15 Dec 1947 **The Welland Canal**

A paper read before the Sphex Club by Geo. L. Barton, Jr. about 1950

My interest in canals and their locks goes back a long way. Fifty years ago cypress and juniper shingles were floated out of the Great Dismal Swamp in Jericho Canal, a ditch ten miles in length extending from the northern rim of Lake Drummond to the edge of the Swamp. It was some six or seven feet in width and held normally not over three feet of water. The shingles were towed for the most part by hand, although I can recall the rotting hull of a miniature stern wheel steamer - a tiny affair - which had once been used for towing. In order to maintain the proper water level in the canal, a lock was necessary at Lake Drummond. The lift from lake level to canal level could not have been more than two feet - three at the most - but I can still recall the fascination of going through the lock in a long narrow barge. The upper gate closed behind us; the lower gate was opened a few inches and we sank gently to the lake level. Dimensions of canals have grown enormously but the principles have not changed nor has the operation lost any of its fascination for me.

A few years later, when my family spent a summer in Buena Vista, I can again recall my interest when my father pointed out to me the remnants of the masonry locks of the James River Canal and told me how the railway had superseded the canal. Since then, having lived in Lexington and in Lynchburg, I have had many opportunities to see the remnants of these locks. And little did I suspect in those earlier days that I would live for seven years almost on the banks of one of the great canals of our continent,

piece of engineering, and a very tangible monument to the peace and good will which has long prevailed between the United States and Canada.

If you will recall your geography, you will remember that Lake Erie and Lake Ontario are roughly parallel for about forty-five miles; the western end of Lake Ontario lies about forty-five miles south of a north-south line drawn through the eastern end of Lake Erie. The Niagara River flows, in an irregular course, due north from the eastern end of Lake Erie. For a little over ten miles it is a smooth navigable river, with a current of about three miles an hour, accommodating the heaviest Lake freighters as far as the city of Tonawanda. It is at this city that the New York State Barge Canal begins its traffic being river-borne from Tonawanda to Buffalo. As soon as the river reaches the city 1/2 1/2 of Niagara Falls, it becomes narrower and shallower; the down grade begins, the current becomes correspondingly swift. For more than a mile above the brink of the great cataract itself, there are vicious rapids which some people consider as beautiful as the Falls themselves. When the water finally plunges over the Falls, it drops 167 feet to the lower Niagara River and then, for a little over six miles, it hurtles through the narrow Gorge, dashing into spray and foam over hidden rocks in waves that sometimes reach a height of twenty-feet. At last it reaches Queenston; here ~~it suddenly~~ the Gorge ends with surprising abruptness and the River again widens out into a calm navigable stream. The Falls and the rapids on both sides make a difference in level between the two Lakes of 327 feet, an impressive figure when one is thinking of lifting a ship carrying a cargo of 25,000 tons.

emptying into Lake Ontario seven miles away.

The two Lakes and the River thus create a tongue of land that is known in Canada as the Niagara Peninsula. (On our side of the River, the corresponding area is usually known as the Niagara Frontier, since no real peninsula is formed.) The highly industrial cities of Niagara Falls, New York, and Niagara Falls, Ontario, straddle the River at the cataract, just about half way between the two Lakes.

The transportation of passengers and freight from Lake Ontario to Lake Erie had long been a problem. Until 1824 portages were used and today, in Niagara Falls, New York, a street named "Portage Road," commemorates the use. It is said to lie on the old Indian portage; it runs through the city diagonally and is part of a fairly straight line between the smooth waters of the lower river and the upper. The transshipment of freight, however, is costly and slow at best and men soon began to think of ways to get Lake boats around the rapids and the Falls,- the only physical obstacle between Chicago and the St Lawrence River. 2|3 As far as I know, there was never any thought of a canal connecting the two Lakes on the United States side of the river. The topography may have been one reason but I suspect the earlier construction of the Erie Canal from Buffalo to Albany was the controlling reason, since the Erie Canal offered cheap transportation of slow freight all the way across the state,- and still offers it. But in 1824 the first Welland Canal was opened for business. It left Lake Erie at Port Colborne, some fifteen miles west of Buffalo and cut across the Niagara Peninsula fairly directly through St. Catharines to Port Dalhousie; it meandered a little to take advantage of the topography.

