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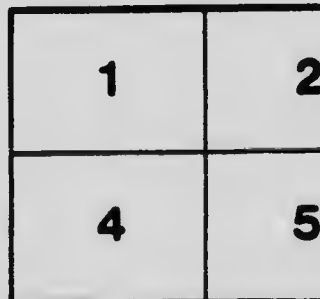
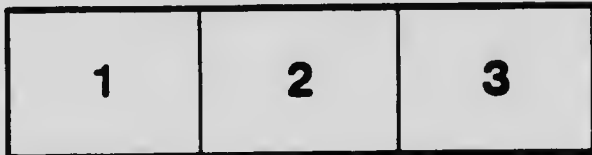
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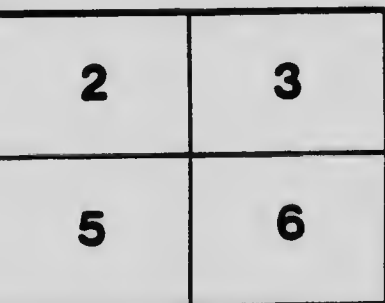
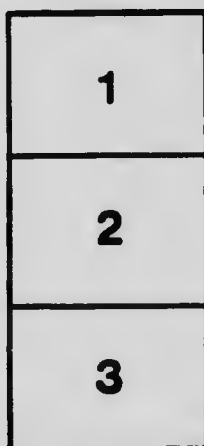
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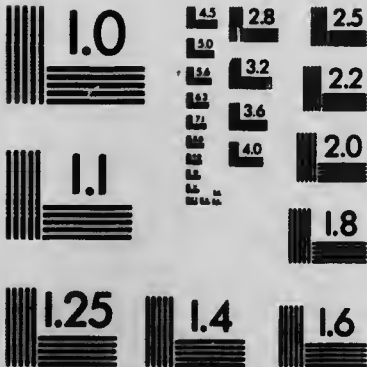
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# **Damming the St. Lawrence**

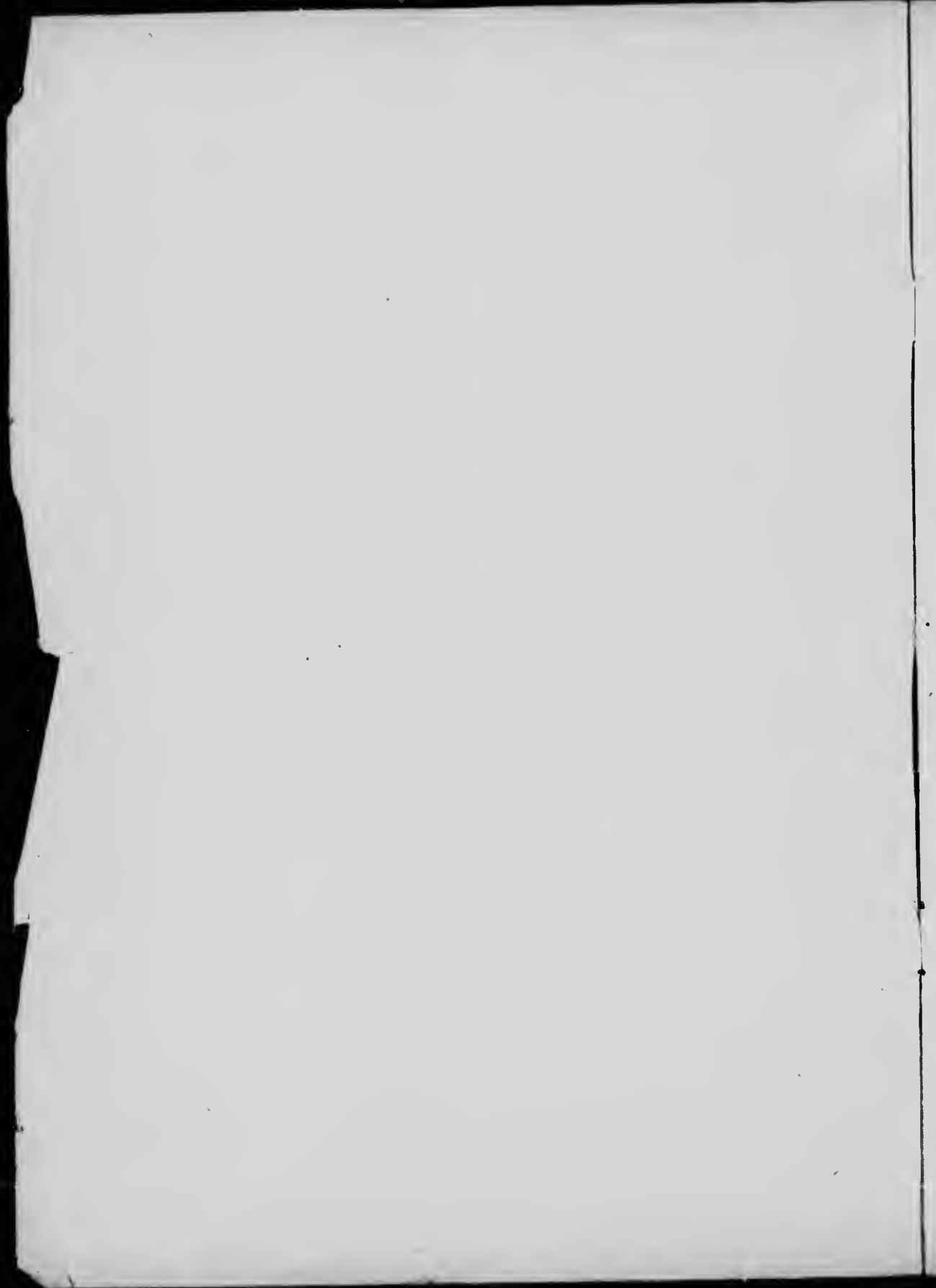
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**A Concise Statement of Conditions  
Pertaining to the River St. Lawrence  
Between Prescott and Cornwall and  
the effect of Damming the River at  
the Foot of the Long Sault Rapids**



