

MR. PREECE thought, after what had been said in the Paper, that it was scarcely necessary to allude again to the advantages of employing electricity as a means of intercommunication in trains. He probably looked upon electricity with a prejudiced eye; but he regarded it as only yet in its infancy, and he believed it would be used for railway purposes to a far greater extent than at present. His impression was (and it was one which had been almost unanimously arrived at by those who had investigated the subject in France and in England) that if the question of intercommunication in trains was to be solved at all, it would be by means of electricity. It was an old subject, and there were several methods by which it could be applied. The conditions laid down for a perfect system of communication in trains were these:—first, there must be a means of communication between the guard and the driver; secondly, between one guard and another; and, thirdly, between passengers and guards. Those were the three great questions left to electricians to solve, and which had not as yet been accomplished by mechanical means. The difficulties had been increased from the circumstance, that all this must be effected with one wire. Taking a train as composed of an engine, two vans—one at the front and one at the rear—and any number of carriages, and supposing a wire to be extended along the train from end to end, it was required that the passengers in any portion of the train should be able to ring the bells on the engine and in the vans. There were several ways of effecting this. The first was by means of what was known as the open circuit, which was the ordinary method by which telegraphs were worked. A battery was inserted in any portion of the circuit, the current flowed through it and set all the bells on the wire ringing. To effect this every carriage, van, and engine, would have to carry its own independent battery. That was, however, an inadmissible condition; and was, therefore, condemnatory of the use of the open circuit in trains. The next means of solving the question was the closed circuit. By this plan a battery, either on the engine or the leading van, maintained a constant current through the wire, which would be stopped by the rupture of the wire at any point, and thereby the machinery would be set in action; but there was this difficulty, that if the current were interrupted by necessity or accident, or even in detaching a carriage from the train at a junction or station, all the bells would ring and a false alarm would be raised. The open and the close circuits were therefore equally objectionable. The next method suggested was that which was usually called the balanced current system. It was this:—if a wire (Fig. 9) extended along the train as before, and a battery were placed at one end, one pole being attached to the train wire and the other to the earth or a second wire, and if a battery were similarly placed at the other end B,

with its similar poles attached to the train wire, then there would be a tendency on the part of those two batteries to send currents in opposite directions, and if those two currents were equal in tension, an equilibrium would be established in that wire, and no current would pass through it; but if the wire were connected to the earth wire at C, then the currents would flow in the direction shown by the arrows, and the bells placed at A and B would be set ringing. There was this objection to the balanced current system, that there must be a battery at each end of the train, and those two batteries must be equal in tension, and must be kept opposed to each other with similar poles, and if any reversal of the vans took place, or an extra van was inserted during the progress of the train, the whole arrangement was put out; unless, indeed, certain switches or commutators were provided to compensate for the disturbance. The use of switches was objectionable, because they were liable to be neglected or put out of order by the guards; and if there happened to be one or more vans in the middle of the train, the two end batteries were overworked in a long journey, while the middle battery expended very little force, and the balance was therefore overthrown. The system he had introduced was a novel application of electricity to this purpose. He called it electric equilibrium. It entirely avoided the use of switches, and threw upon each battery an equal amount of work. If a wire or conductor A (Fig. 10) was taken, and one pole of a battery Z applied to it, the other pole being attached to the earth, the wire acquired the tension of that pole. In the same way, if A were a pipe or hollow tube with closed ends, placed in connection with the steam chest of a boiler, it would be filled with steam of the same pressure. Again, if the similar pole of another equal battery was applied under the same conditions to another conductor B, this wire would also be charged to the same tension. Similarly with C and D, and indeed with any number of conductors, all would be charged to the same tension if the batteries were equal; and, therefore, if they were all connected together to form one conductor like the train wire, Fig. 2, no variation would occur; they would all be equally charged, the wire would be in a state of equilibrium or equipotential, and any disturbance of this equilibrium would result in the flow of currents. If, now, at any spot C, say a passenger carriage, this equilibrium were destroyed, by placing the train-wire in connection with that leading to the earth or return wire, a current would circulate which would be maintained by currents flowing from each battery that would set its own bell ringing, or the indicator on the engine moving. Thus a train might be composed of any number of vans and carriages, placed in any position, and yet the bells could be rung from any spot without the necessity

of compensating for any change or renewal. There had hitherto been a difficulty in meeting the wants of a train which was broken up into sections in its transit and brought together again on its return, and he believed the only remedy was that of electric equilibrium. In place of employing a second wire to allow the current to return to its source, use was made of the metals on the line, which were placed in connection with the commutator. Every van—not every carriage—contained its battery and bell.

