The Great Lakes-St. Lawrence Tidewater Project

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For now more than three-quarters of a century the problem of connecting the Atlantic with the Great Lakes by means of channels suitable for ocean-going vessels has received attention from time to time. At certain times people thought the problem was solved or in process of solution. Canals were constructed paralleling the great rapids of the St. Lawrence, and a canal across the Niagara peninsula connecting Lakes Ontario and Erie about three-quarters of a century ago. But these canals were no sooner finished than the growth in size of the vessels in most common use made it apparent that they were too small, and even when remodeled to their present depth of 14 feet they soon came to be used almost entirely by small craft for local purposes. Any freight handled to or from Atlantic ports was transferred at Montreal or Quebec.

The St. Lawrence River is the international boundary between Canada and the United States for a distance of 113 miles from its outlet at the easterly end of Lake Ontario to St. Regis. From this point to the sea the river is entirely Canadian, but for many years the United States by treaty has had rights of navigation. The Treaty of Ghent, which in 1814 established peace between Great Britain and the United States following our War of 1812, provided for the location of the international boundary. It was soon found, however, that a difference existed as to the interpretation of the terms of the treaty, and there following some years of discussion, at the end of which in 1831 there was an arbitration at The Hague by the King of The Netherlands settling the disputed point. Up to this time there were no rights of navigation by treaty in the river below St. Regis in favor of the citizens of the United States.

In 1842 the Treaty of Washington further defined the international boundary and provided that all the channels in the international part of the river should be free for the use of the citizens of both nations, irrespective of the precise location of the boundary line. This treaty did not give, however, rights of navigation in the lower St. Lawrence, so that its provisions regarding navigation were of local interest. The discussion was continued between the two governments regarding the navigation question, but was considerably interfered with by the Oregon boundary controversy which was actively before the public immediately following 1842, and became one of the chief points of discussion in our presidential campaign of 1844, during which the famous slogan "54-40 or Fight" was formulated. In 1846, however, the Oregon boundary question was amicably settled.

In 1854 another Treaty of Washington was made between the two countries which gave reciprocal rights to both countries for the navigation of the entire River St. Lawrence and the canals in Canada used as the means of communication between the Great Lakes and the Atlantic Ocean. Further provision in this treaty gave British subjects the right to navigate Lake Michigan, and obligated our federal government to urge upon the state governments to secure to British subjects the use of their several state canals on terms of equality with our own citizens. At this time there existed several canals connecting some of our Great Lakes ports with our interior rivers. The Miami and Erie Canal in Ohio and the Illinois and Michigan Canal in Illinois are two examples. In this treaty there was a provision that the British government might suspend the rights of navigation in the Canadian channels upon giving due notice to the government of the United States.

The status continued unchanged until in 1866 the entire treaty was terminated upon notice by the United States, which of course terminated the privilege of navigation for American vessels in the lower St. Lawrence. It was at this time that the famous Alabama Claims controversy arose and actively agitated the peoples of the two countries. This controversy was concluded by the celebrated Geneva arbitration.

In 1871 in Washington there was a new treaty entered into between the two countries which provided that "the navigation of the River St. Lawrence ascending and descending from the 45th parallel of north latitude where it ceases to form the boundary between the two countries from, to, and into the sea shall forever remain free and open for the purposes of commerce to the citizens of the United States." Like provisions were made in favor of British subjects with reference to the Yukon and some of its great tributaries in Alaska. There were also provisions for the navigation of the Canadian canals by citizens of the United States on terms of exact equality with British citizens, and similar reciprocal provisions were made with reference to all of the interconnecting channels between the lakes and with regard to the navigation of Lake Michigan

It will thus be seen that for the last half century the United States has had by treaty a right which in terms "shall forever remain" to the use of the St. Lawrence River. We are therefore entitled to consider and to deal with the St. Lawrence as a stream of international character for its entire length. While in a technical sense it is entirely Canadian below St. Regis, and of course neither our government nor our citizens can have any property rights in the Canadian part of the stream, we do have this perpetual right of use. We ought, therefore, to be ready and willing in our own interest to participate upon fair terms in whatever improvements may be found necessary to make our right of use the most available to us.

