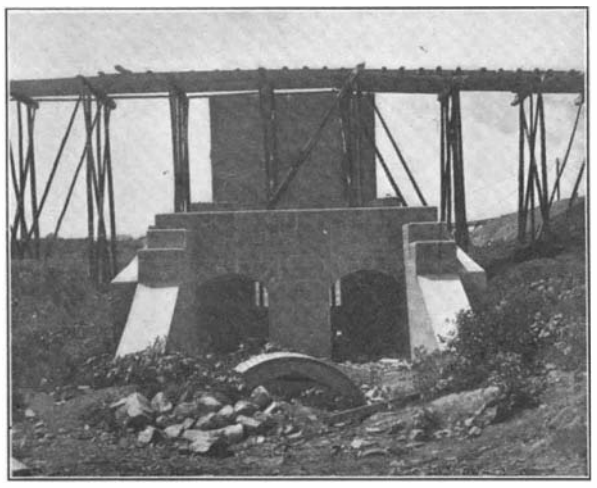
THE CANALS OF CANADA.

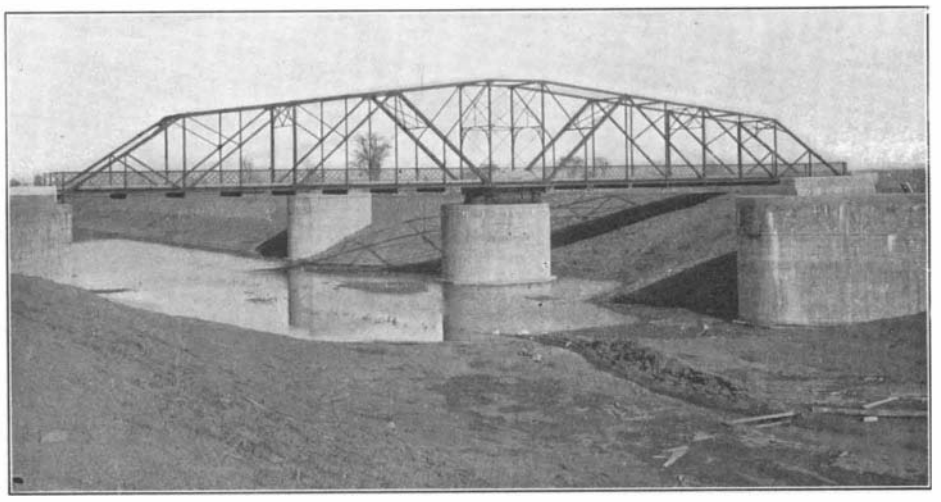
BY WALDON FAWCETT.

The tremendous commercial and industrial development which has lately been inaugurated in many different directions in the Dominion of Canada is chiefly and directly traceable to the opening of the system of enlarged canals, which has made possible the introduction of vessels of moderate draught in the trade of what is known as the St. Lawrence route. It has been realized for some years that Montreal and other points on the lower St. Lawrence River presented admirable facilities as export ports for grain, just as it has been appreciated that the iron industry of Canada needed little fostering to yield rich returns; but activity in both directions has been considerably retarded by inadequate facilities for water transportation.



SLUICES ON LINE OF ST. LAWRENCE CANALS.

