December 7, 1911.

macadam has been widened to twenty-two feet we have kept the rise at nine inches or thirteen-sixteenths of an inch per foot. Were the longitudinal grades capable of a greater fall per foot than we have, a much less crown would be preferred, and our experience has been that the twenty-two-foot road, with its flattened section, is used toward the outside to a degree far in excess of the eighteen-foot road. We have, therefore, had to sacrifice this very desirable feature and considered it expedient to do so for the drainage.

Another of the difficulties to be encountered was the effect of the Niagara River cutting in upon the shore line, and some twenty-five thousand (\$25,000.00) dollars has had to be expended in a rip-rap protection to make the area acquired for the boulevard safe from erosion. At some stretches it was necessary to approach very near to the top of the bank and place the rip-rap far enough from the water's edge to build a new bank. Attention might also be called to the provision that has been made for accommodating a very much increased traffic which is expected within the next few years, and it is pointed out that the roadway can be readily increased to thirty feet in width by simply removing the earth shoulder, partially filling the gutter and extending the metal to the present edges of the gutter. Under this rearrange- . ment the catch basins would be in the proper place to receive the surface water and would probably be kept at their present grade.

The bridges along the route, six in number, have perhaps given a greater degree of satisfaction from a designing point of view than any other part of the construction. The main features of these are shown in the table below.

All are of the arch type reinforced with steel and designed for a uniform load of 200 pounds per square foot in ad-



Arch Bridge During Construction, Showing Centering.

dition to a 20-ton roller or a 40-ton suburban car. I may say that our Commission has no policy respecting an electric railway on this public property, but it was considered wise to provide for such a feature if the proper developments of the district should point to electric traction as a necessity, and that is the reason for the heavy type of bridge adopted. Of course the architectural feature was most important, and it is believed that the structures, as built, will not lag behind the general high standard that has been set for this work. Usher's Creek bridge is built of Queenston blue stone with cobweb masonry, Boyer's Creek is built of field stone and boulders, Black Creek, the longest span (70 feet) was given the most attention and is veneered with Beamsville white or grey limestone with ashlar masonry and ornamental iron panels between pilasters on the parapet wall. Baker's bridge is built of red sandstone blotched with grey.



Arch Used on Niagara Boulevard.

Miller's Creek bridge is the only one built entirely of concrete and Frenchmen's Creek bridge is built of Queenston grey limestone. The intention being in all of these different structures to mark a mile stone on the route.

The foundation for the bridges probably gave us more anxiety than anything else, for the material was of an exceedingly treacherous character and each abutment, with the exception of Usher's Creek bridge, required to be piled. For the foundation, in place of a grillage we used rubble between the piles and allowed the caps to extend into the concrete. The abutment was then built usually in one operation to the point where the arch steel could be placed and then the concrete was brought to the springing line of the arch, and on a line nearly perpendicular to the tangent of the arch ring at this point. The arch ring itself was laid in one operation with the exception of the Black Creek bridge, where the width was divided into three sections, each of which was run continuously. As a further precaution on the Black Creek bridge the arch ring was keyed into the abutment by leaving in the bottom a transverse slot two feet six inches in width at the top, two feet deep, and one foot nine inches wide at the bottom. Dowels were set in both sides of this slot three feet centre to centre, and the lower main bars of the arch ring extended to the bottom of the slot and were wired to the dowels.

Bridge. Stone.	Span.	Rise. 6'	Centers.	Mileage. 163	Concre 1—2—3	te. 1—3—6	1011S Steel 6.7	
Usher SQueension blue cobico				3.I	126	92		
Boyer'sBoulders	30'	5'	5	359 6.8	48	54	3.1	
BlackBeamsville white ashlar	70'	7'	5	438 8.3	376	241	20.3	
Baker'sRed sandstone pibald	30'	5'	9 (FII)	489	82	55	. 4.0	
Miller'sConcrete	30'	8'	5	610	112	50	5.2	
Frenchmen'sQueenston grey	40'	4' -	(hdrs. 6.5)	785				