debate was to a very large extent due to the accident at Peat's Ferry, as they could not drive away the fact that it was this accident, and it alone, about which they were talking in the main. Members of the Association would, he thought, admit that, despite Mr. Selfe's statements to the contrary, the question of the accident was dealt with, and, in a great measure he might almost say, exclusively dealt with, in the paper. However much members might try to lead themselves into the belief that they were discussing the brake question from a broad standpoint, it was patent to everyone that the Peat's Ferry accident was uppermost in their minds as the cause of that accident, and the public discussion and comment which it had been the means of eliciting was beyond doubt the reason why the discussion on Mr. Selfe's paper had extended for so lengthened a period; and it was also the reason why the members of the Association took so much interest in it. To show that Mr. Selfe, in reading his paper, had to all intents and purposes dealt with the question, he proceeded to read several extracts from the paper. He thought that there was not the slightest necessity to quote extensively from scientific papers, which had been in a measure dealt with by previous speakers, but he would like to draw our attention to the report written by Mr. J. E. Harrison, engineer for the North-Eastern Railway Company in England, to his directors, expressing himself in very forcible language.

He would call our attention to the fact that the Tebay line, a portion of the road upon which Mr. Harrison was engaged, was the steepest grade in England, and when we took into consideration the report written by him after his extensive experience and experiments on that line, he failed to see that with such a report as this, coupled with many other similar reports, how we could arrive at any other conclusion than that the Westinghouse brake was the safest for passenger or goods traffic. In concluding his remarks, he would note the last extract he had read from Mr. Selfe's paper, in which he stated that there was a liability to go wrong in several ways, and to which he alluded. Many did go wrong beyond doubt; but we were told in the press what it was that went wrong, and from all the records he could find, dealing with the question of brakes, he had been unable to find a theory laid down based upon the principle of *exhaustion*. While he admitted that there was a possibility under certain circumstances to exhaust the air out of the small receiver, he maintained it was not possible to do so by working the brake fairly, with ordinary care, or with ordinary intelligence, and he maintained that any man who was placed in such a position—to have control of the brakes of a locomotive engine and train—who would be guilty of such negligence as to wilfully pump the air out of the receiver and wreck his train, he would be just as guilty as though he had run his engine into the stops at a station with 130 lbs. pressure on his cylinder. This was the point he wished us to clearly understand, and although he had had the opportunity of witnessing various experiments with the Westinghouse brake, he could not arrive at any other conclusion than he had stated, viz., it was impossible, with ordinary intelligence, with ordinary care, and that it was not possible, unless some tricky movements of the valve were resorted to, to extract the air from the receiver.

Mr. Fischer said that it was not his intention to discuss the merits or demerits of the Westinghouse and Vacuum brakes, either as compared with the Hanscom brake or amongst themselves, but he rose to correct an omission on the part of Mr. Selfe, which might possibly lead some of the members to the erroneous conclusion that, besides the railway brakes just mentioned, there was not at least one other brake worthy of consideration. That Mr. Selfe was not aware of the existence of the brake to which he was about to refer was hardly credible, as it had been exhibited at the Inventions Exhibition held in London in 1885, and during Mr. Selfe's recent visit to England. This gentleman's paper being (judging by its title) supposed to deal with railway brakes generally, he found it necessary, in common fairness, to supplement his paper. He referred to the "Heberlein Automatic Friction Brake." The time allowed to speakers to-night being necessarily limited, it would not be possible for him to give a full description of this brake, and should therefore refer those who took an interest in this subject to the *Engineer* of April 2nd, 1886, where a full explanation of its working, as well as diagrams, would be found, and from which he proposed to quote hereafter.