Tough  
N.Y.  
"D"  
No. 1 1 2



As announced in previous issues of *The Leader*, a delegation from Morrisburg and vicinity, including Reeve J. H. Meikle, Councillors R. E. Gibson and Irwin Hilliard, and Capt. W. J. Murphy, J. Wesley Allison, Morrisburg; Reeve M. J. Casselman, of Williamsburg, and Reeve C. E. Cameron, of Iroquois, went to Ottawa on Wednesday to enter their protest on behalf of the residents of this district in opposition to the proposed damming of the St. Lawrence at the Long Sault. They were received at 11.30 a.m., by the Rt. Hon. Sir Wilfrid Laurier and Hon. George P. Graham, who gave them an hour's attentive hearing. The delegation presented strong and entirely new arguments to the Ministers, showing that the proposition to dam the St. Lawrence should not be permitted, or even considered. Several memorials were left with them, the first being that of the town of Morrisburg; one signed by the reeve of Iroquois and the reeve of Williamsburg township, which represented the farmers between Prescott and Mille Roches along the St. Lawrence. Another was signed by Capt. Murphy, a river captain for over forty years, and a man who knows all the shoals, currents of the river and the ill-effects of ice-jams, while another was signed by Capt. Logan, of Waddington, N.Y.

In order that our readers may know how keenly the people of this district feel towards this proposition, we give the memorials that were left with the Government:—

To the Honorable Sir Wilfrid Laurier, and the Members of the Dominion Cabinet:—  
Honorable Sir,—

Whereas the Municipal Council of the Village of Morrisburg and the people living along the St. Lawrence River, in the County of Dundas, view with serious alarm the

vigorous steps the parties in charge of the Long Sault Development Scheme are taking to induce the Government of the Dominion of Canada to pass such legislation as will enable them to dam the St. Lawrence at or near the foot of the Long Sault Rapids.

By past and bitter experience such people have learned of the dangers of an abnormal rise in the waters of the River St. Lawrence.

During the years 1879, 1887 and 1905, ice dams were formed across the River St. Lawrence near the Village of Farran's Point. This became blocked by the piling up of frazil ice and caused the river to rise twelve to thirteen feet at Morrisburg. The damages resulting from such high water and floating ice shoving over the land were, amongst others, destruction of dwelling houses, barns and out-buildings, trees, telegraph and telephone poles.

By reason of the rise in the river as aforesaid, the water powers of the Williamsburg Canal were wiped out. Under leases from the Government of the Dominion of Canada, being numbered respectively 8513, 13815 and 16110, the Corporation of the Village of Morrisburg have contracted and acquired thirty-five horse powers to run their waterworks system, put in at an expenditure of thirty-five thousand dollars (\$35,000.00).

