The Authors. have been necessary with any other arrangement would have been justified.

Mr. Aldington. Mr. ALDINGTON, in replying further to the Discussion, observed that the scheme for the construction of the Victoria Dock had been promoted by Mr. G. P. Bidder, Past-President Inst. C.E., the contractors having been Messrs. Peto, Brassey and Betts. Those parties had already interested themselves in the development of the marshland between Bow Creek and Gallions to the extent of promoting and building a branch line of the Eastern Counties Railway from Stratford to North Woolwich. The Victoria Dock had been constructed by the Victoria (London) Dock Company under powers conferred by Act of Parliament (The Victoria (London) Dock Act, 1850, 13 & 14 Victoria, Cap. 51), and had been opened in 1855. The land had been purchased by the Dock Company, and records showed that it had been obtained from private owners, there having been no mention of the North Woolwich Land Company in the documents. In 1864 the London Dock Company and the St. Katharine Dock Company had amalgamated, and had purchased the entire Victoria Dock from its original owners with the exception of the pontoon dock, which had remained private property. The pontoon dock had been sold by the Victoria Dock Company to the Thames Graving Dock Company, Ltd., in 1860. From 1866 until 1897 it had been the property of the Victoria Graving Dock Company, Ltd., and in 1897 it had been purchased by the London and St. Katharine Dock Company. The London and St. Katharine Dock Company, which owned the Victoria Dock, had opened the Royal Albert Dock in 1880. The King George V Dock had been constructed by the Port of London Authority, and had been opened by His late Majesty King George V in 1921.

Paper No. 5035.[1]

"The Flow of Water through Rectangular Pipe-Bends."

By POWYS DAVIES, M. Inst. C.E., and SHIVRAM VASUDEO PURANIK, B.E.

Correspondence.

Mr. Addison. Mr. HERBERT ADDISON observed that during the past year he had been making a series of experiments on pipe-bends, with almost the same object as the Authors' experiments. His own tests had been made

[1] p. 83 (February).

on bends of square section, both of carefully-machined brass and of unmachined cast iron, so that when the results were available it would be most instructive to compare them with the results obtained from the teak-wood bends used by the Authors. He hoped to be able to present his results to The Institution in the near future. Mr. Addison.

Mr. D. G. ELLIOT was of opinion that, while not definitely so stated in the Paper, it would appear that the Authors were assuming that a Pitot tube recorded velocity heads, $V^2/2g$. Although in the case of pipes a Pitot tube appeared to record velocity heads, he wished to point out that in general the impact head, V^2/g, was recorded by the tube. The apparent divergence from that rule which took place when a Pitot tube was used in a pipe might be explained by the reasoning given in T. Merriman's and T. H. Wiggin's American Civil Engineer's Handbook [1] and in a paper [2] by Messrs. G. S. Williams, C. W. Hubbell, and G. H. Fenkell. Mr. Elliot.

The Authors stated on p. 103 that " It would appear at first sight to be impossible for the Pitot tube to record a momentum of flow greater than that which occurred in a direction normal to its orifice, but the fact remained that it did record such a momentum." He felt, however, that the reasoning cited above offered a simple explanation of such a phenomenon; namely, that the velocity at the wall had approached a magnitude comparable with that at the centre. He was of the opinion that the Authors' experiments on the open horizontal flume had proved only that the velocity at the walls of the flume was not negligible. As turbulence of flow was not the only factor affecting wall velocities (although admittedly it was a very important one), he could not accept as justifiable the " reasonable inference " reached by the Authors from the results of their experiments.

In conclusion, he would like to express his appreciation of the data which the Authors had made available.

The AUTHORS, in reply, observed that Mr. Addison's experiments ought to provide data of considerable value, and they awaited their publication with interest. They were unable to accept Mr. Elliot's suggested explanation of the Pitot-tube results. The authorities whom Mr. Elliot quoted had pointed out that it made very little difference which form of expression was adopted (namely $V^2/2g$ or V^2/g) because the change was provided for in the coefficient of the instrument, a conclusion with which the Authors agreed. Furthermore, the nature and magnitude of the flow at the walls of the flume were constant throughout the experiment, and therefore could The Authors.

[1] p. 1369. 5th Edition. New York, 1930.

[2] " Experiments at Detroit, Mich., on the Effect of Curvature upon the Flow of Water in Pipes." Trans. Am. Soc. C.E., vol. xlvii (1902), p. 1.

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).