workmen, at any wages which they could afford to pay, under the contracts made by them in 1834. The commissioners therefore felt it necessary to make an advance on those prices of 10 per cent. in 1835, and 30 per cent. in 1836; in consequence of which, and of some alterations in the plan, the expense has far exceeded the above estimate; but notwithstanding these difficulties, this magnificent and important work would probably have been completed in the year 1838, and now in full operation, if the necessary funds which have already been voted for it by the Provincial Legislature could have been procured.

About £362,134. 11*s*. 10¼*d*. Halifax currency have been expended on this canal altogether, including the sums paid for land and claims for damages; and if it be now carried on to completion without further delay, it will only require the comparatively small sum of £51,500 Halifax currency to make it navigable; but if it be left in its present state, every year will add very materially to the injury which a large unfinished work of this kind must necessarily receive from being so exposed to the effects of the trying climate of this country.

Owing to some difficulty which has occurred in raising money for the debentures that have been voted for this purpose by the Provincial Legislature of Upper Canada, in consequence of the present political and financial difficulties of the province, this work is now suspended for want of the comparatively small sum above mentioned, the expenditure of which will, it is believed, make it navigable, and thus give a steam-boat navigation from the head of Lake Ontario to Coteau du Lac, at the lower end of Lake St. Francis, about 36 miles below Cornwall.

There are some unsettled claims for damages to property of no great amount, which must eventually be provided for, as well as the sum of £5,215. 15*s*. 6¼*d*. Halifax currency, for which the commissioners have given notes bearing interest to some of the contractors and other persons for work, &c. performed since the money which they have received from the Government was expended; and it is true that a further outlay of £10,000 or £12,000 will eventually be necessary at some future period, in order to give the work a finished appearance; but this is not at all essential to its utility, and therefore it may be delayed until the canal is completed and in operation, when there can be no doubt that the tolls will soon raise that sum, and thus the

whole amount eventually required for this canal will be about £57,300 sterling.

In this canal the fall is 48 feet, which is overcome by 6 locks of 8 feet lift each, besides the regulating or guard-lock at the upper end. These locks (which are all built of cut stone of the best description) were required by the Provincial Act to be made 55 feet broad, and not less than 150 feet long; but Mr. Wright, considering that vessels of such a breadth would require a much greater length in order to give them a due proportion, very properly increased the length of the locks to 200 feet between the gates, so that they will now pass steamers from 175 feet to 180 feet long, and upwards of 52 feet broad. The depth of water over the lower mitre-sill of the locks was required by the Provincial Act to be 9 feet, and therefore the other parts of the canal have been made 10 feet deep; and as descending vessels will not be able to pass down this part of the river with safety, the width of the canal at the bottom has here been made 100 feet. There is a surf berm 2 feet below the water surface on each side of the canal of 5 feet in breadth; all the slopes, both inside and outside, have 2 feet base to 1 foot perpendicular, and therefore the breadth of the canal at the surface of the water is 150 feet; the banks are made 4 feet above the water surface, and 12 feet broad at the top.

In order to avoid bridges, road culverts have been built where bridges would otherwise have been indispensable. They have been constructed of good coursed rubble masonry, giving a passage of 12 feet broad, (of which $2\frac{1}{2}$ feet are taken off for foot passengers,) and 10 feet high to the crown of the arch, which, rising $3\frac{1}{2}$ feet, is built of cut stone 1 foot 6 inches thick, laid in cement: the top or outside of the arch is covered with flat stones, laid in cement, which are afterwards covered with 2 feet of puddle.

The expenditure of the money required for this work, as well as the general management of every thing connected with it, has been entirely under the control of the commissioners appointed by the Provincial Act above alluded to, who have annually rendered a full report of their proceedings, as well as a detailed statement of the expenditure, to the Legislature. The work, after a fair competition by public advertisement, has been performed by contract, and in general the contractors have been a most respectable body of men.

The stone used for the locks is a compact limestone,[4] being a species of

[4] Its specific gravity is $2666\frac{2}{3}$.

black marble found a few miles from the canal, easily worked, and easily procured in large masses, so that many of the courses are 2 feet thick: the specification for the masonry required that none of the courses should be less than 12 inches, but generally from 16 to 24 inches; the stretchers not less than 3 feet long, and the headers not less than 2 feet in the length of the course. The whole of the masonry of the locks is laid in mortar, composed of hydraulic lime or cement from Messina, (a village situated in the State of New York, about 9 miles from the canal,) and a due proportion[5] of sand.

The lock-pits have in all cases been excavated in clay or gravel, so that there are no rock foundations. The canal generally has been excavated through hard clay or gravel, which changes in some places to light loam and sand. At the Long Saut, where the excavation has been from 40 to 50 feet in depth, the first 10 feet of it have been generally through stiff clay, below which it is mixed with gravel and some hard-pan, with occasional veins of sand and a quantity of large boulders, which are principally of limestone. There is no rock excavation in any part of the canal as now executed between Cornwall and the Long Saut, but in some sections there is a large quantity of loose stone and large boulders.

A full and minute description of the masonry, &c. of the locks, as well as of the construction of the lock-gates, the improvements invented by one of the contractors, Mr. Wilkinson, in the capstan and shaft, in the mode of adjusting the friction-rollers, and in constructing the valve-gates, will be found detailed at length at the end of this Report.

The works above mentioned comprise all the improvements required in Upper Canada. In the Lower Province there are three rapids between Lake St. Francis and Lake St. Louis, which will require to be overcome; and the canal between Lachine and Montreal will require to be very much enlarged, or probably it will be better to make a new canal altogether between these two places.

No vessels of any size have ever attempted to pass that part of the St. Lawrence which runs between Lake St. Francis and Lake St. Louis, large barges alone having hitherto been employed here on account of the *rapids at Coteau du Lac, the Cedars, and the Cascades*, which, like the rapids of the Long

[5] The proportion was from 2 to 3 parts of the cement to 1 of sand, the smaller quantity being allowed when St. Regis or river sand was used.

Saut, cannot be navigated safely by descending vessels of a large size if heavily laden. The Legislature of Lower Canada, therefore, in the year 1833, authorized the appointment of commissioners for the improvement of this part of the navigation, who employed Mr. Wright and Mr. Mills to make a Report on this part of the river, in doing which they suggested the three following plans.

1st. By forming a canal from M^{c}Donald's Point at the lower end of Lake St. Francis to the foot of the rapids at Coteau du Lac, then entering the river, and making use of it in those parts which can be navigated without much difficulty, and connecting them by intermediate canals at the rapids of the Cedars and Cascades, which form a serious obstacle to the navigation.

According to this plan, it is proposed to make use of about 8 miles of the river, and to form about 6$\frac{3}{4}$ miles of canal in the whole distance, which is altogether about 14$\frac{3}{4}$ miles. In doing this, 9 locks will be required, and the expense is estimated by Mr. Mills at £235,782. 3*s*. 2*d*. Halifax currency.

2nd. By commencing a canal from M^{c}Donald's Point, above mentioned, and following the general direction of the river, but going rather more inland, and thus forming one continuous canal of about 14$\frac{3}{4}$ miles in length to the foot of the rapids of the Cascades. This plan will require 10 locks, and the expense is estimated by Mr. Mills at £324,943. 11*s*. 5*d*. Halifax currency.

3rd. By commencing a canal also at M^{c}Donald's Point, but running across by a route still further inland 13$\frac{1}{2}$ miles to the Lake of the Two Mountains, which it enters a little below the church at Vaudreuil. This plan will require 10 locks, and the expense is estimated by Mr. Mills at £402,164. 4*s*., but it would require a further expense of £40,598. 15*s*. 11$\frac{1}{2}$*d*., making altogether £442,762. 19*s*. 11$\frac{1}{2}$*d*., to extend this communication through to Lake St. Louis, as an additional lock would be necessary in order to pass the rapids at St. Ann's. This plan, therefore, appears to be decidedly objectionable, because it is far more expensive than either of the others, and because the Lake of the Two Mountains is always closed by ice for a longer period every year than Lake St. Louis and the River St. Lawrence; and another very decided objection to this route is, that there appears to be no good channel of sufficient depth between Lake St. Louis and Vaudreuil.

I have not yet had time to devote so much attention as is necessary for a proper examination of either of these plans on the ground; but I am disposed to agree in the opinion expressed by Mr. Mills in his Report, that the first plan is preferable to either of the others, inasmuch as it appears to be the

cheapest; but I am of opinion that his estimate is far too low, and that it will cost £374,300 sterling. I proceed, therefore, to enter a little into the details of that plan, as follows.

In order to pass the rapids at *Coteau du Lac*, Mr. Mills proposes that a canal should commence at M^c^Donald's Point, and pass down along the north bank of the river as far as Fer à Cheval, a little below the fort: the length of this canal will be a little more than 2¾ miles, its breadth at the bottom 100 feet; and as the river falls 17 feet in this distance, two locks will be required here, besides guard-gates at the upper end; the expense of which will be about £117,050 sterling.

With reference to this part of his plan, Mr. Mills remarks in his Report, that "it interferes with and will destroy all the improvements which have been effected by the British Government" (at Coteau du Lac); and he adds, "I have laid my plans disregarding them altogether, presuming that every privilege and facility would be given to the province, without the least hesitation, in view of the improvement proposed."

On this I would remark, that his plan does here interfere very materially with the fort and barracks at Coteau du Lac, the latter of which must necessarily be removed, as well as the powder magazine, if it be adopted; but good permanent buildings might be constructed of equal extent, and affording better accommodation, and a suitable alteration in the fort might also be effected, for the sum of £3,250 sterling, which will increase this part of the estimate altogether to £120,300 sterling.

From Point Fer à Cheval to the village of the Cedars, a distance of 6 miles, there is a good and direct channel, having from 12 to 35 feet of water; and therefore the river may here be said to be navigable for this distance by large steam-boats, although there are three points which present some difficulty to sailing vessels, viz., Point au Diable, Point à Wattier, and Point à Biron.

At the first of these points the current runs at the rate of about 5 miles an hour for about 452 feet; at the second it runs about 4 miles an hour for only a short distance; and at the last it runs about 5 miles an hour for nearly a quarter of a mile. In this whole distance of 6 miles the river falls 7½ feet; the bank here is from 20 to 30 feet high, and composed of clay, with some veins of sand, which, as they cause frequent slides into the water, would present a very serious obstacle to the construction and maintenance of a canal along this part of the bank, either on the top near its brow, or along the bottom;

and it is rather a singular circumstance that, though this difficulty occurs again below the rapids at the Cedars, where the river is also navigable for steamers without a canal for some distance, it does not occur at any of the rapids or intermediate points where a canal is indispensable.

At the rapids of *the Cedars* the river falls 30 feet 9 inches in a distance of nearly $1\frac{3}{4}$ miles; a canal of this length, therefore, must be constructed here, which may be carried across Point aux Cèdres, and formed from thence along the river to Point à Moulin, through which it may be cut to the navigable part of the river below. It will require three locks of 8 feet 9 inches lift, and a single lock of 10 feet lift, making four in all, besides guard-gates at the upper end. The whole expense will be about £125,000 sterling.

From Point à Moulin the river is again navigable for steamers for a distance of a little more than $1\frac{3}{4}$ miles to Point à Coulonge, there being a channel from 10 to 35 feet deep, which, however, is not so direct as that above the Cedars. Between these two points the current runs about $2\frac{1}{2}$ miles an hour, and the river falls 1 foot 9 inches. The bank of this part of the river, like that above the Cedars, is also subject to slide off into the water, thus presenting a very serious obstacle to the construction of a canal, and therefore it is fortunate that one is not required here.

From Point à Coulonge to Lake St. Louis, a distance of a little more than $2\frac{1}{4}$ miles, the navigation of the river is obstructed by the rapids at Split-Rock Point and the Cascades, the latter of which present one of the most formidable obstacles of the whole.

In this distance the river falls 25 feet 3 inches, and therefore three locks will be necessary, besides guard-gates at the upper end, viz., one at Split-Rock Point of 7 feet lift, two at the entrance from Lake St. Louis of 8 feet 9 inches and 10 feet lift respectively: the canal will be cut through Split-Rock Point, and also through the point at the Cascades, which being composed of rock, the excavation here will be very expensive. In the other parts Mr. Mills proposes to form the canal by constructing a bank along the river to retain the water to its proper level. The expense of this section will probably amount to £129,000 sterling.

From hence it appears that the whole distance from Lake St. Francis to Lake St. Louis is a little more than $14\frac{1}{2}$ miles, which may be divided into five sections, as follows: the *first* section from M^{c}Donald's Point, near the steamboat landing, to Point Fer à Cheval; the *second* from Point Fer à Cheval to

the village of the Cedars; the *third* from the Cedars to Point à Moulin; the *fourth* from Point à Moulin to Point à Coulonge; the *fifth* from Point à Coulonge to the entrance of Lake St. Louis at the foot of the rapids of the Cascades.

The *second* and *fourth* of these sections, comprising a distance of nearly 8 miles, are already navigable for steamers, and therefore nothing is required to be done to them, although the river falls 9½ feet in this distance; in the other three sections, comprising a distance of about 6¾ miles, the river falls 73 feet, in which 9 locks will be required of various lifts; so that the whole descent from the foot of Lake St. Francis to the head of Lake St. Louis is about 82½ feet, and the estimated expense required to render this part of the St. Lawrence navigable for large steamers is £374,300 sterling.

In the latter part of this Report, Mr. Mills states, that he visited the south side of the river, and passed over the country from Lake St. Francis to Beauharnois on Lake St. Louis, but not with instruments, and therefore he does not speak positively on the subject; he says, however, that "he believes it will require a longer canal, and although very feasible, yet possessing no advantages and no extraordinary facilities for construction."

In the year 1835, Mr. Baird was employed, in conjunction with Mr. Stevenson, a civil engineer residing in Lower Canada, by the agent of the 'Seigniory' of Beauharnois, in order to prove that the south side of the river does possess advantages over the north side, and that a continuous canal may be made more easily, and at a smaller expense, on the former than on the latter.

According to the Report made by Mr. Baird, it appears that a cheaper canal may be constructed by following the River St. Louis for some distance, the expense of which he estimates at only £194,800. 7*s*. 10*d*.; and, according to the Report made by Mr. Stevenson, a canal may be made by a route running nearer to the St. Lawrence, the expense of which he estimates at only £224,444. 5*s*. Halifax currency. Both of these estimates are lower than Mr. Mills's first and cheapest plan; but I am of opinion that they are too low, as well as those made by Mr. Mills, and that this work cannot be executed properly for the sum mentioned; but before I can venture to give a decided opinion upon either of these routes, it will be necessary to examine each of them far more minutely than I have yet had leisure to do. I have no doubt, however, that the communication between Lake St. Francis and

Lake St. Louis can be completed for the sum I have put down for this purpose.

It is proper that I should here notice a remark, very justly made by Mr. Mills on this subject. In reference to the south side of the river, he says that, "Purely geographically, this would seem the most natural and direct route for a canal between these waters;" but he adds, that "there is a political objection to its being constructed on the south side of the St. Lawrence, which I will barely name. The work in contemplation must be considered national in its character, and therefore ought to be so located as to be least in danger in case of foreign invasion."

If this was considered an objection in 1833, when Mr. Mills made this Report, how much more ought it to be so considered after the events of 1837 and 1838; for it is quite certain that if this canal had been constructed and in operation on the south side in 1838, the communication would have been interrupted by those persons who rendered necessary the march of the Highlanders from Glengarry to Beauharnois, as well as the expedition to Napierville, Château-guay, &c. And this certainly may be considered a strong objection to placing the canal on the south side of the St. Lawrence, because it would be so much exposed in the event of a war with the United States. To this it may be answered that the communication now under consideration is chiefly, if not altogether, intended for commercial purposes, and that the whole line of the St. Lawrence would be so much exposed in the event of a war as to preclude its use to any great extent. This important question, however, requires full consideration, and it will of course be decided by higher authority than the Report of any individual. I have here provided for placing the canal on the north side of the St. Lawrence, according to Mr. Mills's plan; and if Mr. Baird and Mr. Stevenson are correct, the sum I have mentioned will be more than sufficient for placing it on the south side, if that route shall be finally decided on.

I think it probable that by putting one or two dams across from the north shore to Grande Isle, the river itself may be made navigable nearly all the way to St. Timothy; but I have not yet had an opportunity of examining the ground sufficiently to enable me to speak positively on the subject: I am, however, induced to believe that in any case it may be found possible to construct a canal on the south shore cheaper than on the north.

From the foot of the rapids of the Cascades large steamers may pass through

Lake St. Louis to Lachine, a distance of about 21 miles, without meeting with any serious obstruction. As far down as the middle of St. Bernard's Island, which is situated at the mouth of the River Château-guay, the navigation of this lake has always been found good; but it has been very generally understood that large vessels could not pass the shoals or banks of sand and stones which occur opposite the mouth of that river. I have, however, ascertained from actual observation, as well as from the information I have obtained from the most experienced pilots on this lake, that there is a good navigable channel by which vessels drawing not more than 9 or 10 feet of water may pass down to Lachine without difficulty.

THE LACHINE CANAL.

The rapids between Lachine and Montreal render it necessary to form a continuous canal of about 9 miles in length between these two places.

A joint-stock Company, which was incorporated by an Act of the Provincial Legislature about twenty years ago, caused the preliminary surveys to be made for this purpose in 1819; in the following year the Provincial Government purchased the rights of this Company, and commissioners were appointed to superintend the work, which was fully opened for the use of the public in 1825, since which time it has been in constant use, and it is now generally in good order.

The present canal is about $8\frac{1}{2}$ miles in length; its width at bottom is 28 feet; at the top water line, where the excavation is in rock, it is 36 feet, and where it is in earth, 48 feet, with 5 feet depth of water.

The locks, which are built of cut stone, are 100 feet long and 20 feet broad; they are seven in number, including the guard-lock, and of various lifts, from 6 to 9 feet; the whole descent from Lachine to Montreal being about 45 feet.

The total cost of this work was £109,601. 0*s*. 9*d*. Halifax currency. The tolls, which in 1825 were only £1280. 12*s*. 4*d*., have very much increased during the last ten years, and they amounted this year to £6638. 10*s*. 4*d*., as will be seen by the statement given in the Appendix.

At the upper end, near Lachine, the excavation has been carried through solid limestone rock for upwards of 2 miles, where the cutting has been rather deep; but from thence to Montreal it runs chiefly through clay and gravel,

and the ground is generally very favourable for the purpose, excepting near the fourth mile stone, where a species of hard-pan occurs for about half a mile.

The stone for the upper locks was obtained from Caughnawaga, and that for the lower locks from the quarries near Montreal.

The present entrance at Lachine is very inconveniently situated, even for the small vessels which now pass through it, on account of the shoals and rocks in the neighbourhood; it will therefore be necessary, in forming a canal for large vessels, to make the entrance at Leichman's Point, nearly half a mile higher up the river, where the water is deep very near the shore, and the entrance will be very commodious.

Considering the great expense that would be required to alter the present canal, and enlarge it to the dimensions now proposed, and also the very serious inconvenience to which the public would be exposed if they were deprived of its use for two or three years, which they necessarily must be if any attempt be made to enlarge the present work, I have projected a new canal altogether, which, beginning at Leichman's Point and running in rear of the village of Lachine, will cross the road leading to Montreal a short distance from the foot of the hill, and meet the present canal about 4 miles from Lachine, by which means some deep cutting in rock excavation will be avoided, and altogether this part of the line will be more commodious than the present one, and more easily executed.

