Canadian Railway and Marine World

April, 1914.

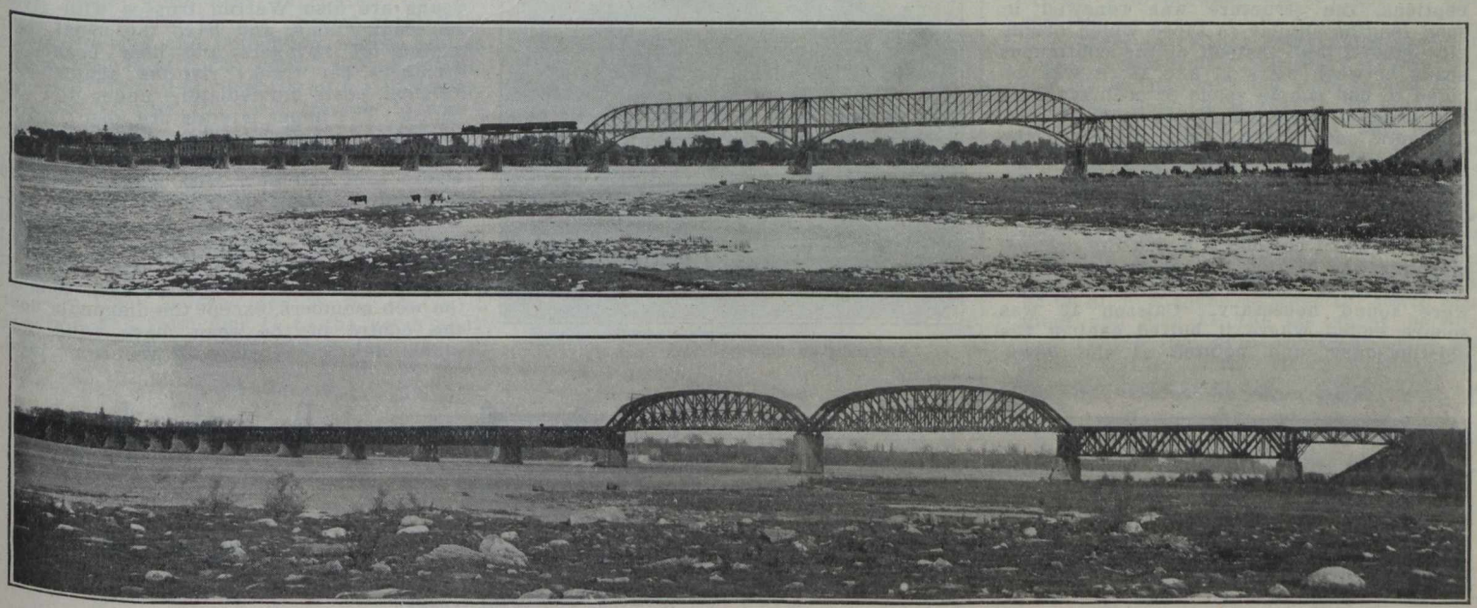
Double Tracking of the Canadian Pacific Railway's St. Lawrence River Bridge.

By P. B. Motley, M. Can. Soc. C.E., Engineer of Bridges, C.P.R.

The C. P. R. crosses the St. Lawrence River about seven miles above Montreal, near the Indian village of Caughnawaga. This crossing is on the best of several trial lines which were located and estimated on, in the years 1883-1885. Amongst the more important were the Nuns' Island line and the Heron Island line, besides the Caughnawaga line which was eventually chosen. These trial lines are located between the G. T. R. Victoria Bridge and Lachine, the object in all cases being to obtain an outlet from Montreal towards the east and south with the least possible expenditure when the crossing of the river, as well as mileage, were taken into account. The Victoria Bridge is approximately 2 miles long, and the engineers sought, if possible, to obtain a considerably less expensive crossing.

The Nuns' Island line gave a long crossing of the river in comparatively deep water. The Heron Island line gave a shorter bridge, located for the most part in shallow but very swift water composing the Lachine Rapids. In both these crossings the question of navigation had to be considered and difficulties connected with it weighed considerably in the discussions. The Caughnawaga crossing was finally adopted as being the most economical and as suiting best the requirements of navigation. The bridge is approximately five-eighths of a mile long, and navigation was taken care of by using two through spans of 408 ft. each over the deepest portion of the river to allow for waterway, and a headway of 60 ft. above highwater. This avoided the use of a swing or other movable span which, in this part of the swift flowing St. Lawrence River, would constitute a serious menace to navigation. The span lengths in the balance of the bridge were generally 270 ft. and 240 ft., and were dictated by the judgment of the engineers with respect to ice flow in the river.

The decision as to the crossing having been made, the substructure of the bridge was begun, with the late P. A. Peterson, M. Can. Soc. C. E., as Chief Engineer, in the spring of 1885, and the erection of the steelwork was carried out during the winter of 1886-7. The contractors for the substructure were R. G. Reid & Co. (the late Sir Robert Reid), and the engineer in charge for the company was the late G. H. Massy, M. Can. Soc. C. E. The steel work was designed by the late C. Shaler Smith and the Dominion Bridge Co. was given the contract for its manufacture and erection. The steel was especially designed with a view to quick and simple erection, as it was impossible to place falsework in the deeper portions of the river where the 408 ft. spans are located. For these reasons the designers decided upon a peculiar type of construction. This consisted of a set of 4 spans (2 deck and 2 through) continuous over five supports, which enabled the steel work of the side or flanking spans to be erected first on falsework, and the main channel spans to be erected by the cantilever method, the flanking spans being used as anchors,—some steelwork was also cantilevered both ways from pier 13 located in the centre of the channel. When these several spans were connected, they formed, as aforesaid, a continuous span over five supports, fixed at the centre on pier 13 and expanding both ways therefrom. The channel spans, as noted above, were made of through design to allow steamers to pass under at full speed, and Mr. Shaler Smith solved the problem of combining deck and through spans by a very beautiful and interesting method, that of curving the ends of the spans, as shown in the photigraphs and plans. This procedure is open to criticism from a mathematical point of view, but, considering that the pier supports were founded on rock and, in addition, had adjusting screws, so that the ideal conditions upon which the calculations had been made, could be at all times maintained (if necessary), the design was considered justifiable. The engines, for which the old structure was designed, were equal approximately to Coopers E35 loading, followed by a train-load of 2,500 lbs. per lineal foot, and the material in the structure was steel, except stringers, counters and windbracing where it was iron. The design lent itself admirably to rapid erection, which was borne out by the fact that the steel took only twelve months to erect ready for traffic. By 1910, the requirements of traffic had necessitated the use of much heavier locomotives than were considered in the original design and, in addition, the increasing volume of traffic made it advisable to double track the line from Montreal eastward. Bids were, accordingly, called for on designs prepared by the C. P. R. engineers, and a contract was subsequently entered into with the Dominion Bridge Co. for the removal of the old spans and the erection of the new. A contract was also made with The Foundation Co. for the extension of the substructure to accommodate the extra steelwork. In the old structure there was no traffic to be taken care of, but in the new it was not allowable to interfere with the regularity of passing trains. This considerably complicated the problem, and, under the circumstances, it was decided that the only possible way of ensuring all the requirements was to build two independent single track bridges, and remove the old bridge in sections, transferring traffic from side to side, as will be described later.



Lachine Bridge, C.P.R. Old and New Bridges from Caughnawaga Side, Looking Down Stream.

SUBSTRUCTURE.—From observations during the life of the old bridge, it was noted that the ice of Lake St. Louis generally