With reference to the breaking of the glass face in the instrument, by means of which the attention of the guard was called by the passengers, Mr. Preece showed that a very slight blow was sufficient to break the glass and give access to the ring or handle, which had to be pulled to give the signal. External signals were of use only in cases of false alarm, and then only in the day-time. For economy, as well as for other reasons, he had abandoned the use of external signals, and confined himself to the means of raising the alarm within the carriages themselves.

A most important feature of his system was the arrangement for communication between the guards. He might mention that this apparatus had been applied on the South Western, the Midland, and the Great Northern Railways. It had travelled over 500,000 miles, but during the whole of that time there had never been occasion to attract the attention of the guards. He hoped eventually to substitute for the 'look out' signal the blowing of the steam-whistle.

Mr. J. J. ALLPORT remarked, that he had been associated with most of the leading railway managers of the kingdom, on every Committee appointed by the Railway Companies to investigate this subject, in 1852, 1853, 1864, and 1865, and the experiments were still being carried on. He was not at present in a position to give a decided opinion, either upon Mr. Preece's, or any other system. He sat on the Committees in 1864 and 1865, when upwards of three hundred plans were brought forward by different inventors, and, he was sorry to say, with very little practical result. He was inclined to adhere to the opinion, which had been frequently expressed, about the extreme delicacy and want of uniform action of electricity for the purposes sought to be obtained. On the Midland Railway two trains had been fitted with Mr. Preece's apparatus, and occasionally it got out of order. On one occasion the whole of the bells were set ringing without apparent cause, and could not be stopped. The apparatus had been at work since last April till recently, but was never of any practical use to the passengers, and it was now discontinued. It was stated in the Paper that the rope-and-bell system had been adopted and abandoned on the Midland Railway. That was not the case.

Mr. PREECE said, he only alluded to the experiment of the rope and bell between passengers and guard; it was still continued between guard and driver.

Mr. ALLPORT went on to remark, that the rope and bell was early adopted on the Midland, London and North Western, and other lines. It was still in operation in almost every Midland train, and had been so for the last ten or a dozen years, but in no single instance, out of the hundreds of thousands of trains run in that period, could he recollect that it had been found of any practical benefit. It so happened that the week before last a carriage sheet caught fire between Bedford and Hitchin. On that occasion the ordinary passenger engine became disabled at Wellingborough, and a goods engine, which was there at the time, was attached to the train; but there were no means of attaching the rope and bell to the goods engine. On the sheet taking fire the guard attracted the attention of the driver by putting on the break, and the train was stopped within the distance of half a mile. He mentioned this to show how easy it was for the guard to call the attention of the driver. He was aware that a strong feeling existed on the part of the public to have communication between passengers and guards. It had engrossed the attention of managers for several years, but he was not prepared to say they had arrived at a solution of the problem. The experiments would be continued, and if any satisfactory invention could be applied, if it were simply to satisfy the public mind, railway companies would adopt it at once. But anything which required delicate manipulation, like electricity, and was so seldom required, would, he feared, be found out of order, when wanted. Like everything else out of use, it was generally useless when required. For instance, at many private houses and establishments where fire-engines were kept, possibly unused for years, a fire took place, when it was found either that the hose was rotten, or the valves were out of order, or the engine could not work, and so the premises were burnt down. So it would probably be with this electrical machinery, when required it would be "found wanting." But at the same time, if some simple and efficient means could be devised, railway companies would be glad to adopt it. He could understand that on the London and South Western it had worked well for two years. Mr. Preece himself was connected with it. If it were properly attended to, and watched after the running of every train, and all the parts looked to, the apparatus might remain in order; but in the routine of the ordinary staff of a railway, these matters were not generally attended to, more especially when for periods of three or four years together, it was never required to be put into practice.