This brake belonged to the class of chain brakes, which Mr. Selfe (after informing us of his own failure to design a satisfactory apparatus of this description), summed up as follows:—"*Since then the author has paid no attention to chain brakes, although there are several varieties that have had their day, but they are fast becoming things of the past.*" Now this assertion was not warranted in the face of the opinion expressed by the Jury of the Inventions Exhibition, who had placed the Heberlein brake on exactly the same footing as the Westinghouse and Vacuum, viz., they awarded a gold medal to each of them, and of which brake the writer in the *Engineer* said:—"That through the improvemenls made since the introduction of the Heberlein, it has been converted from a very bad brake into a *very good one.*"

The Heberlein brake had all the good points of the air brakes (even including the Hanscom), while it had at least two additional features to its advantage over the others:—(1) It had no pump or ejector, which could get out of repair, the brake being actuated by the momentum of the train; and (2) It was not an absolute necessity to have all the vehicles of a train fitted with air pipes to make the brake act through to the last vehicle, which was generally a guard's van; but vehicles with or without brake appliance could be mixed up at will, and by simply passing a spare length of rope over them, the brake could be actuated from any part of the train.

The Heberlein Brake could be applied to any degree desired, put on or taken off as often as the driver thought fit, and could be graduated to a nicety, so as not to inconvenience passengers, without exhausting the motive power; for the reason that while the train was in motion the motive power was at hand.

As to relative cost, he was of opinion that the Heberlein apparatus could be fitted for about half the money of any other automatic brake known.

The Heberlein brake had been adopted for all the Prussian subsidiary lines, and was also in use (among others) on the following railways and light railways:—Jura-Berne-Lucerne, Swedish States, Bahia and San Francisco, Gefle-dala, Harz-Mountain, Saronno-Como, La-Sarthe, Kiel-Flensburg, Saxon States, Orel-Witepsk, La Guayra and Caracas, Brunswick, Java, Oldenburg, Puerto-Cabello and Valencia, Mecklenburg-Southern, Arezzo-Fossato, and in England on the Colne Valley Railway.

A few more quotations from the *Engineer* might be justified, as illustrating the use of this brake on a very heavy line. Mr. James Livesey, engineer-in-chief of the La Guayra and Caracas line, writes:—"For a distance of nearly 20 miles there is a continuous gradient of 1 in 27, with a succession of curves and reverse curves of 130 feet radius from one end of the line to the other." The trains on this line are fitted and worked with the Heberlein brake.

On the Prussian State railways about 3000 miles of line were either open for traffic or under construction, on which the Heberlein brake was in use or to be used exclusively as the normal brake.

Mr. Selfe, in his concluding paragraph, said that:—"Up to the present time, it appears that for the goods traffic of the New South Wales railways, nothing has been submitted to the Government so cheap and effective as the Hanscom brake; and nothing that is in use at present for passenger trains can compare with it for cheapness and efficiency, if consideration is given to first cost, the comfort of passengers, and security of working;" to which he would like to add, *that before any brake was adopted for the goods traffic on the N.S.W. railways, careful enquiry into the merits of the Heberlein brake should be made*, and he did not hesitate in saying, that for this particular work, the "Heberlein" would beat any of the other known railway brakes.

Mr. H. W. Kerle remarked that there was one point which had been brought forward very prominently (that was the exhaustion theory), whilst everything else had been left out in the cold. The question of merit in brakes did not lie in one particular point.

The real question was which was the best on the whole. He had no doubt that the Westinghouse brake could be exhausted. Any machine designed to do certain work could only perform or carry out that particular kind of work, and if it were improperly used or applied it must lose its effect. They were shown a sketch or diagram on the previous evening explaining how the Westinghouse brake would act on a falling grade, and that, after a certain number of applications, the pressure in the reservoir could be reduced very considerably; in fact, it could be reduced so low as to be useless. But that was a one-sided diagram altogether. There was nothing shown as to when or how long the applications were made, or whether they were allowed time to recoup themselves after the brake was taken off. Taking the Hanscom brake in this particular instance of descending grades, there was no doubt but it could be more advantageously used than the Westinghouse brakes as at present fitted. Respecting the Vacuum brake, it would have been a very good thing on Mr. Adams' part if he had shown how the brake would have acted, especially if it were applied in an ordinary case. As Mr. Jones remarked, the question of leakage could be taken as being much about the same. Mr. Selfe stated in his paper that the brakes were known to leak after being in use for three months.