250 horse powers to run their electric lighting system, erected and equipped at an expenditure of thirty-five thousand dollars.

750 horse powers to run their electric power plant, which has cost the said corporation seventy-five thousand dollars.

Besides the foregoing, there is the waterpower under lease to certain individuals.

Your memorialists are satisfied that the damming of the Longue Sault will cause such a rise in the river as to utterly obliterate the



practical use for commercial purposes of the aforesaid water powers, and we strongly protest against any change being made in the natural flow of the river by your Government that will prevent your Government from fulfilling its contracts under said lease.

The direct result of damming the river at the Long Sault will be to slow up the current of the river west of said dam, and cause larger quantities of frazil ice to form, which will cause dams to be formed in the river and cause the same to raise and back up over the land and destroy much property.

We believe the scheme has directly for its object the granting to capitalists who must of necessity sell their product in a foreign country. If the Longue Sault should be utilized for power purposes, it should be retained until such time as the population of our country would warrant the use of that power in our own country for manufacturing purposes. At the present time there is not sufficient need of that developed power in our country. Montreal and Ottawa are more than fully supplied. If that power be once developed and taken to the United States, it will never be brought back, and our share of that magnificent heritage and birthright will be gone forever.

We also fear that the matter of the Longue Sault development is entirely different from power at Niagara Falls, in that it would be a joint development, and would in fact, if not in theory, be under the control of the stronger and wealthier partner. Again, it would necessitate the placing of our shipping under the control of a foreign Government, the larger canal being within the territory of the United States, and hence we believe that in time the whole scheme would lead to serious international complications, and it should be

our earnest desire to strictly avoid the originating of causes for such complications, and

Finally, for mere commercial purposes to enrich capitalists, why should the scenic beauty of our noble St. Lawrence be destroyed?

This memorial was signed and sealed by the village clerk.

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The following memorial, signed by the reeve of the village of Iroquois and the reeve of Williamsburg township, was presented:—

On behalf of the people of Dundas residing between Mille Roches and Prescott, we respectfully but most vigorously enter our protest against the proposed scheme of damming the St. Lawrence at the Long Sault by the St. Lawrence Power company.

Aside from the general Canadian sentiment, which is widespread, and which has been repeatedly expressed from various parts of the country, there are very many tangible reasons to be advanced against the undertaking.

Naturally, the strongest feeling of animosity toward the scheme exists in those communities lying along the river itself. This was more evident as a whole some months ago, when the subject was first brought to the attention of the public; but we are sorry to see one or two of the larger towns (as for instance, Brockville) have become not only lukewarm in their opposition, but actually favorable to the scheme. This change has been brought about by a vigorous propaganda carried on through the local papers, which apparently have very suddenly experienced a decided change of opinion with regard to the project. This change has been attributed to various reasons by various people, but without casting too much reflection on their sincerity, we feel justified in saying that many of the inducements held out by the papers on

behalf of the company, are not only quite vague, but entirely impracticable.

The inducement of cheap power was offered to Morrisburg as well as to Prescott, Brockville, etc.; but we were and are more dubious than they of the fulfilment of the promise, for various reasons; among these reasons the statement of several experts who declare it would not pay the St. Lawrence Power Co. to erect and maintain a transmission line to these points for the comparatively insignificant amount of power required; but that the company will transmit the great bulk of their power to New York, where it can be delivered en bloc.

But, in addition to this, the fact must not be overlooked that the towns and farm lands east of Prescott are liable to serious damage from the raising of the water, which will occur. In the case of the town of Morrisburg, for instance, we have good reason to fear that the raise of water would flood the tail races of their municipal power plants, and destroy their docks, etc., as at present, according to Government survey, 1896, the water at the foot of the Morrisburg canal is only 10.85 feet above level of water in river at head of Cornwall canal.

To what length the water will be backed up at Morrisburg by the proposed dam, even the best of expert engineers are unable to calculate. To illustrate this, we beg leave to quote Professor Mansfield Merriman, of Lehigh University, one of the greatest authorities on hydraulics, and the author of several works which have become standard among engineers:—

"When a dam is built across a channel, the water surface is raised for a long distance up stream. This is a fruitful source of contention, and accordingly many attempts have been made to discuss

it theoretically in order to compute the probable increase in depth at various distances back from a proposed dam. None of these can be said to have been successful, except for the simple case where the slope of the bed of the channel is constant and its cross-section such that its width may be regarded as uniform, and the hydraulic radius be taken equal to the depth."