Mr. EDMUND TATTERSALL said, at an early period of his life he had suggested the simple plan of the rope and bell, which Mr. Allport

had referred to as a means of communication between guards and drivers, but he did not imagine that the system would ever be allowed by the railway managers to be extended as between passengers and guards, although he always thought it necessary. He had considerable difficulty in getting the plan tried, but it was now carried out on nearly every line, and the Great Northern paid a small sum for the use of it for two years. It occurred to him that it was a disgrace to the present age, that mechanical talent could not invent some contrivance by which the desired means of communication could be obtained. He believed it to be quite possible, and he expected that it would shortly be carried out. Having been a competitor with Mr. Preece, he was ready to pay tribute to the ingenuity of the system described in the Paper, as far as he was capable of judging, not being an electrician, and to the zeal and ability with which the subject had been prosecuted. Mr. Tattersall had had similar facilities afforded to him by the Directors and Manager of the South Western Railway for carrying out experiments on their rolling stock; but his plan was reported to have failed in one particular when tried. He thought that Mr. Preece's system did not place the means of signalling sufficiently within the reach of all the passengers; but still he was ready to admit, having seen it in operation, that it possessed great merits. A similar system had, he believed, been prepared and tried by Mr. Woodfield.

Mr. ALLPORT remarked that he had tried Mr. Tattersall's plan at least a hundred times during the journey from London to Derby, both in cuttings and on embankments, and with the train going fast and slow, and in every possible position, and he had failed in every instance to attract the attention of the guard. Mr. Tattersall was in error in speaking of the present system of communication between the guard and the driver as his own. An examination would convince him of his mistake.

Mr. F. J. BRAMWELL understood Mr. Preece to have drawn a distinction between the system of opposing currents and that system which he called equilibrium currents. He had gathered, from Mr. Preece's explanation of the diagram of the "opposing current" system, that there was employed at each end of the train a battery, and that the similar poles of those batteries were connected by the wire which extended from one end of the train to the other, whilst the opposite poles of the batteries were connected to earth. That this being the condition of things, no action took place until in some one of the carriages a connection was also made between the continuous wire and earth, and that then both batteries came into play. It was said there were objections to this system. The diagram which exhibited the equilibrium system showed, as Mr. Bramwell understood it and its explanation by Mr. Preece, a battery in

every vehicle of the train, all the batteries having their similar poles coupled by a wire extending the whole length of the train, and their opposite poles all connected to earth; and it was stated that when in any carriage a communication was made between the connecting wire and earth, the batteries would go to work. From the subsequent explanation, however, and from the diagram, it appeared that the practice was not to put a battery in each vehicle, but merely in the various break-vans which might be expected to be detached with sections of the train at junctions; and that in a train which was not to be broken up into sections one battery only was used at each end of the train. With this condition of things he had failed to understand what it was that constituted the difference between the opposing system of currents and the equilibrium system, and fearing that others might have experienced the same difficulty, he thought he might be doing service by asking for an explanation.

Mr. N. BEARDMORE wished to ask, whether it was the fact that the train might be broken up at random, or whether there must always be a guard's van with a battery introduced to place the train in circuit: in other words, whether the tail of a train might be detached, and 'foreign' stock be joined on without failure of the apparatus.

Mr. S. A. VARLEY was desirous of explaining an electrical plan of train intercommunication, which had been fitted to the Royal Train on the London and North Western Railway, and which, in addition to experimental trips, had worked successfully on four journeys to Scotland and back.

The value of the telegraph, as an auxiliary in railway signalling, was now generally admitted; its application to train-signalling was a further development in the same direction. A railway train was in fact a section of the railway. Mr. Martin had, therefore, considered, that the system adopted should be assimilated, as much as possible, to that which his long practical experience had led him to consider the best.

Railway telegraphs might be divided into two systems,—one in which an audible signal was employed to call attention to a permanent visible signal, and the other in which an audible signal alone was depended upon. At the head of the former stood the system which had been adopted on, and been most completely developed by, the London and North Western Railway. Mr. Martin's might be considered as the London and North Western system of block signalling, and Mr. Preece's as the South Western bell system, as applied to trains. Mr. Martin had not had the advantage of trying a large number of experiments; but the system he had adopted for raising an alarm was nearly identical with that put forward by Mr. Preece.