After meeting the present canal, it may be carried along the north side of that work until it comes near Montreal, where it will be necessary, in order to avoid the expense of purchasing the numerous valuable buildings which have been erected near the lower locks, to carry it into the old canal, which may for this short distance be enlarged without much inconvenience to the public, as the forwarders may very easily for one season cart their goods, &c. to the point of junction.

Some alteration may probably be made with advantage in the disposition of the locks. No. 1, or the regulating lock, will be near the entrance. At the Côte St. Paul, locks Nos. 2 and 3, which now fall 12 feet by two combined locks, I propose to place one of 9 or 10 feet lift; and by making No. 4 or the St. Gabriel lock to fall 10 or 11 feet, instead of 8, we shall obtain the same level as at present in the reach below that lock, from whence the remaining descent of 25 feet into the St. Lawrence may be overcome by three locks, thus reducing the number of locks to six instead of seven.

Three small culverts will be required as at present, besides an additional one between the entrance of the new canal at Lachine and its meeting the old one at the point above mentioned; one swing or drawbridge at each end, and three intermediate ones: viz., at the crossing of the main road near the foot of the hill; at the crossing of the road between the Tanneries and the Côte St. Paul; and at the crossing of the Lower Lachine Road above Montreal; besides which, from six to eight accommodation bridges are said to be necessary; but I think that some of these at least ought, if possible, to be dispensed with, or probably large scows may be substituted for them.

It will be desirable to straighten the course and deepen the bed of the little River St. Pierre, without which large claims for damages resulting from the backing of the water in wet seasons may be anticipated.

The expense of this canal, according to this plan, will be about £324,600 sterling.

From Montreal any vessels which can pass through the canals above described will be able to proceed to Quebec without difficulty, and thus the whole expense of improving the communication by the Welland Canal and the River St. Lawrence for large freight steamers from Lake Erie to Quebec, and of thus opening a continuous inland navigation from tide-water at the latter port of 1600 *miles in extent*, may be estimated at £2,228,700 sterling. It will be desirable to undertake the St. Lawrence Canal from the Long Saut to the Cascades and the Welland Canal in the first instance; both of which may be completed in three or four years from the time of their being properly commenced, provided a sufficient number of workmen are procured for the purpose, by encouraging a large emigration. The other works mentioned in this Report may also be completed in the same time from the period of their being commenced.

Between Montreal and Quebec the shoals on Lake St. Peter's offer a very serious impediment to large vessels heavily laden from the sea; but as such vessels cannot possibly proceed beyond Montreal, this difficulty, though a very serious inconvenience to that city, does not materially affect the trade of the Upper Province and of the Western States, and therefore I do not feel it necessary to take any further notice of it in this Report, which is respectfully submitted for your Excellency's consideration.

GEORGE PHILLPOTTS.

Detailed Estimate of the Masons' Work, Carpenters Work, Timber and Iron-Work, &c., required for the construction of one of the Locks on the St. Lawrence Canal, with Gates complete.

Masons' Work in the Lock.

		£.	s.	d.
Main body of lock	3925 yards.			
Main breast	147 ,,			
Upper breast	117 ,,			
Extension of wings	506 ,,			
Anchor stones	32 ,,			
	4727 yards of masonry at 40*s.*,	9,454	0	0
Excavation of lock-pit, foundation, &c., 11,500 yards, at 1*s.* 3*d.*		718	15	0
Labour in puddling and filling in rear of walls, &c., 4800 days at 3*s.* 9*d.*		900	0	0
28,500 feet superficial 2-inch pine plank laid double on the floor of the lock chamber, and under the walls, £17. 10*s.*		498	15	0
7250 superficial feet of ditto laid in sheet piling, £8.		58	0	0
4100 superficial feet of 5-inch hard-wood plank laid in the recess floor, £32. 10*s.*		133	5	0
12,000 feet of timber laid in the foundation, at £43.		516	0	0
Twenty-seven trusses framed and laid for recess floors, each £11.		297	0	0
Iron-work for ditto, 10,544 lbs., at 9*d.* per lb.		396	8	0
1067 of 4-inch spikes for recess floors, weighing	1717 lbs.			
Thirty-three of $1\frac{3}{8}$-inch iron bolts for main breast, $3\frac{1}{2}$ feet long, weighing	1036			
Sixty-six of 1-inch fox-wedged iron bolts, $1\frac{1}{2}$ feet long	703			
	3456 at 9*d.*	129	12	0
Total of masons' work, &c., in body of lock		13,095	15	0

Carpenters' Work, and Timber in the Gates.

	White Oak.	Pine.
One pair of upper gates.		
Twelve bars 28 × 13 inches, 32 feet long each (oak)	$970\frac{2}{3}$	
Two quoin-posts 18 × 20 inches, 16 feet long (ditto)	80	
Two mitre-posts 18 × 16 inches, 16 feet long (ditto)	64	
Eighty planks $2\frac{1}{2}$ inches thick and 12 feet long, and 10 inches broad (Norway pine)		800
One pair lower gates.		
Eighteen bars 28 × 13 inches, 32 feet long (oak)	1456	
Two quoin-posts 18 × 20 inches, 22 feet long (ditto)	110	
Two mitre-posts 18 × 16 inches, 21 feet long (ditto)	84	
Eighty planks $2\frac{1}{2}$ inches thick, 16 feet long, and 10 inches broad (Norway pine)		$1066\frac{2}{3}$
	$2764\frac{2}{3}$	$1866\frac{2}{3}$

	White Oak.	Pine.
Brought forward	2764⅔	1866⅔
Two mitre-sills (oak).		
Four pieces 22 × 12 inches, and 33 feet long	242	
One piece 25 × 9 inches, and 12 feet long	21	
The 4-inch studs between the bars of the gates will come off the other sticks.		
	3027⅔	1866⅔

	£.	s.	d.
That is, 3027⅔ of oak timber at 2s. 6d. per foot	378	9	2
2000 feet of 2½-inch Norway pine, at £7. 10s.	15	0	0
Carpenters' work, framing gates, and fixing iron-work, &c.	400	0	0
Laying mitre-sills	47	0	0
Fitting anchor stones, boring for bolts, &c.	35	0	0
Total for timber and carpenters' work, in gates, &c.	875	9	2

Iron-work in the Gates.

	Upper Gate.			Lower Gate.		
	Wrought Iron.	Cast Iron.	Brass.	Wrought Iron.	Cast Iron.	Brass.
Sixteen ⊓ plates, weighing lbs.	1312	..	..	1312	..	..
Sixteen T plates	752	..	..	..	..	..
Forty do.	..	..	..	1880	..	..
136 screw bolts and nuts for do.	680	..	..	..	..	..
208 do. do. do.	..	..	..	1040	..	..
Four valve-gates, with rods and fixtures	2564	..	122	2748	..	122
Four valve-gate screws, with fixtures	1521	328	168	1521	328	168
Two friction-rollers, with bars, &c.	1122	340	128	1274	340	128
Two do. screws and brass boxes	96	..	78	96	..	78
Twelve pieces of segment	..	4317	..	..	4317	..
Six plates for do., with spikes	600	..	..	600	..	..
Eighty-four bolts for segments	336	..	..	336	..	..
Twenty-two screw bolts for mitre-sills, nuts and washers	319	..	..	319	..	..
Sixteen rag bolts for blocks for mitre-sills	224	..	..	224	..	..
One plate and spikes for do.	113	..	..	113	..	..
Two bars for edge of do.	424	..	..	424	..	..
Fifty-two spikes for do.	19	..	..	19	..	..
Twelve bridge knees	336	..	..	336	..	..
108 bolts for do.	54	..	..	54	..	..
Twelve hand-rail supports and two hand-rails	717	..	..	717	..	..
Four caps for quoins and mitre-posts, with hoops and nails	184	..	..	184	..	..
Two anchors, with hoops and wedges, &c.	900	..	120	900	..	120
Sixteen bolts for do.	134	..	..	134	..	..
Four capstans and drums	68	3248	59	68	3248	59
Four capstan shafts	1488	..	..	2032	..	..
Four do. with well covers and brass boxes	4	1160	81	4	1160	81
Twenty-four bolts for do.	12	..	..	12	..	..
Carried forward	13979	9393	756	16347	9393	756

	Upper Gate.			Lower Gate.		
	Wrought Iron.	Cast Iron.	Brass.	Wrought Iron.	Cast Iron.	Brass.
Brought forward . . . lbs.	13979	9393	756	16347	9393	756
Four capstan T plates, with brass boxes . .	156	..	81	156	..	81
Twelve bolts for do.	48	..	..	48	..	..
Four capstan steps, with plates, boxes, and bolts .	222	..	35	222	..	35
Eight capstan handspikes	444	..	..	444	..	..
Two chains 43 feet long	408	..	..	408	..	..
Two do. 81 feet long	770	..	..	770	..	..
Two fixtures for do. on gates	233	..	..	233	..	..
Four riders for capstan	272	..	98	272	..	98
Four iron braces for gates, $17\frac{1}{2}$ feet × 4 inches × $\frac{5}{8}$ inches	576	..	..	..	..	..
Four do. do. $21\frac{1}{4}$ feet × 4 inches × $\frac{5}{8}$ inches	..	..	..	732	..	..
Two connecting do., 2 feet long	32	..	..	32	..	..
Twenty bolts for do., with nuts	160	..	..	..	..	..
Twenty-eight do. do.	..	..	..	224	..	..
Two quoin-post steps, hoops, &c.	74	186	8	74	186	8
Two snubbing posts	38	66	..	38	66	..
Twenty bolts, with nuts and washers for connecting the bars of the gates together . . .	411	..	..	..	..	..
Twenty-six do.	..	..	..	533	..	..
720 7-inch spikes for planking	735	..	..	..	..	..
1300 do.	..	..	..	975	..	..
Total	18558	9645	978	21508	9645	978
				18558	9645	978
Total quantities in both gates . . .				40066	19290	1956

	£.	s.	d.			
Therefore 40,066 lbs. of wrought iron at 9*d.* per lb. . . .	1502	9	6			
19,290 lbs. of cast-iron at $3\frac{1}{2}$*d.* per lb. . . .	281	6	3			
1956 lbs. of brass at 2*s.* 6*d.* per lb.	244	10	0			
Frame-work, &c., of gates				2028	5	9
Timber, and carpenters' work				875	9	2
Masons' work, &c., in the lock				13,095	15	0
Total for lock				15,999	9	11
Add 15 per cent. for contingencies				2400	0	0
5 per cent. superintendence				800	0	0
				£19,199	9	11

A single lock may therefore be estimated at £19,200.

THE LOCKS.

The walls of the locks are built upon floors laid longitudinally on sleepers of pine or hemlock 12 inches square, which cross the lock at 8 inches distance from each other. The floors of the chambers of the locks are 2 feet 6 inches lower in the middle than at the sides, so that the sleepers meet there at an angle of nearly 167°, like an inverted roof, which prevents their rising; under the walls they are laid horizontally. These sleepers are supported by seven rows of range timbers laid longitudinally under the front and rear of the walls, under the middle of the chamber, and half-way between the front of the walls and the middle of the chamber; and they are well secured to these longitudinal timbers by oak treenails. The spaces between the joists being well filled in with gravel, the horizontal part under the walls is covered with 4-inch plank, the remainder with a course of 3-inch plank, and the joints of the latter are afterwards covered by a course of 2-inch plank; the whole being well secured with oak treenails and ragged iron bolts when necessary. The floors within the recesses for the gates are of 5-inch plank, either of oak or rock elm, laid on twelve rows of timbers 12 inches square, which are placed 2 feet apart, and framed upon the heads of piles driven at a distance of 2½ feet apart under the walls, and 4 feet apart between the walls. Wherever the nature of the soil in the lock-pit prevented the driving of piles, inverted trusses made of timber 12 inches square have been used as a substitute for them; these are placed about 13 inches apart, excepting at the angle of the mitre-sills, where an additional truss has been put in: additional piles have also been placed at this angle where piles have been used. The flooring between the wing-walls outside the recesses is laid level on timbers 12 inches square, placed 8 inches apart, and it is carried down about 4½ feet below the masonry of the lower wings; that part which is under the walls is supported by cross timbers laid longitudinally as in the chambers, but only 2 feet apart; the remainder is kept from rising in the middle by means of anchor stones, about 3 feet square and 2½ feet thick, to which they are secured by fox-wedged iron bolts 1 inch thick. Plates VIII. and IX.

The walls of the chambers are 20 feet high and 13 feet broad at the bottom;

they rise with a slope of 8 inches to the foot in front for the first 10 feet,[6] and afterwards with a slope of 1 inch to the foot; and by means of offsets at the back, their breadth is reduced to 5 feet under the coping, which is 16 inches thick, and 4 feet broad.

The walls of the recesses are perpendicular in front, but as they curve horizontally to receive the gates, they are 10 feet 5 inches broad in the middle, and 11 feet 6 inches at each end; their breadth is reduced by offsets at the back to 9 feet 2 inches at the height of 10 feet from the foundation, and to 5 feet under the coping, as in the chambers. At the hollow quoin piers, which are perpendicular, the locks are 55 feet broad, and at the end of the gates $55\frac{1}{2}$ feet. The centre of the lower chain hole is 16 feet below the end of the recess, and from this centre the outer edge of the coping, for the circular part of the wings, is described by a radius of 8 feet.

In order to keep the valves or sluices (which are placed in the lock-gates) below the water surface, and also to preserve the wooden floors of the recesses, the breast of the locks only rises in the first instance 6 feet above the bottom of the chamber walls, at which level the recess floors are placed; a second or upper breast is consequently required at the upper part of the recess, which is 3 feet high and 8 feet thick, and the top of which will support the stop logs[7] when necessary: the circular part of the upper wings is described from a centre taken in the line of the back of this upper breast, with a radius of 8 feet.

The walls of the lower wings are finished like those of the chambers. Those of the upper wings have a slope in front of 3 inches to the foot as far up as the water level, and from thence to the coping they have only a slope of $1\frac{1}{2}$ inch to the foot.[8] They are 9 feet thick at the bottom, and they are reduced by offsets in the back to 5 feet thick below the coping.

The man-holes are 2 feet square; but they are enlarged to 3 feet for a distance of about 4 feet, where the T plates are built into the wall to support the capstan shaft.

[6] These walls would have been better if the lower part had been built like the upper part, with a slope of 1 inch to the foot. Anchor stones might have been placed to keep the timbers from rising, if necessary.

[7] A caisson may probably be adopted here with advantage, instead of the logs.

[8] These walls would have been better if built with the same slope as the upper part of the chamber walls.

The timber and plank used for the foundations are pine or hemlock. The trusses and planking of the upper recesses are of rock elm.

Several rows of sheet piling, made of 3-inch pine plank, tongued and grooved, are placed across the locks under the planking, being well secured to the timbers, and carried to the outside of the masonry. They are placed at the head and foot of each recess across the lower end of the locks below the wing-walls, and in some cases across the upper end also.

LOCK-GATES.

The lock-gates are 32 feet 6 inches long each, the cross bars being 29 feet 4 inches in length, the mitre-posts 18 inches × 16 inches, the quoin-posts 20 × 18 inches. The two lower bars are 12 inches thick; the upper bar is only 10 inches thick: these being the principal bars, all of them are 27 inches broad in the middle, 16 inches at the end next the mitre-post, and 18 inches at the quoin-post, having a convex curve towards the head of the canal of 10 inches, and a tenon into each post of 9 inches. Plate X.

The intermediate bars vary in thickness from 12 to 9 inches, according to their position; they likewise have a convex curve on the upper side, and a concave curve on the lower side, of 7 inches;[9] and as $2\frac{1}{2}$ inches are taken off for the thickness of the planking on the upper side, they are only $17\frac{1}{2}$ inches broad in the middle, $13\frac{1}{2}$ inches broad at the end next the mitre-post, and $15\frac{1}{2}$ at the quoin-post. They are placed at different distances, according to their heights from the bottom, varying from 9 to 16 inches, except the two lower bars, which are 18 inches apart, in order to give room for the valve-gates.

These valve-gates, which are affixed to the second bar, are on quite a new construction, the invention of David Wilkinson, Esq., of the Cohoes Falls, State of New York, one of the contractors for the lock-gates. The peculiar novelty in their construction consists in their being so made as to open by the pressure of water from above, and they are closed by means of a screw against the head of water, the weight of the paddle-gate being made to assist in closing them. Plate XI.

[9] This curve has been cut out of the lower side of these bars, in order to make them lighter; it may be doubtful, however, whether it is not as well to leave it in.

The openings for these valves, of which there are two in each gate, are 5 feet long, so that the column of water which passes through them when opened is 20 feet by 15 inches, and it is computed that they will fill the locks in about 5 minutes.

These valve-gates open on horizontal hinges attached to the second bar, which is so placed that these hinges are 1 foot below the water line of the lower level; their under surface being curved, gives the water a downward course when passing through them, and thus prevents its injuring the vessels in the locks. The hinges are let into the under part of the second bar, between two studs of 9 inches thick, the lower bar being bevelled to conform to the downward course of the water; the screws which close the valve-gates are 3 inches in diameter, and they are worked on the bridge of the lock-gate by a frame, as shown in the plan.

Plate XII. The lock-gates move on a friction roller which runs on a segment of cast-iron. This roller is 16 inches in diameter, and it is let into the lower bar about 3 feet from the end of the gate.

It is held in its place by means of two stirrups of iron, to which is attached an iron rod $2\frac{1}{2}$ inches in diameter, the upper end of which works in a screw box let into the under side of the top bar of the gate, by means of which this end of the gate is supported, and it may be raised or lowered when necessary. With a view of giving strength to the outer end of the lower bar, where it is cut to receive the friction-roller, a piece of oak is added on the top 6 inches thick and 6 feet long, which is secured above and below by means of wrought-iron plates $\frac{5}{16}$ths of an inch thick, connected by six bolts $1\frac{1}{8}$ inch in diameter.

In order to prevent the gates from settling at all in the middle, on account of their great length, two braces of 4-inch bar-iron $\frac{5}{8}$ths of an inch thick, are carried down from the head of each post to the second bar, on which they nearly meet at the middle, where they are connected together by a piece of bar-iron of similar dimensions; they are let into all the bars of the gates immediately under the planking, and they are secured to the post and to each bar by iron bolts 1 inch in diameter.

The bars of the gates are further kept in their places by means of small studs 4 inches thick and the full width of the bars; on the sides of these studs screw bolts with nuts are placed, connecting each bar to the one above and below it, and thus the whole is kept firm together.

The bars are connected to the posts by means of single tenons, each of which is 9 inches long, and $\frac{1}{3}$rd the thickness of the bar in width, that is, $5\frac{1}{2}$ inches at the mitre, and 6 inches at the quoin-post, and they are boxed into the post with a shoulder of $\frac{1}{2}$ an inch. They are all held to their places in the posts by means of T and ⊓ plates, made of 4-inch bar-iron $\frac{5}{8}$ths of an inch thick, extending upwards along the posts on both sides of the gates, from the middle of the lower to the middle of the upper bar, that part of the plates which runs along each bar being 3 feet 7 inches long. These plates are all attached to the gates by means of screw bolts with square nuts running through from the upper side, and connecting them with the corresponding plates on the lower side.

The upper side of the gates is covered with $2\frac{1}{2}$-inch plank of Norway pine, grooved and tongued together, and let into the bars, which, as well as all the rest of the wood-work of the gates, are of the best white oak.

