Engineering astride the border

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by

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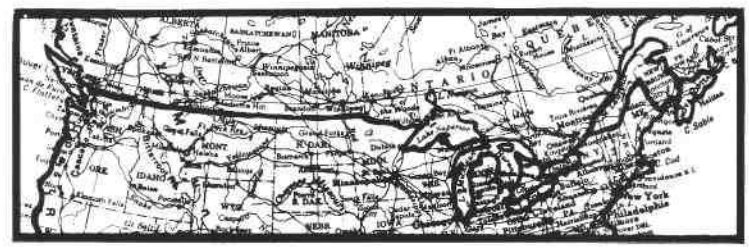
ENGINEERING ASTRIDE



THE BORDER

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From a talk given by the author at the Cleveland Convention of the American Society of Civil Engineers, May, 1959.

A few months ago, standing on the top of the great earth dyke which flanks the Canadian part of the immense new power house at Barnhart Island on the St. Lawrence, the writer had by his side a close friend, a distinguished scientist and engineer from a distant land. The Director of the St. Lawrence Project for the Hydro-Electric Power Commission of Ontario, standing there in the warm sunlight of that lovely summer day, told how this vast construction project had been carried out by two countries, working independently but side by side, without the slightest difficulty or real argument from the very start of the actual work. The foreign guest was amazed. "How can such things be?" he asked. "How can two great countries such as yours co-operate so closely? And if you can do it, why cannot other countries do the same? What is the secret?" These questions are worth considering, but without launching into the usual eulogy about the more than five thousand miles of undefended frontier.

IT IS doubtful if any of the popular speakers about the Seaway has reminded his audience, when talking about the frontier, that one of the great early American border forts was found to have been built in Canadian territory when surveys were checked. To be reminded of such an early piece of construction *really* astride the border may, however, provide a good starting point for a realistic look at the inter-relations of American and Canadian civil engineering, with special reference to works that are near the long border.

The St. Lawrence Seaway will assuredly stimulate greatly the commerce on the vast international waterways provided by the Great Lakes. Built with all the accustomed speed of modern construction, the Seaway and associated power works constitute a monumental project of civil engineering. When they were officially dedicated, there may have been some who remembered that it was almost exactly 27 years since (on July 18, 1932) a solemn treaty was signed covering the prosecution of this great undertaking. Unfortunately, the treaty failed to win the necessary two-thirds majority of the votes of the U.S. Senate and so it proved to be abortive. Canada had to wait. Even the imperative of war failed to win a simple majority of senatorial votes for the executive agreement prepared to authorize the start of construction in 1941.

These things are not said in any way critically. They are statements of historical fact that show that the answers to the simple questions cited at the outset are not clear-cut. The delay in the start of construction had many consequences, not the least of which was that the Province of Quebec, without the power that could be developed by a dam at the Lachine Rapids, one of the seaway works, had to go elsewhere for much needed power. Work was therefore started instead on the Bersimis project in northeastern Quebec, which will eventually develop 2 million hp.

For many reasons, therefore, Canadian patience was sorely tried, with the result that in 1951 the Prime Minister suggested to the President of the United States that if the International Joint Commission would agree to the generation of power jointly by New York and Ontario in the international section of the St. Lawrence, Canada would herself carry out all the associated seaway work. The Commission did so agree, on 29 October 1952, and Ontario and New York went ahead with the power works at Barnhart, now completed and in operation. Before Canada could get started on the Seaway construction, however, other factors had emerged which eventually led to the international agreement under which the job has been successfully carried through to completion—as a Canadian project on the Canadian part of the river from Montreal to Lake St. Francis, and as a joint project with the United States in the international section from there to Lake Ontario, all costs being shared. In this joint project the lift from the tail-water level at Barnhart is made by two locks on the U.S. side. At Iroquois, the lock to pass the Regulator Dam is in Canada. Later there may be locks at both places in both countries when the traffic so requires.