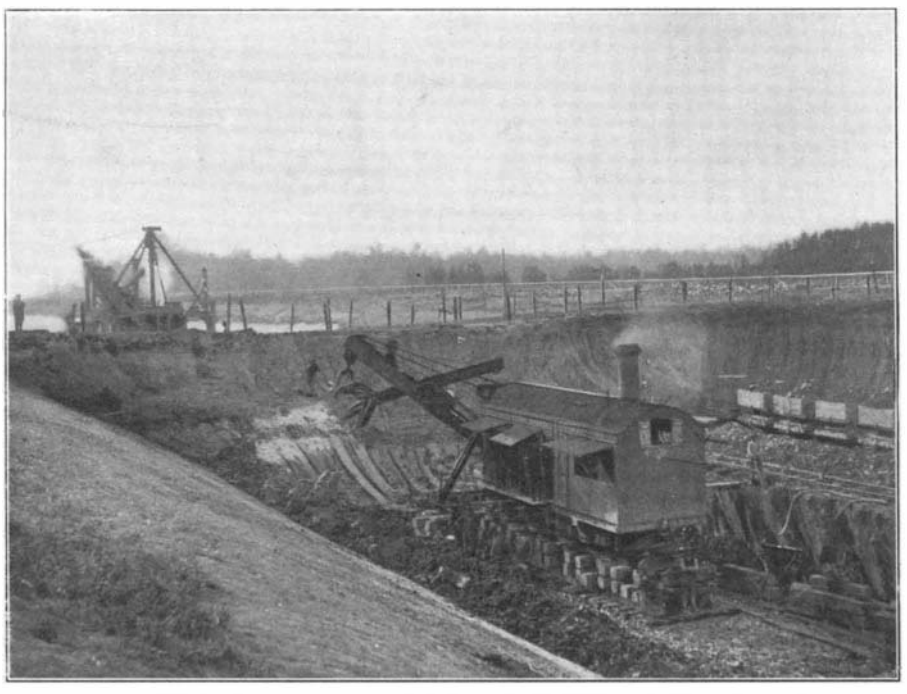
That the importance of a waterway linking the Great Lakes and the Atlantic, and the benefit which it would confer, not alone upon Canada, but upon the entire region bordering on the Great Lakes, has been realized, is attested by the immense interest which has been manifested in the investigations of the Deep Waterways Commission appointed by Congress a few years ago to compare the advantages of the various routes, exclusively in American territory, for a navigable channel from fresh to salt water. Canada has felt the necessity of such an avenue of communication far more keenly than the United States; for not only has she practically no shipping on the Great Lakes, but almost the only outlet for the product of the grain fields of Manitoba—one day to become the greatest cereal-producing region in the world—has been found in rail lines, which by reason of meager competition have been disposed to offer few advantages to the shipper. On the other hand, however, Canada had what the United States with its immense lake fleet and network of railroads had not, a natural waterway to the coast, which with a moderate expenditure could be adapted to the traffic of ships of fair size throughout its entire length.



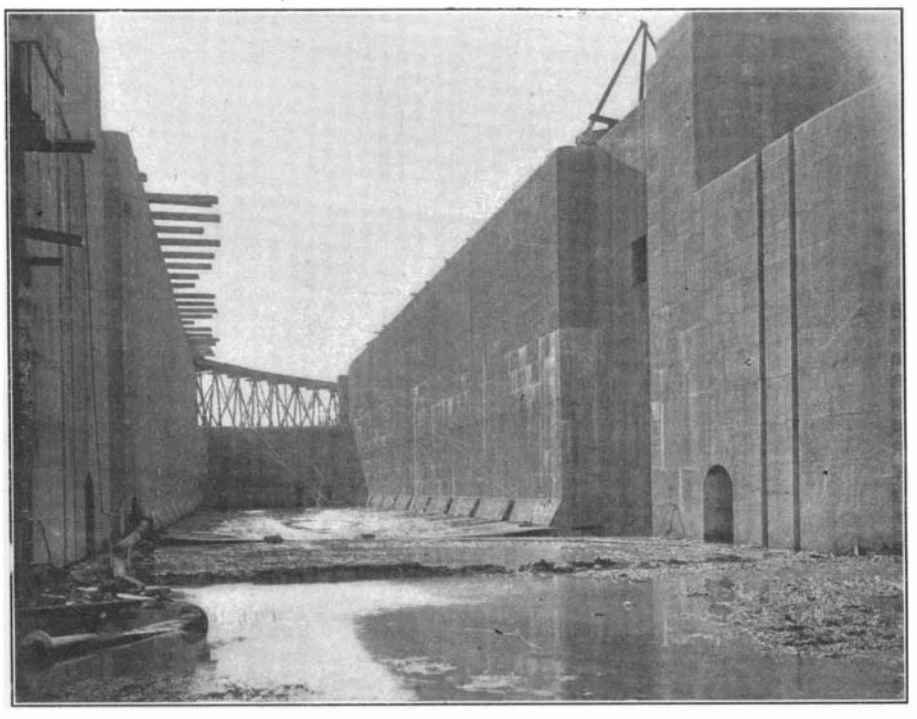
TYPE OF HIGHWAY SWING BRIDGE IN USE ON THE ST. LAWRENCE CANALS.