In this connection I point out that the treaty rights which I have referred to carry no provisions with respect to the development and use of power. Therefore, we have only our national right to the use of half of whatever power the international section of the river when properly improved may yield. Any more than this must be a subject of negotiation, as must be the ques-

tion of our participation, if any, in the improvement of the river below St. Regis.

In 1909 the two governments made a further treaty providing for an International Joint Commission, three members to be Canadian and three United States, to have jurisdiction over all boundary water matters. This treaty provides that "the navigation of all navigable boundary waters shall forever continue free and open for the purpose of commerce to inhabitants and to the ships, vessels and boats of both countries equally." Like provisions were extended to Lake Michigan and the use of canals connecting boundary waters then existing or thereafter to be constructed on either side of the line.

In 1913 various business organizations in the Middle West became interested in the question of proper improvement of the St. Lawrence River, and in the very early days of 1914 a small committee, among them Mr. Julius Barnes, of Duluth, the late Mr. M. F. Rittenhouse, of Chicago, and the writer visited Washington and conferred with Secretary of State Bryan. At this conference we suggested that the subject be taken up officially with Canada, the general purpose being to improve the St. Lawrence for navigation and for power. This step was actually taken, but owing to the resignation of Secretary Bryan and the precipitation of the great war in the summer of that year, it was some months before we obtained any positive information of the fact. Canada, of course, was involved in the war from the beginning, and obviously could do nothing that would involve the expenditure of either money or man power. A courteous answer was made to the communication of our State Department, and there the matter rested until after the armistice.

In January, 1919, there was formed a new organization, the Great Lakes-St. Lawrence Tidewater Association, of which I have the honor to be president. The scope of the organization was much larger than the small nucleus of 1913-14, and has been rapidly extended so that now sixteen states are members, including your own good state of Ohio.

Our new organization became active at once, and established working headquarters at Duluth under the very effective management of Mr. Charles P. Craig, executive director. Through efforts of friends in the United States Senate and House of Representatives a joint resolution was passed in the early part of 1919, in which the International Joint Commission was requested to investigate the whole problem of improving the St. Lawrence River so that ocean-going vessels might freely pass to and fro between the Great Lakes and the Atlantic, also as to power development and to report to Congress—

(a) As to the need for the improvements;
(b) The best method;
(c) The probable cost;
(d) The proper and equitable division of cost between the two countries.

Immediately after Congress passed these provisions the Canadian government, by order in council, took the same action. Each government then appointed a conference to consider and formulate exact instructions to be issued and to define for the International Joint Comimssion the exact scope of the work to be undertaken and steps of procedure. These conferences met and agreed very promptly. The two governments also appointed each an engineer and charged them with the duty of deciding and reporting on the engineering question—that is, the best method for making the improvement and the probable cost thereof. The engineer for the United States is Col. Wm. T. Wooten, and for Canada, Mr. W. A. Bowden. These engineers have been actively at work since early last spring, and their report is expected in the very near future—perhaps during the coming month.

During the progress of the investigation by the engineers, the International Joint Commission held many hearings in various parts of the country as far west as Calgary, Helena and Boise, and as far east as Boston and at New York, where the last hearing was held December 6, 1920. As soon as the engineers' report is received, there will remain for the International Joint Commission the problem of negotiations and the formulation of their report for the two governments. It is expected that this stage of progress will be passed during the approaching spring.

It is not the purpose of this paper to go into the commercial and traffic aspects of the whole question in detail, and it will be sufficient here to say that an overwhelming case has been made as to the need for opening the St. Lawrence to seagoing ships.

As was stated at the beginnig of this paper, the whole subject of connecting the Great Lakes with the sea has been under consideration at intervals for many years. Before entering in detail upon the discussion of the St. Lawrence route, it will be interesting to mention some of the other possibilities, particularly two which have from time to time received careful attention and have been much advocated.

