The Authors. not affect the results. It seemed likely, however, that the size of the orifice had a good deal to do with the results, and that if it had been practicable to have had an orifice of, say, 1/100 inch diameter, the results might not have been abnormal.

Students' Paper, No. 918.[1]

"Modern Permanent-Way Design."

By Ronald Bridgman, Stud. Inst. C.E.

Correspondence.

Mr. Peters. Mr. Reginald Peters observed that the Author seemed to have been a little hasty in assuming that the subject had not been properly treated before. More than 25 years ago he had been engaged on works embracing extensive permanent-way layouts, and at that time the "old Caledonian" method of calculation had been found inadequate and had been modified on the same principle as that suggested in the Paper; further, he had not been alone in the field. Both as a maker and a user of crossings his attention was first drawn to the degree of refinement to which the calculations set out in the Paper had been carried, to match which the rails would require to be very accurately machined, say at the crossing-splice to within $\frac{5}{1,000,000}$ inch. It was, he considered, pertinent to ask what value such particularity possessed in relation to material which could not and need not be accurate to within many hundred times the limits which the Paper sought to impose. Taking, as an example, the outer curved track of the double junction on p. 149 and starting from the toe of the switches, oppositely corresponding portions of the axes of the two rails might be set down as follows:—

Outer rail.	*Inner rail.*
flat	flat
arc	arc
flat	arc
arc	flat
flat	flat (one slightly leading)
arc	arc
flat	arc

It was obvious that the two axes could not be parallel and, in

[1] p. 135 (February).

Mr. Peters. practice, approximate parallelism was obtained by using non-circular arcs. The marginal variations involved were minutes of angle and feet of radius or lead, whilst the Author's Tables implied that they were half seconds and thousandths of an inch. If practical accuracy was the aim, the Paper could have been very considerably condensed. Standard layouts comprised 33 per cent. of point-and-crossing work, and the dimensions had been sufficiently accurately calculated and employed for years ; 66 per cent. consisted of applying standard material to non-standard conditions. For that purpose drawings to a proper working scale were the quickest and most reliable guides. The Author's pronouncement against them in his "Conclusion" might be attributable to his advocacy of the peculiarly unworkmanlike and diminutive scale of 16½ feet to an inch. For the remaining 1 per cent., using such proportions figuratively, a few general equations and a Table of constants furnished all the theory required. In his opinion it was necessary for theory to take more note of limiting conditions.

The Author. The AUTHOR, in reply, observed that Mr. Peters criticized the calculations for being carried to an impractical degree of refinement. If the final dimensions had been given to the same degree of accuracy as that used in the working-out, that would have been the case. In Appendix II, Tables III, V and VI, however, it would be seen that radii were given finally in decimals of a chain, running dimensions to ⅛ inch, and angles of crossing to minutes (that was to say, the difference between angle of 1 in 9 feet 6 inches and 1 in 9 feet 7 inches was 4 minutes). That degree of accuracy was considered practical in the final dimensions, but, to obtain it, it was necessary to use a greater degree of accuracy in the working-out, owing to the very acute angle of the triangles that had to be solved. For example, in calculation No. 6 (Appendix III),

$$\tfrac{1}{2}\,A\hat{O}C = 0^\circ\ 10'\ 2{\cdot}3''$$
$$\text{and } AC = 6{,}600 \sin \tfrac{1}{2}\,A\hat{O}C = 19 \text{ feet } 3 \text{ inches.}$$

An error of 1 minute in $\tfrac{1}{2}\,A\hat{O}C$, suggested as being practical by Mr. Peters, would lead to an error of 1·92 foot in AC, and crossing C (angle 1 in 10 feet 4 inches) would be thrown approximately 2¼ inches out of alignment. Whether or not that was unnecessary refinement depended on the standard of smooth running required from the track.

The time involved in the calculations was small (the longest example given, No. 6 (Appendix III), took on an average 2 hours for each double junction on a curve), whilst the graphical errors, inevitable in dealing with curved tracks even when a large scale was used, were eliminated. It was thought, therefore, that the

The Author. system of calculation described did justify itself, while the layouts designed by that method had shown very satisfactory alignment in practice.

Paper No. 5047.[1]

"The River Foyle Crossing (Londonderry Waterworks)."

By WALTER CRISWELL, O.B.E., M. Inst. C.E.

Correspondence.

Mr. Cotterell. Mr. A. P. I. COTTERELL was especially interested in the remarks on p. 195 about the nature and the bearing-power of the river-bed. They tended to show that although the surface materials formed a slurry when saturated with water, yet at a depth below the zone of saturation they would bear an appreciable load, amounting to as much as 1 ton per square foot at a depth of 4 feet. The Author had not stated the composition of the slurry-like material, and whether clayey or sandy ingredients were the chief characteristic. Apparently, however, below the scour-line and when protected from the influence of irregular scour due to spates in the river, that load could be carried indefinitely.

Some years ago he had had occasion to investigate the soft subsoil of the alluvial flats bordering the mouth of the river Usk, near Newport, Mon. It had been proposed to construct settlement-tanks with a maximum load when full of water of about 1 ton per square foot; heavy buildings in the neighbourhood had, however, settled considerably, and it had been desired to make certain that a settlement-tank, if constructed at the spot in concrete (reinforced where necessary), would stand up to the work without breaking its back. The subsoil was somewhat firmer than the soft underwater silt described by the Author, and consisted of a soft alluvial soil of a blackish blue, but containing also much sand. In order to test the bearing-power at a depth of 6 feet, an excavation about 9 feet 6 inches by 8 feet 3 inches in area had been made, and a box 16 square feet in area and 6 feet deep had been loaded to a total weight, including the box, of 21·45 tons. The inter-space between the box and the timbering had also been loaded with dry bricks as a counterbalance to the specially-loaded area, a space between the bricks and the box of not less than 3 inches having been maintained.

[1] p. 190 (March).