The bridges of the gates are of 3-inch oak plank 27 inches wide; they are supported by iron knees $3\frac{1}{4}$ inches by $\frac{5}{8}$ths of an inch, and by pillars or posts of iron $1\frac{1}{2}$ inch diameter, which run through the knees, and extend upwards 3 feet, in order to support the hand-railing, which is of rod-iron $1\frac{3}{8}$ths of an inch in diameter.

The mitre-sills are 22×12 inches, and they are so placed as to form a salient angle of 130°; they are secured to the recess floors by means of screw bolts $1\frac{1}{2}$ inch in diameter and 29 inches long, four of which pass through the planking to the middle of each truss or cross timber below; the thread of the screw is 12 inches in length, to correspond with the thickness of these timbers: the whole is well bedded in cement. On the lower side they are further supported by three blocks of wood, which are likewise secured in the same manner as the mitre-sills by four screw bolts through each. The block at the centre or point of the sills is covered by a wrought-iron plate to prevent the chain of the gates from wearing the mitre-sills; it is 6 feet by 22 inches; those on the sides are 5 feet by 18 inches. A bar of 4-inch wrought-iron $\frac{1}{2}$ an inch thick is placed along the top of the mitre-sill, projecting about $\frac{1}{2}$ an inch on the upper side, so that the pressure of water against the gate may make a close joint. This bar is let into the mitre-sill and secured to it by spikes.

The lock-gates are opened by means of close-linked chains 2 inches in diameter, made of wrought-iron $\frac{9}{16}$ths of an inch thick, which are attached

to the gates near the friction rollers by strong hooks, so constructed that the chains can be taken off and replaced if required without drawing off the water from the canal. These chains are worked by a capstan placed on the walls of the locks, turning a perpendicular wrought-iron shaft 3 inches in diameter, having a cast-iron drum round the lower end of 5 inches in diameter, to the bottom of which the chain is attached; and as it rises by the turning of the capstan, it is kept in its place, and prevented from becoming entangled in any way, by means of a rider (also the invention of Mr. Wilkinson) placed at the bottom of the capstan, which is constructed by having a thimble to pass around the drum, the under edge of which is made in a spiral form with a tube attached to the same, through which the chain passes.

Plate XIII.

A wrought-iron step 3 inches in diameter is inserted in the masonry at the bottom of the man-holes to receive the drum, and it is kept in its place by a wrought-iron plate 15 inches square. A brass box is inserted in the bottom of the drum about 1 inch thick, which covers this step. The capstan shaft is supported and kept in its place by means of a T plate of 4-inch bar-iron $\frac{5}{8}$ths of an inch thick, built into the masonry about $5\frac{1}{2}$ feet from the bottom, having a brass box for a bearing to prevent friction, and brass boxes are also placed in the iron stirrups, which hold the friction-rollers, for the same purpose.

The man-holes are covered by circular cast-iron plates about an inch thick, one half of which is made to open, in order to enable a person to descend in case any thing requires repair; and in the centre of these plates a brass box also is placed, which forms a third bearing for the shaft.

The capstan head is made in two parts, in the lower of which two palls are placed to prevent its being turned the wrong way.

The quoin-post is supported by a cast-iron step let into the recess floor, which runs into a socket in the bottom of the post, having a small brass plate 1 inch thick placed on this step to prevent friction. The diameter of hole which is made in the floor to receive this step is 1 inch more than that of the step itself, in order to allow the screw attached to the friction-roller to raise the gates if necessary.

The quoin or heel-post is kept in its place by a collar fastened to the anchors which are let into the coping. This collar is wrought-iron $2\frac{1}{4}$ inches square, and within it are placed two half hoops of 6-inch bar-iron $\frac{1}{4}$ of an inch thick, connected together by the collar which passes through them. A

small lip $1\frac{3}{4}$ inch broad projects over the coping from that part of the hoop which is between the anchors, in order to prevent any thing falling down behind the quoin-post; and small plates of brass $\frac{1}{2}$ an inch thick are let into that part of the quoin-post which is in contact with this hoop. The anchors are of wrought-iron 6 inches wide and $1\frac{3}{4}$ inch thick, gradually tapering to 4 inches in width at the ends. They are let into the coping, and secured to the masonry by $1\frac{1}{2}$-inch iron bolts 3 feet long, having round nuts at the top, counter-sunk into the anchors, so that no part projects above the surface. These bolts are secured in the masonry by means of a composition of sulphur and iron ore, of nearly equal weights, which expands and fills the holes better than lead, and which is in every respect equally good and much cheaper.

APPENDIX.

A.

Abstract of the Tolls collected on the present Canals between Lake Erie and Montreal during the year 1839, as shown in the following statement.

	£.	s.	d.
Welland Canal	12,700	0	0
Rideau ,, ...	7,000	0	0
Ottawa ,, ...	2,000	0	0
Lachine ,, ...	6,638	10	4
Total in 1839,	£28,338	10	4

Statement of the Tolls collected on the Welland Canal from 1833 to 1839.

Year.	Amount of tolls collected.			Remarks.
	£.	s.	d.	
1833	3618	1	6¾	
1834	4300	8	5¾	
1835	5807	5	11¼	
1836	5754	12	3½	
1837	5516	4	4	
1838	6740	13	10	
1839	12700	0	0	This is given as an approximation, the return not yet having been received.

Statement of the Tolls collected on the Rideau and Ottawa Canals during the years 1837, 1838, and 1839.

Year.	Rideau Canal.			Ottawa Canals.			Total.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
1837	4189	16	0	No returns yet received.					
1838	5297	8	8	1754	1	6½	7051	10	2½
1839[1]	7000	0	0	2000	0	0	9000	0	0

[1] The accounts for the present year are not yet made up, but these amounts have been given as near approximations.

Statement of Tolls collected on the Lachine Canal from 1825 to 1839, both years inclusive. Montreal, 24th December, 1839.

Year.	Downward.			Upward.			On boats, &c. wintering, and on boats, &c. built and repaired, and wharfage dues, &c.			Total.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
1825	1089	14	8	190	15	8	..			1280	10	4
1826	1571	2	1½	458	16	4½	..			2029	18	6
1827	2433	19	7	818	16	7	..			3252	16	2
1828[2]	321	11	10	54	8	6	..			376	0	4
1829	1884	15	3	1040	15	4½	..			2925	10	7½
1830	3708	3	3	1604	17	11½	..			5313	1	2½
1831	4461	12	10	2171	5	6½	..			6632	18	4½
1832	3802	7	9½	2107	12	0½	..			5909	19	10
1833	4844	0	3½	2310	3	9	..			7154	4	0½
1834	4308	6	11½	2222	15	11	..			6531	2	10½
1835[2]	39	12	7½	41	3	1	..			80	15	8½
1836	3869	16	8	2409	19	4½	97	4	0½	6377	0	1
1837	2438	17	9½	2158	9	8	65	17	5	4633	4	10½
1838	2982	14	5½	1705	16	9	63	3	9	4761	14	11½
1839	4180	2	3½	2369	3	6	89	4	6½	6638	10	4

B.

The Erie Canal, which connects the tide-water of the Hudson River with Lake Erie, was commenced in 1817, and completed in 1825. It is 363 miles long, and its original cost was $7,143,789, equal to £1,785,697. 5s. Halifax currency; the canal being only 40 feet wide on the surface, and 4 feet deep.

---

[2] Mem.—No tolls were collected after 1st May in the years 1828 and 1835 respectively, the Provincial Acts authorizing their collection having been suffered to expire. If this had not been the case, it is estimated that the tolls for those years would have been as follows:

	Downward.	Upward.	Total.
In 1828 . .	£2496 19 9	£1014 1 11	£3511 1 8
In 1835 . .	3234 11 7½	2264 5 5½	5498 17 1

(Signed) F. Griffin,
Secretary, Treasurer, and Toll Collector.

The following is a statement of the Tolls received on it since its completion:

Year.	Dollars.	Halifax currency.			Remarks.
		£.	s.	d.	
1824	340,000	85,000	0	0	
1825	566,000	141,500	0	0	
1826	762,167	190,541	15	0	
1827					
1828					
1829					
1830	795,054	198,763	10	0	
1831	1,194,610	298,652	10	0	
1832	1,195,804	298,951	0	0	
1833	1,422,695	355,673	15	0	Reduced 20 per cent.
1834	1,294,956	323,739	0	0	Reduced 15 per cent. since.
1835	1,491,952	372,988	0	0	
1836	1,440,539	360,134	15	0	
1837	1,144,170	286,042	10	0	
1838	1,414,174	353,543	10	0	

D.

Extract of a Letter from C. J. BURCKLE, Esq., one of the most respectable Merchants at Oswego, in the State of New York, to Lieut.-Col. PHILLPOTTS, Royal Engineers, dated Oswego, 2nd June, 1839.

"The enclosed papers will put you in possession of some authentic information as to the views entertained by our States' Government and people of the importance of the Western trade: they furnish statistical statements of the amount of its tonnage, value, increase, &c., and will convince you that it is considered of the utmost importance by the States of New York, Pennsylvania, Maryland, Virginia, and latterly of South Carolina, to draw as much of it as possible to their sea-ports; that very large sums are now being laid out, and have already been laid out, and that still larger ones are contemplated to be laid out, upon improvements tending to obtain this great, this all-desirable object.

"I myself am of opinion with the old experienced engineer, Benjamin Wright, that *none of the intended and already established routes can compete, in cheapness of transportation, with that via the Welland Canal and St. Lawrence River, whenever an uninterrupted steam-boat and ship navigation from the Upper Lakes has been opened to Montreal and the Ocean;* particularly if the dangers of the Gulf of St. Lawrence in spring could be remedied by a connexion with the Bay of Fundy; and should, in aid of this cheapness of transportation, judicious and liberal regulations respecting the importation of wheat, flour, cotton, tobacco, ashes, lumber staves, &c. into England via

the St. Lawrence be adopted, the current of trade will soon be forced from its accustomed into the new channel: the commercial as well as political effects this diversion of trade would produce in the United States may well be pronounced as prodigious; for rest assured, that if once the West exports via Montreal, *it will and must soon import the same way*, particularly bulky and low-priced articles: for instance, crockery-ware; the transportation of that low-priced article from New York to Chicago is generally £25, and often £30 per ton of 2000 lbs. Now let us suppose a vessel laden with 300 or 400 tons should sail from Liverpool to Chicago via the St. Lawrence and Welland Canal, (which on an average would not require more than eight or ten weeks to perform the voyage,) it would earn from £9000 to £10,000 in that time,—an enormous freight: this would, of course, create competition, the price would be greatly reduced, and the consequence would be, that earthenware would be delivered in the West at so low a rate that more, much more would be consumed, and thereby the British manufacturer, ship-owner, &c., greatly benefited. This would be the case with other low-priced and bulky articles, such as iron, iron castings, hardware, glassware, paints, &c., sugar, rum, and molasses from your colonies, &c.; but, Sir, may we not reasonably suppose that the finer articles of manufacture, &c., would soon follow, and be added to the coarser merchandize, particularly if, as may reasonably be supposed, the city of Montreal should like New Orleans, be amply supplied with what would be wanted? The people of the West would demand from the United States' Government that their ports should be made ports of entry for foreign merchandize, and they being entirely unaccustomed to the very rigorous and highly vexatious revenue laws of the United States, and by no means as tame and submissive as the people on the Atlantic shores, they would revolt at them, the tariff or protective system would soon become entirely obnoxious and hateful to them, the commercial relations with Atlantic states and cities would be greatly weakened, and, in fact, entire new interests created throughout the Great West, all tending to benefit England and the Canadas. At present all the vessels navigating the lakes are laid up during at least five months of the year: make your Welland Canal equal to your improvements on the St. Lawrence (at Cornwall), so that steamers and sailing vessels of a large size can navigate the lakes from the ocean, most of the small vessels now in use would soon prove unprofitable, and large vessels be preferred, who may proceed to sea with their cargoes of wheat, &c., previous to the closing of the navigation in the fall, and return with cargoes of merchandize, sugar, rum, molasses, &c., in spring.

"I might extend my speculations on the consequences *ad infinitum*; the mind gets lost in the contemplation; and I think that the subject well deserves the most serious consideration of your statesmen. It would completely silence faction and discontent in the Canadas, and give an impulse of life and activity to Old England itself.

"Permit me to observe further, that I have consulted the most eminent ship-builders of New York on the feasibility and practicability of constructing vessels of from 300 to 400 tons burthen, fit to navigate the ocean to any part of the world, and pass through your

locks on the St. Lawrence of 200 feet length, 50 feet breadth, and 9 feet depth; they tell me *that it can be done easily.*

"If these hasty remarks should prove of any use to you, by suggesting new ideas or otherwise, it will afford me great gratification.

"I remain with great respect, Sir,

"Your most obedient servant,

(Signed) "C. J. BURCKLE."

Extract from a Letter from BENJAMIN WRIGHT, Esq., Civil Engineer, to Lieut.-Col. PHILLPOTTS, Royal Engineers, dated Scott's Ferry, Albermarle County, Virginia, July 2nd, 1839.

"I set down as true that for all that part of the year when the lakes, and rivers falling into the lakes, can be navigated free from ice, and the proper connexion now in progress of execution between Lake Michigan and Illinois Rivers, between Wabash and Lake Erie, between Wisconsin and the Green Bay, (together with some railroads now making,) shall be completed, that the trade of all the country now forming the States of Ohio, Indiana, Illinois, Missouri, Michigan, and the territories of Wisconsin and Iowa, which will soon become States, will all find it for their interest to export eastward, and receive their merchandize from the ports north of the State of Virginia on the Atlantic.

"Now with all the competition which is arising between Baltimore, Philadelphia, and New York, for the trade of this great country, it is impossible to see where or how the division of the products of the soil, and the merchandize to supply the inhabitants, will be made as to these cities. And here I may digress a little by saying, that Montreal may have a share of this trade if she pleases to do so, as long as she is connected with England, whose Government can by proper laws induce the exports of the soil to pass that way whenever they choose to do so, after the proper facilities by way of improvement of the St. Lawrence and the Welland Canal are made.

"The territory lying north of the Ohio, and north of the Missouri River, and east of the Rocky Mountains, will in twenty years contain from twelve to twenty millions of souls, who are working, energetic, industrious people: this population must export and import a very large amount of value. I have no tables to show the value of exports and imports per head as applied to other countries, neither do I think that any such tables would apply to the population of this country. We are a different people from any other; we can effect more with the same number of men than any other people; we have more energy of character, more resources within ourselves, than other nations, and we cannot therefore be estimated as others. But as we have no other data to take, I do not see but you must assume—say, dollars and cents per head for exports, and dollars and cents for imports, and then assume that the population will

increase in a certain ratio. Next year the census of the United States will be taken, and you will see that the increase in the part of country I have assumed as trading eastward will be very great.

"Now the question is, what portion of this trade will concentrate upon Lake Erie? I say, one half; because all the rivers, Ohio, Wabash, &c., are hardly navigable for boats for four months on an average, and the last year, for more than five months no navigation was carried on upon the Ohio because of low water. I was near the Ohio in September last, at a point 300 miles below Pittsburgh, and there was then only 18 inches water in the channel. The merchants of Cincinnati and other towns did not receive their foreign merchandize bought in August until December or January.

"*Now*, of the trade which falls upon the lakes, what portion can be induced to go to Montreal? This is a question of very difficult solution, as much depends upon the acts of the Government in its municipal regulations; much depends upon the safety and rapidity with which property is or may be converted into money.

"If this trade was put upon such a footing as to induce the flour to go to Montreal, and be thence shipped to England, you would soon see (after the improvements are made) millions of barrels of flour sent from the great wheat-growing country in Ohio, Indiana, Illinois, Michigan, and Wisconsin (the finest wheat-growing country in the world) to Montreal. With your increasing manufacturing population in England you could from this source be certain of a resource of bread stuffs;—if Poland and the Baltic failed you, here is a certainty, which Great Britain can find nowhere else to look for supplies of a bad harvest. Think of this as a matter of great moment, and it will justify the mother country in making the St. Lawrence a good and perfect navigation; and I may ask, why may not this course be the strongest tie to the people of Canada to remain connected with the mother country? or will there for ever be demagogues and restless spirits to make the people uneasy?

"I have endeavoured to answer your circular as well as I could, although you are very sensible that from the rapid changes going on in these States, more particularly in the new States, on the Ohio and Mississippi, all statistical tables of exports and imports are no data at all for the statesman to found his calculations upon: he must anticipate and assume data from the rapid improvements, the increased population, and wealth of those States, regularly progressing as they are; and that before the improvements of the St. Lawrence and Niagara Rivers could be completed, there will be a surplus of the products of the earth, to be sent to foreign countries, of many millions value. Look at the new State of Michigan, and see that, notwithstanding the emigration to that country, there is supposed a surplus of flour and grain to the amount of a million of dollars in value."

II.

Extract from a Report of the Select Committee of the Legislature of New York, on the petition of the Inhabitants of the County of Oswego. In Assembly, 14th April, 1834.

"The subject referred to the Committee, in whatever light it may be viewed, may justly be considered of the first importance, both to the enterprise and interests of the State of New York. The citizens of this State have witnessed with high satisfaction the commencement, completion, and successful operation of the Erie Canal, which has more than answered the expectations of its ardent and patriotic projectors. The value of property has been multiplied manifold; the arm of industry has converted the almost interminable regions of the forest in the western part of the State into fertile fields, enriching alike the hardy cultivator and the great commercial emporium of the State; cities and villages have arisen, as if by enchantment, where, but for the Erie Canal, would now have been a wilderness. Great and important have been the results of these works of internal improvement, not only to this State, but to a portion of the territory bordering upon the basin of the great western lakes."

* * * * * * * * * *

"Three great objects were primarily contemplated in constructing the Erie Canal:—first, to furnish the citizens of this State with an easy and cheap conveyance of their surplus produce to market; second, to secure and preserve the trade of the West; third, revenue.

"The first of these objects has been attained, and the attention of your Committee has been principally directed to a consideration of the second. That to secure and preserve the trade of the West is an object worthy the continued exertions and resources of the 'Empire State,' cannot and will not be denied; that it is so secured may well be doubted. The importance of the western trade will be seen by a view of the vast extent of country bordering upon and surrounding the western lakes,—a region of country more fertile and productive the sun in his course through heaven does not shine upon. If we glance an eye over the immense regions connected by the western lakes and their tributary streams,—if we regard the fertility of soil, the multiplicity of product which characterize those regions, and if we combine these advantages afforded by nature with the moral energy of the free and active people who are spreading their increasing millions over its surface,—what a vista through the darkness of time opens upon us! We see arts, science, industry, and social happiness already increasing in those countries beyond what the most inflated fancy would have dared to hope thirty or forty years ago.

"As yet the commercial and agricultural resources of the West are not developed.

These twin sisters of the wealth of nations are yet in their infancy. Owing to the rapid increase of population in Ohio, and the wild and uncultivated state of a portion of her territory, the surplus productions of her farmers have until recently been consumed within her own territory. Michigan[2] and Illinois, comparatively speaking, have furnished nothing for transportation; but when their exhaustless soil shall be cultivated and improved by the hardy and industrious yeomanry of the north and east, who are emigrating thither to a degree unprecedented in the annals of our country, their rich productions will be put afloat, and will find a market upon the shores of the Atlantic, *through such channel as presents safety, cheapness, and speed to the most advantageous market.* The citizens of the West have witnessed the commencement, progress, completion, and effect of the splendid system of internal improvements in this State, and are nobly imitating the example with an enterprise and zeal worthy their character. Already are the head-waters of the Mississippi connected at different places with the great chain of western lakes, by means of canals and railroads. The channels of communication now opened, and which will hereafter be opened, between the lakes and the interior, will be thronged with vehicles of transportation, conveying the rich fruits of the labours of millions of free and happy people to flourishing cities and villages upon the shores of the lakes, whose population, wealth, and enterprise will be equalled only by those upon the shores of the Atlantic.