This first Welland canal, a great project in its day, was only a miniature of the present fourth Welland Ships canal, yet its dimensions were impressive for its day. Its locks were 110 feet long and 22 feet wide. There was a depth of eight feet of water on the sills of the lock gates. The lift of the two several locks varied from six to eleven feet and as a consequence 29 locks were required for the total lift of 327 feet. Passage must have been a bit slow, yet the canal was a great advance over the old portage. I do not know the maximum cargo capacity of the canal boats of that day.

The history of canal building across the Niagara Peninsula has been one of swift obsolescence. Scarcely had one canal been completed when improvement in and increase in size of the Great Lakes cargo carriers made the canal seem outmoded. The first and second canals were constructed and operated by private capital. In 1870 the Federal Government of the Dominion of Canada assumed control of the canal and at once began work on the third canal. I shall not dwell longer on the earlier canals, except to record one interesting fact: in the third canal the locks were only 270 feet in length and 45 feet in width with a draught of only 14 feet. The Great Lakes cargo carriers rapidly outgrew these limitations and the ships which could pass through these locks became known as "canalers," to distinguish them from their larger sisters sailing on Lakes Michigan, Huron and Erie. ~~In my~~ Many of these smaller vessels are still in use and in my visits to Port Colborne I have occasionally heard a resident 3/4 say somewhat contemptuously of a passing vessel, "Oh, that's just a canaler."

Sometime about the turn of the century an International Joint Commission

began to study the problem of capacity and in 1913 work was begun on the present Welland Ships Canal. This work was interrupted by the First World War but was resumed as soon as possible. It was opened for navigation April 20, 1931 and was formally opened with considerable ceremony Aug. 6, 1932. The total cost was 131 millions of dollars.

Let us suppose that we are aboard a Lake grain carrier leaving Toronto on the up voyage for one of the ports on Lake Superior. Our vessel is an ungainly looking object slightly over 800 feet in length and with a beam of 70 feet. It resembles nothing more than a long goods box with a very blunt prow and a conventional stern much lower than the stem of an ocean freighter. As we have no cargo aboard on the up trip, our bow rides much higher than the stern and this adds to our ships ungainly appearance. At the bow there is a forecastle ~~surmounted~~ containing quarters for most of the crew and this is surmounted by a conventional pilot-house. The bailers and engine are crowded as near the stern as possible - here again the Lake vessel differs from the ocean carrier - and from the low superstructure arises a single large smoke stack. From this trails a continuous serpent of heavy smoke; we burn a low-grade coal which will not generate high steam pressure. Our motive power is therefore a compound single screw engine instead of the triple-expansion engine usually found in steamships.

Between the two deck structures fore and aft lie more than 650 feet of deck, almost all of it hatches. These hatches have been designed to fit the grain elevators of the upper Lakes and the unloading apparatus of the lower Lake ports. Perhaps it is more correct to say that the vessels itself, the canal locks, the loading and unloading

apparatus have all been designed with a single end in view, - economy of time, in order that the vessel may be standing still as little as possible. The absence of any noticeable tide on the Lakes simplifies somewhat the designing of all these facilities and they have reached a high degree of efficiency. Known instances where a freighter has taken on a cargo of 25,000 tons of ore at Duluth in two hours and then, at the lower Lake ports, has had this cargo unloaded 97% in four hours. During these four hours the vessel has been refueled and re-provisioned and is ready to start on another round trip.

Leaving Toronto, we steam across Lake Ontario on a course almost due south and in a few hours we are entering the harbor at Port Weller, about seven miles west of the mouth of the Niagara River. This harbor is formed by piers which have been built out into Lake Ontario for more than a mile and a half; it is 400 feet wide at the entrance, and double that width inside and has an area of 150 acres.

The harbor narrows and we are approaching Lock #1 at Port Weller. Two huge thick walls of concrete over fifty feet in height loom up in front of us, creating an 80 foot wide canyon into which we glide almost noiselessly under our own power. The fender, a 3½ inch steel cable raised and lowered by a structural steel arm, is dropped behind us to protect us and the lock gates from a vessel which might get out of control behind us. Then the huge gates close behind us. Each gate is 78' in height, and 42' in breadth and weighs 454 tons. (30 feet of the gate is, of course, below water, and the two gates ahead of us, holding back the canal water, need be only 48 feet in height.) All these gates are mitered so that the pressure of the water serves only to close them more tightly.

stern and the lower gates; the fender at our bow was already in place when we entered the lock. A few men on the lock have thrown our lines over the bollards. The water begins to boil around our hull as it enters the lock through several tunnels and we are rising, steadily and quietly. When we entered the lock, the tops of our smokestack was just level with the tops of our concrete canyon. Only [illegible] twenty minutes later we have been lifted 46.5 feet; our water line is only 11½ feet [illegible] the tops of the lock and the spectators who a few minutes ago were looking down at us, are now gazing up at us, shielding their eyes with their hands to protect them from the glare of the sky.