Although the Canadian system of canals has only just been brought to the point where it is proving a factor in the utilization of the natural resources of the country, the Dominion government has, since Confederation in 1867, spent more than $75,000,000 on the various canal systems, the backbone of which is of course the Welland and St. Lawrence waterways. These two systems, together with those portions of the St. Lawrence River where no improvement has been necessary and the chain of Great Lakes and their connecting rivers, gives to Canada what is unquestionably the most remarkable uninterrupted course of inland water communication in the world, a stretch of almost 2,400 miles extending from the Straits of Belle Isle to the ports at the head of Lake Superior.

The project of a Canadian waterway of a uniform depth of 14 feet, extending from the Great Lakes to the Atlantic coast, was first seriously considered in 1872, and it is probably due largely to the fact that plans prepared about a quarter of a century ago have been carried out without alteration or amendment, that the canals just completed were not made somewhat deeper. At the time the scheme was first mapped out the immense, steel, freight-carrying steamers now in service on the lakes were unthought of, even as a remote possibility, and it was supposed that a channel capable of accommodating vessels drawing 13 or 14 feet of water would meet all the requirements of any trade which might be developed in this part of the continent. Long before the system was completed the Canadians discovered their mistake, but it would have

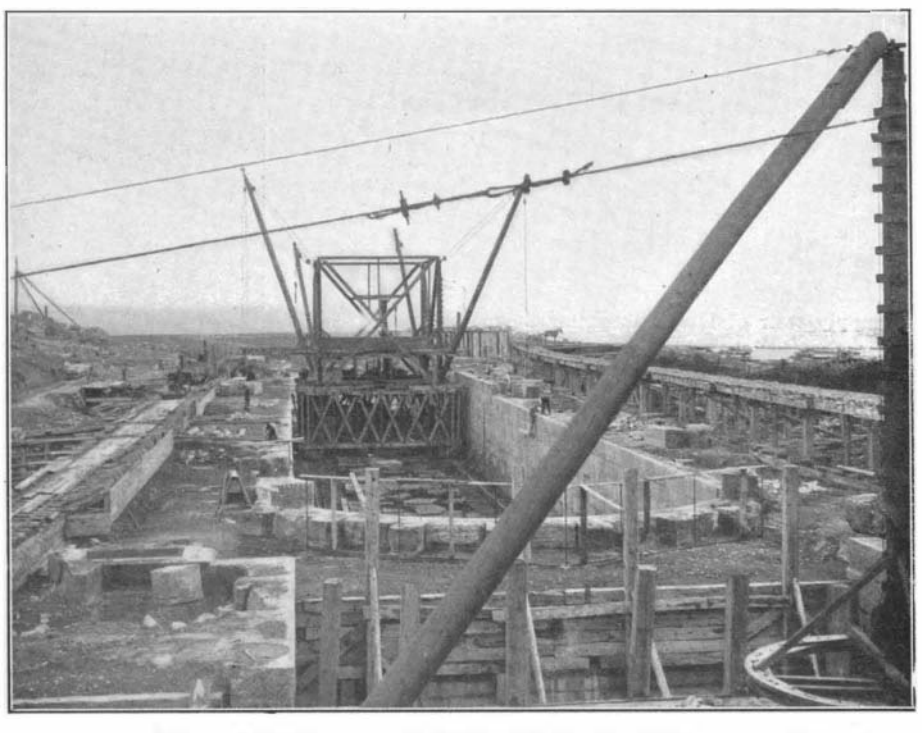


STEAM SHOVEL AND FLOATING DREDGE AT WORK ON CANAL.



VIEW TAKEN IN INTERIOR OF ONE OF THE LOCKS.