In pursuance of provisions by the United States Congress there was conducted an investigation in the years 1898-99 by Board of Engineers on Deep Waterways. The late Alfred Noble was a member of this board, and the whole subject was gone into thoroughly. Amongst the possible routes investigated was the so-called "Oswego-Mohawk route," which in general was planned to connect Lake Ontario at Oswego with the Hudson River just below Albany. Report was printed as part of the records of the second session of the Fifty-sixth Congress, House Document 149.

The proposed waterway as surveyed leaves Lake Ontario at the city of Oswego about a mile west of the mouth of the Oswego River. An artificial harbor was contemplated protected by two new breakwaters. From this terminus the channel was located in southeasterly direction to the town of Minetto on the Oswego River. Following up the stream then for 21½ miles to Phoenix, it turned easterly, crossing the divide, and into Oneida Lake. Crossing this lake to the mouth of Wood Creek, the location goes up that stream and across country to Rome on the Mohawk River, which it follows to Rotterdam Junction. Leaving the Mohawk at this point, the location passes across the divide through South Schenectady to the head of Normanskill River. The line as located follows this stream to the Hudson just below the city limits of Albany.

Two locations were made, both substantially as stated above, but with difference in levels. The so-called "high level line" was to have a summit

level at 416 feet above tidewater with water supply to be furnished by reservoirs located in the Black and Salmon River valleys and brought to the canal by feeder lines, a distance of about 94 miles. As an alternative to this long feeder, a tunnel was proposed extending from the south end of Black River reservoir to the upper Mohawk, a distance of 20.5 miles. The lower level route contemplated a summit elevation of 379 feet above tidewater, this being the mean level of Oneida Lake. For this alternative plan the water supply was to be secured by using Oneida Lake as a storage reservoir. It was estimated that this would furnish sufficient water for all but the driest seasons, during which the supply would have to be brought from the Salmon River valley.

The mean level of Lake Ontario was stated in the report at 245.4 feet above tidewater, based upon which figure the summit levels of the so-called "high and low level lines" would have to be 170.6 and 133.6 feet respectively above the Ontario level. It was estimated by the board that the high level project water requirement would be 1600 second feet for a 30-ft. waterway. The reservoirs in the Black and Salmon River valleys were calculated to have 70,000,000,000 and 7,000,000,000 cu. ft. capacity respectively, while the useful storage capacity of Oneida Lake was reckoned at 25,000,000,000 cu. ft.

Based upon the water supply above stated, the calculated tonnage capacity of the proposed canal with 30-ft. depth was slightly less than 35,000,000 tons per annum.

The total distance between Oswego and New York City by the route under consideration is 314 miles, and the estimated cost for 30-ft. depth was in 1899 $195,870,000. It was found that a large amount of work would be necessary in the Hudson River below the canal terminus, also that the channels of the Mohawk and other rivers would have to be much improved so as to take care of flood conditions. In the whole canal route it was found there would be 95 miles of excavation between banks—51 miles through shallow waters and 27 miles of open water navigation. This, of course, does not count the Hudson River.

The improvement of the Oswego-Mohawk route contemplated 31 locks and no power development. The route, if considered now, would have to be materially changed, because during the last decade New York State has reconstructed its barge canal system, and has occupied much of the suggested line and taken up certain rights for water supply. Among this route's disadvantages are the high cost, limited water supply and lack of incidental power. Because of the long restricted channels and many locks, passage through it would be slow. It is proper to mention also that Oswego is much nearer the principal European ports than is New York City. In considering comparatively the cost of the construction of a ship channel via the Oswego-Mohawk route, it must be remembered that transit through the Welland Canal or some equivalent of it would still be necessary for almost all of the traffic; and should the United States build its own canal between tidewater and Lake Ontario, Canada could hardly be expected to permit present treaty rights to the use of her Welland Canal to stand.

While the "all-American" or Oswego-Mohawk route just referred to was under discussion, Canada began an investigation of the Georgian Bay route, and in 1908 an exhaustive report was published by the Canadian Department of Public Works; but the project was for channels suitable for vessels of only 20-ft. draft, which would now be regarded as entirely insufficient and not worth further consideration.