Mr. Selfe: That is one brake—a single brake.

Mr. Kerle continued: Well, that might apply in both instances. If a train were descending a long grade, and the Vacuum brake were applied at the top of the hill, the brake would be graduated more or less as required; but in the event of the packing rings being out of order in any way, as there was more or less of atmospheric pressure on the under side of the piston—the reservoir on the top side being in vacuum—there would be a leak. Now if this leak was of a serious nature we should lose the vacuum on the top side, and the brake would be useless. The speaker then proceeded to deal with the stopping of trains with the different brakes, and said the time the Hanscom brake took to pull up was about three times longer than the Westinghouse brake, and therefore it was very much inferior in that respect.

He also said that there was nothing in the Hanscom brake or in the Vacuum brake to disconnect it in the case of anything going wrong. For instance, in the event of one of the joints breaking between the train pipe and the cylinder there was no cock of any description with which to disconnect the cylinder from the whole of the train. The result was that the whole of the brakes were rendered inoperative. These things were absolutely necessary, because, in the event of a slight accident or a leak being found in any of the cylinders, it would be necessary to disconnect one of those sets of brakes. They did not want to disconnect the train, especially if it were going down the side of a mountain. Again, in speaking of the Westinghouse brake, as regarded the triple valve, which was considered to be a very complicated matter, he thought they should look to results. They had seen the reports of the Board of Trade—which were doubtless authentic—and by reading those returns members could actually see what occurred. He had examined the triple valve, and he did not think there was much in it to get out of gear. It might possibly get out of order when fitted on a train, but then it would only be one of the valves, and of course not the whole of them. If a train was improperly fitted with brakes, then an accident might be expected, and it would occur with anything. In speaking of the Vacuum brake, there was another matter to be taken into consideration—that was the excessive waste of steam, as at the time when a person wished to apply the whole of his steam he must use his ejector to take his brakes off. That was a great defect. He concluded by saying that it should be proved conclusively, by open trials, which was the best brake for passenger and for goods traffic. It was far better to have open trials, and let the public have the best brake, than to have them mixed up.

Mr. J. Laing then rose to ask the President if he would give his statement respecting the trials of the Westinghouse brake, as he knew the members of the Association wished to hear it.

The President said he was quite prepared to give the statement. He also informed the members that the remarks in the paper he would read simply included the opinion of Mr. Pollock and himself; the gentlemen present could take them for what they were worth. He then read the following paper:—

PARTICULARS OF TRIALS OF THE WESTINGHOUSE BRAKE,

Conducted in the presence of Mr. Robert Pollock and myself, on Saturday, the 3rd of September, 1887.

The train consisted of engine, tender, and seven carriages. Five of the carriages were fitted with the Westinghouse brake, also the tender; the other two cars being added to make up the required weight.

WEIGHT OF TRAIN.

	Tons.	Cwts.	Qrs.
Engine and Tender	59	5	2
No. 40 Carriage	16	10	0
„ 63 „	16	10	0
„ 65 „	16	10	0
„ 191 „	16	14	0
„ 10 „	6	10	0
„ 99 „	16	8	1
„ 117 „	16	2	0
	164	9	3
Total weight of train	164	9	3

SIZE OF SMALL RESERVOIRS.

No. of Carriage.	Description.	Length in Inches.	Dia. in Inches.	Contents in Cubic Inches.
191	2nd Class A type	22½	11½	2337
40	1st Class A type	29½	11½	3064
65	Compo. A type	29½	11½	3064
63	1st Class A type	22½	11½	2337
10	Compo. 4-wheeled	20½	9½	1453

SIZE OF BRAKE CYLINDERS.