"The surplus productions of this extensive region will find their way to the Atlantic. *Natural communications possess facilities and advantages which artificial never will and never can.* Lake and river navigation is being understood. *Steam power has changed every thing.* Twenty-three by-gone years have witnessed improvements in commercial facilities in our own State which have claimed the admiration and imitation of the world.

"The lethargy under which the people of Canada have slumbered for the last century has been thrown off, and they are now fully awake to the importance of internal improvements. They are beginning to appreciate the *natural water communications with which nature has so bountifully supplied them.* They have entered the lists, and are nobly contending for a participation in, *if not a monopoly of,* the rich dowry of the western trade. Their enterprise has caused a communication to be opened around the Falls of Niagara, a distance of forty-one miles, by which vessels carrying 1000 barrels of flour can go through, without being lightened, at an expense of one cent per barrel, exclusive of tolls. The amount of business done upon this canal will be seen by a reference to the fact, that 50,000 barrels of salt passed through it during the last season; and had the requisite repairs been made so as to have opened the canal with the commencement of lake navigation, the revenue would have amounted to more than £50,000.

[2] It will be seen that this was written in 1834. During the late season, 1839, Michigan is said to have exported one million bushels of wheat.

"The evil which the Canal Commissioners *feared in* 1812 *now really exists.* The produce designed for transportation upon the Upper Lakes is now let down to Lake Ontario by means of this canal with facility and for a trifling expense. The prediction of the Canal Commissioners, '*that articles for exportation when once afloat on Lake Ontario would, generally speaking, go to Montreal, unless our British neighbours were blind to their own interests,*' *is now fully verified.* By a reference to the parliamentary proceedings of the Canadas during the last winter, it will appear obvious that they are not thus blind; that, on the contrary, they duly appreciate the importance of this trade, and that the greatest industry, activity, and talent are employed in the attainment of further improvements on the most magnificent scale. Appropriations have already been made for the improvement of the St. Lawrence, by which it is intended to connect the Atlantic with the lakes by ship and steam-boat navigation. Let them make the Welland Canal and the St. Lawrence navigable as they purpose to do, and which they will do, for steam-boats, *and Cleveland will be within sixty hours' ride of Montreal.* When these improvements are completed, *vessels of* 300 *tons can load at Chicago, at Cleveland, at Detroit, at Oswego, and other ports on the lakes, and deliver their cargoes at foreign ports.* When direct exportation has once succeeded, *direct importation will follow as a matter of course.* When the Welland Canal shall be completed, *and the St. Lawrence improved, as designed, goods may be delivered at Cleveland, from London, for less than one half of what it now costs by the way of New York and the Erie Canal.* Make the Erie Canal a public highway, *and the Canadian route will be preferable by one quarter in point of expense.* The vast superiority in the great point of economy in transportation effected upon *natural water communication, admitting of navigation by large vessels or steam-boats, above transportation upon canals and railroads, has been satisfactorily proved by experience on the Hudson, the lakes, and the great rivers of the West.* Even at the present reduced rates of toll upon the Erie Canal, river transportation has the advantage by more than 300 per cent. The charge upon the transportation of wheat, per bushel, from Troy to New York, *is three cents,* while the *same transportation for a like distance upon the canal cannot be effected for less than ten cents.*

"The importance of the western trade has aroused a spirit of enterprise and competition in sister States. To participate in this trade, rival canals and railroads have been constructed in Pennsylvania, Maryland, and Virginia; and it cannot be denied that these are already diverting a part of that trade from its natural current towards the lakes and Erie Canal, and will no doubt continue to produce such diversion in a ratio regularly augmented in their progress to completion. It cannot be questioned that a great portion of the produce and merchandize going to and coming from the fertile countries, at some distance south of the great chain of the lakes, and east and north of the tributary streams of the Mississippi, must find their way into Virginia, Maryland, and Pennsylvania. To prevent this diversion, the tolls upon the Erie and Ohio Canals have been very judiciously reduced during the present winter."

* * * * * * * * * *

"That the trade of the West is of vast importance, and is becoming yearly more and more important to the commercial interests of this State, cannot admit of doubt; and that there is danger of its being diverted, or a portion of it at least, through other channels than the Erie Canal to the Atlantic, your Committee think is equally apparent.

"In the spirit of enterprise and rivalry with which our southern and northern neighbours are actuated, your Committee see no cause for serious apprehension, jealousy, or alarm, because they believe it is within the power of this State to secure the trade of the West beyond the reach of competition or rivalry.

"The remedy, and only remedy, which can be applied to secure to ourselves and posterity this rich inheritance of national wealth, is by opening a communication between the Hudson and Lakes Ontario, Seneca, Cayuga, and Oneida, of sufficient magnitude to admit the passage of the smaller[3] class of steam-boats, and of the ordinary vessels which navigate those waters. The advantage to be derived from such a communication must be apparent to all. It will combine safety, cheapness, and expedition, the three great considerations in commercial enterprise, and save the loss and expense attendant upon numerous trans-shipments." * * * * *

"The amount of revenue to be derived from transportation is difficult to be imagined, and much more difficult to be ascertained. Judging, however, of the future from the past and the present, we may safely come to the conclusion that ten years will not elapse, after the completion of the proposed project, before we witness the same busy scenes upon its waters that we do no upon the Erie Canal. Calculation, like our advance in numbers, outruns fancy. *Things, which twenty years ago a man would have been laughed at for believing, we now see.* At that time, the most ardent mind proceeding on established facts by the unerring rules of arithmetic, was obliged to drop the pen at results which imagination could not embrace."

Extract of a Letter from BENJAMIN WRIGHT, Esq., Civil Engineer, to JOSEPH E. BLOOMFIELD, Esq., dated New York, 1st April, 1834.

"The project which the Canadians have in hand to make a steam-boat canal of ten feet water, to pass all the rapids between Montreal and Ogdensburgh, on Lake Ontario, is one which has a very important bearing in its consequences upon the people of the State of New York and the Erie Canal tolls. It is certain to my mind, that with such a canal as I have projected along the St. Lawrence and Welland Canal, in good order, that all the products of the soil, from all the Upper Lakes, can be carried

[3] It is now generally admitted that *small steam-boats*, as here described, cannot compete with large ones; and therefore this communication, if completed, could not compete with the route proposed by the St. Lawrence.

to tide-water *a great deal cheaper by this route than they can ever be done by the Erie Canal or any other work.*

"The plan of the improvements as projected along the St. Lawrence is, to make short canals and locks around the rapids, leaving the steam-boat to navigate the river and lakes in all the intermediate spaces. The whole length of all the canals (although in seven or eight different pieces) does not exceed 31 miles, and about 175 feet of lockage. This can be executed for about three millions of dollars, and completed in three years from the time of its commencement, if they choose to do so.

"That the Welland Canal can and will be put in good order there is no doubt, as it appears by the measures adopted at the last session of their parliament, that they intend to make it a Government work, and will, no doubt, do so next winter.

"I have not said any thing about the competition which is to be looked for from Pennsylvania, if she goes on to form a connexion between her canal at Pittsburgh with the Ohio Canal at Akron. This latter place is about forty miles from Cleveland, on Lake Erie, and we see already that Pennsylvania has been this year navigating her canals since about the 10th of March. The truth is, and we ought not to disguise it, that Pennsylvania can navigate three or four weeks earlier than we can, and even Canada can open her Welland Canal nearly one month earlier than we can our Erie Canal; and the St. Lawrence Canal can be navigated earlier than our canals, if they pay a little attention to management to clear the ice."

Extract of a Letter from General DUNCAN, of Illinois, to the Hon. CHARLES F. MERCER, Chairman of the Committee on Roads and Canals, dated December 30th, 1833.

"Sir,—Allow me most respectfully to call your attention, and that of the Committee of which you are chairman, to the proposition submitted by me on the 17th day of December, 1833, authorizing an inquiry into the expediency of a grant by Congress of efficient aid to the State of Illinois to enable her to construct a steam-boat channel from Lake Michigan to the Mississippi River.

"It can scarcely be necessary for me to urge the importance of an early completion of this great work to every portion of this Union, connecting, as it would, more than twenty States.

"By this small improvement we should secure the most extensive internal steam-boat navigation that now is, or perhaps ever will be, known, penetrating for more than twenty-five hundred miles the most fertile regions of country on the globe; capable of supplying every part of Christendom with every thing necessary to make man independent and happy, and on whose lakes and rivers are seen in increasing numbers the whitening sail and torrent-stemming boat.

"Through this channel the sugar, cotton, rice, and tobacco of the south, the lead,

coal, bread-stuffs, pork, beef, and other products of the West, would pass to the North, exchanged for their salt and timber, manufactures and merchandize.

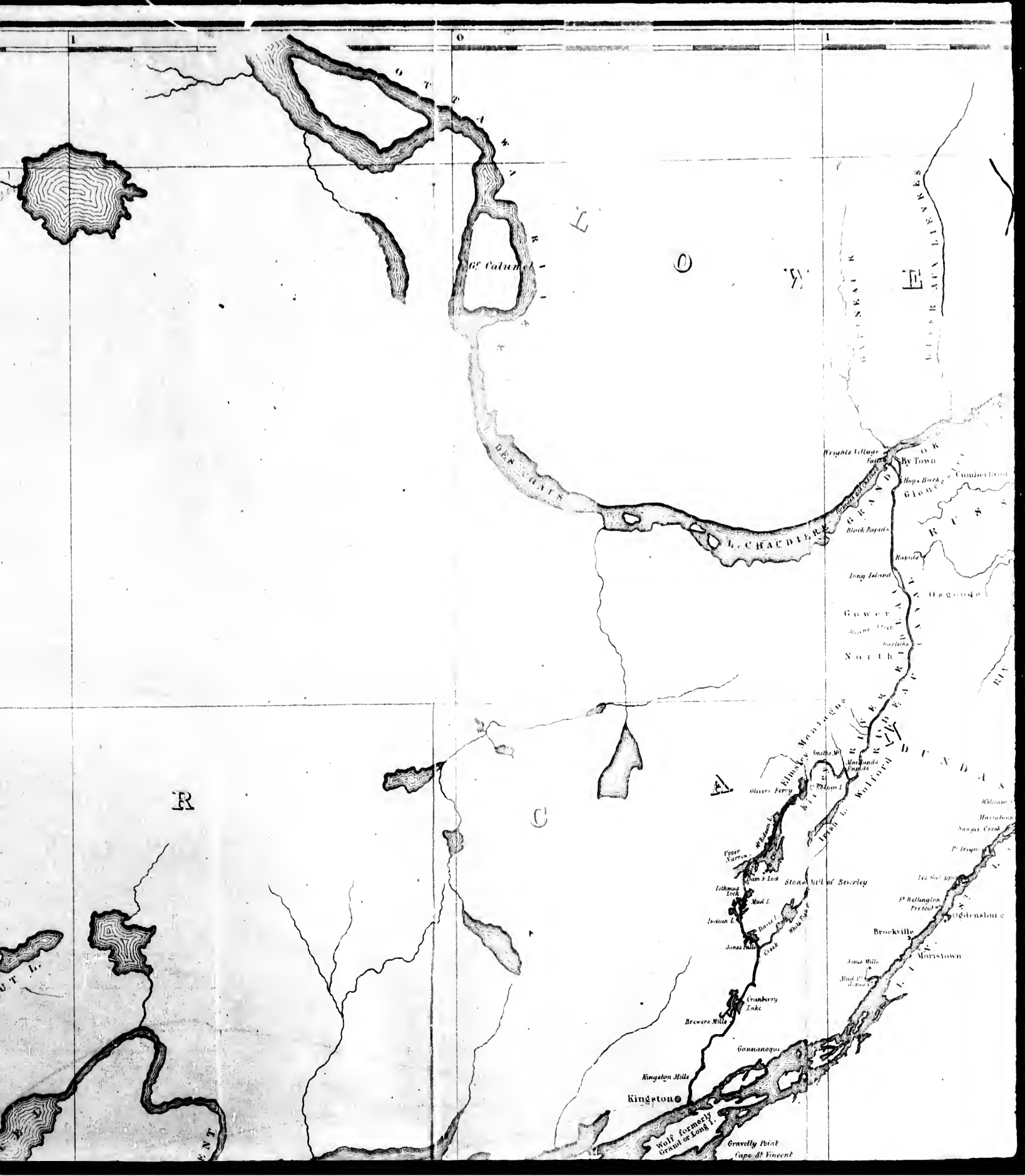
" It is now estimated that there are about 315 steam-boats on the western waters, and about 350 schooners, smaller vessels and steam-boats, on the lakes; the increase of which can scarcely be anticipated, when we see that the steam-boats have increased from 1 in 1814, to 315 in 1833, less than twenty years, and the vessels, &c., on the lakes have increased almost as fast.

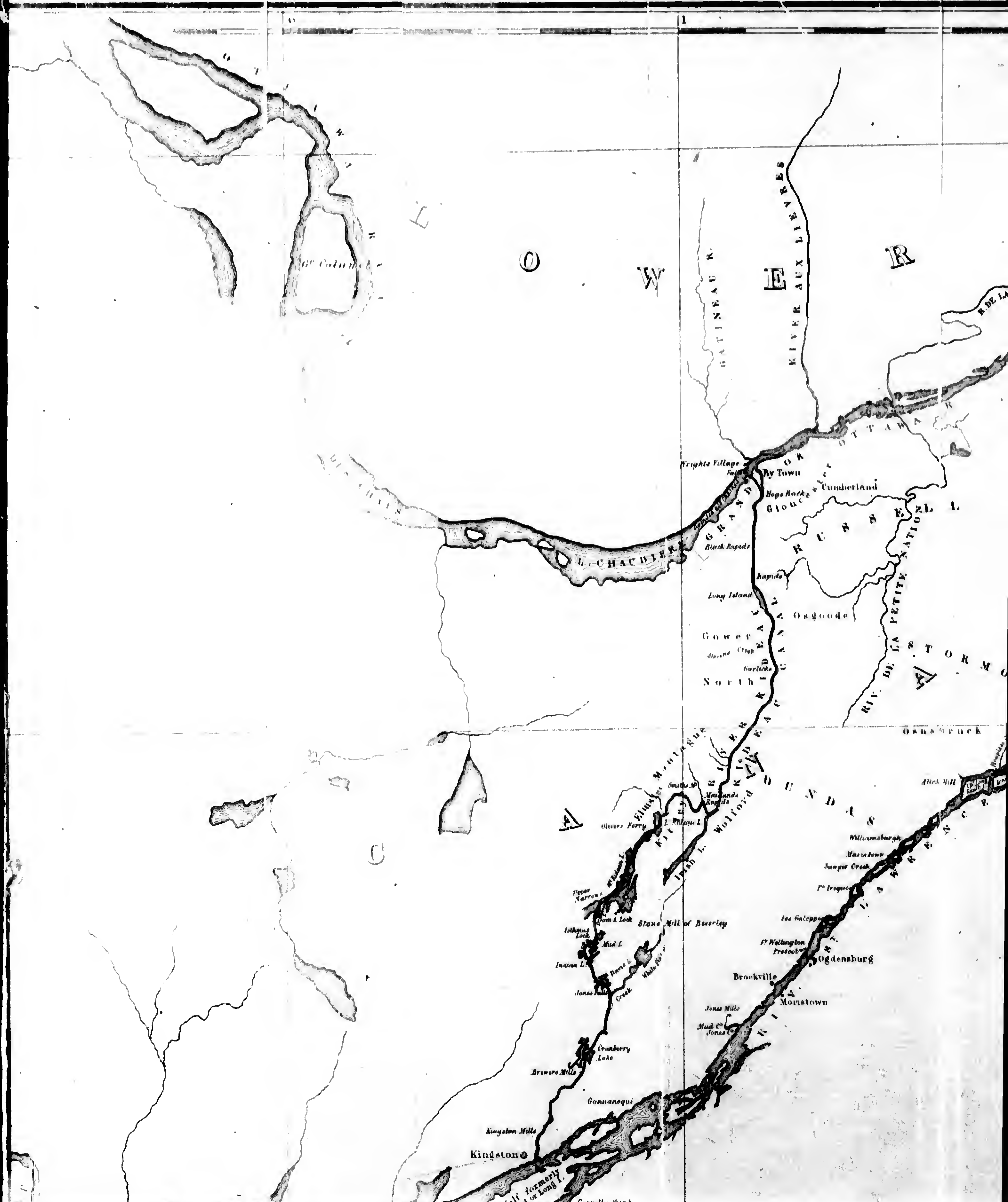
" The commerce carried on on the western waters was estimated this year at one million seven hundred thousand tons, which is said to have been worth about one hundred and seventy millions of dollars; freights have been reduced from five dollars to thirty-seven and a half cents per hundred from New Orleans to Louisville; passage and other charges have fallen in the same ratio: the amount and value of the commerce on the lakes can scarcely be estimated except by the number of vessels engaged in carrying it on, and the unequalled growth and improvement of the whole lake country. It seems to me that national pride, as well as national interest, should press on the accomplishment of this great work.

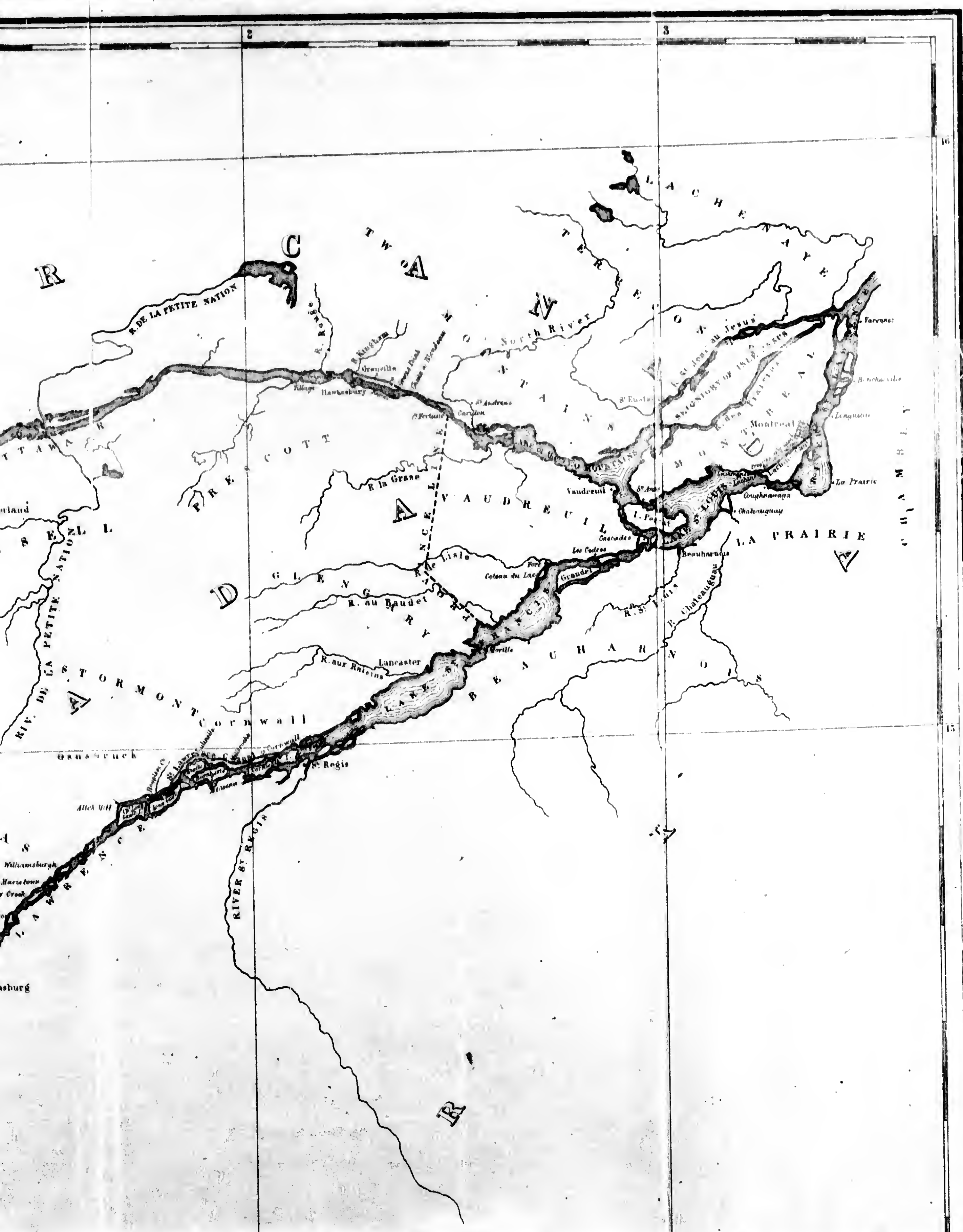
" Of its practicability there can be no doubt, unless the observations of more than one skilful engineer have been deceptive; and it is the shortest and best, if not the only route for the union, by such a channel, of these vast national waters.