In 1952, however, it was said in some American engineering circles, statements even appearing in print, that Canada could not possibly carry out the Seaway project on her own, that her suggestion of doing so was just a political move, that she was just bluffing. That assertion, coming from fellow engineers, was not easy to take. Those who made this assertion had, apparently, never been to the eastern end of Lake Erie to see how ships both large and small manage to get to Lake Ontario, 326 feet below. This is done by way of the Welland Canal, one of the great canals of the world, which conveys the largest of upper lake freighters up and down the Niagara escarpment in just seven locks. It is entirely a Canadian achievement, just as were the five preceding, smaller

Welland Canals—in conception, design, construction and cost. Officially opened on 6 August 1932, more than a quarter of a century ago, the "new" Welland Canal cost $131,900,000. Replacement today is estimated to cost $350,000,000.

The sceptics could just as readily have gone to the western end of Lake Erie and into the St. Clair River, to have a look at the "chemical city" that has developed around Sarnia, and in particular at the installations of the largest and most successful of Canadian chemical plants. It makes synthetic rubber and was built at the height of war emergency, in 1942-43. Many will recall how critical a material rubber proved to be in the early war years and how it was decided that six synthetic rubber plants had to be built with the highest of all war priorities. Originally, it was planned that all six should be built in the U.S.A., on the grounds that even one such job was beyond the capacity of Canadian engineers and constructors.

Fortunately, the Minister in the Canadian Government responsible for war supplies knew well what the Canadian construction industry could do, for he was an engineer himself, the Rt. Hon C. D. Howe. He was able to have the original decision changed and so, after some delay, Canada was given the sixth and last plant to build. All equipment and process designs were shared between the several plants, a superb piece of American engineering, but plans for the Canadian plant site, its service structures and utilities were prepared by Canadian consultants, and the entire project built by Canadian contractors, using as many as 8,000 men on the square mile occupied by the plant. Last of the six to be started, it was said at the time that the Canadian plant was the first to be finished. Be that as it may, the fact remains that the first carload of styrene was shipped from this plant, to an unspecified destination in the United States, eleven months to the day after the first sod was turned.

Arvida

Moving a little away from the border, but still on St. Lawrence waters, many know the lovely sail up the Saguenay River, past Tadoussac, past Capes Trinity and Eternity, and finally into Ha-Ha Bay to the small port of Bagotville. Approaching the wharf there, late one fine evening in July 1942, a tourist was overheard explaining that on the other side of the tree-lined hills behind the little town there was "nothing but trees and rivers and lakes all the way to the Arctic Ocean." Little did she know that just the other side of the hills at which she was looking was the world's largest aluminum plant, at Arvida, then being expanded at breakneck speed, and that to serve it with vital power there was even then being completed possibly the greatest of all Canadian construction achievements, the building of the Shipshaw power plant. Developing 1,200,000 hp. this entire project involving five dams, large tunnels and a great power house, was "on the line" less than eighteen months from the start of active construction, eighteen months that included one of the most severe winters ever experienced in the Lake St. John country.

This recital of what Canadians can do will suggest the atmosphere of Texas—or should one now say Alaska, if the largest state is to produce the tallest tales? These are not tall tales, however, but matters which come to mind as one considers those pointed questions as to how two countries manage to work together so harmoniously in the carrying out of civil engineering works. This is surely done, despite the impediments that others may put in the way, because of mutual respect for what each can do when American and Canadian engineers work together and because of common high purpose. Canadian concrete experts may never persuade Americans that placing mass concrete in high lifts is good practice (thinking now of that same St. Lawrence power house). Canadians may never convince some Americans that winter concreting is an economical procedure, but both have learned much from the other; so may it always be.

And when Canadians and Americans do work together, with administrative and political hurdles removed, then the impossible becomes merely a challenge, the incredible merely a tale to be told. Think for example of the DEW Line, that great line of outposts for continental defence—much of it built in Canada, but with American money; designed by American engineers, but with some assistance regarding local conditions from Canadians; built in Canada by Canadian prime contractors but with invaluable assistance in the delivery of men and supplies from the American Navy and Air Force. There were some difficulties, naturally, but not at the joint working level. To stand on the Arctic Coast of Canada at a DEW Line installation and to be unable to distinguish Canadian workers from American is to see further vivid evidence of what can be done together.