All 10 in. diameter and 12 in. stroke except No. 10, which was 8 in. diameter and 12 in. stroke.

STROKE OF BRAKE PISTONS.

No. 40	had a Stroke of	$7\frac{1}{2}$	Inches.
,, 63	,, ,,	$7\frac{1}{4}$	,,
,, 65	,, ,,	$7\frac{1}{4}$	,,
,, 191	,, ,,	$6\frac{1}{4}$	,,
,, 10	,, ,,	7	,,
	5)	35.25	inches.
		7.05	inches.

MEAN STROKE 7.05 INCHES.

In one of the Carriages were fitted four (4) gauges, the pipes being connected as follows :—

One to Main Reservoir.
,, ,, Brake Pipe.
,, Small Reservoir.
,, Brake Cylinder.

There was also an indicator and pressure guage connected to small reservoir, which very clearly recorded the variations of pressure in reservoir, the number of applications of the brake, also the time during which it was applied. On the engine, or rather on the tender, were two gauges—one from small reservoir end, one from brake pipe.

Mr. Pollock was on the engine, and noted all the necessary particulars relating to the steam pressure in boiler, speed of donkey pump, pressure on air guages, etc., while I remained on carriage watching the variations of pressure, etc., on the respective guages. I may mention that the size of donkey pump is—steam cylinder, 6 in. dia. and 9 in. stroke; air cylinder, $6\frac{1}{2}$ in. and 9 in.

The train left Redfern about 9.45 a.m., and went as far as Thornleigh, where all the trials were made. The grade was about 1 in 45, and the average time of each trial was from three to four minutes, and the distance run from two to three miles.

FIRST TRIAL

Pressure in main reservoir	... ...	80 lbs. per square inch.
,, main brake pipe	... ...	70 lbs. ,, ,,
,, small reservoir	... ...	70 lbs. ,, ,,
,, brake cylinder	... ...	0 lbs. ,, ,,
,, indicator gauge	... ...	76 lbs. ,, ,,

Time of trial, three minutes--approximately; thirteen applications of the brake; donkey going full speed (about 60 revs.); 133 lbs. steam on locomotive guage; brake piston pressure ranged from zero to 36 lbs., while the pressure in the small reservoirs was reduced from 70 lbs. to 5 lbs.; the pressure in the main reservoir remained almost constant, the first application bringing it down to 70 lbs., but afterwards it went up, and remained quite steady at 75 lbs.; so that when all the small reservoirs were practically exhausted there was a pressure of 75 lbs. in the main reservoir.

SECOND TRIAL.

This trial was very similar to the first, but perhaps it may be desirable to state the exact conditions.

Pressure in main reservoir	...	...	87 lbs. per square inch.	
" main brake pipe	...	...	70 lbs. "	"
" small reservoir	...	...	70 lbs. "	"
" brake cylinder	...	...	0 lbs. "	"
" indicator gauge	...	...	70 lbs. "	"

Time of trial, three minutes fifteen seconds; then whistled for hand brakes, and forty-five seconds afterwards came to a dead stop. Total time, four minutes. Fifteen applications of the brake. No. 99 carriage taken off; donkey going half speed; 137 lbs. steam on locomotive gauge. During trial the pressure in the brake cylinder ranged from zero to 35 lbs. The pressure in small reservoirs was reduced from 70 lbs. to 5 lbs. in less than three minutes. The main reservoir pressure ranged from 87 lbs. at start to 50 lbs. at finish; that is, when the small reservoirs were practically empty the gauge on main reservoir showed a pressure of 50 lbs. per square inch.*

THIRD TRIAL.

Ran over the same ground, but under different conditions. In this case all the air brakes were disconnected, excepting on tender and one carriage cock shut behind, and the couplings disconnected, also all the other brakes off. Came down same grade in 2½ minutes, and only used the air brake on tender

* NOTE.—The variation in main reservoir (87 to 50) was due to the fact of the donkey going half speed.