the enlarged Welland Canal, drawing 14 ft. of water & carrying 2,212 tons of corn. The through route between Montreal & Port Arthur at the head of Lake Superior, now open for a 14 ft. navigation, comprises 73 miles of canal & 965 miles of river & lake waters, a total of 1,038 miles. To Duluth, the total distance is 1,162 miles. The approaches to the canals & the channel through the intermediate river reaches are well defined & are lighted with gas buoys, rendering their navigation by night as well as by day feasible & safe. In the case of the Soulanges Canal, the canal is well lighted throughout by electricity, a system which will be extended to other canals before long.

With the more intimate knowledge of the new channel through the St. Lawrence now possessed by the river pilots, full advantage will, no doubt, be taken of the improved facilities afforded by the enlargement works; & this great water highway from the west will realize the aims of its projectors & constructors in giving rise to the establishment of lines of deep draught vessels on the route, with the beneficial result of a vast impetus to the trade & commerce of the country. Already, indications of movement on all sides promise the early & rapid delevopment of the new era of progress, not only in the direction of the production & transport of crude materials, ores, grain, coal & lumber, but in the enormous expansion of manufactures & industries on the shores of the great lakes & their connecting rivers, notably the iron & steel & ship building industries, to all of which the ability to employ vessels earrying 3,000 tons of freight direct to the seaboard & Europe, which Canada has now afforded, must inevitably prove a great stimulant. The growth of the main centres of production & collection on the lakes as shown by the last U.S. census of 1900 is sufficient indication of the prodigious vitality of the region. Since 1890 Buffalo has increased 37% to a population of 352,000. Cleveland, the great ship building centre, 46% to 382,000. Toledo, 61% to 132,000. Detroit, 38% to 286,000. Milwaukee, 39,% to 285,000, & Chicago, 54% to 1,699,000. To this has to be added the fact that during the fiscal year ended June 30, 1899, vessels were built on the great lakes to the extent of a total gross tonnage of 183,317, of which 139,765 tons were steam vessels. In the previous year this total amounted to 190,743 tons, & the total for the past 11, 1889 to 1899 inclusive, to 816,297 tons.

Though, naturally, not marked in equal degree, the tendency to a similar industrial development on the Canadian side is very evident, especially so at Sault Ste. Marie, where, in addition to the existing important pulp & paper mills, the establishment of large iron & steel works is in progress. At Collingwood, also, & Kingston like works are projected, while at Depot Harbor, on Georgian Bay, a system of wharfs & elevators has been constructed for the accommodation of the grain trade. The very extensive harbor improvement works at Montreal, with the system of wharfs & elevators in that connection will naturally tend to attract traffic down the canals to that port. The improvements at Port Colborne, the Lake Erie entrance of the Welland Canal, are in progress. They comprise the deepening of the approaches to the canal to 22 ft., & the construction of two docks, with piers 200 ft. wide, upon which grain elevators will be erected to transfer grain to the 14 ft. draught canal boats when required. The deepening of the approaches to the Sault Ste. Marie Canal, at present limited to accommodating vessels of 17½ ft. draught, so as to give a depth of 22 ft., thus enabling the canal works to be utilized to their full extent (which is the same as the U.S. canal on the other side of the river), will probably be carried out next year.

The construction of the new works for the improvement & extension of the Trent Canal system is proceeding. When the present contracts are completed a 6 ft. navigation will be afforded from Lake Simcoe to Heely's Falls, a distance of about 160 miles, leaving the portion between Heely's Falls & the Bay of Quinté, Lake Ontario, & the portion from the head of Lake Simcoe to Georgian Bay, Lake Huron, still to be dealt with. A question has, however, arisen as to the expediency of adopting Port Hope as the Lake Ontario terminus instead of Trenton, & a survey has been made with a view to ascertaining the feasibility & cost of that route. The letting of the contract for the Trenton-Frankford section has, meantime, been postponed.

During 1899 & 1900, under special appropriations voted by Parliament, surveys have been conducted on the upper River Ottawa with a view to ascertaining the feasibility & probable cost of constructing a canal system which will give a 14 ft. navigation from Georgian Bay down that river to Montreal, a scheme proposed many years ago & lately revived by private parties with considerable energy. It appears to be clearly established that such a series of works can be built at reasonable cost, which would attain the end desired.

St. John's, Nfld., Electric Railway.

By R. F. Markill.

Newfoundland abounds with small & large fresh-water ponds, many of which are so situated that, with very little expense, they can be turned into valuable sources of power. About eight miles from St. John's, high in the hills which form the rugged coast line of the island, are a number of these ponds, emptying into the sea at a small fishing village called Petty Harbor, & here it is that R. G. Reid, of Montreal, the proprietor of the Newfoundland Ry., has built the power-house for the electric transmission plant that, on May 1, 1900, began to supply energy for the operation of the St. John's Electric Ry.