Behind all such co-operation in the actual construction of civil engineering projects lies the much more difficult task of co-operation in the planning of these international ventures. For boundary water problems, this is done by the International Joint Commission, with equal membership from both countries, and under joint chairmanship. Another distinguished Canadian engineer, General A. G. L. McNaughton, has long served as the Canadian chairman of the International Joint Commission. This great venture in international engineering understanding has now a history of over half a century of splendid achievement. Great and difficult problems have been solved by this unique arrangement, with very few questions ever having had to be referred to higher authority or to the courts. Great problems are even now under consideration by the I.J.C. All civil engineers will hope that the Commission's work will continue to show what can be done by two nations, acting in concert, with a reciprocal sharing of responsibility, a reciprocal recognition of capabilities, a reciprocal interchange of skilled service.

Samuel Fortier

To speak of this co-operation as a reciprocal process may sound strange to some, especially to those who never think of Canada as very much more than the great white blank that appears north of the U.S. border on all too many American maps. It would be invidious to cite modern examples of the other side of the penny but if one turns back the pages of engineering history for a few moments, it is easy to illustrate what is meant. Samuel Fortier, for example, is a name now little known but a name still familiar to those few who know the history of irrigation in the western States as that of one of the great pioneer irrigation engineers of America. Fortier was, however, a true pioneer in the field of soil mechanics. Fifty years before the name *soil mechanics* had been coined, Fortier was experimenting with soil stabilization, soil compaction and other so-called modern techniques of soil engineering. And he was a Canadian, a native of Leeds, Quebec, trained at McGill University.

He graduated in 1885, but heard the call to the West soon after, for he was in Denver by 1890. His great work was done with the United States Department of Agriculture, where he became Associate Chief of the Division of Agricultural Engineering. He also served the Agricultural Colleges of Utah and Montana and was on the staff of the University of California for two periods. Fortier was not the

only Canadian who helped with the start of irrigation in the West. The town of Ontario, in California, was so named by two young Canadians, the Chaffey brothers, who went out west from a small place near Ottawa in the 1830's. (Later, they also started irrigation in the Murray Valley of Australia where one may now see a memorial to them.)

Turning to a different branch of civil engineering, the longest railway tunnel in North America, east of the Mississippi, is still the Hoosac Tunnel of the Boston and Maine Railroad. It is located in the heart of the mountains at the northwest corner of Massachusetts, near North Adams. Nearly five miles long, it is still in excellent condition and in regular service even though it was opened for use in 1877. How many know that it was finally built, after several false starts, by two Canadians? These were the Shanly brothers, Walter and Francis, two members of a quite remarkable group of young engineers who, by great good fortune, served Canada in the early days of her railway building and at the hey-day of canal construction. The Shanlys had gained such an enviable reputation as engineers and builders in Canada that the Commonwealth of Massachusetts invited them, in 1868, to submit a tender for the construction of the Hoosac Tunnel, after other contractors had failed. Their offer was accepted. They started work in 1869 and the tunnel was completed, on schedule, in 1874. The brothers introduced several new features into tunnel work, the most notable being the first use in North America of nitro-glycerine as an explosive; they paved the way for the great advance in tunnelling that followed in the next few decades.

T. C. Keefer

The only meeting that the American Society of Civil Engineers has ever held in Ottawa was in 1913. One of the highlights of the meeting was a garden party, held in the garden of one of Ottawa's lovely homes. In the centre of the garden was the host, then in his ninety-second year, still keen and active mentally but slowed down physically by the burden of his years. His name was Thomas Coltrin Keefer; he had been a friend of Walter and Francis Shanly. Far more than that, he was the acknowledged dean of Canadian engineers, the only man to serve twice as President of the Canadian Society of Civil Engineers (which became, in 1918, the Engineering Institute of Canada). His second term in the Canadian presidential chair coincided with his tenure of another office, for he was also the eighteenth President of the American Society, the only Canadian ever to hold this office. Small wonder, then, that he had a garden party at his home when the Society met in his own city; small wonder that those who were there regarded the event as so memorable an occasion. For Thomas Keefer was born in 1821, trained as an engineer on the early Erie and Welland Canals, steadily gaining such a high reputation that his practice at least touched almost every major Canadian civil engineering project of the nineteenth century.