All this has been accomplished with a silence that is impressive, one might almost say mysterious. A single operator in the small concrete-and-glass cabin has governed every movement. Unless you had been standing quite close to one of the motor houses, where you might have heard the whir of the electric motors as they opened or closed the huge gates, you would have heard nothing except the boiling and splashing of the water for the first few feet of the rise and an occasional scrape of our hull against the side of the lock.

As soon as the water has raised us to the proper level, the upper gates swing open, the safety fenders are raised, a bascule highway bridge goes up and we steam out into the first reach of the canal. We are on the surface of a huge prism of water. The bottom of the prism is 200 feet in width, the upper surface is 310 feet; the minimum depth is 25 feet. The slope of the canal banks is therefore 25 vertical feet in 55 horizontal feet or 24½°. The usable width of the canal permits us to pass another vessel of like size with a minimum danger of collision or sideswipe. One should bear in mind that we

enter and so travel the entire length of the canal under our own steam. We have no assistance from tugs or from electric locomotives on tracks parallel to the canal, such as are used on the locks of the Panama Canal.

The banks of the canal are planted, wherever practicable, with trees of various kinds and the ground is blanketed with grass. For several miles we steam through grape country; for miles on both sides of us vineyard adjoins vineyard, and in the fall the air is heavy with the odor of grapes. At the end of about three miles we come to Lock # 2, at Carleton Street, St. Catharines, where we are raised another 46.5 feet and only a little farther on Lock No. 3 at Homer lifts us a third time through the same distance.

When we leave the Lock # 3 at Homer, we are in full sight of the twin flight locks at Thorold. These six locks, arranged in pairs like three giant stairsteps, raise us a total of 140 feet. These locks are built so close together that the upper gates of Lock No. 4 serve as the lower gates of Lock No. 5, while No. 5's upper gates similarly serve No. 6. Since these three locks are arranged in pairs, one sees vessels ascending and descending side by side and on at least one occasion I have seen a vessel in each of the ~~three~~ six lock at the same time, three ascending and three being lowered. Thorold is by far the best point for an a sightseer who is interested in such things.

Less than a mile farther on we steam into Lock No. 7 and when we have again been raised 46.5 feet, we have reached the top of the Niagara Escarpment (6/7) and are ~~almost~~ up to the level of Lake Erie. Before we leave this lock, however, there is (16) much ~~about~~ about the Niagara Escarpment.

The Niagara Escarpment is a giant terrace which extends from Hamilton, Ontario, some 45 miles from Niagara Falls to a point some what east of Rochester, New York. Geologists tell us that in some prehistoric age this escarpment formed the southern shore line of Lake Ontario; the land now lying between the Escarpment and the present shore line is unusually fertile, producing a great deal of fruit and garden truck. When the level of Lake Ontario was lowered by some seismic upheaval, the Niagara River was left falling over the Escarpment at a point some six miles north of the present cataract. Year by year the heavy fall of water ate its way farther and farther back; the Falls receded and the Niagara Gorge was left. The slow but steady process of erosion continues.

This process of recession gave rise to a story not too much enjoyed by some residents of Niagara Falls. The Niagara Falls Country Club is situated on the Escarpment at a point only a few hundred yards from the spot where some millions of years ago the original Falls tumbled into the lake below. A visiting speaker at a banquet in the Country Club, much disturbed by continuing noise outside, paused in his address to ask whether anyone knew just why the Falls had moved six miles further back. Receiving no answer, he said "well, I can not say myself but I suspect the Falls moved back so as to get away from the noise of the Country Club." As the Falls themselves are not exactly silent, his remark had added point. Someone left the room and the noises stopped - for the time being.