At present only two lakes have been dammed, one having an area of 25,000,000 sq. ft. & the other 1,000,000 sq. ft., making a total of 26,000,000 sq. ft. Besides these two reservoirs now in use, there are two others within close proximity having areas of 9,000,000 & 31,000,000 sq. ft., respectively. A dam & gate are at the mouth of the larger lake to regulate the flow of water, as is required, so that there may be no waste.

From the mouth of the smaller lake a wooden flume 3,468 ft. in length, carried along the side of the hill, conducts the water to a point 187 ft. above the power-house. It is constructed of native spruce 8 ft. x 8 ft. framed timbers on 3 ft. centers, planked on the bottom with 2½ in. & sides 2 in. The flume practically ends in a rock tunnel 368 ft. long, cemented at the junction. Not any lining is used inside, the rock being sufficiently water tight. At the other end are located the pen-stock & gate. From here a pipe 318 ft. long, 6 ft. 6 ins. in diameter, brings the water into the power-house below. This pipe is made of steel plates ⅜ of an in. thick, anchored to 22 concrete pillars, embedded in solid rock. Two anchor bolts 5 ft. long, riveted to the sides of the pipe, run through the basin & are bolted to timbers at the back.

The generating station is 138 ft. long by 24 ft. wide, constructed of native blue stone, with wooden roof covered with sheet iron, cemented floor, & well lighted by large windows. Only two generators & one water-wheel have been installed, but everything is ready for placing another wheel of the same capacity & also two more electrical units. The wheel is of the turbine type, having a rated capacity of 1,868 h.p. when operating under a head of 187 ft. The wheel is regulated by an electrical governor. On the shaft is a 9-ton fly-wheel, made up of sheet steel plates, bolted together & turned in a lathe. Two Westinghouse generators are directly connected to the water-wheel, one on either side. They are rated at 600 kilowatts each, revolving armature, 3-phase type, running at 237 revolutions a minute, & delivering 500 volts at 60 periods a second. Two exciters furnish the field current for generators & lights for the station. They are directly connected to a 50 h.p. turbine, one on either side of the wheel, arranged in the same manner as generators. They have a capacity of 15 kilowatts each, 4 pole, 110 volts, 605 revolutions a minute.

The switch-board is the ordinary Westinghouse type, consisting of 4 white marble panels, 2 for the generators & 2 for the exciters, with the usual number of ammeters, Niagara-type wattmeters, volt-meters & a Mershon compensator for loss on the line. The current is conducted from the switchboard to the primary side of the step-up transformers on twelve 500,000 circular mil lead-covered tables. On each transformer is mounted a Westinghouse 500-ampere quick break switch for the purpose of opening the primary side if necessary. Three Westinghouse transformers of 400 kilowatts each, oil cooled, raise the voltage to 15,000 volts for transmission. They are connected in delta. From the secondary side the current goes through 6 high tension pole switches & circuit breakers to the bus-bars & thence to the pole switches connected to the line circuits. The Worts lightning arrester is used. These are installed in loft at the end of the building over the high-tension switches.

Current is brought into St. John's over two pole lines, in order to insure against interruption of the service. The poles are about 125 ft. apart; three wires of no. 5 B. & S. medium drawn on each line, Locke three petticoat glass insulators & locust wood pins, boiled in paraffine wax, are used, as they are believed to give best results where there is so much fog & rain. There is one cross-arm on each pole, with a pin at either end & a pin in the top of the pole, thus forming an equilateral triangle. The wires are not spiraled. A telephone line connects the generating station with the sub-station, wires being transposed every 4 poles.

The sub-station is at the west end of the city, just beside the dry dock. In appearance it very much resembles the power-house, being constructed of the same material & having a concrete floor, etc. The dimensions are 90 by 30 ft. Line wires enter the end of the building through high tension pole switches similar to the one in generating station, thence to the high-tension bus-bars & distributing switches to four 100-kilowatt Westinghouse oil-cooled transformers for 2 rotary converters. The transformers are connected Scott system, giving a 2 phase current at 400 volts. The sub-station also contains four 150 kilowatt transformers, giving 2-phase currents at 2,040 volts, used for city circuits. The high-tension switches are pole-switches, with fuses, each having a marble slab with an air gap of 3 ins. between slabs & a shield of asbestos 38 by 30 ins. Two rotary converters are at present installed, but foundations are ready for 2 more. These converters are rated at 200 kilowatts each, speed 720 revolutions, & 500 volts for street railway circuits. The switchboard is of white marble, 9 panels in all, 4 of which are used for the rotary converters & 1 for railway feeders, the remaining 4 for light & power, 2 panels for each. All station appliances are of standard Westinghouse types of latest forms. The remaining interesting feature of the sub-station is that the Manhattan series alternating enclosed arc system will be installed immediately for the street lighting. This will necessitate the addition of one more panel to the switchboard.