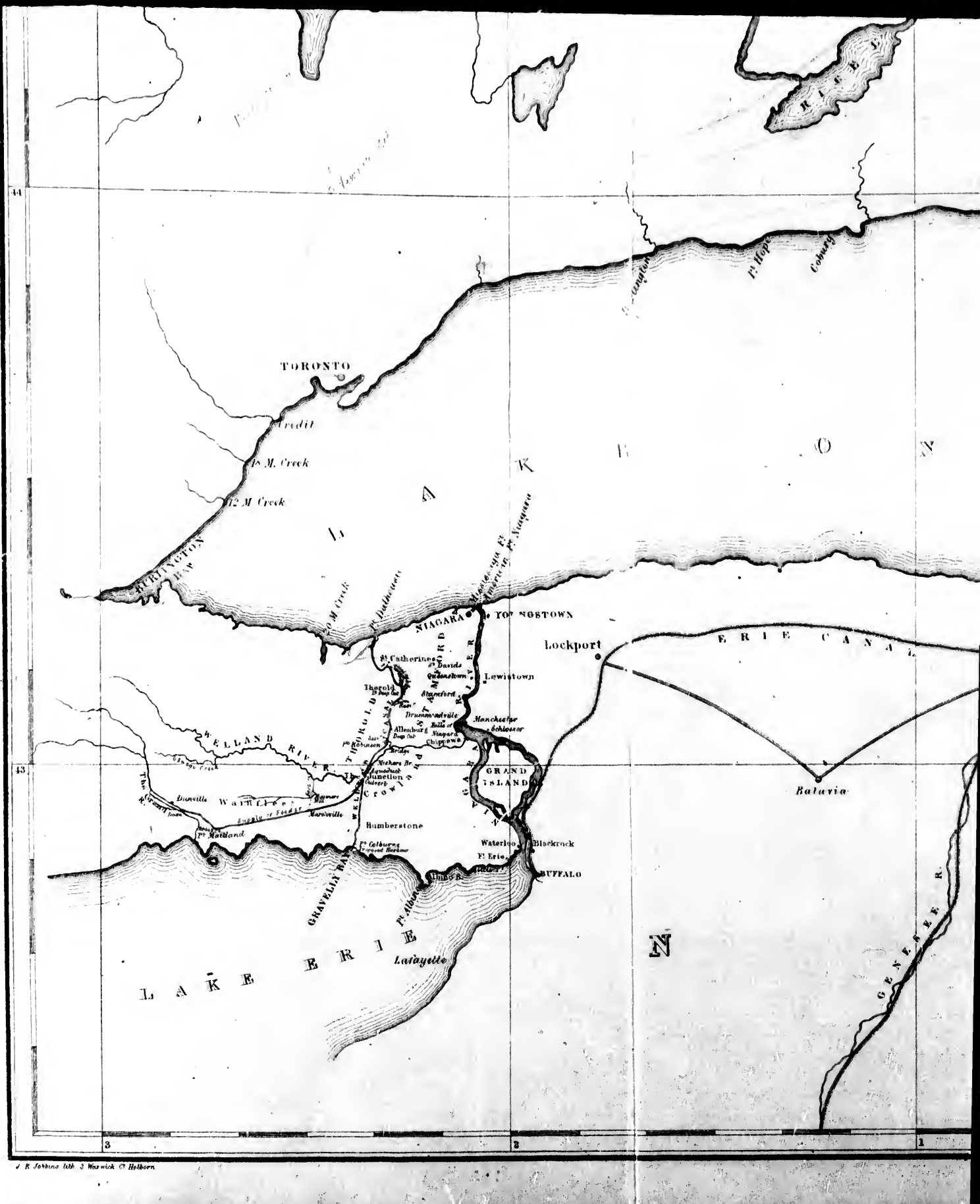
" There is a reason for the immediate action of Congress on this interesting subject, which I will respectfully suggest. A portion of the country on the contemplated route of this canal, and on both sides of the Illinois River, is rapidly settling; an extensive commerce is now carried on with New York, Philadelphia, and Canada, from Chicago, on Lake Michigan, and through the Illinois River to New Orleans, and all the West, which is pressing the State for an immediate construction of this work; and I am confident that the next Legislature of Illinois will commence a work of some kind to connect these waters."


3
2
1
16
15
MOOSE RIVER
Lake Nipissing
Matchedash Bay
GLOSTER R.
NOTTAWASUGA BAY
Penetenguishene
SEVERN R.
L. SIMCOE
Barrie
TROUT L.
P
E
P
U

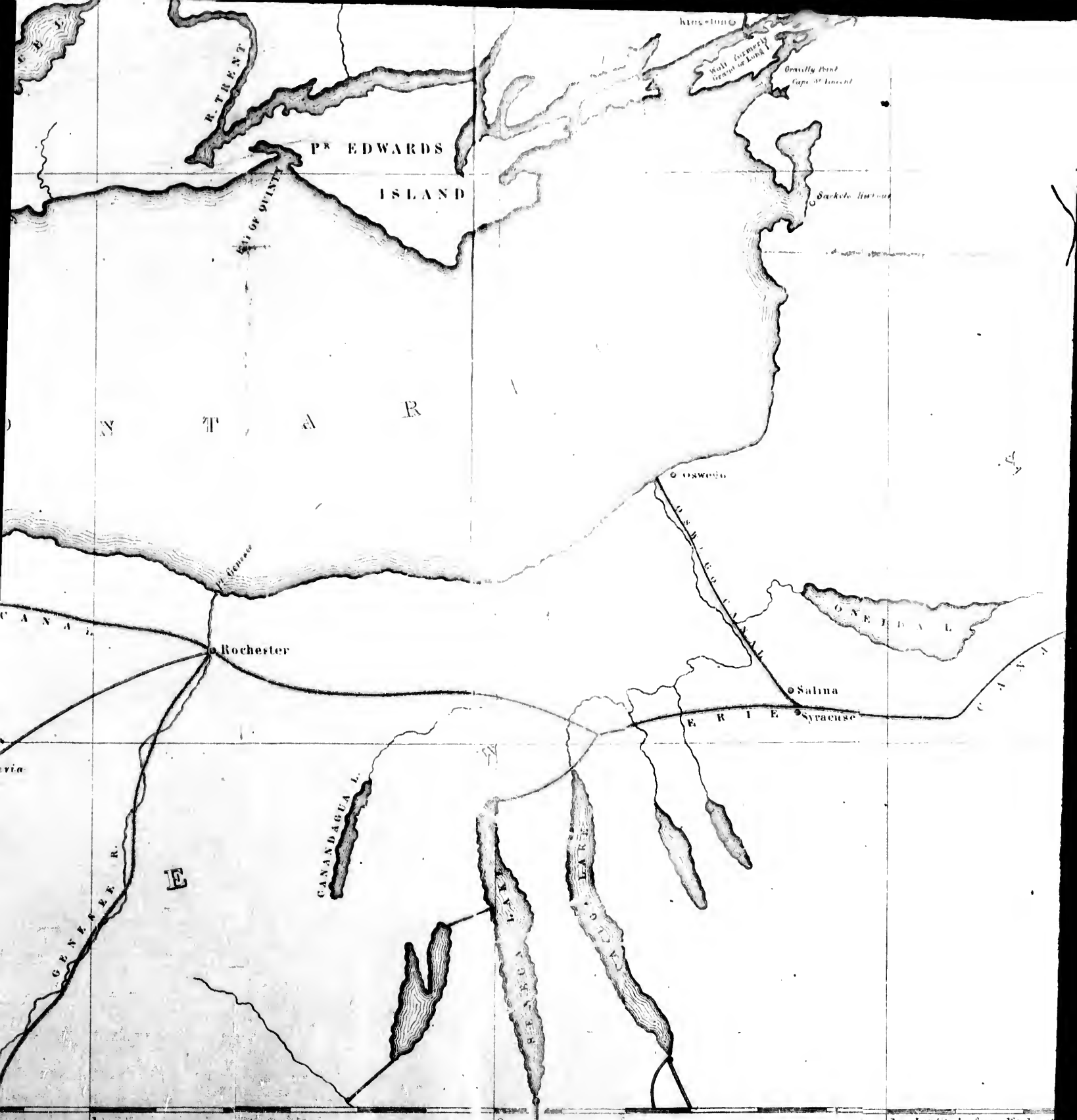

Gt Calumet
Wrights Village
By Town
Hugs Rock
Black Rapids
Rapids
Long Island
Gower
Osgoode
Oliver's Ferry
Upper Narrows
Dam & Lock
Isthmus Lock
Mud I.
Stone Mill of Beverley
Jones Falls
Brockville
Morristown
Cranberry Lake
Brewers Mills
Gananoque
Kingston Mills
Kingston
Wolf formerly Grand or Long I.
Gravelly Point
Cape St Vincent

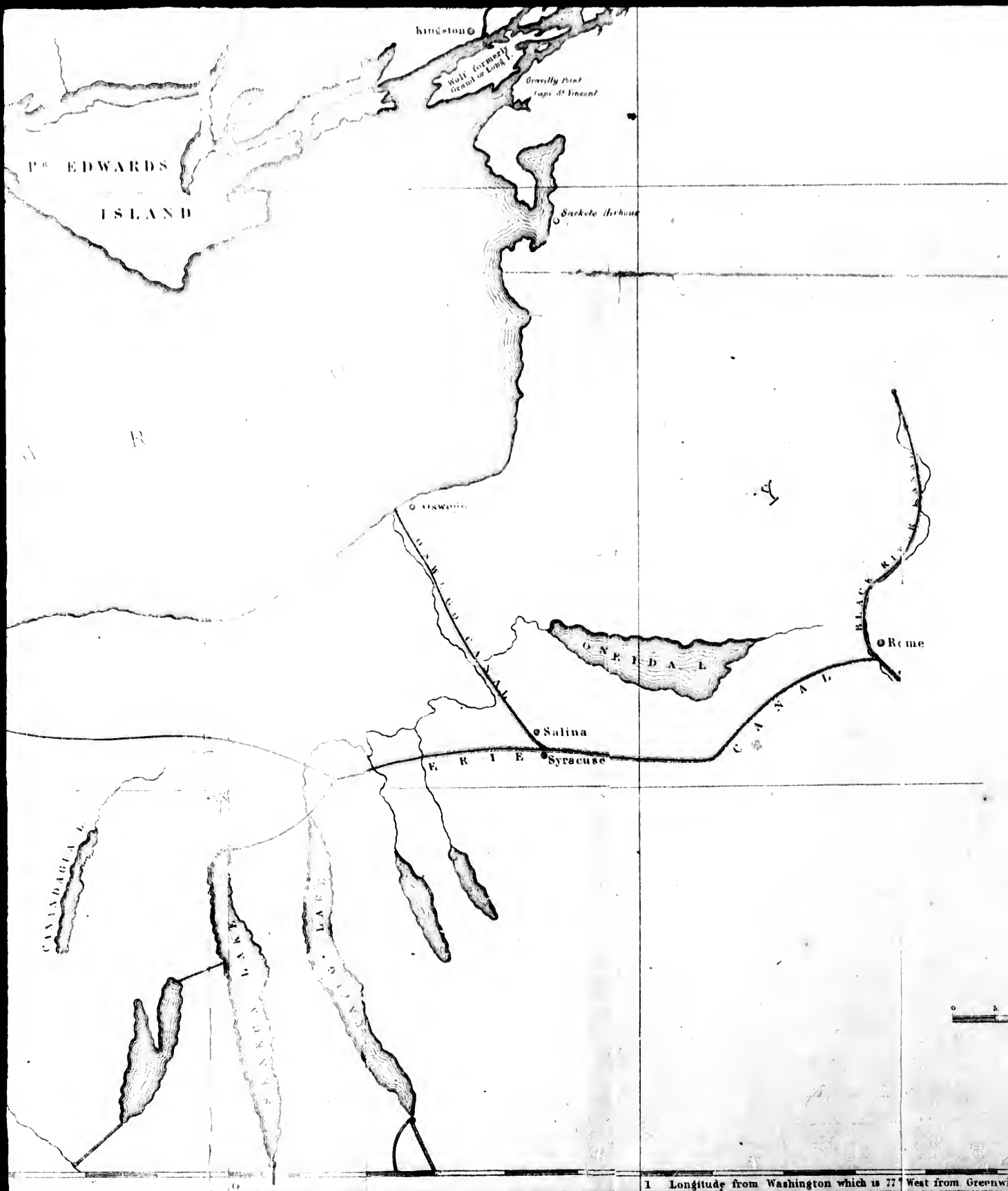

LOWER
CANADA
OTTAWA
RIVER AUX LIEVRES
GATINEAU R.
R. DE LA
OTTAWA R.
OR GRAND
Wrights Village
By Town
Hogs Back
Gloucester
Cumberland
RUSSELL
L. CHAUDIERE
Black Rapids
Rapids
Long Island
Osgoode
Gower
North
RIDEAU CANAL
RIV. DE LA PETITE NATION
STORMO
Osnabruck
DUNDAS
Elmsley
Montague
Smiths M.
Oliver's Ferry
Wolford
Irish L.
Williamsburgh
Matilda
Sawyer Creek
Pt Iroquois
Stone Mill of Beverley
Upper Narrows
Isthmus Lock
Mud L.
Indian L.
Jones Falls
Creek
Les Galoppes
Ft Wellington
Prescott
Ogdensburg
Brockville
Morristown
Jones Mills
Mud Cr.
Cranberry Lake
Brewers Mills
Gananoque
Kingston Mills
Kingston
Wolf formerly Grand or Long I.
Gravelly Point
ST. LAWRENCE R.


2
3
R
C
A
R. DE LA PETITE NATION
R. Rouge
R. Kingham
Granville
Hawkesbury
Village
North River
St Andrews
Carillon
St Fortune
St Eustache
R. St Jean au Jesus
Varennes
Boucherville
Longueuil
Montreal
Lachine
Coughnawaga
Chateauguay
La Prairie
LA PRAIRIE
Vaudreuil
I. Perrot
Cascades
Les Cedres
Coteau du Lac
Beauharnois
R. Chateauguay
VAUDREUIL
PRESCOTT
OTTAWA R
R. la Graise
R. de Lisle
R. au Baudet
GLENGARRY
D
R. aux Raisins
Lancaster
STORMONT
Cornwall
Osnabruck
St Regis
BEAUHARNOIS
RIVER ST REGIS
RIV. DE LA PETITE NATION
Williamsburgh
Mariatown
LAWRENCE



J. R. Jobbins lith. 3 Warwick Ct. Holborn.


R. TRENT
Pr EDWARDS
ISLAND
Bay of Quinte
Kingston
Wolfe formerly Grenadier Island
Gravelly Point
Cape St Vincent
Sackets Harbour
Oswego
Rochester
Salina
Syracuse
ONEIDA L.
ERIE
CANANDAGUA L.
GENESEE R.
LAKE
LAKE
1
0
1 Longitude from Washingt



1 Longitude from Washington which is 77° West from Greenwi

Sketch

OF THE LINE OF

WATER COMMUNICATION,

FROM THE PORT OF

LAKE ERIE TO MONTREAL;

To accompany Col! Phillpotts *Report on the*

CANAL NAVIGATION OF THE

CANADAS.

1842.