Historically this route is of great interest, following as it does up the Ottawa River from its outlet in the beautiful Lake-of-the-Two-Mountains, just above Montreal, through Ottawa, Canada's capital city, to the town of Mattawa, thence over the divide westward to Lake Nipissing, across that considerable body of water, through the Pickerel and French Rivers to the Georgian Bay. It was by this identical route that the early explorers, Radisson, La Salle and Marquette, all reached the upper lakes and penetrated the Mississippi, Wisconsin and Illinois valleys. La Salle also penetrated Ohio via Lake Erie, but because the fierce Iriquois occupied the southerly shore of Lake Ontario and the Niagara region, it was not until many years after the discovery of the Straits of Mackinac that the falls of Niagara were seen by white men.

This route has one advantage over both the Oswego-Mohawk and the St. Lawrence routes—it is the shortest of the three from all points on Lakes Superior and Michigan. This advantage is 225 miles, as against the latter, but this is more than offset by the fact that the improvement, while serving these two upper lakes, would isolate both Lakes Ontario and Erie with their important cities of Toronto, Hamilton, Rochester, Buffalo, Erie, Cleveland, Toledo and Detroit.

The distance from Georgian Bay to Montreal is 440 miles, and the summit level was planned at 99 feet above Lake Huron. Twenty-seven locks were provided for and a total of 45 dams great and small. The water supply found at the summit was quite limited, being but 540 second feet, sufficient for but 5,000 lockings per year, but a supplemental supply was found possible, sufficient to double this volume of traffic. These figures, however, apply only to the lock dimensions as planned, and could not be realized if the canal were replanned with locks the same as the Welland Canal.

There is considerable power development along the main rivers of this route, but the surveys and report did not include this as an incident. Probably 1,000,000 horse power could be realized at a large additional expense, and in widely scattered and relatively sparsely settled regions where there is little or no demand.

Owing to the long reaches of canal proper and canalized channels, relatively narrow and shallow, passage of ships by this route would be quite slow, this disadvantage being enough to offset the greater distance from points on Lake Superior and Lake Michigan to within less than 24 hours. Canada never adopted the report and never provided any of the $99,000,000 for construction, estimated in 1908 as the needed amount. The route, if restudied and re-estimated on 30-ft. basis, would no doubt be somewhat modified and the cost would

surely run well up toward $250,000,000. There would also be the disadvantage of probably two weeks shorter season, because of worse climatic conditions.

At this point it seems wise to digress somewhat and refer in some detail to the Welland Canal. In reality this is a link in the total chain of improvements necessary to connect the Great Lakes with the Atlantic via the St. Lawrence.

It is now almost a century since the first project for connecting Lakes Erie and Ontario was started by a private corporation chartered in Canada. The plan then was for a small canal with 8 feet of water on the sills and extending only from Lake Ontario to the Welland River at Port Robinson and thence down the Welland to the Niagara River above the falls. There were on this canal 40 wooden locks 110 feet long, 22 feet wide. Two small sailing vessels actually passed through this route late in the year 1829. The canal was never a success, and was taken over by the government of Upper Canada in 1841 and its enlargement was undertaken. The first Welland Canal therefore that is entitled to that name was opened for traffic in 1845, but the route was still down the Welland River to Niagara River. During the succeeding five years the original canal feeder starting in the Grand River near its outlet to Lake Erie was enlarged and made a part for navigation purposes, this work being completed in 1850. The locks were built of masonry, and the total number reduced from 40 to 27. The dimensions also were altered, being increased to 150 feet length, 26½ feet width, and with 9 feet of water on the sills. Within a few years this canal was improved, and the depth increased to 12 feet by building up the banks and increasing the height of the lock walls. In this condition the canal was found useful and sufficient for about 25 years. During this period there continued of course the development of the vessels in general use, and between 1875 and 1882 the Canadian government built the present Welland Canal so as to accommodate vessels with 2 feet greater draft, but more especially to provide locks of greater length and width. The new location was also straighter and the total length was reduced to 26¾ miles. Only 26 locks were used instead of 27.