AQUEDUCT FOR CONVEYING GRAISE RIVER UNDER THE SOULANGES CANAL.

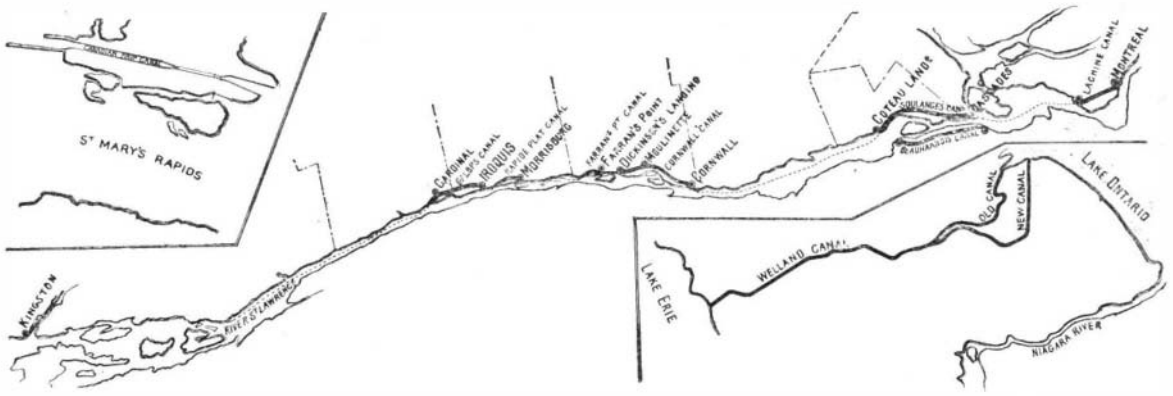


LOCK UNDER CONSTRUCTION—MASONRY PLACED IN POSITION BY DERRICK TRAVELING ON FLOOR OF DOCK.

been manifestly useless to make the new canals deeper unless a like improvement could be introduced in those first constructed, and so the original uniform depth was adhered to.

The St. Lawrence system proper consists of six canals, ranging in length from one to fourteen miles. With the Welland Canal, which goes to make up the seven artificial waterways between Lake Erie and the sea, the canals have an aggregate length of over seventy miles. In this distance there are 53 locks, overcoming a height of 533 feet. To bring the locks to their present uniform dimensions of 270 feet in length and 45 feet in width, more or less extensive alterations had to be made on each one; nor did a single one of the half a hundred locks have, originally, the desired depth.

The canal system of the St. Lawrence River is necessary to enable vessels to make the ascent of 207 feet from the level of the river at Montreal to Lake Ontario and to avoid the dangerous rapids which are found at various points. The menace which these have constituted to navigation interests has been well illustrated by experiences during the interval when the improvements on the canals were uncompleted. Upon occasions when the demand for lake-built craft for Atlantic coast service was urgent, the Standard Oil Company and other interests allowed several vessels which were of too great draught to pass through the canals to "shoot the rapids." This proved an extremely hazardous proceeding, and several of the craft were either lost or seriously damaged.



MAP SHOWING THE CANADIAN SYSTEM OF LOCKS AND CANALS ON THE GREAT LAKES AND THE ST. LAWRENCE RIVER.

The largest, the most lately completed, and decidedly the most interesting canal of the St. Lawrence system is the Soulanges, which in the details of design and construction may be taken as typical of the most approved practice in waterway construction in the Dominion. The Soulanges is fourteen miles in length, and not only overcomes the difference of 82 feet between the levels of Lake St. Francis and Lake St. Louis, but enables vessels to avoid sixteen miles of dangerous rapids. This canal cost $5,250,000, is operated by electrical power, and is claimed in point of equipment to be the most modern in the world. Vessels may traverse the waterway by day or night, and it is a remarkable fact that the canal has only two curves and that the entire fall of 82 feet is overcome by four locks.

