DISCUSSION.

Mr. L. Hargrave considered that the author had given undue prominence to pistons as compared with diaphragms, and he would like to hear the author's reasons for partiality.

Mr. G. Ashcroft stated that he superintended the fitting up of the first Westinghouse brake in New Zealand, but for the past ten years he had had nothing to do with this class of work, but he still felt a very keen interest in this most important question. The brake proposed by the author appeared to him to be a most admirable one. It was provided to meet most of the contingencies which might arise, and possessed many points of superiority over the Westinghouse brake. There were no doubt some minor details which would require modification, but these were so small and the remedies so obvious, that any engineer employed to fit up the brake would correct them. It produced a melancholly feeling in him when he considered the time and money wasted by an engineer of ability in these experiments, and the great improbability of this brake being taken up by the Government authorities. Regarding the question as to which end of the train the brake power should be first applied, his experience on the steep grades in New Zealand was entirely in favour of it being applied at the rear end. He was aware that the opinions of many railway engineers were quite at variance with this method, as there was a belief that it would result in breaking the couplings, but such was not the case. He was much surprised at the results obtained at the recent brake trials by the Vacuum brake, by which it was conclusively proved that it could be made just as efficient as the Westinghouse brake.

Mr. W. D. Cruickshank stated that he attended the meeting with the intention of listening rather than taking part in the discussion. As a member of the late Board appointed by the Government to inquire into the relative merits of the Westinghouse and Vacuum brakes, it would be very questionable taste on his part to deal with anything beyond the constructional details of these appliances. His opinion of the question was that it was one that required a considerable amount of study before it would be possible to express an opinion of the merits of any particular type with authority, and with regard to the invention under discussion he had had but very little time to consider its various points. There was not the least doubt that the author, in pointing out that the Westinghouse brake could be only graduated one way, had called their attention to the weakest feature in this appliance, and one that was of especial importance on the New South Wales railways. For example, on the mountains from Katoomba to Emu Plains the line had gradients which he did not think were equalled in any part of the world, hence the necessity for trains being fitted with brakes that could be graduated both on and off. As far as the author's paper was concerned, he considered that it concentrated itself in the invention of the controlling valve, which appeared as far as he (the speaker) could judge to be a most ingenious, sensible and practical appliance. He was under the impression when first glancing over the paper that nearly the whole of the advantages of this brake were represented by the two train pipes, and if such had been the case it would not be difficult for the Westinghouse Company to attain the same object by the addition of another pipe. The Westinghouse brake was the outcome of some of the highest intelligence both in England and America, and, although it was a complicated appliance, it had been practically demonstrated in hundreds of thousands of instances that it was reliable. With regard to the new quick acting brake the quick acting gear only came into play in an emergency, and the valve worked in a very satisfactory manner.

On some points there was a resemblance between the author's and the Westinghouse brake. He had examined Mr. List's brake, which in theory was much better than the Westinghouse. It had many good points, but the objection that he took to it was that with the constant pressure behind the pistons there was a possibility of the air leaking through while the train was running, and if the brakes were required at full power on an emergency, the necessary pressure might be wanting. In other respects it was a very good invention, and would prove far more economical than the Westinghouse. At the late trials in testing the Westinghouse and Vacuum brakes for leakage each train was put on a grade of 1 in 30. The brakes were put on with full power, and the locomotive then cut off. From memory he believed the Westinghouse had from 62 to 64 lbs. pressure. In 30 minutes one of the brakes leaked off, and in 83 minutes the train began to move. With the Vacuum brake the results were very similar. He was prepared to admit that when the trials commenced he had an instinctive feeling that the Westinghouse was the better brake of the two, but as the trials progressed and the results obtained were compared he was compelled to change his opinion. They were both good brakes, but for graduation, simplicity and general usefulness the results of the trials had forced the conviction on his mind that the Vacuum brake was the best of the two, and he was glad of this opportunity of giving the members his opinion on this matter. He considered Mr. Selfe's brake a much better appliance than the present Westinghouse system, and was aware of the difficulties involved in introducing such an invention, but possessing real merit it must eventually assert itself.

Mr. Middleton, a visitor, stated that he had studied the author's design, and wished to compliment him on the ingenuity exhibited. At the same time he (the speaker) thought, although not the cheapest appliance obtainable, it certainly deserved to be tested, and before spending £300,000 in fitting the goods rolling stock with brakes, a few more trials should be

made to prove beyond doubt which was the best brake in existence.

Mr. W. Shellshear, after complimenting the author on his invention, stated that on an examination of the Board of Trade returns it would be found that nearly eighty per cent. of the failures of the Westinghouse brake were due to broken hose pipes. To get over the exhaustion difficulty there must be two train pipes. With one pipe the difference between the author's and the Westinghouse brake was not great.

Mr. List, a visitor, in reply to Mr. Cruickshank's remarks regarding the possibility of leakage with his (the speaker's) brake, stated that he was prepared to put one of his cylinders to the test with any other type, and also work it without lubricant. Referring to the Westinghouse brake, he said that it was without doubt a good one in the hands of a good driver, but many drivers could not or did not work it properly.

Mr. N. Selfe asked whether it was correctly reported that at a recent trial with the List brake having a length of piping representing a train 1000 feet long the time required from the movement of the handle to the brakes being on at the rear end of the train was $2\frac{3}{4}$ seconds.

The President stated that this was correct, the time having been taken by Mr. G. Ashcroft.

Mr. W. D. Cruickshank pointed out that it was impossible to obtain accurate results of the time required except by electric appliances.

The President then called the attention of the members to the questions asked at the conclusion of the paper. He considered them simple questions, and as regarded the first two the discussion which had taken place answered them. There was an idea existing among a certain section of the community that whatever was required by us must be imported, but surely this was not necessary when we had the skill and appliances for manufacturing here. He considered that the author should have received the courtesy due to him from the gentleman who

received the drawings of his brake, and have accepted his (the author's) offer to explain the features of his invention. If it proved better than either the Westinghouse or Vacuum brake, why should it not be adopted? He believed that the Commissioners for Railways were really anxious to obtain the best article. This being so, he thought it would be wise on their part to grant any man of an inventive turn of mind an opportunity of displaying his powers.

Mr. W. D. Cruickshank considered the Railway Commissioners the most abused men in New South Wales, and they had been so ever since they had taken office. They were constantly having all sorts of schemes laid before them, and they were not justified in making tests of all of them, but he was confident that they wished to obtain the best brake for their rolling stock. They were not personally acquainted with the author, and did not know that he (the author) was one of the leading engineers in the colony. If they had known, there was no doubt that they would have given this invention greater consideration.

On the questions being put to the meeting, Nos. 1, 3 and 4 were answered in the affirmative, and No. 2 in the negative.

Mr. N. Selfe, in reply to Mr. Shellshear's remarks, stated that that gentleman was evidently misled, as many others were, because he (the speaker) had not laid sufficient stress upon its being a single pipe brake. He had found that the Westinghouse brake often leaked off in two minutes, and that it was to provide against such contingencies that the second pipe was added to his brake. As regarded Mr. List's brake, he thought that in many respects it was a practical one, but having to stand the rough wear and tear on a train it must be placed in the same category as others. He wished it to be understood that the remarks made in his paper regarding the Railway Commissioners were not the result of any personal feeling, but he thought that the official who had to deal with the matter might have treated him more courteously.