The above conditions mentioned in the exception are a long way from being fulfilled in that stretch of the St. Lawrence River between the site of the proposed dam and Morrisburg. One can hardly imagine a large river more non-uniform in a distance of fifteen miles, than this section, being cut up by numerous islands, the shore line indented by numerous bays, with long projecting points, causing some stretches to be narrow and deep, and others to be quite wide and shallow. A Government chart of this section of the St. Lawrence River, prepared by A. J. Grant, C.E., in 1896, for the Canadian Government, shows a fall of only 10.85 feet in the distance of 15.7 miles from the foot of Morrisburg Canal to head of Cornwall Canal, or an average fall of 8 ins. per mile. Now the Long Sault Rapids is practically the outlet of this fifteen miles stretch of river. If this free outlet causes a fall of 8 ins. per mile, then if this outlet is obstructed ever so little, it would cause an ever lessening proportional fall in surface of river for an indeterminate distance back, or in other words a "back water;" or, as the experts would describe, the slope of the uniform flow is an asymptote to the back water curve. That this back-water is much greater than the average person would imagine, the following simple illustration will show:—A stream five feet deep is to be dammed so that water will be 10 feet at dam. The uniform slope of

stream is 1 foot per mile, and its channel is such that the coefficient is .65. It is found that at the distance of 5 miles upstream the water is 6 feet deep. That is the water is raised one foot at a distance of 5.7 miles upstream from dam in spite of fact that fall in bed of channel is nearly 5.7 feet.

During the winter season all these adverse conditions will be increased by ice troubles of several kinds. First, the surface area of the river above dam will be immediately and considerably increased, thus lessening the current and allowing the shore ice to form out much further and thicker than at present, and therefore lessening the width of the open channel. So we have a winter condition in which the bays of ice are largely increased in area and the open channel considerably lessened in width, hence it will be much easier for an ice bridge to form by swinging out one of these numerous ice bays by a favorable wind. Even under present conditions several ice bridges have been formed in recent years. A bridge once formed, though even on the surface, is quickly re-enforced by floating ice and frazil ice. This frazil ice is always present to some extent in our open streams, and extends down several feet from the surface in the shape of fine crystals. These crystals adhere to anything in the stream they touch, and readily collect on the under surface of the ice in the main channel, viz., the ice bridge. Successive layers of this soon forms a curtain extending from the under surface of ice bridge down several feet. This curtain also catches all the anchor ice which has risen part way to surface and then floating with current is just in shape to hang on any obstruction in its path, thus increasing the wall. So it is quite apparent that these ice curtains may form miles upstream from where the ice-

bridge was first swung across, finally forming a complete jam in the river.

How far the water will back up when this occurs, is indeed hard to determine, as the worst jam up to present did not approach to having such favorable conditions for formation.

So much for an open channel down the river, but with the plans proposed by the company, the current will not in this increased cross-section be strong enough to keep the channel open very long, after winter once sets in.

In the first place the company's engineers are stating that the current leading from the dam will flow slowly enough for heavily laden boats to make good time upstream, and secondly, that they will utilize the sluice gates which will be situated in the dam far below the water surface, to prevent the water flowing over the spillway, and in this way decrease the amount of frazil ice formed by the cold water striking a thin sheet of roughened surface of water, and which now nearly every winter collects to such an extent in Lake St. Francis that it floods out the lower portions of the town of Cornwall.

Now, both these cases go to prove that it need not be necessary for a bay to swing out to start an ice blockade in the river; but that either the surface ice in the slack water in front of the dam or the constant stream of floating ice coming up against the dam when the water is going through the sluices and not over, will soon collect in quantities sufficient to completely cover that section of the river for miles upstream.

Again, it is a well-known fact that a power company in our northern climate will spend vast sums in order to obtain a reservoir or forebay in front of its racks

large enough and hence quiet enough to allow the surface to become frozen over and stay in that state most of the winter. What would the Lachine Power Co. give for such a forebay, and what would it be worth to Massena during even the present mild winter?

Therefore, the inevitable conclusion is that the conditions which the engineers of the company must have for the successful operations of their plant and lock approaches will be the very conditions that will allow in winter time the formation of a continuous sheet of ice above their dams for a considerable distance up-stream.

And as stated above, although these would be the conditions with a dam, and also the ideal conditions for the maintenance and constant operation of their power plants, they are the very conditions which are sure to lead to the most disastrous results in the formation of large ice-jams early in the winter, which will increase to unprecedented dimensions as the season advances.