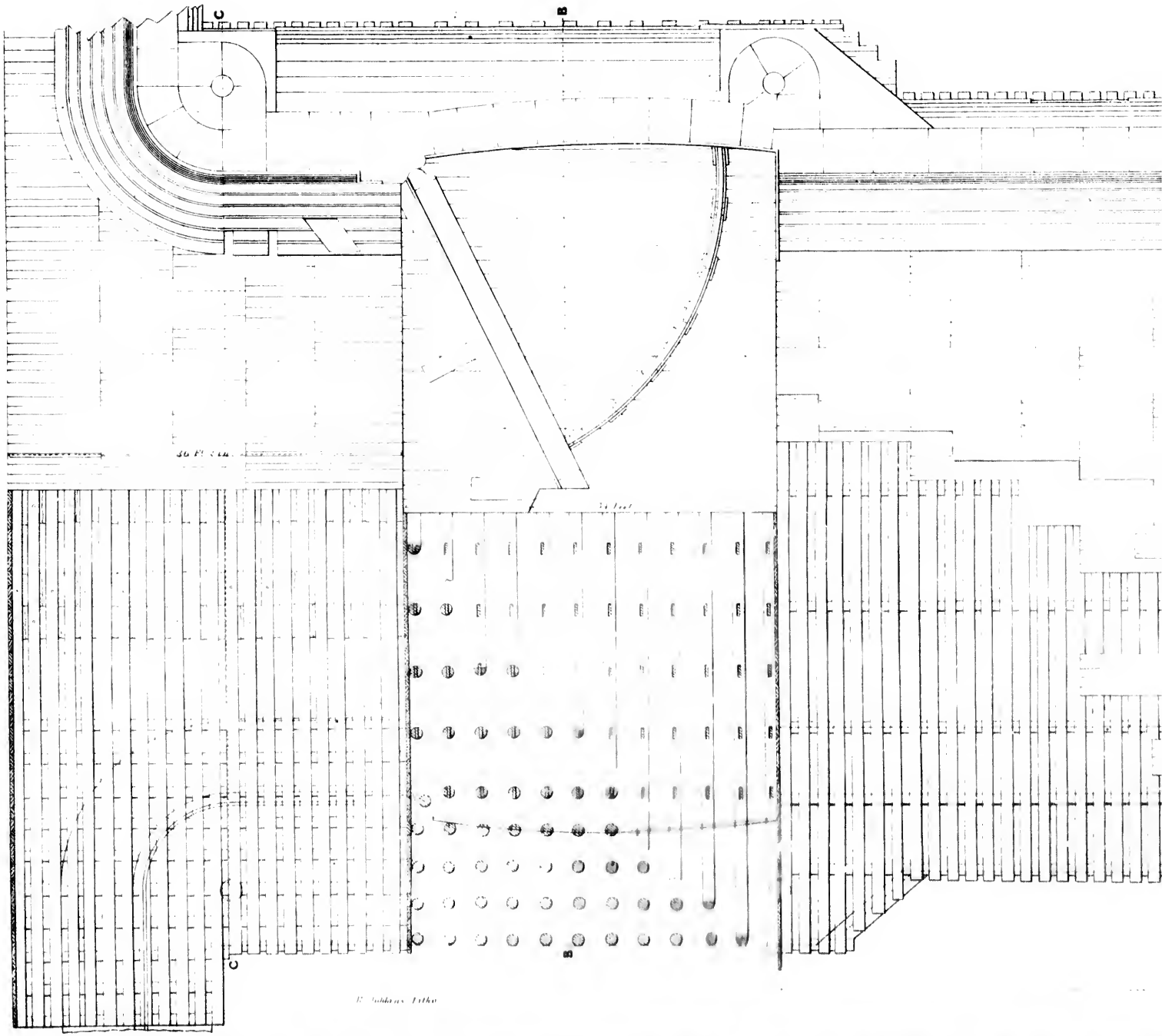
SCALE

0 5 10 20 30 40 50 60 Miles

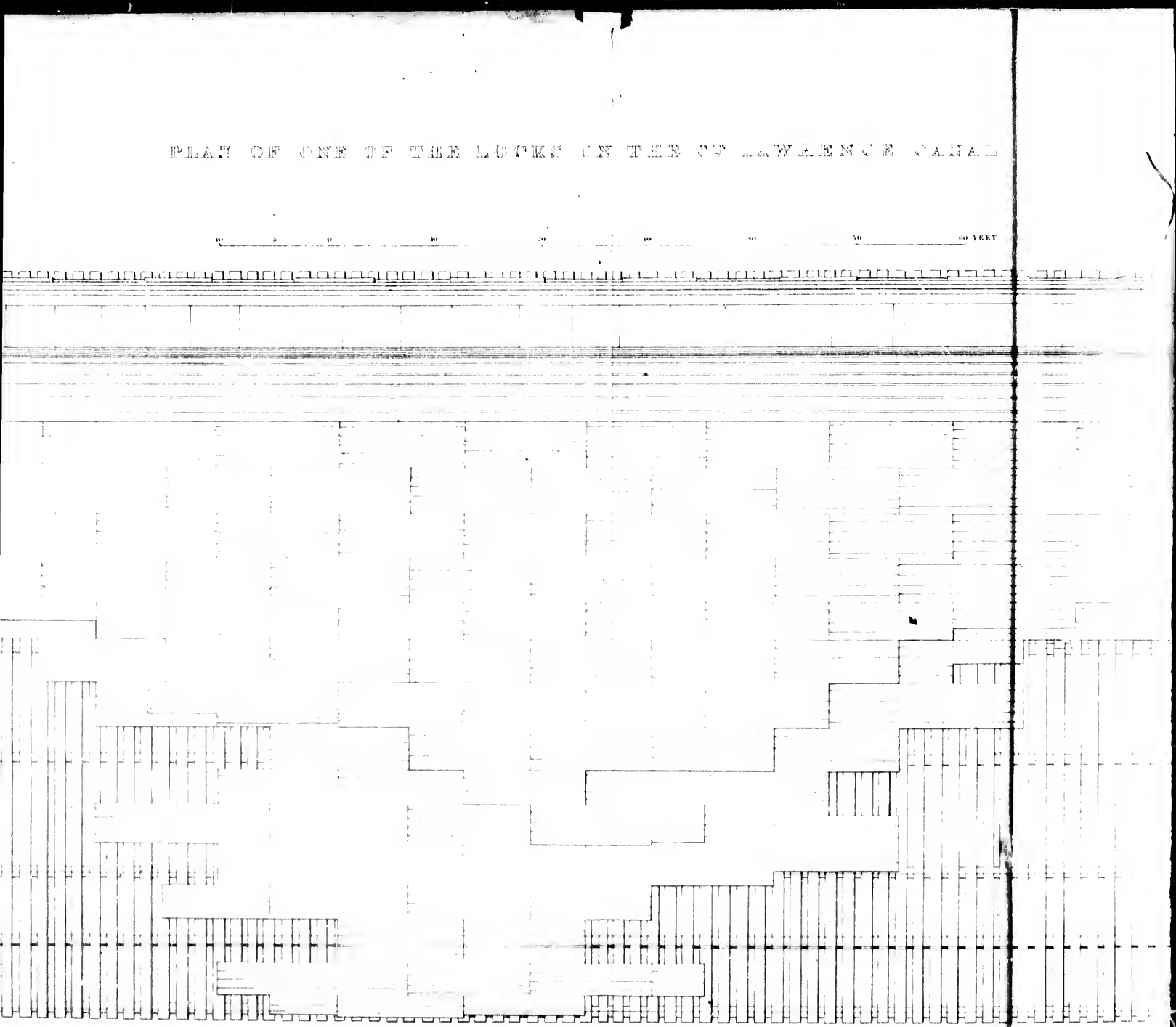
John Weale, 59, High Holborn, London. 1842

which is 77° West from Greenwich

J. R. Jobbins, Del.



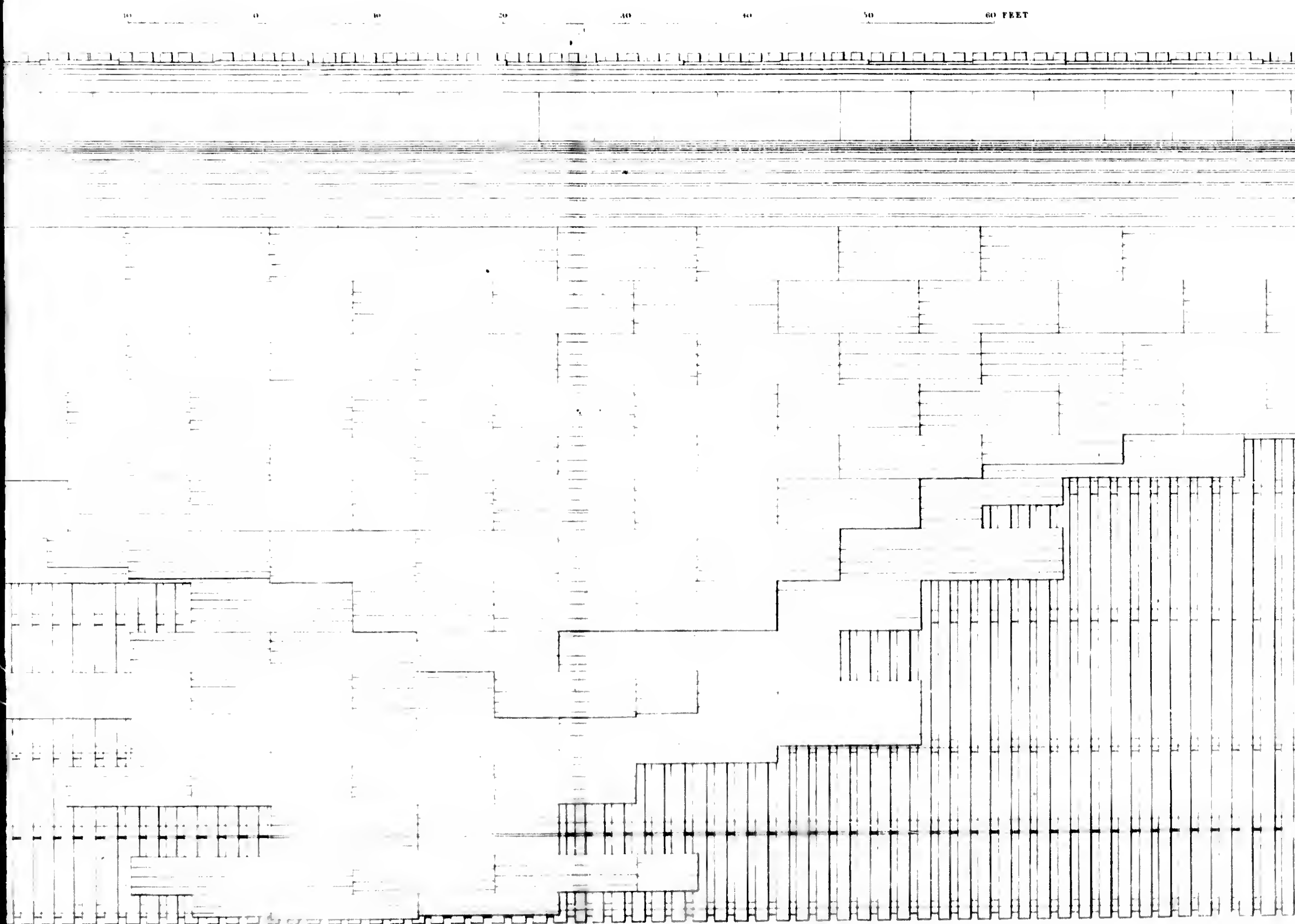
PLAN OF ONE OF THE LOCKS ON THE ST LAWRENCE CANAL



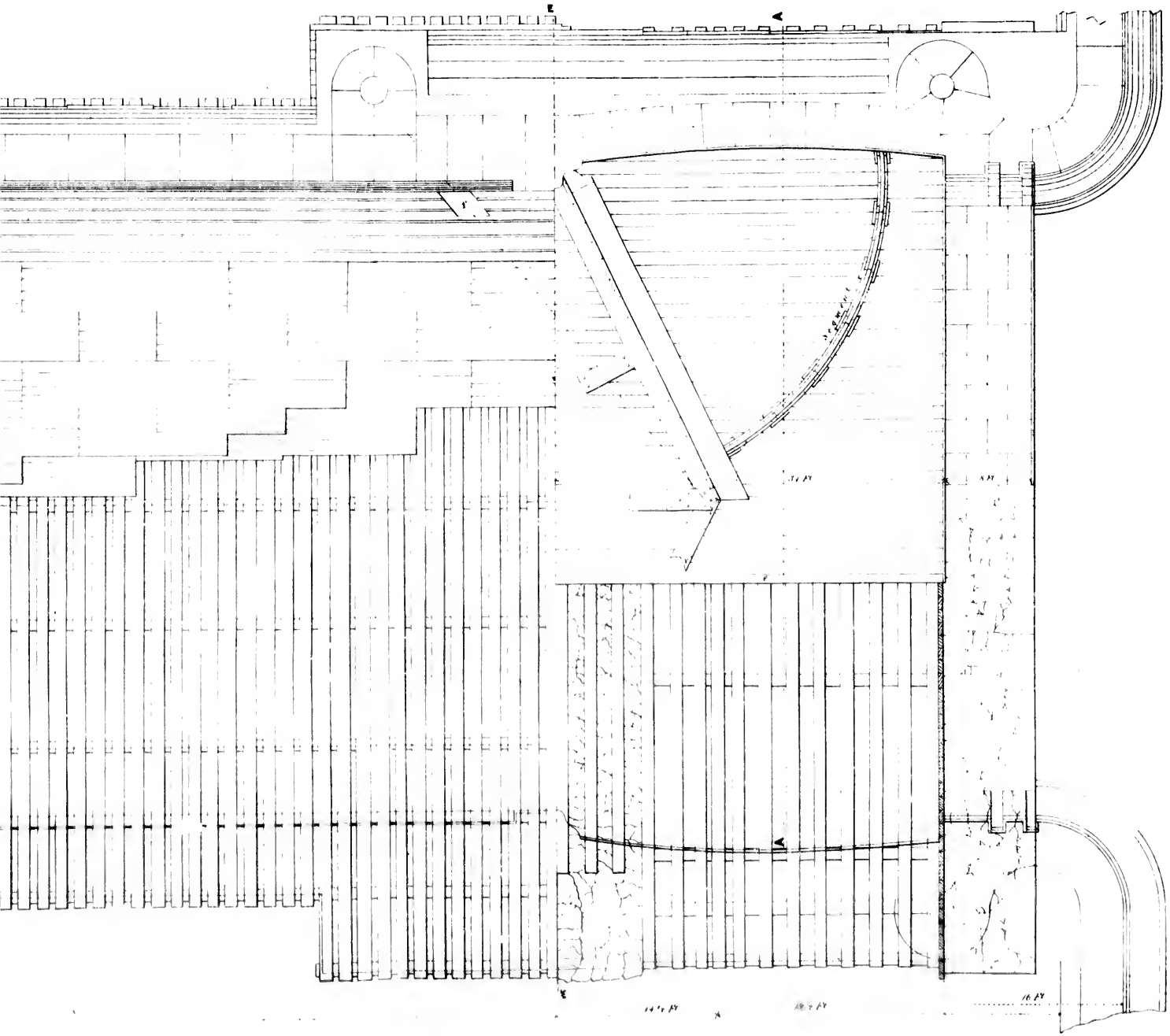
1827

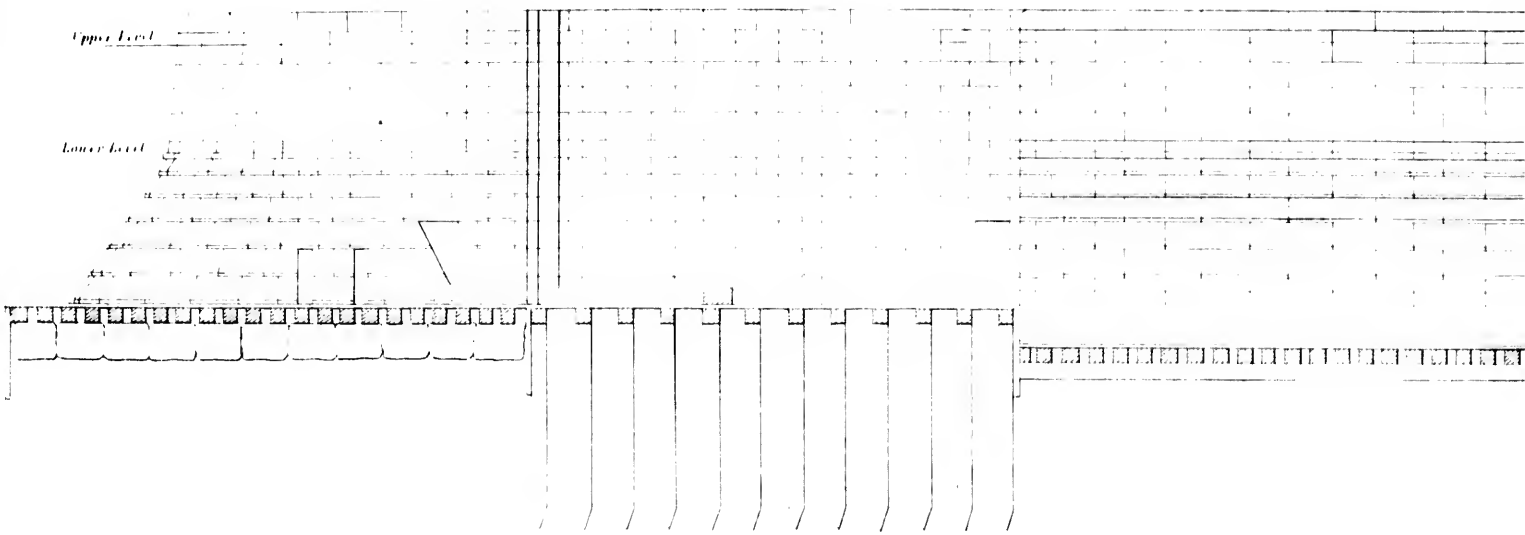
John Weale architectural Library 59 High Holborn

PLAN … OF THE …CKS ON THE ST LAWRENCE CANAL

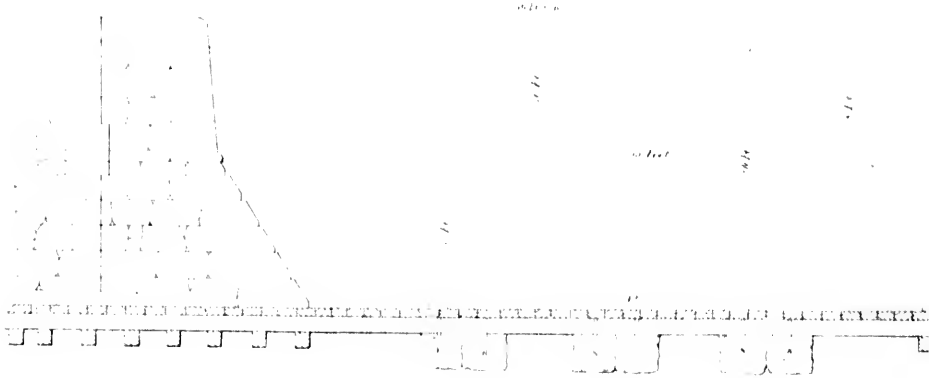


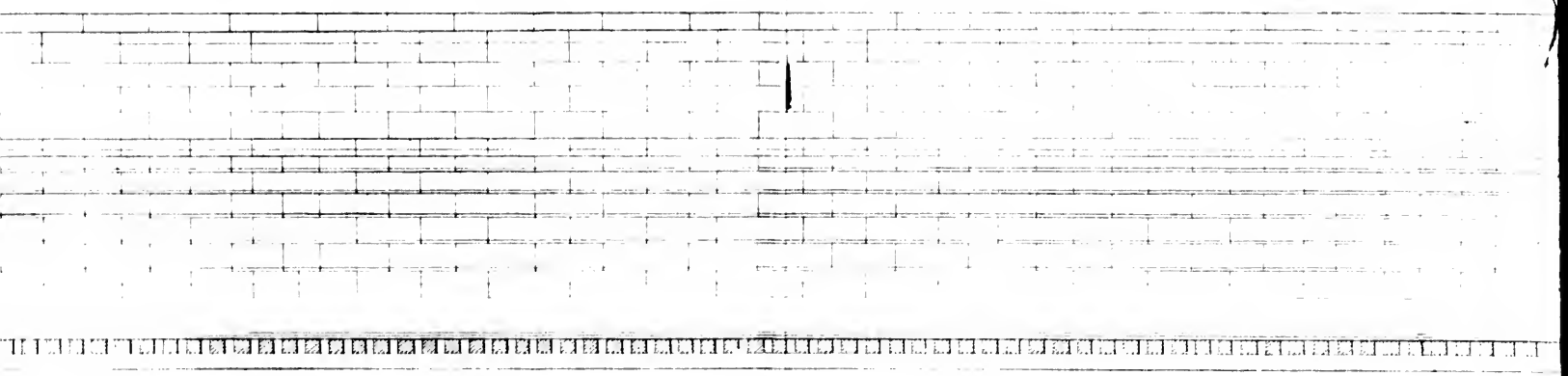
John Weale … High Holborn





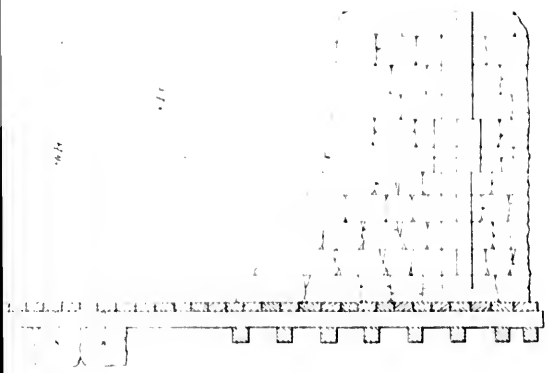
SECTION THROUGH CC.