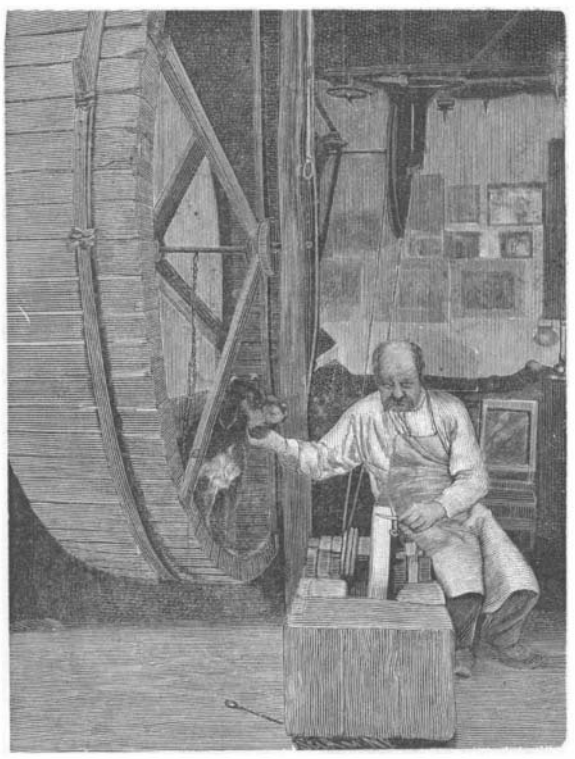
One of the chief points of novelty in the Soulanges is the introduction of concrete to a large extent in the walls and foundations of the locks. In the locks of the Welland and most of the other Canadian canals the backing is of masonry, but in this latest canal the mass is concrete faced with stone. Each of the locks has a lift of 23½ feet and is 350 feet in length, 46 feet wide and 42½ feet high. At the upper end there is a breast wall about 23 feet high of solid masonry. The water to fill or empty the lock is conveyed through tunnels in the side walls which are 25 feet apart at the base. Control is effected by means of sluices, placed in wells behind the recesses for the gates, and operated from the coping of the locks. From the tunnels the water is introduced to the chamber of the lock by twenty cast iron pipes, each of 2½ feet diameter, ranged ten on either side. The means of escape is, of course, by the same avenue. The lock is filled in about five minutes, and under ordinary conditions a lockage can be made in from 12 to 15 minutes.

The question of the provision of an adequate water supply in all parts of the canal at all times has been solved by the provision of commodious side channels. At the intake at Lake St. Francis the water designed to maintain an uninterrupted flow is passed through a supply weir of large dimensions provided with four sluices and debouching into a channel or raceway behind the guard lock. This is continued to the lower end of that structure, where it joins the main canal. The sluices, which are of the vertically operated steel, shutter type, so common in Europe, are operated by electricity, as are also the locks and bridges. All of the forty sluice-gates along the canal are submerged, and no water for supply is passed over the breast walls.

One of the most interesting mechanical features of the canal is found in the application of electrical power to the operation of the gates. Owing to the height of the wells at the lower entrance and the solidity of the gates, each large leaf weighs fully 90 tons in the air. Preliminary experiments with a dynamometer on one of these when in place showed that a force of fully 3,000 pounds was required to move it through the water at the rate of 15 feet per minute. This movement was effected by attaching a horizontal operating bar or strut to the gate about half way between the heel and miter. On the side of this strut a rack of sufficient length was fixed into which a pinion was geared and driven by electrical power. A system somewhat similar has been in use on the North Sea canal for several years. It might be noted in conclusion that three small rivers, tributaries of the St. Lawrence, pass under the Soulanges Canal through iron pipes.

The second most important canal of the St. Lawrence system is the Cornwall, which is 11½ miles in length, overcomes a lift of 48 feet and ends at the town from which it derives its name. The Welland Canal, although as explained not in the St. Lawrence system, constitutes a most important link in the chain of communication which the new waterways have opened up. The Welland, extending from Lake Erie to Lake Ontario, is almost 27 miles in length and has a total rise of about 327 feet. It was opened in 1883 for vessels drawing 12 feet of water, and four years later for vessels with a draught of 14 feet.