The following extract from the report of the Montreal Flood Commission will be of interest in showing the points at which ice troubles are in the habit of occurring:—

"The St. Lawrence is a river of such width and depth that notwithstanding the great volume of water which it carries (its low-water discharge above Lake St. Peter being 315,000 cubic feet per second), its extreme range between highest and lowest watermarks is only about six feet, or one-tenth that of the Ohio at Cincinnati. Whenever this range is exceeded, as at Cornwall, Beauharnois and Montreal, it is only in winter, and is due to the packing of ice. The river below Montreal is affected by ice from tide-water to the foot of Lachine Rapids—a distance of 80 miles—and with the exception of

what are called airholes, the whole surface is covered with ice. But above the Lachine Rapids, the winter level is only elevated by ice for a short distance opposite Cornwall and Beauharnois. All the remainder embracing both open water river section and ice covered lake sections, with rare local exceptions, maintains the ordinary level. The exceptions are where an ice bridge or jam may occur in the narrower channels above the Cornwall Canal in very severe winters, or where a bridge is formed artificially by sawing off enough bondage ice and swinging it across the channel to an island, to give communication to the main land. These bridges do not effect the river levels at that site, but by arresting floating ice, may advance the bridge up-stream to a point where shallower water and a swifter current may cause a pack and form a dam. The open water sections are about 40 miles in length, between Cornwall and Prescott, and about 15 miles between Lake St. Francis and Lake St. Louis, and about 10 miles between the ice-covered portion of the latter and the foot of the Lachine Rapids. There is no case of a permanent winter dam where there is open water immediately below it (as in the case of a gorge at the break-up of the ice), but the permanent winter rise at Cornwall and Beauharnois takes place under the same conditions as that at Montreal, namely, the junction of a river section of open water with one which is closed, or of a strong current with comparatively dead water."

The damage done to the river front in Montreal before the costly protecting wall was built, is well known. Ice bridges and shoves have been of common occurrence at the Cedar Rapids. Cornwall has experienced many floods caused by the accumulation of ice in Lake St. Francis.

The surface ice on Lake St. Francis only serves to form a bridge and this catches the abundant and incessant flow of slush ice mingled with more or less of detached surface ice. This flow from the swift channel striking the quieter waters of the Lake is checked, giving the frazil ice an opportunity to cement the larger cakes together, thus adding to the strength of the front of the bridge. Meanwhile the bordage-ice, thickened by frost and snow (made heavier by thaws and occasional rain, as well as the filling up underneath by frazil and anchor ice) begins to encroach upon the waterway, causing a gradual rise of the surface. This rise lifts the bordages, and often detaches them from the shore, when in a favorable position and aided by wind and current, they move down the main channel until arrested by the ice bridge. Then if there occurs a heavy snow-storm with a wind sweeping the surface of the large bays of their snow (the river at times becomes very nearly impassable in row-boats from this cause) we have a mass which quickly fills any interstices in the floating cakes, and the up-stream march of the ice-bridge becomes very rapid.

Now, with a dam at the Long Sault, all this accumulation will occur in its quiet waters early in the season—depending upon the weather—the bridge will rapidly extend up-stream until it reaches Weaver Point, where the width is greatly lessened by the rocky projection, and the current proportionately increased. Here the ice flowing down the river collects against the narrow front of the bridge. At first the floating cakes are often tilted on edge by the current extending some distance both above and below the surface, and all the open spaces are rapidly choked with frazil and floating snow slush. Some of the lower

aiding cakes of anchor ice with an abundant supply of frazil during favorable conditions, find their way under the surface, but only to rise and become firmly attached to the undersurface when the quieter waters are reached, and hence gradually increasing the thickness of the surface and forming a hanging curtain near the front of the ice-bridge. The jam here grounds on the south shore, and when the water rises to a sufficient height in front, enough pressure is obtained to cause a shove, which naturally takes the same direction as the slope of the river-bed, that is towards the Canadian shore. This occurred in 1887 and 1905. In the former year a brick house was cut down and the occupants barely escaped with their lives. A little farther along another house had its lower storey destroyed and the house wrecked. But these shoves only tend to tighten the jam, and a second bridge forms above it, and this proceeds up the river until another narrow portion is found. In 1905 this second bridge extended six miles above Weaver's Point, or just above Morrisburg, its front running from above Canada Island in an oblique line down stream towards the canal bank. Here, fortunately, warmer weather stopped its progress, otherwise a second jam would have been formed, and as the current sets very strongly towards the north shore, the accompanying shove would very likely have sheared off the canal bank, as well as making a wreck of the town's pump-house, and other buildings along the shore.