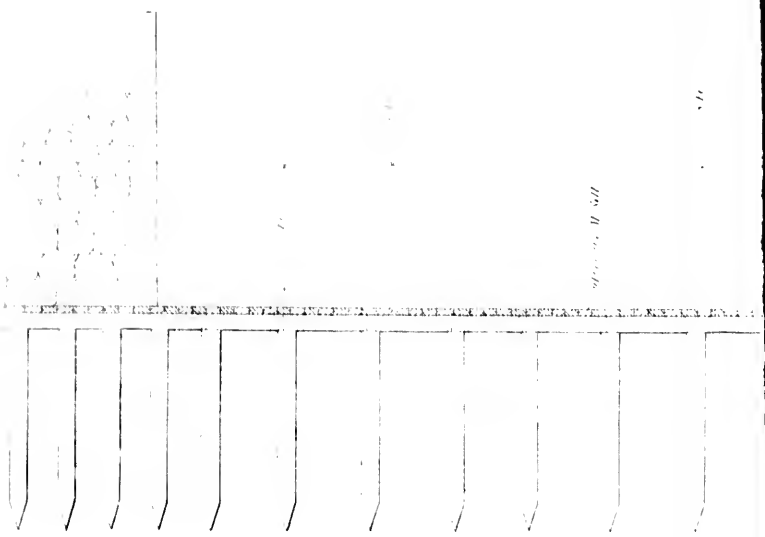




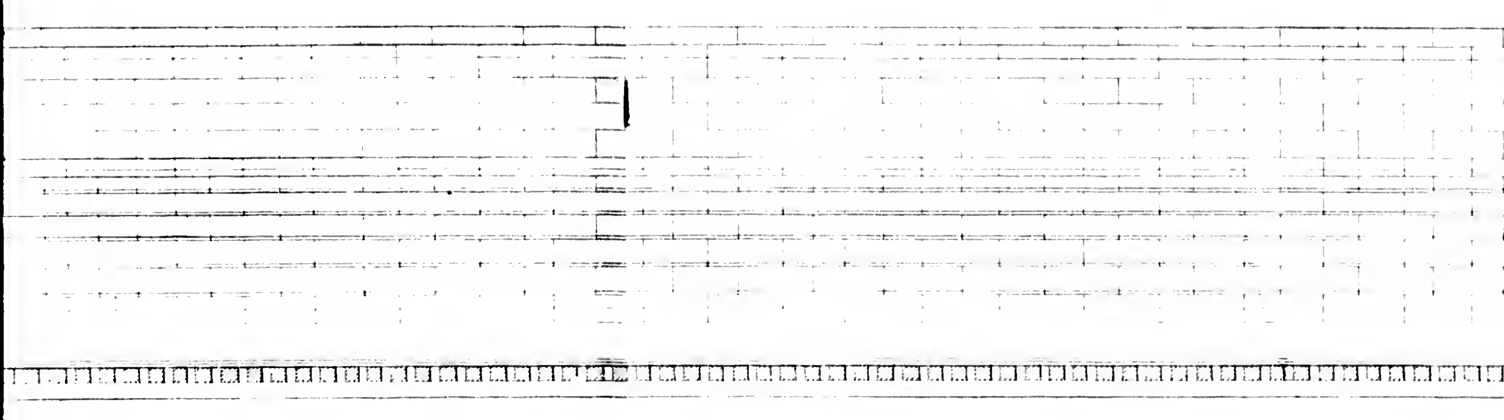
10 5 0 10 20 30 40 50 60 FEET

SECTION THROUGH **BB** WHERE PILES ARE

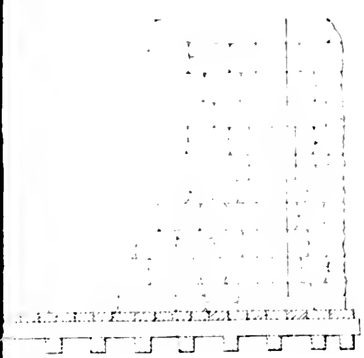


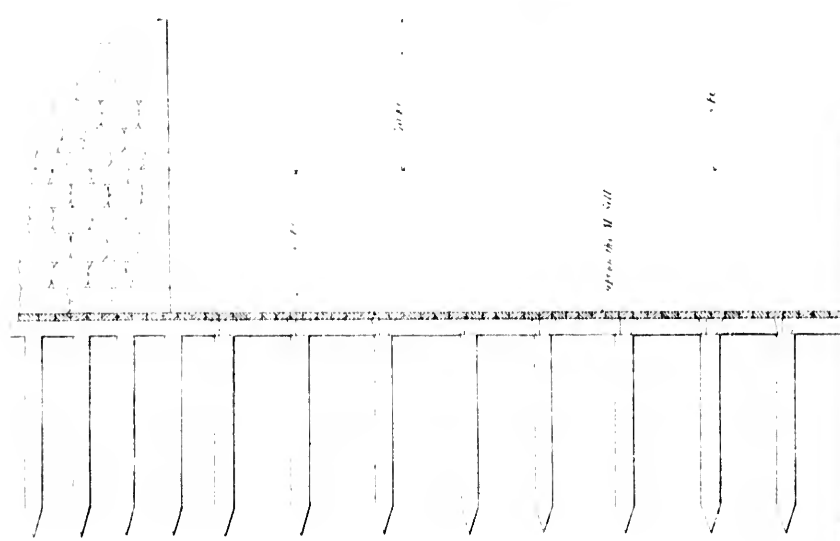


ELEVATION OF ONE SIDE OF A DOCK AND
SECTION THROUGH [illegible] FOUNDATION

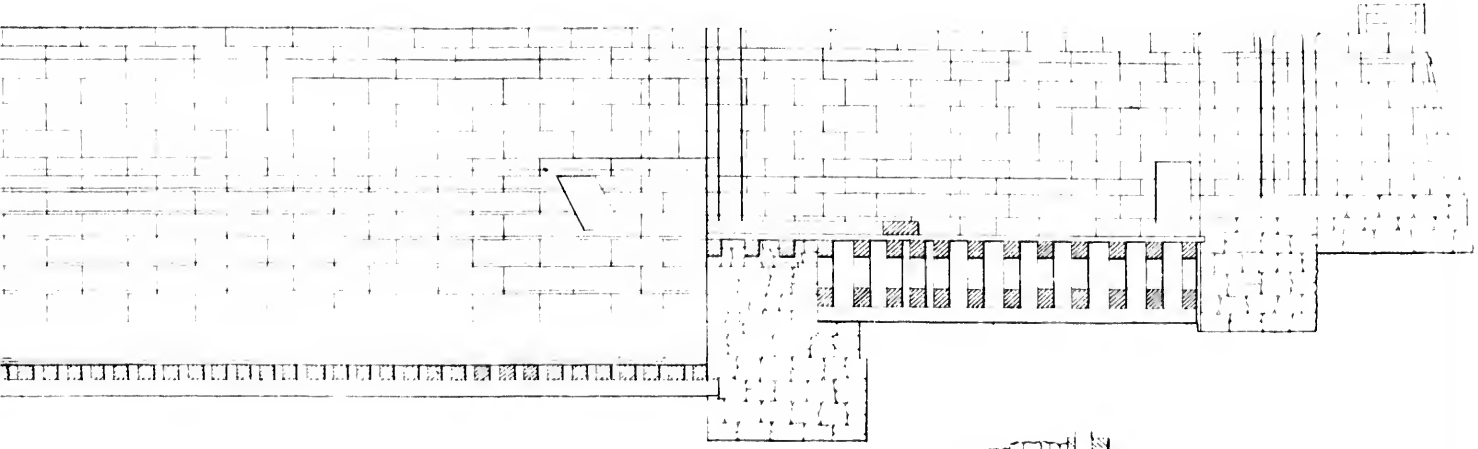


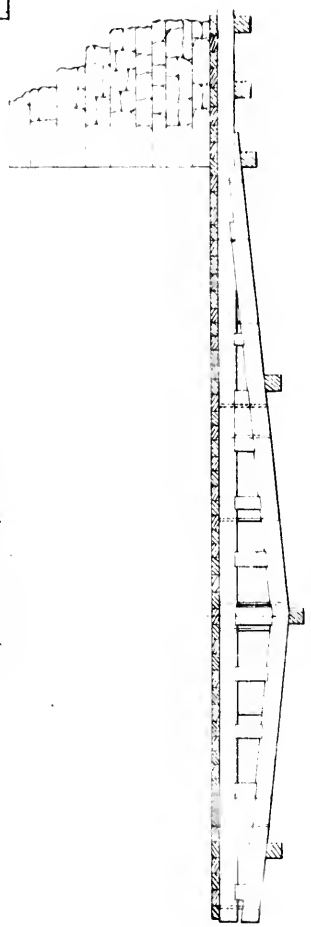
SECTION THROUGH BB WHERE PILES ARE USED





John Weale, Architectural Library, 59 High Holborn

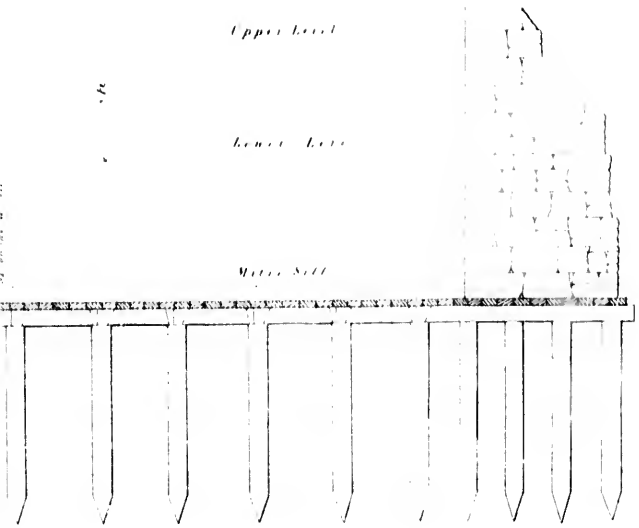


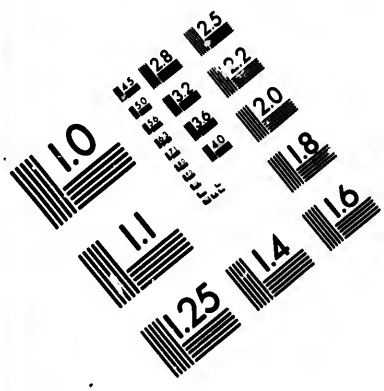


SECTION THROUGH AA

Shewing the Timber adapted when Piles cannot be driven

HERE PILES ARE USED





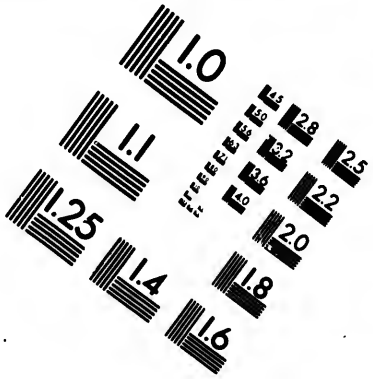
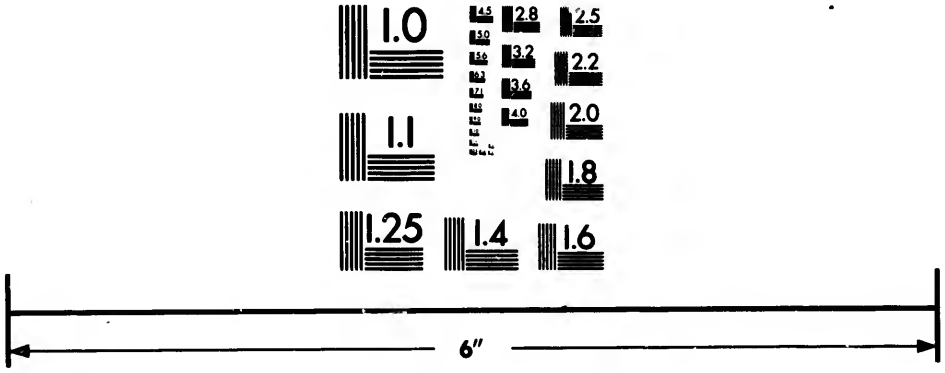
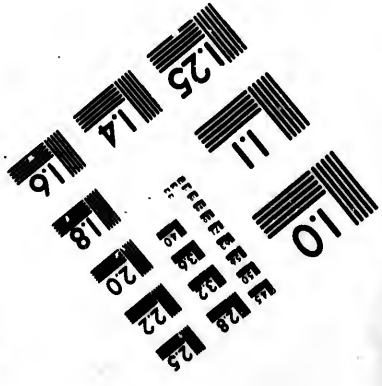


IMAGE EVALUATION TEST TARGET (MT-3)





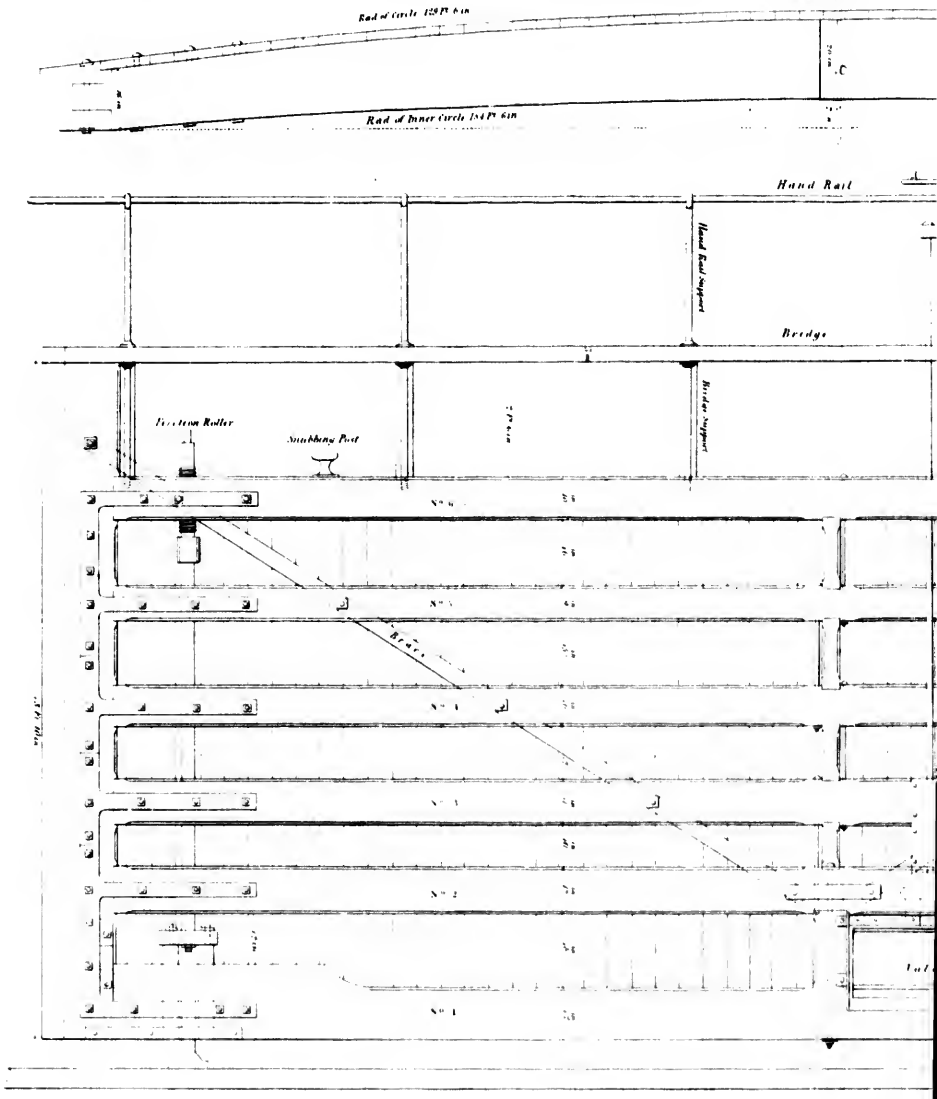
Photographic Sciences Corporation

23 WEST MAIN STREET
WEBSTER, N.Y. 14580
(716) 872-4503

2.8
2.5
2.2
2.0
1.8
1.0

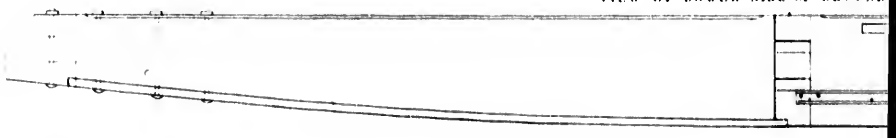
UPPER GATE, ST LAWRENCE

BAR N° 5



VIEW OF UPPER SIDE OF LOWER BA

VIEW OF LOWER SIDE OF SECOND

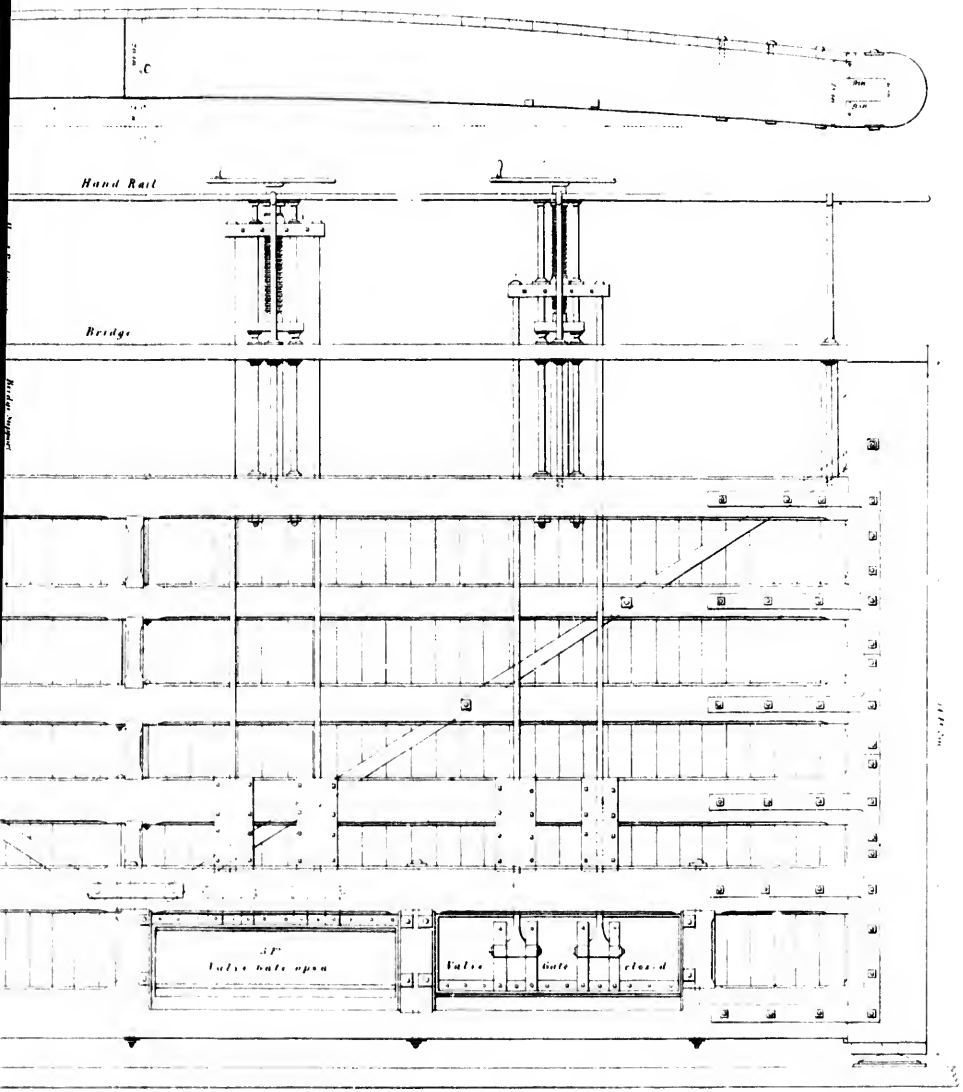


0 1 2 3 6

J. B. Atkins, Lith.

...E, ST. LAWRENCE CANAL.