The locks of the Welland and St. Lawrence Canals are, as has been stated, 270 feet long from the miters of the gates, and 45 feet in width, but this does not convey a strictly correct idea of the largest size of vessel which may lock through, this being dependent upon the model of the bow and stern of the vessel. A vessel that is sharp forward at the deck line and narrow at the stern can lock several feet longer than one that is nearly full beam of the locks. The reason why a steamer of narrow beam may lock through longer is found, of course, in the fact that she may



AN OLD CUTLER'S SHOP AT THE EXPOSITION.

be swung to one side of the lock and one gate opened, and then to the other side of the lock while the other gate is being opened.

It will thus be appreciated how vessels ranging all the way from 240 to 270 feet represent the maximum capacity of the locks for craft of different types. Generally speaking, however, it may be stated that the vessels especially adapted for traffic on the St. Lawrence route are each capable of carrying, on an average, 68,000 bushels of wheat or 3,000 tons of iron ore.

There have been a large number of these vessels constructed within the past two years, and the shipyards of the Great Lakes being unable to supply the ships as rapidly as desired, several contracts were placed abroad. The majority of the vessels thus far constructed are designed especially for the grain trade, an American syndicate having planned to build great elevators at Montreal and ship at least 25,000,000 bushels of grain via that route each year. The new canal system is also serving as an impetus to the shipbuilding industry on the Great Lakes, several vessels for Atlantic service having been constructed on the inland seas within the past year.

Destruction of Rats by Bacilli.

Now that the rat is considered to be an important agent in the spread of plague, means are being adopted to lessen its numbers. For this purpose, J. Danysz proposes to employ cultures of an organism, recently isolated by himself, which is pathogenic for the rat. The organism was isolated during an epidemic occurring among field mice. It is a short bacillus, somewhat like the Bacillus coli, and at first is only slightly pathogenic to rats. By cultivation in broth and upon agar and successive passages through rats, its virulence toward these animals is much augmented, and they contract a fatal disease by ingestion of food contaminated with the organism. In one experiment 200 rats were fed on bread steeped in broth cultures of the organism, and in less than three weeks 80 of the animals succumbed. Tried practically in a store and in some stables, a great diminution in the number of rats was noticed after a dissemination of cultures of the organism.—Ann. de l'Inst. Pasteur.

THE OLD CUTLER'S SHOP AT THE EXPOSITION.

An example of the life led of old by a family of working people outside of the often unwholesome agglomeration of workshops was offered at the Exposition in the cutlery shop of "Old Poitou." It was a large room, at the back of which was a bed with coverings of coarse fabric, and around which stood rustic chairs here and there. Strips of bacon for drying were suspended from nails in the ceiling. In the fireplace hung two pots, one for the kitchen and the other for the tempering of knives and scissors. A large wooden wheel placed against one of the walls attracted special attention. It was this that, through its revolution, set in motion the cutler's grindstone. In this room the cutler worked from morning till night, while his wife occupied herself with the cares of the household.

But what revolved the big wheel? Scarcely had the cutler seated himself in front of his grindstone when a large dog jumped into the wheel, and, beginning to walk therein, set it in motion.—Lectures pour Tous.

Bids for Raising the "Maine."

Five bids were opened recently in Havana for the raising of the "Maine." The amounts asked for varied from $735,000 to $80,000. The bids were rejected and new ones asked for, to be opened on February 1, 1901. There is a stipulation that dynamite shall not be used in blowing up the vessel. The successful bidder may retain the ship. Twelve new bids were tendered.

The Current Supplement.

The first page engraving in the current SUPPLEMENT, No. 1310, is devoted to a fine portrait of Lord Armstrong, who has done so much for ordnance and naval engineering. "A New Page-Printing Telegraph" describes the invention of Mr. Donald Murray. "Nineteenth Century Medicine" is an important and elaborate article. "The Silkworm" is a valuable article, accompanied by many interesting engravings. "Corn Growing" describes the result of twelve years' work at experiment stations. "The Hall of Illusions at the Exposition of 1900" gives interesting details of lighting. "The New Rifle of the Germany Army" is fully described and illustrated.

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(Illustrated articles are marked with an asterisk.)