The canal when so improved was of great use, and for a short time the problem was considered solved. The growth of shipping, however, continued so rapidly that the canal soon came to serve for local use almost exclusively. A few trans-Atlantic vessels have from time to time passed through it, and during the great war many of the vessels previously in use on the Great Lakes were taken out to the Atlantic, many of them by cutting in two, and some of them were locked through on their sides. Considerable new tonnage was built on the Great Lakes during the war period, and taken out light or with partial load, the lading being completed at Montreal.

Shortly before the beginning of the war the Canadian government set about building a new ship canal between Lake Erie and Lake Ontario. A comprehensive plan was adopted after much study, the route was again shortened and straightened, and the whole project was entered into upon an up-to-date and quite reasonably adequate basis. In general, the location is much the same, and considerable reaches of the present canal are to be used, the principal divergence being at the northerly end where an entirely new set of locks and outlet into Lake Ontario are being provided. The length is 25 miles. The water level is to be maintained the same as the present canal, namely, 568 feet above sea level. There are to be regulating locks in the summit reach of the canal to take care of the fluctuation of Lake Erie above this point. The channel cross section is to be 200 feet bottom width and 310 feet at water line. The depth for the present in the earth sections is to be 25 feet, but all structures will be sunk to a 30-ft. level so that the canal may be deepened by the simple process of dredging at any future time. It is quite likely that this deepening will be done as a part of the construction program before the completion of the work.

The most radical difference in the construction is in the locks. The engineering world has learned a good deal about lock construction since 1882, and what was then considered a maximum lift seems to us now almost amusing. Instead of 26 locks, in the present canal, there are to be only seven, all of equal lift, viz., 46½ feet. The lock length is increased to 800 feet and the width to 80 feet. Ample ponds are provided in connection with the various locks so as to facilitate their operation without waiting for the slow flow of water through small channels. The ponds vary in size from 100 to 200 acres.

The engineers considered carefully, and seemingly have amply provided in their plans for minimum waste of time in passing through the Welland ship canal. The valves and culverts in the walls are sufficient to permit filling in less than eight minutes. The normal time required to pass a vessel through one lock will be 20 minutes, and the estimated time of passing a loaded vessel through the entire canal, instead of being from 15 to 18 hours now consumed in passing present Welland Canal, will be cut to eight hours. That this can be realized in practice is amply demonstrated by the quick passage of vessels through locks at Sault Ste. Marie and by the operation of the locks on the Panama Canal.

Construction work on the new Welland ship canal was well under way when the great war began, and for about a year thereafter Canada continued work, but at a reduced rate. The work was stopped for financial and man power reasons in the fall of 1915, and of course was not resumed until after the armistice. In 1919 construction was again taken up, and has been actively continued since that time. The estimate is that between one-third and one-half of the total work is now done. Three years of rapid work would probably bring completion, but it is more likely that five years will be taken because the usefulness of the new Welland ship canal will hinge quite largely on the improvement of the St. Lawrence.

In passing it should be noted that the present canal will be kept intact, and of course will be useful for smaller vessels; also that Canada undertook and is carrying out this great improvement entirely at her own expense. The estimates made when the work was begun indicated a total

cost not exceeding $50,000,000. With conditions as they are it is evident that the total will greatly exceed this sum, and probably will run up to $80,000,000, and possibly as high as $100,000,000.

Coming now to the St. Lawrence proper, it is a matter of great regret that the report of the government engineers is not in hand. Anything that can be said touching the engineering phases of the improvement must therefore be to a certain extent speculative, and must express merely an informal and tentative opinion as to the conclusions which will probably be reached and based upon known physical conditions and obstacles to be overcome. It was the hope of the writer when the engagement was made to prepare and read this paper that the engineers would have finished their work so that their conclusions and recommendations could be definitely stated.