From navigation charts, the next narrow parts of the river can be easily located as Pine Tree Point and Rockway Point at Iroquois, where a shove, which must take the same direction as the current, would certainly destroy the low-lying portion of that town.

During the jam of 1879, although the ice did not reach within four miles of Morrisburg, the water ran over the banks of the Morrisburg Canal at the head locks above Rapide Plat, so it is well within reason that with an early formation down the river and a severe winter, the water should raise to a far greater extent than it did that year, and easily overcome the fall of 3.36 feet between the head of Morrisburg Canal and Iroquois. How much farther this bridge with its jams would proceed up the river no one can tell.

But the history of the last three serious blockades are well known. The oldest inhabitant never heard of a jam in the river till they swung these obstructions at Croil's Island.

That of 1879 was caused by the swinging of a bay across from Croil's Island to Baker's Point, in the north channel, and from head of Croil's Island to the American shore on the South side. The ice extended as far as Weaver's Point, the first narrow part of the river, where a jam occurred, and the shove which followed swept across the low-lands at that point. At this time the water was raised at Morrisburg, a distance of 6 miles up-stream from the front of the bridge, to a greater height than that caused by the jam of 1905.

In 1887 the bridge was swung again at Weaver's Point in the North channel, but across the channel between Chat and Croil's on the South side. The first jam, as in 1879, occurred at Weaver's Point, the ice bridge extending only a short distance above it. The water at Morrisburg was raised 12 feet above normal, and was only prevented from flooding the canal by the placing of flash-boards on the lock-gates at the head. The shove at Weaver's Point destroyed both a brick and frame dwelling, which were in its path.

All the roads along the river were flooded and a portion of the farms bordering on the bank of the river.

In 1905, the ice bridge started from the same points as that of 1887, but this time the bridge, after forming a jam at Weaver's extended a quarter of a mile above Morrisburg, the front running from the head of Canada Island obliquely down stream to the canal bank. At this narrow section of the river the cakes were lying up-ended, many being thrown on top of the bridge and along the shores, others forced and held under the water surface, and a second jam was in the process of being formed. However, the lateness of the season and a period of mild weather prevented the completion with its attending shove.

Between the above years other bridges have occurred at Weaver's Point, but mild and unfavorable weather caused them to break up before the water was raised to much extent.

#### Some Effects on Navigation.

Next consider some of the detrimental effects of the proposed plans on navigation. The new and improved locks will be located between the foot of the Long Sault Island and the American shore. With this method of overcoming a 47-foot lift in one lockage, or even two, will there ever be breakages, with their accompanying disasters, such as have occurred at Sault Ste. Marie?

The channel between Barnhart's Island and the American shore leading to the proposed site of the locks is intricate, winding, with several cross-currents and strong back eddies, all of which make it very difficult for navigating even the shorter craft, either up or down. Then consider the proposed state of this channel when its main feeder between the Long Sault Island and Barnhart's is dammed and the South channel

is completely shut off with locks and its quiet water approaches. The water will be lowered and will flow swifter, so that it will be impossible to make the points with any ordinary craft.

Every river man knows that the current opposite Cornwall is running swifter than any place in the boat channel between the Cornwall and Morrisburg Canal, and it certainly would not be a saving in time to cause a boat to hang in such a current.

Then again, with an ice bridge extending even as far as Morrisburg, it is doubtful if the river could be cleared of ice, especially the great heavier masses gathered in the swift water, in time for the usual opening of navigation, and certainly would close navigation a month earlier at least, thus cutting off at both ends during the busy season; and, in addition, there is liable to be a much longer delay caused by damage sustained to the canal banks by the ice shoves accompanying the ice jams.

With the high water of the past few seasons (and the water of the last two years has had the highest level since 1871) the canal banks have suffered considerably from the wash of the liners as they pass down the channel. Now, with the river dammed, this would be continually occurring, and would be an additional expense to the Government of hundreds of thousands of dollars per annum.

