waters, and of the materials forming the muskegs and underlying soils. These investigations covered both the Laurentian formation which underlies the greater part of the length of the aqueduct, and the limestone which occurs towards its westerly end. The results show that the sulphates and sulphuretted hydrogen were not present in the former and in minute quantities only in the latter. The method adopted of constructing the aqueduct in a shallow trench, permitting of the drainage of the muskegs nearly as low as the bottom of the aqueduct, will allow very little ground water to come in contact with the concrete. The report doubly emphasizes the use of good materials as a further safeguard against any injurious effects.

For the first 9 miles of the route the land through which the aqueduct will pass is higher than Indian Bay, and necessitates a deep summit cut, for gravity flow. This is shown to advantage in Fig. 4. From this point the gradient is quite variable, although down-grade all the way to Transcona; hence the varying sizes and cross-sections of the aqueduct, as shown in Fig. 5, ranging from one 10 feet wide and 9 feet in height with a sectional area of 73.6 sq. ft., with a hydraulic radius of 2.33 feet (used at the summit cut where there is a low gradient) to one 5 feet high and 5 feet wide, with 20.9 sq. ft. cross-section, and a hydraulic radius of 1.24 feet used where the gradient is highest. The profile shows four river crossings, viz., Falcon, Birch, Whitemouth and Brokenhead Rivers, where the aqueduct is depressed and reinforced, and is provided with waste weirs and blow-offs. These crossings require special construction. At the Falcon River depression a pile foundation will be required for about 600 feet, and the depression itself will be 150 feet in length. The top of the aqueduct will be sufficiently low in the water to permit of the passage of boats of light draft. The depressed portion is to be reinforced with steel, and the concrete walls thereat will be considerably thicker than under ordinary circumstances.

The depressions and strengthened sections at Whitemouth and Brokenhead Rivers are similar, although for a part of the distance at the latter crossing, where the muskeg is too steep to permit of the construction of the aqueduct upon a solid natural bottom, a pile and timber foundation will be required. At this crossing also, and through the low-land on either side of it for a distance of 13,000 feet, the circular form of aqueduct reinforced with steel has also been adopted, so that this portion will withstand the pressure resulting from building it 10 feet or more below the regular grade line. The diameter of this particular section is 7.2 feet. At Birch River there is the alternative of carrying the aqueduct over, instead of below, the surface of the water.

At the waste weirs, provision will be made to dispose of any excess of water over the capacity of the pipe line, leading from Transcona into Winnipeg, which might accidentally be permitted to enter the aqueduct at Indian Bay. This may be accomplished by placing stop-planks across the aqueduct to stop or throttle the flow through it. Blow-offs, other than at the locations mentioned above, will be placed where opportunity offers, being convenient for use during the construction of the aqueduct, and while it is being repaired, and to be used in emergencies when the aqueduct is in service.

For the last 26,000 feet of the concrete reservoir leading toward Transcona, the section of aqueduct to be used is designed to withstand the internal pressure that will develop when it is necessary, at some time in the future, to build a large reservoir there, and to provide a pumping station. This portion of the aqueduct has been designed of circular form, 8 feet in diameter, and provided with steel reinforcement. The section shown in Fig. 6 is designed to withstand the pressure due to 20 feet of water.

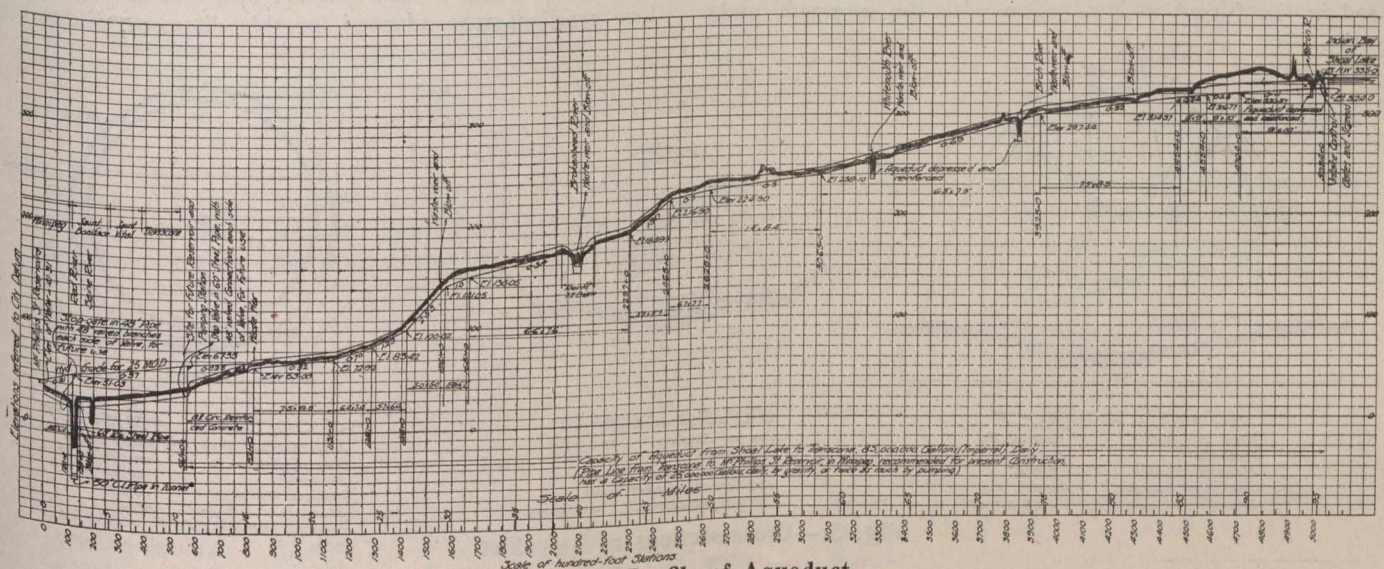

Fig. 4.—Profile of Aqueduct.

As the aqueduct, with the exception of the reinforced portions above mentioned and some other short lengths at river crossings, is not expected to stand any considerable upward pressure on the arch, measures are to be taken to prevent the opening of the sluice gates at Indian Bay to a height which will permit a quantity of water to enter the aqueduct much, if any, in excess of the rate of 25,000,000 gallons daily, which is the limit of the capacity of the pipe line leading from Transcona to the city reservoirs. The waste-weirs already mentioned will act as a further safeguard in permitting the discharge into the crossed streams of excess of water.

The concrete mix recommended for the construction of the aqueduct, for strength, permanency, and water-tightness, is one of Portland cement, two of sand, and four parts of screened gravel. To prevent transverse cracks in the structure, the precaution is to be taken of building in sections not more than 20 feet in length, and where one section joins another, a steel bar about 3 inches