The St. Lawrence is one of the finest streams on the face of the globe and is unique in several important respects; its waters are absolutely clear; the stream above Montreal has an average width of perhaps two miles, and in many places is much wider; there are many islands, especially in the upper end in what we know as the Thousand Island region, and below this region in many places there are islands dividing the river so that there are two, three or more channels; for nearly all the way above the rapids there is ample width and depth for any vessel, so that navigation can proceed without restriction as to speed. Because of the great reservoir capacity of the lakes, the flow of the stream is remarkably uniform. Gaugings have been made and recorded for about half a century, and the average flow is 241,000 second feet. The maximum and minimum are substantially 25% above and below this volume. I believe there is no other great stream on the earth that can at all compare with the St. Lawrence with respect to small variation. Compare the figures just stated with a variation between maximum and minimum of 30 to 1 in the Mississippi at Keokuk and in the lower Ohio. There are 45 miles of rapids in three main groups. The upper series of these rapids begins at Ogdensburg and ends at Lake St. Francis, which is 31 miles long and approximately five miles wide directly in the channel of the river. The second series of rapids are between Lake St. Francis and Lake St. Louis, which also is in the geological channel of the river. This lake is 16 miles long and is of irregular shape. Indeed it is connected with a still larger lake known as Lake-of-the-Two Mountains. This lake lies in the geological valley of the Ottawa River and connects the Ottawa with the St. Lawrence. The third rapids, the greatest of all, is the Lachine and lies just above Montreal.

During the same period when the Welland improvements in their various mutations were made, Canada was also occupied with canals bypassing these various rapids. The problems were met in about the same general way, and substantially the same adequacy, or perhaps it would be better to say inadequacy of channels and lock dimensions were constructed and operated. Canals exist today and are in use bypassing all of the rapids so that vessels drawing up to 14 feet of water and not greater than 250 feet length go and come with reasonable facility. In 1919 these canals passed a total tonnage of approximately 2,000,000. The traffic was, of course, almost wholly local. What has previously been said with regard to traffic through the Welland Canal during the war period applies equally to these canals.

In that part of the St. Lawrence which constitutes the international boundary there are 23½ miles of rapids to be overcome, and the total fall is substantially 92 feet. It seems fairly certain that two dams will be recommended in this part of the river—one at or near St. Regis, practically at the point where the international boundary leaves the river. Another dam will in all probability be recommended at or very near to Morrisburg, Ontario. It is altogether likely that this dam will be so designed and constructed as to create slack water, not only over the rapids between its location and Ogdensburg, but all the way back to Lake Ontario, thus serving also to regulate the level of this great lake. It is also likely that the dam at St. Regis will be designed to slack water the river back to the Morrisburg dam, so that the two will not only drown out all of the rapids above them, but will slack the entire international section of the river for the full 113 miles.

In the Canadian section of the river the problem seems to be quite similar to the international section, and it seems aitogether probable that a dam will be recommended at the head of Lake St. Louis to back the water up to the foot of Lake St. Francis.

The Lachine Rapids and their control constitute a more difficult and greater problem than the ones previously mentioned. The city of Montreal is built so close to the river and alongside the rapids that the problem is not by any means a small one. That the rapids can be drowned out by one or two dams is of course obvious, but it is not by any means sure that the cost would be justified by the power development, particularly for the first one or two decades, during which it is not unlikely that the power from the dams higher up in the stream would amply supply the market on both sides the international boundary. It may be, therefore, that the engineers will recommend for the present a reconstruction of the existing Lachine Canal so as to make it of ample size for ocean-going ships, which of course can be done at much less expense and perhaps at a cost low enough so that it could be amortized within say twenty years, the power development to be made then.