The Cornwall bridge, spanning the river and owned by the New York & Ottawa Division of the New York Central Railway, has a clearance of only 60 feet from the water. Therefore, how will the boats pass under it if they should be forced to take this channel. The R. & O. boats running the rapids have all cut off their spars. When the bridge was built, the engineers decided that the bottom of the river was not suitable for a pier, even if

it were practical for a swing section to be operated, and it would certainly be impracticable to increase the height of the bridge sufficiently to give the steamers the necessary head room.

Capt. W. J. Murphy presented the following memorial:—

That the property owners and citizens of Morrisburg and vicinity should feel strongly over the proposal to dam the Longue Sault Rapids is very natural, as life-long residents, men of much experience on the river, who have watched the operations of its waters winter and summer for long years, and understand its currents, shoals and rapids, are strong in their opinions if this scheme is carried out that the canal and docks at Farran's Point and Morrisburg will be submerged, even in summer time. The damage to property not only at Morrisburg, but along the river front for miles up and down, as well could not be estimated.

There is a fall in the river from the head of the Galops Rapids to the foot of the Long Sault of some 90 feet, with open water in winter for about 50 miles above the Sault. A succession of rapids occur from the head of the Galops Rapids to the foot of the Long Sault. In places the rapids are shallow, and narrow stretches at some points; the banks in winter are piled with snow, and this is continually being drifted into the river, forming slush ice; heavy falls of snow occur, adding to the large flow of slush ice. At narrow points this is jammed together, and checks the flow of the ice. Any obstruction that stops the flow of the current would produce ice jams at these places; ice formed from snow is the worst in case of stoppage. At points near the lower rapids it becomes solid and grounded on the bottom of the river; the continued flow of ice and snow

adds to the mass, and a solid jam is formed. At once a raise of the water occurs above the dam, the heavy bay ice is loosened by the raising of the water, and is added to the already accumulated mass; shoves occur, and the accumulation growing more solid as it continues to be shoved together, should weather conditions continue favorable, this goes on for days, and results in such serious floods as are referred to below. It is a matter of proof that at one time the water raised at Morrisburg during one night, 15 to 20 inches. Inquiry made by telephone at Farran's Point elicited the reply that there was no jam of ice at that place. A further inquiry at Dickinson's Landing being made, it was learned that an ice jam had formed below the Long Sault Rapids near Cornwall, of about 20 feet in height, and that this had caused a rise in the water at Dickinson's Landing of from 3 to 4 feet.

In 1887 an ice jam formed at Farran's Point, and the water raised at Morrisburg 12 feet above normal, to the extent that the water ran over the top of the gates from the river, and boards were put on the top of the gates to prevent the flooding of the canal. At this time Rapide Plats was smooth water.

At a point opposite Morrisburg, in the State of New York, one-third of a farm was under water, and the owner had to build platforms to keep his cattle out of the water; had the water gone much higher his stock would have been lost.

At Weaver's Point, a short distance below Morrisburg, the ice shoved, taking down a brick house, which caught fire from the stove and was destroyed, the occupants having only time to get out, so sudden did the shove occur. A short distance above, the lower storey of another house was des-

troyed.

The proposed dam if built, is sure to decrease the speed of the current and cause the jamming of the ice, the Long Sault being in reality a safety valve for this portion of the river, taking away the ice formed in the swift open water above.

The fact that the serious flood of 1879 was caused by the swinging of an ice bridge at Farran's Point, is positive proof that any obstruction that stops the flow of the ice produces the jams.

Were the proposed dam to be built, there is every reason to think that for some distance at least above the head of the Long Sault there would be slack water. This would become frozen across and operate precisely as did the ice bridge swung at Farran's Point in 1879.

The oldest inhabitants now living never heard of an ice jam in the St. Lawrence until ice bridges were swung.

The ice jam of 1879 did not reach within four miles of Morrisburg, and yet water was higher than in 1905, when the ice jam extended a quarter of a mile above the village. At that time, had a heavy fall of snow occurred, it would have shoved at the foot of the rapids, and carried away the power house and flume, and might have caused a break in the canal, and no doubt an untold amount of damage would have been done. As it was, the fire at the pumping station was put out under the boiler.

In case the dam is built, the jam would start much earlier in the season, consequently a larger accumulation of ice would be made, and heavy falls of snow for a longer period would cause a more serious flood.

It is said by the promoters, through the press, that much time would be saved in moving passengers and freight by boats using the



proposed lock in the dam to be built in American territory. Experienced river men think a matter of fact that the current above Cornwall is so strong that no tow