BAR N°5



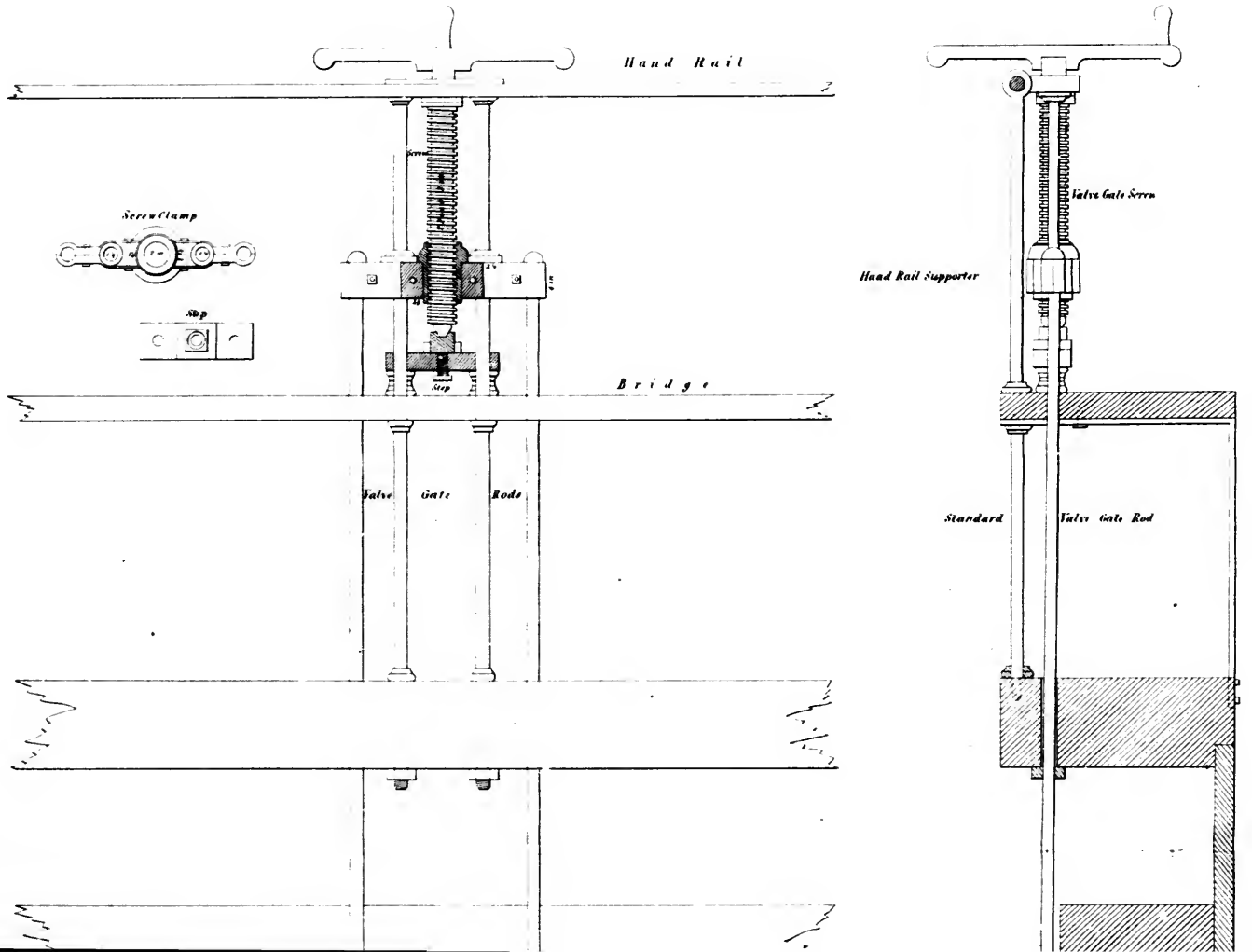
...F UPPER SIDE OF LOWER BAR N° 1

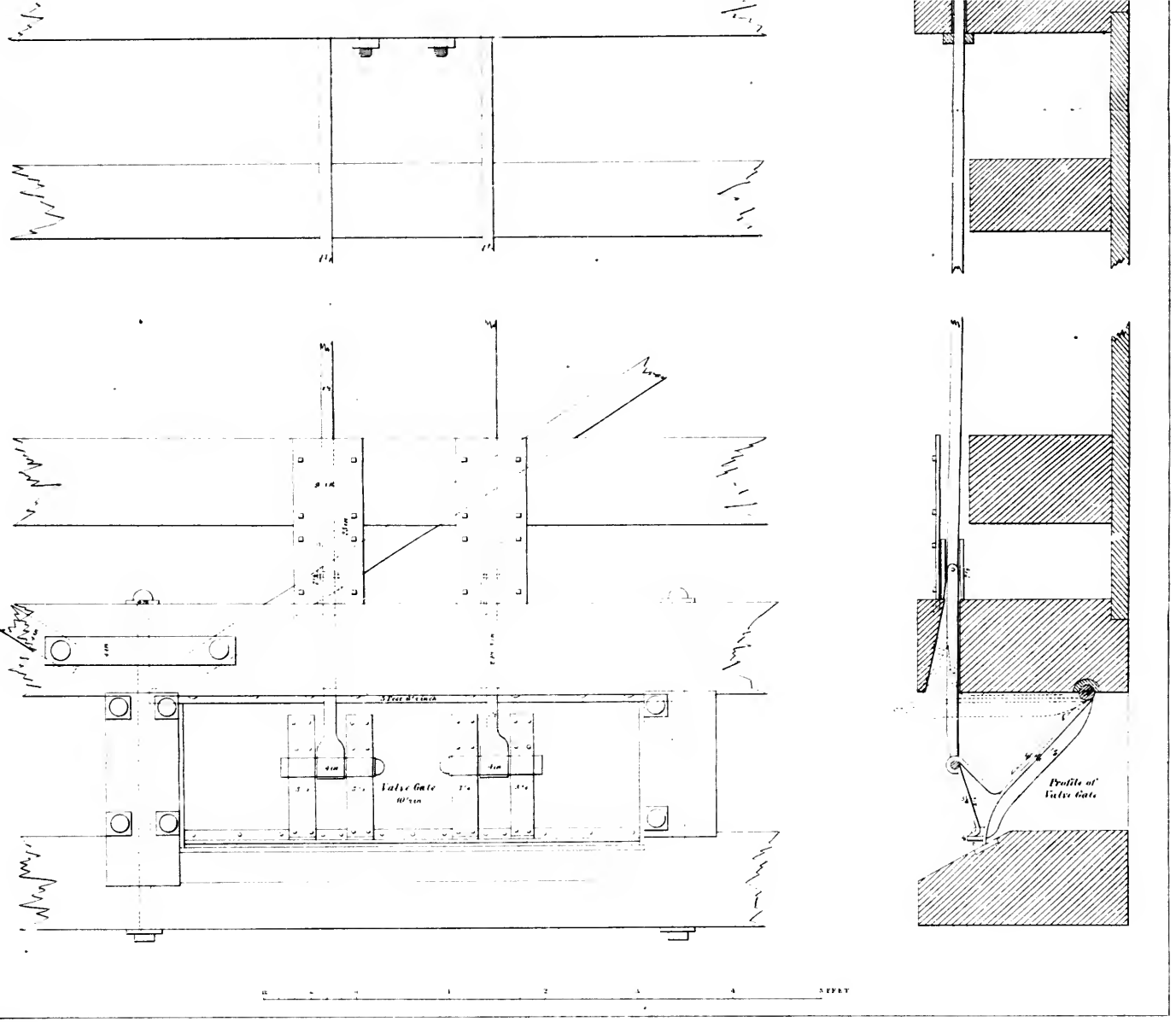
...OF LOWER SIDE OF SECOND BAR N° 2

3 6 9 12 FEET

PLAN OF THE IRON WORK *used for opening & shutting the* VALVE GATES *on the* ST LAWRENCE CANAL

To accompany Lt Colonel Phillpotts Report on the Inland Navigation of the Canadas

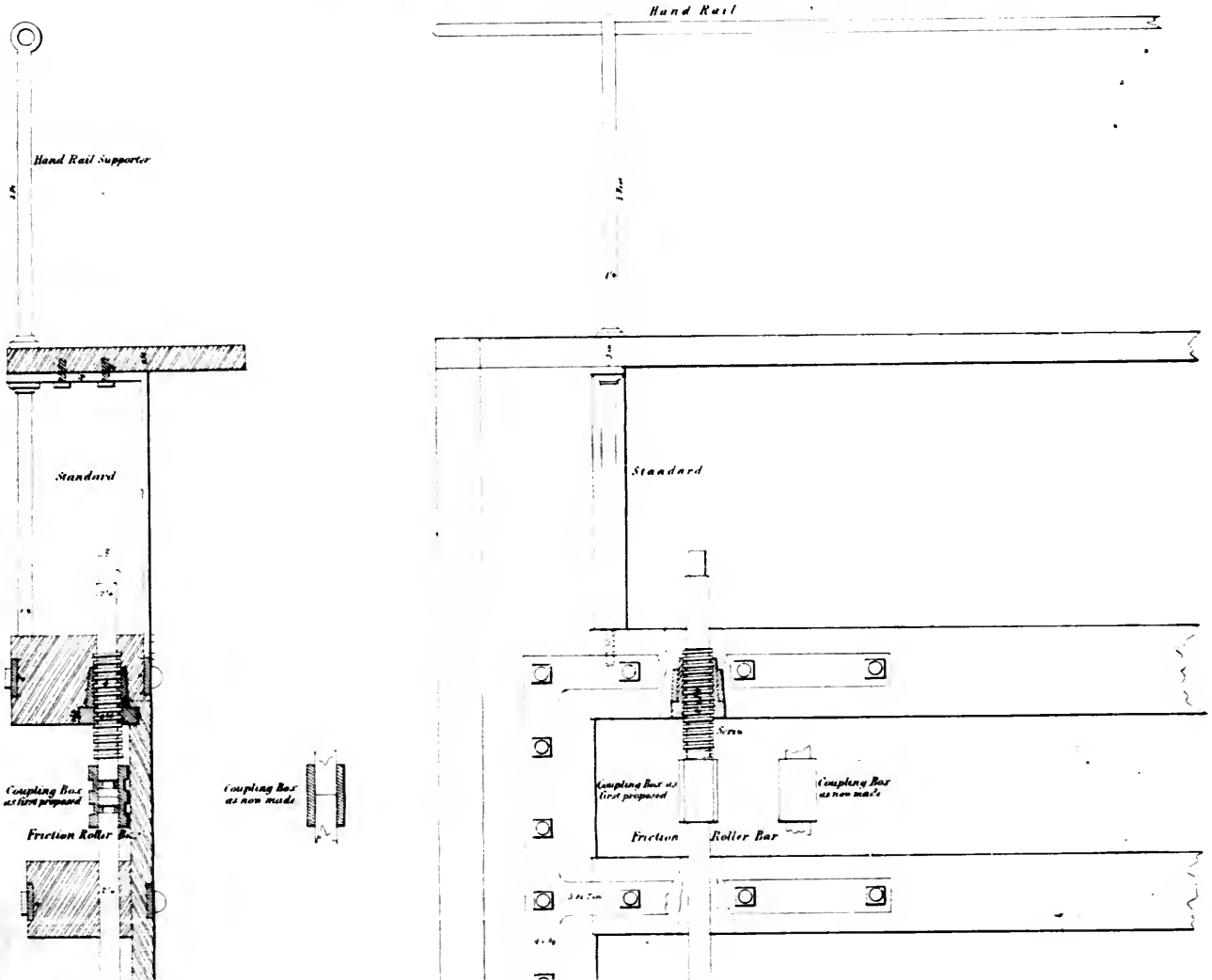


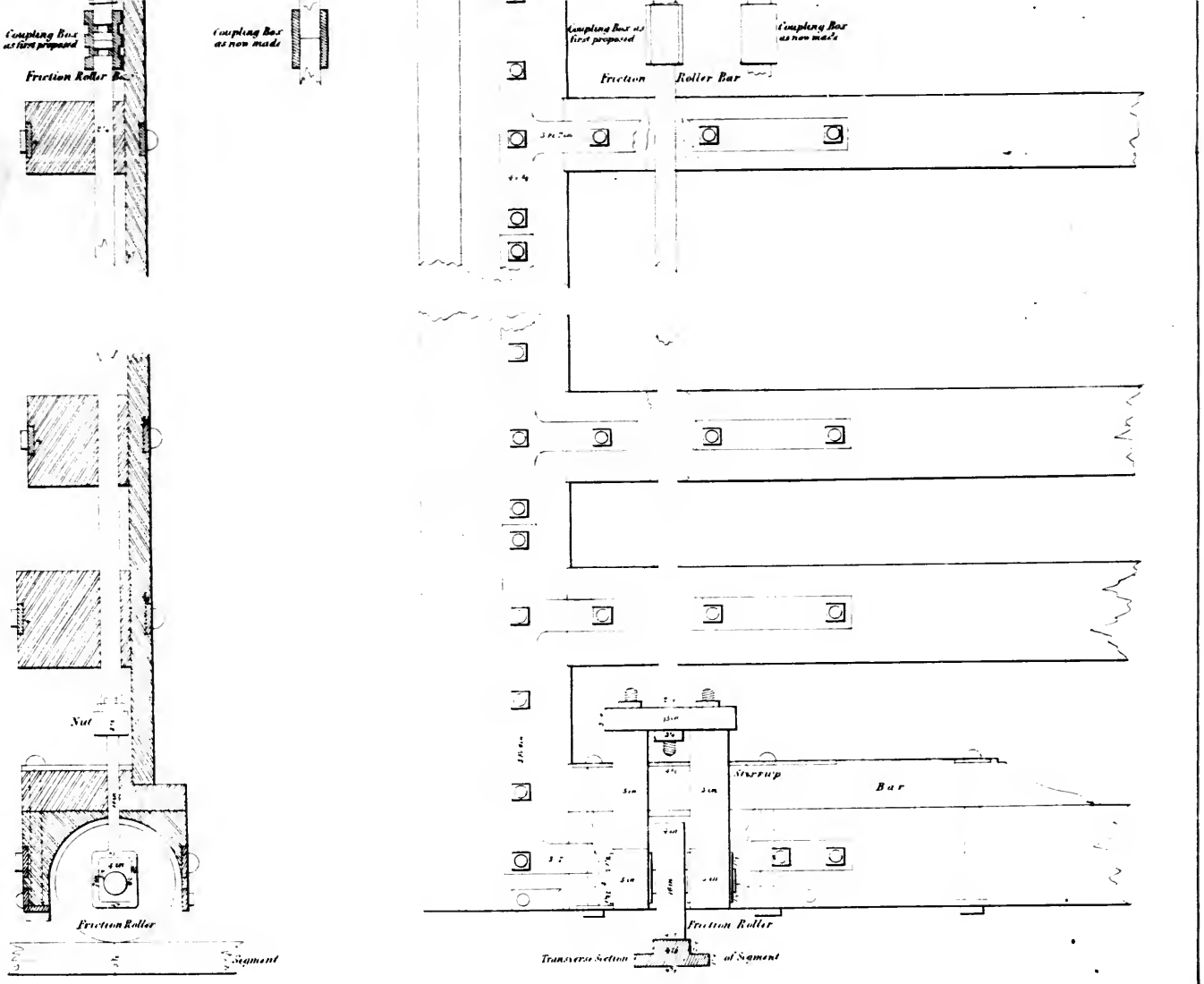


J. R. Tobbins Lithe

PLAN OF THE IRON WORK & BOLTS used for adjusting THE FRICTION ROLLER ON THE LOCK GATES OF THE St LAWRENCE CANAL.

To accompany Lt.t Colonel Phillpotts Report on the Inland Navigation of the Canadas



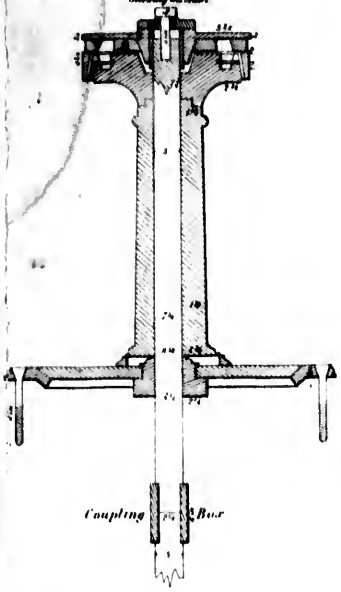


SCALE ¾ OF AN INCH TO A FOOT

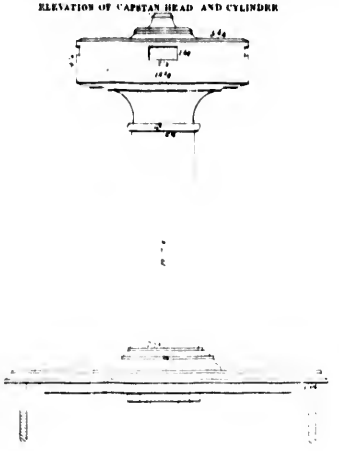
Inches 1 2 3 4 5 6 1 FEET

PLAN OF THE IRON WORK *used for opening and shutting* THE LOCK GATES ON THE ST LAWRENCE CANAL.

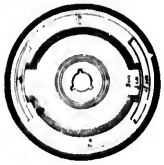
SECTION OF CAPSTAN HEAD AND CYLINDER *Showing the Shaft*

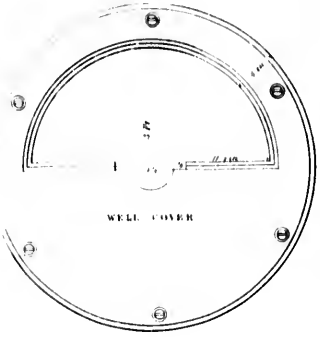


ELEVATION OF CAPSTAN HEAD AND CYLINDER



PLAN OF LOWER PART OF CAPSTAN HEAD





WELL COVER

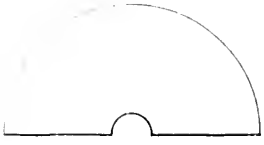
Coupling Box

Coupling Box

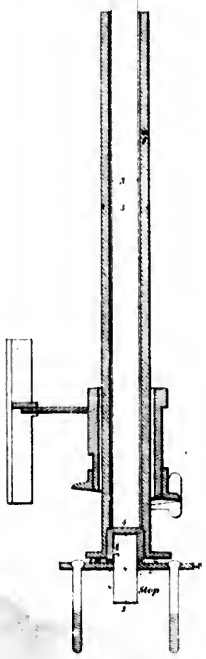
Capstan Shaft

Capstan T Plate

Capstan T Plate



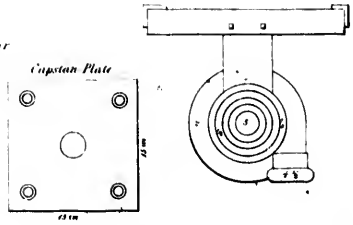
Capstan Drum



Capstan *Rider*

Capstan Plate

Plate



Inches 0 1 2 3 FEET

J. Ashby sc. Lithe

John Weale Architectural Library, 59 High Holborn