The power possibilities also make the St. Lawrence unique, for they are not simply great, they are stupendous. If you calculate the value of 240,000 second feet of water over the total fall between the upper river and Montreal, two hundred twenty-one feet, taking no account of the affluents that fall into this reach of the river, the horse power figures slightly over 6,000,000. This is for the whole stream, both the international and all Canadian parts. Of these possibilities stated in gross, 2,500,000 horse power would come from the international and 3,500,000 from the Canadian section of the stream. Perhaps 70%, which is certainly attainable, is a fair figure for this presentation. This spells over one and three-quarters million horse power for the international part of the river, which is more than twice the

total now developed on both sides of the line at Niagara Falls. It follows that whatever bargain may be made between the two governments the minimum share for distribution within United States territory will exceed what is now shared by both countries from all the Niagara plants. Whether in the negotiations the International Joint Mommission will reach any other basis of division of the total power, or whether they will conclude not to recommend any basis, but recommend the development jointly by a common agency, letting distribution of power freely follow the demand, remains to be seen. That this body of able, practical men will reach conclusions fair to both countries and workable from financial and business points of view is certain.

As engineers you will be interested in the problem of load factor. And here again it is regrettable that the engineers' report is not available, and the writer fears, lest in his earnestness for the project as a whole, and the lack of that intimate knowledge possessed of course by the engineers, he may run into gross error. It does seem, however, from the broad facts as to the flow and its steadiness and the storage capacity afforded by the great and lesser lakes, that conditions may be controlled so as to permit a much greater percentage of utilization of total power possibilities than any other large stream affords. To begin, so to speak, at the beginning, suppose Lake Superior levels be controlled so as to counteract measurably the larger seasonal variations of the total outfall from the Great Lakes system; and suppose also that the much talked about and often recommended regulatory works be installed in Niagara River, so that Lake Erie will be made to supplement Superior, may we not conclude that the flow of the St. Lawrence season by season and month by month can be made to conform almost exactly to the mean flow? Perhaps some regulation of Lakes Michigan and Huron would also be necessary. If so, this can be done easily and cheaply. If the flow of the river can thus be made to conform closely to its mean seasonally, what can be done to make the actual power output conform to the demand peak? If the engineers recommend, as I believe they will, the improvement by means of great dams and the upper dam be so made as to serve for the regulation of the level of Lake Ontario, it would seem to follow that the actual use of the water within the different parts of each day could follow the demand almost exactly, and if the peak demand should be say twice the mean, it would only be necessary to install the wheel, generator and transformer capacity to equal the peak. The lesser lakes, St. Louis and St. Francis, would be of great help toward this most desirable end. The more one studies the power possibilities of the St. Lawrence, the more fixed becomes the conclusion that we who inhabit this continent have in this stream a priceless heritage. The rapids which for over three centuries have been looked upon as a mighty barrier imposed by nature against progress, will certainly by the next and all future generations be esteemed as a boon to mankind. This boon it is the province of the engineers to present to the public in finished form, harnessed and ready to help lift the load from the shoulders of our fellowmen. Charles Whiting Baker recently stated that the improvement of the St. Lawrence is the greatest engineering problem now under consideration in the world, and perhaps the greatest ever known. Shall the engineers of this generation hesitate because of these statements? Did they hesitate when our country entered the greatest war ever known? Their answer will be the same, and with the same absolute fidelity and with an even greater will to victory this engineering problem will be met. A personal word may be pardoned. It has not been within the chosen field of the writer of this to specialize in the branch of our profession within which comes the solving of such problems; but the proudest feeling of a not short professional life has come with the assumption of the duty of standing as the head of the organization which has undertaken to convince the people of the United States that the mighty St. Lawrence must and shall be taken out of the column of our liabilities and placed in large figures among our national assets.

The engineer not only deals in physical facts, but he is an idealist, and the St. Lawrence has even a higher significance than merely to carry our commerce and turn our factory wheels. For now more than a century peace has prevailed between our country and our neighbors of the north. We are of one blood and one language, inhabiting adjoining great sections of one continent. We must constantly cement and strengthen the fine friendship that has so happily prevailed. How may we lend greater aid to this delectable condition than by uniting in the solution of a great problem that so vitally concerns both peoples, solving with common effort and at common expense the physical problems that are a part of our common heritage? As we have been allies in a mighty war, so let us be allies in meeting this problem of peace, the product of which shall be more and more peace.

As brother engineers I sound a call to you therefore to be champions not only of the cause of engineering advancement, but champions in the cause of everlasting peace and living friendship between next-door neighbors.