Naturally, therefore, Keefer had much to do with the steady development of the St. Lawrence Canals, his work in this field continuing through most of his professional career and culminating in his membership of the International Deep Waterways Commission which conducted one of the first studies of the practicability of a deep ship canal between the Great Lakes and the sea. In this and many other ways, not least by his presidency of the A.S.C.E., he served the two countries well. At that garden party, the old gentleman could have shown a tangible link with the very first St. Lawrence Seaway which dates back to 1832, for Mrs. Keefer's father, Thomas McKay, was one of the builders of the Rideau Canal. So well did McKay execute his masonry work that, just before the Canal was opened, the Superintending Engineer, Lt.-Col. John By, presented to him a beautiful silver loving cup as token of his appreciation of work well done. The cup was bequeathed to Mrs. Keefer and is now in the possession of Thomas Keefer's grandson, another bearer of his distinguished name.

Reference to the Rideau Canal as the first St. Lawrence Seaway may be surprising to those who have never heard of the Rideau Waterway. It is the Canal that joins the cities of Ottawa and Kingston, formed by the canalization of two rivers and the linking of their headwater lakes. It is 127 miles long, includes 47 masonry locks and over 50 dams, large and small. And it was constructed by the Royal Engineers of Great Britain between 1826 and 1832, through what was then the virgin forest of Upper Canada. It was built as a military waterway, as a direct aftermath of the war of 1812, to provide an alternative route between Montreal and Kingston (by using the Ottawa and then the Canal), in case hostilities should break out again and the supply line up the rapids of the St. Lawrence be ambushed from the American side.

Fortunately, the Rideau Canal had never to be used for this warlike purpose. Today, it is used as never before for invasion purposes — the invasion of the lovely Rideau Lakes by hundreds of American holiday makers. But for over 20 years it served as the first St. Lawrence Seaway, a large fleet of small steamboats plying a busy trade on the "Triangular Route" from Montreal up the Ottawa River, then up to the Rideau Lakes and down again to Kingston, usually returning to Montreal down the rapids of the St. Lawrence. In 1855, the first St. Lawrence Canals were finished after the expenditure of over $20 million, a really vast sum for those days which almost bankrupted Upper Canada, and which had appreciable influence upon Canadian history. The great activity on the Rideau was over. For the next 103 years, shipping was to sail up and down between the sea and the Great Lakes, using the St. Lawrence Canals which Canada built and rebuilt on her own. The Seaway of 1959 is no new thing, it should be recalled, but just a greatly enlarged version of what Canada herself has provided for international use for over a century, and without charge for these many years.

Thomas Keefer might well have told about all this, with a smile, had one been privileged to chat with him in his garden on that June day in 1913. He would certainly have told of one of his earliest boyhood memories—how, on a day in November 1829, he had seen the first two vessels to use the first Welland Canal, as they passed his home at Thorold, sailing side by side, one American and one Canadian, on their way up from Lake Ontario to the Welland River and so into Lake Erie. One hundred and thirty years later, two fleets of boats, gunboats but sailing on peaceful occasions, side by side in true naval comradeship, come up again from the sea, this time officially to participate in the opening of the greatest seaway link of all. As a part of the ceremonies on that day a stone was unveiled, granite set into the solid concrete of the great power house. One need go no further than this stone to find the answer to those early questions, for there engraved for all to see, for all time, are these words:

"This stone bears witness to the common purpose of two nations whose frontiers are the frontiers of friendship, whose ways are the ways of freedom, and whose works are the works of peace."