All this is quite a digression from our canal journey and we had best get back to Thorold and Lock No. 7, which had raised us the last 46½ feet of the vertical part of our trip. We still have sixteen of the canal's 25 miles to accomplish. We are passing through an industrial area now and there is much less natural beauty. Half way to Lake Erie we pass through Welland, the county seat of County Welland, where a bridge lifts a whole section of Main Street to let us pass under, and what we encounter a natural obstacle which the builders of each of the four canals have had to surmount.

7/8 The Welland River flows roughly at right angles to the Canal and it is of such irregular flow that it could not possibly be used as a part of the waterway. The builders of the present canal solved it with wholly satisfactory results by means of a syphon culvert under the bed of the canal. Six concrete tubes, each 22 feet in diameter with vertical end shafts of the same size, carry the river down & under the canal and bring it up on the other side. These syphon culverts have proved ample to pass the heaviest flow of the river which, in the time of spring freshets, has risen as high as 28,800,000 cubic feet per hour or 8,000 cubic feet per second. The construction of this culvert presented quite a problem in engineering, which was finally solved by the construction of a huge cofferdam. This cofferdam enclosed the whole area in which the syphon culvert would occupy but before the dam could be built, the old or 3rd Welland Canal had to be diverted to the east at this point in order that navigation might not be interrupted.

From Welland to Humberstone is smooth sailing. At the Humberstone we enter the long control lock, 1380 feet. Only one other lock, somewhere in Holland, surpasses it in length. Although this lock does not lift or lower a vessel, we are passed through it just as we were passed through the locks that lifted us over forty feet. For this is the lock that guards the whole canal. If some accident should destroy or dislodge the gates of some lower lock, water would of course fall rapidly in the upper reaches of the canal and this in turn would cause the waters of Lake Erie to pour into the canal. The guard lock at Humberstone can be used to shut out all water from the canal or to admit water as needed. Only thus can the canal water in the reaches of the canal be kept at the proper constant depth and the canal banks and machinery be protected from the erosion and damage of a violent current.

Once through the control lock, we steam through the city of Port Colborne, with its fair sized harbor. We leave the huge plant of the International Nickel Company on our left and two large grain elevators on our right as we steam out past the breakwater into Lake Erie. Eight hours have passed since we first entered the harbor at Port Weller and began our journey through the canal.

8/9 The mechanism of the canal and all its appurtenances has been designed not only for efficient operation but also with an eye to safety, - safety of the canal itself and of adjacent property

that the operator can conduct the the lockage of a vessel only in the prescribed order. If in spite of all safety devices, a ship should get out of control and carry away a lock gate, hydraulic linkages automatically operating the control valves in the regulating towers at the different locks would prevent the flooding of lands and property adjacent to the canal.

A few comparisons may help to give you some idea of the purpose of which the canal serves. The total lift of the locks ~~has~~ is, as I have already said, 327 feet. Stand at ~~one~~ by the monument in front of our Court House and look down at the tracks of the Norfolk and Western Railway; 176 feet vertically separates the two spots, a height only nine feet more than that of the American Falls. But the Welland canal lifts a ships through almost twice that ~~distance~~ height; the three flight locks alone at Thorold would lift a ships from the Union Station to the Municipal Church, and within about the same horizontal distance. The total lift in the Panama Canal is only 85 feet, for which three locks are used at Gatun. The lift ~~at~~ in the five parallel canal locks at Sault Ste. Marie is only 20 feet.

Again, let us suppose our 25,000 ton carrier had had to unload its cargo ~~on~~ into railroad cars at Port Weller for transshipment across the Niagara Peninsula. An extensive and expensive unloading apparatus at Port Weller would transfer our cargo to two trains of 125 cars each, provided each car held 100 tons. Unusually heavy motive power would be required to haul such trains, especially at the Escarpment, where even an operable gradient could be obtained only by a devious route. At Port Colborne, another transfer installation would put our cargo on another vessel for its journey up the Lakes. The actual saving in time and money is difficult to estimate.

9/10

The net tonnage weight of freight passing through the canal per year has for some time run around 12 million tons. In 1941 the tonnage handled was 13,232,263. This would require 530 ships of maximum size but, since not all are of this size, a far larger number of vessels pass through the canal every year. Or, to use our railroad comparison again, this tonnage would require ± 132,322 freight cars - again supposing each car to have a capacity of 100 tons - and these would be made up into 5,060 separate trains of 125 cars each.

