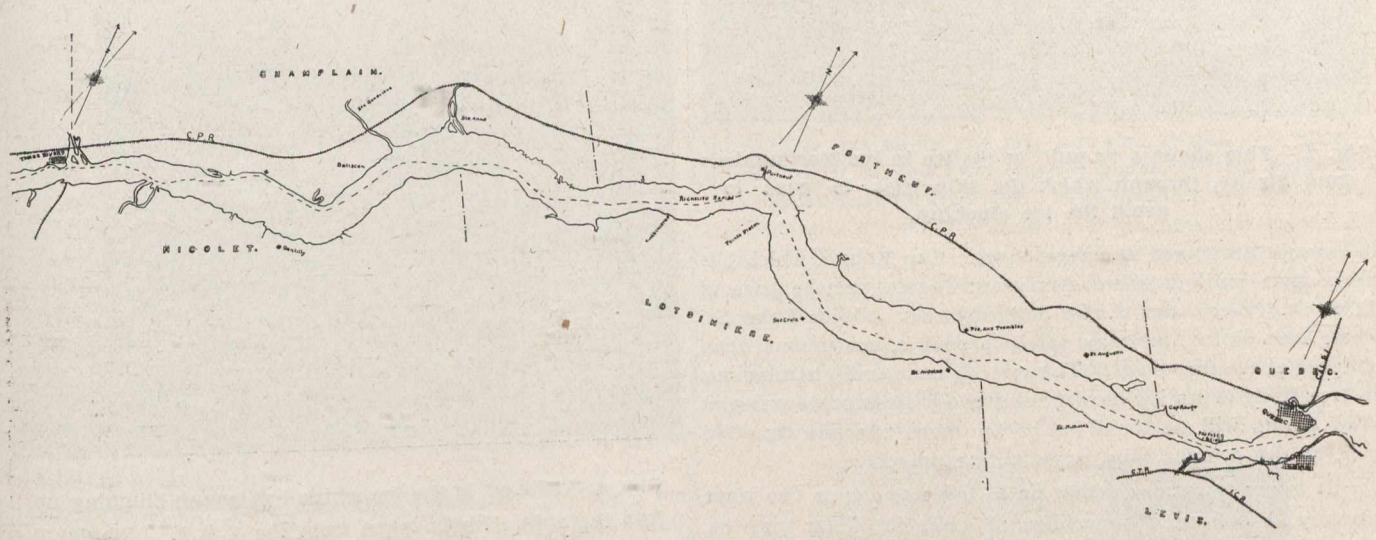
Cape Race. She then returned to Quebec, and resumed her lighthouse work. She was placed at Quebec last winter and the present one to handle the ice at Cap Rouge.

The "Lady Grey" is a twin screw, steel vessel, built at Barrow, G.B., in 1906. She is 172 feet long, 32.2 feet wide, 15.9 deep; 65 net, 733 gross tonnage, and of 353 nominal h.p. Next to the "Earl Grey," she is the newest ice breaker in the fleet, and was designed more for river work. She was stationed this year at Quebec to assist the "Montcalm" in keeping the river clear at Cap Rouge.

Winter navigation has been maintained for many years on the Great Lakes. At the Straits of Mackinaw, in Lake Michigan, and the City of Duluth, on Lake Superior, winter ice-crushing ferries are operated through three or four feet of solid ice for a distance of fifty or sixty miles. These break the ice down chiefly through the action of the bow propeller. They successfully attack floating ice in the lake from five to ten feet thick. It was at Port Huron in 1890 that the value of the bow propeller was first discovered. Capt. Houghton when stopped in his attempts to force his privately operated ferry through the ice turned his boat around and backed into the ice, finding out by this means how rapidly the wave created by the screw broke the ice and sucked it down out of his way. He therefore had built a ferry with a bow propeller. The Russians copied this design to great advantage. Up to the present time, none of the St. Lawrence River ice-breakers have been built in this way, although it is of special assistance in an ice pack.

The Royal Commission appointed to study the formation of ice on the St. Lawrence River, as it affected the winter and spring floods, completed their report in 1886. As a result of their work, they recommend keeping the river open in winter from Montreal to tide water, in order to offer a free runway for the ice. They recommend the use of ice-breakers, and reported that winter navigation on the St. Lawrence was perfectly feasible. They distinctly stated that this offered the best means of keeping the river from flooding. In spite of their suggestion, however, no determined attempts have been made to keep the river clear of ice. This year, ice-breakers have been placed at Quebec by the Government in order to prevent the formation of the ice-bridge at Cap Rouge. This ice-bridge, which usually forms early in the winter, effectually stops the channels and lasts long into the spring. During last winter (1908-09), it was attacked by the ice-breaker "Montcalm" after it had formed and securely packed. Nearly the entire winter was spent in cutting a channel through it, Fig. 1, but the result was satisfactory, and navigation opened nearly two weeks earlier as a consequence. This year (1909-10), the "Montcalm" and "Lady Grey" have been stationed at Quebec, and no ice-bridge has been allowed to form. On three occasions it took, but the boats effectually cut it away in a few hours. The effect of this has been noticed on the upper reaches of the river, and at no time has the river been closed between Quebec and Three Rivers. The Royal Commission reported that if the ice-bridge at Lake St. Peter could be kept from forming, there was sufficient head of water between Lachine Rapids and there to effectually keep the channel open. As soon as the bridge forms it stops the floating ice, and the pack sets in at once, running back and covering the whole river. If the ship channel in Lake St. Peter and the Sorel Islands be kept open and Cap Rouge be free, all the ice would pass out to the sea. Mr. T. C. Keefer points out in his presidential address to Section Three of the Royal Society of Canada in 1897, the only difficulty is Lake St. Peter, where



St. Lawrence River from Montreal to Quebec.

Fig 1.—Showing a cut in the Cap Rouge ice bridge in March, 1909. This is pack ice with frazil underneath. Photo taken from the "Montcalm."