than iron, this margin may be very much reduced. Of course slight variations in the percentage of carbon in steel produces wide margins in its ductility, but a rigid inspection at the mill can guard against this. In the Lachine Bridge great care was taken in securing a mild uniform steel with an ultimate of about 60,000 lbs. with a ductility of 18 per cent. in 12 diameters. The tests subsequently made on some of the full sized members at Pittsburg, Penn., showed the material to be the same as when tested in small specimens. The material was found to be all that could be desired, and the Steel Company of Scotland deserve great praise in furnishing a uniform steel, something which is not easy to obtain. Their process is the Siemens Open Hearth process.

2nd.—The moments of inertia in the formulæ are assumed as constant, give results which are entirely on the safe side, giving strains which are greater than they actually would be, especially over the piers.

3rd.—The supports which may be assumed to be out of level can be at any time adjusted by means of the adjustible beds at the ends of the balancing spans at A (see Plate IV), and any inaccuracy in the distribution of dead weight can be at any time noticed in the variation of the strains in the ties at the centre of the channel spans at "W" (see Plate IV).

The three objections to the continuous girder are very serious, and would have undoubtedly been sufficiently strong to have prevented using a continuous girder for these spans, had it for the conditions under which this design was made, a consideration of these will at once show that the problem for closing the two channel spans was certainly solved in the most scientific manner, when it is borne in mind that the positions of the piers were all fixed, and it was impossible to use false-work in raising the two channel spans.

The trusses for the continuous girders, it will be noticed, are of the double intersection type, as in the eight 240 feet deck spans. A question might be raised as to the possibility of making correct calculations of the strains in the curved portions of the channel spans, inasmuch as the two systems here combine their strains one into the other. It would be impossible to do so if the calculations were made for each system separately, but here the calculations for the two systems were carried through together, and the work was very much simplified in using the graphical methods entirely, for calculating the strains in the continuous girders for the Lachine Bridge. As to the methods used in the calculations, the author wishes to say that Mr. Moore, of Saint Louis, has recently prepared a lithograph, which shows all the essentials necessary to understand the methods used in a very concise form, consequently here full details as regards the calculations will be omitted.

The unit strains used in the details are essentially as follows:

Steel @ 12,000 lbs. per square inch for tension.
Iron @ 8,000 " " " " " "

The only tension members that are iron are counter-rods and the wind bracing. For the wind bracing a higher unit strain was used. The compression members were all figured by the "Rankine-Bouscaren" formulæ, which are certainly the best formulæ in use, as they give results which agree more nearly with the results obtained from actual tests than any other formulæ. As used in the Lachine Bridge the formulæ are for steel.

$$P = \frac{10000 - \frac{l^2}{r^2}}{1 + \frac{l^2}{36000 \times r^2}}$$ for fixed ends.

$$P = \frac{10000}{\frac{l^2}{r^2} + 24000 \times r^2}$$ for one fixed end and one pin ends.

$$P = \frac{10000}{1 + \frac{l^2}{18000 \times r^2}}$$ for two pin ends.

These formulæ are so well known that no explanation is necessary. The 10000 lbs. for steel in the numerator is substituted for 8000 lbs. for iron, as given by Mr. Bouscaren in his report to the Board of Trustees for the Cincinnati Southern Ry. As the matter of guard rails in railway bridges has now become so very important, it would perhaps be well to say that when the Lachine Bridge is completed, a train of cars could be run off the track for the entire length of the bridge, without the passengers being aware of it. The ties are spaced with 4 inch openings, and the wheels are guarded by two heavy guard rails on each side of the track. The only accident that could possibly happen to a train of cars on this bridge is, that they could be blown bodily off the track, provided a western cyclone should happen to visit this section of the country, which is not at all probable.