The five parallel locks at the Sault Ste Marie handled 87,633,699 tons in 1927, the last year for which I was able to get figures. This is nearly eight times the tonnage passing through the Welland Canal and over three that which passed through the Panama Canal. The Suez Canal handles about the same amount as the Panama. The Soo is not really a canal; rather is a single battery of five parallel locks at the rapids of the St. Mary's River. Much of the tonnage passing through the Soo is ore and wheat destined for Detroit, Toledo, Cleveland and Buffalo, all which are on Lake Erie and therefore stop short of the Welland Canal.

The ample capacity of the Welland Canal is used as an argument by supporters of the St. Lawrence waterway improvement program. If the St. Lawrence and its canals were to be enlarged to the same capacity as the Welland and the Soo, all such the largest ocean freighters would be able to come inland as far as Chicago and Duluth for their cargoes. I have seen a 10,000 ton Norwegian tramp sailing up Lake Huron; she was headed for a port on Lake Superior where she would take on a cargo of grain. Over against this argument must be set the tremendous cost of construction, maintenance, and operation, and the fact

that all Great Lakes and Upper St Lawrence shipping is ice bound for from four to five months of every year.

No description of the Canal would be complete with out some reference to the effect of winter upon its traffic. Those of us who have spent our lives in a climate like that of Lynchburg can not easily visualize the cumulative effect of prolonged severe cold. Insurance policies upon Lake shipping, vessels and cargo, expire December 1st. A few hardier companies seek their vessels on one more round trip but the freighters often get into serious difficulties with ice and are rescued at considerable risk by cutters and ice breakers of the U.S. Coast Guard. All shipping stops by Dec. 15. When the vessels reach Buffalo on their last down trip, they do not discharge at once their cargoes of ore and grain, since the ore docks and grain elevators are already filled to capacity. The vessels lie at anchor in the harbor, awaiting an opportunity to unload. When that opportunity arrives, several powerful tugs help a vessel break its way through the ice to the pier or the elevator.

10/11

On the Niagara River, ice breaks loose in the upper river, tumbles over the Falls and, joining with ice that is already there, freezes with it in a jam which is called the ice bridge. Some years ago this ice bridge reached an unusual height, rising above the concrete abutments, upon which rested the arch of the old Falls View Bridge, it crumpled enough of the steel arch to cause it to collapse into the river, where for some two months over 350 tons of steel lay upon the ice. The spring thaw finally permitted it to disappear, though some of it rode downstream a considerable distance on the ice floes.

As for the canal, it is drained. The locks and

conduits are carefully drained and the water is let out of the reaches of the canals and the weirs. The canal lock at Humberstone has all its gates closed to hold back the waters of Lake Erie. A little water remains in the channels in the locks. All employees except the necessary watchmen are placed on vacation and the whole canal is deserted in animate thing.

I have spent many happy and interesting hours along this canal and one of my personal and selfish grudges against the late Herr Hitler is to be found in the fact that he deprived me of this indulgence. In the first World War ~~that was~~ a serious attempt was made to blow up one or more locks. I do not know the details but the plot had some ramifications on inside of the river. In 1939, as soon as war began, the Canadian Government at once ~~threw~~ threw an efficient guard along the canal and also around the electrical generating plants and the canals (we would call them huge flumes) which supply them. Every bridge had its guard and no pedestrian or vehicle was allowed to loiter near the canal. At first this guard duty was performed by training units on stations nearly built, as these units went overseas, the duty was taken over by the older men of the Home Guards.

11/12

At the beginning of this paper I referred to the canal as a monument to international friendships. Not only was it designed by a joint commission of Canadian and United States officials and engineers but it has always been used by ships of both countries on free of tolls. This true that ships pay the men who ~~p~~ moor the vessels in each lock but this is only a nominal

charge of $15 for a ship under 200 feet in length, and of $20 for the larger ships. Have are no other fees. Thus, although it lies wholly within Canadian territory and is operated by ~~that~~ the Canadian Government, this is in reality a link in the great unfortified boundary line which is so utterly incomprehensible to visitors from Continental Europe. They cannot grasp the understanding & peace which renders such a canal ~~then~~ possible. How I for one hope - selfishly - that that peace long prevails, for I'm looking forward to the time when I may have the leisure to sit once more upon a lock, scuff my heels against the concrete wall and watch the ships go by - and ups and down.

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which joins rather than separates Canada and the U.S. and