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Mr. Varley then proceeded to illustrate the working of the apparatus. In each compartment there was a lever-box, and when a passenger decided to raise an alarm, he pulled the lever handle, and in the act of doing so set the bells in all the vans ringing. To prevent repudiation of the signal, the lever when once pulled could not be replaced, until the guard came round and unlocked the box. So far the electrical arrangements of Mr. Martin's system were the same as Mr. Preece had lately adopted; but Mr. Martin's system did not stop here. The apparatus in each of the vans was furnished with three keys, on which were engraved "stop instantly," "stop at the next signal station" and "van bells." When the attention of the guards had been called, the guard in charge exercised his judgment whether to stop instantly or at the next signal station. Having decided, he depressed the key with the corresponding signal; the effect of this was to set a bell fixed on the weather-plate of the engine ringing, and also to deflect an indicator over to the signal legibly painted on a dial. After the guard had depressed the key by means of a peg, he kept it permanently depressed, and the engine-bell continued ringing, and the indicator to point to the signal, as long as the key was pegged down. When one of the guards wanted to call the attention of the rest, he depressed the key engraved "van bells," the effect of which was the same as when one of the lever-boxes was pulled. The advantages of Mr. Martin's system were, that an audible signal was used to give an alarm, and that the instructions were conveyed by permanent visible signals, about which there could be no misapprehension.

Mr. SPAGNOLETTI, in describing the action of a system of train-telegraphing introduced by him on the Great Western Railway, remarked that there were few matters connected with the working of railways more publicly discussed than that of communication between passengers and guards and drivers of trains. A railway company not only dealt with the carriage of goods, &c., but was intrusted with the safety of the passengers. It was, therefore, necessary that a question of this kind should receive every consideration at the hands of railway companies; and in such a matter he did not think public opinion could be altogether disregarded. Any system of train signalling to meet the present emergency must be simple, strong, certain in action, and economical. In working out the plan he had introduced, he had given these primary requirements every consideration. It had been argued, that train communication was so seldom brought into practical operation, and the chances of its being used were so few and far between, that when required, any mechanical or electrical appliances were liable to be out of order. To this it might be replied that, on the Great Western and other lines, several instru-

ments were employed, more intricate and delicate in their action, and not constructed with a view of such unfrequent usage, than that which he was about to describe; and no such contingency had arisen from their being seldom used, inasmuch as ordinary inspection was sufficient to keep them in proper working condition. It would be part of the guard's duty to test the apparatus before the train started, and if anything were wrong to report it, and to record any defects that might be noticed. In the system he had introduced there was an outside visible signal, as well as an electric signal. The apparatus he proposed to place in the passenger carriages was shown by a model which was described. It consisted, in each compartment, of a handle, placed over the carriage window, and secured by a pin with a chain attached; the object of the pin being to prevent the handle being moved by accident. To call the guard's attention, the pin had to be removed, and the handle to be turned, when a disc outside the carriage was brought into sight, and the bells in the guards' vans were rung by electricity, and if necessary a bell could also be rung on the engine, or a disc instrument could be placed on the engine, similar to that used on the Metropolitan Railway. The handle, when once turned, could only be replaced by the guard, who was provided with a key for the purpose. The coupling between the carriages was formed of an insulated wire cable, with a hook and eye at each end, so that whichever way the carriages might be turned, a connection could be made. The end of the cable was formed by the conducting wire running through a spiral wire. The spiral wire was stronger than the conducting wire, and the latter would be the first to break. In that case, any part of the train breaking away, the spiral wire would be pulled through the brass 'rose,' which was connected with the earth, and contact would be made by friction, which would give an indication to the guard that the train had broken away, and until the wire was removed, the bells would continue ringing. A small spring or plate was so placed in connection with the earth, that the hook resting on the spring would give notice to the guards if the train was not properly made up. There was another way of making the connection between the carriages, but as it did not come within the limits of economy so closely as the cable, he could not so strongly advocate it. This plan embraced an iron bar with a link at each end, to take the place of the present coupling chains, the electrical connection being effected by one link being tapped with a brass stud, to which a spiral wire was attached, so as to yield to the movement of the carriage; or by two springs pressing on it, so that contact was maintained by the wire under the carriage with the links at the other end of the carriage, and so on throughout the train. The end of the hook and eye was bossed with brass, so

that there was a brass contact, which was kept clean by the oscillation of the train.

In another plan of giving the alarm, the disc was placed at the end of the carriage. Any person turning the handle, pulled a wire, which was passed through the curtain-rods of the carriage windows; this drew the bolt from the disc, and then it fell down into the position for attracting attention. The wire, being studded with pieces of iron, formed the electrical conductor as well. By that plan one disc answered for each carriage, and the handle being locked, showed the compartment from which the alarm was given. For a night signal, the disc fell upon a fuse, which was lighted by percussive action; or the fuse could be lighted by a friction string. On the Great Western the fuse burnt with a bright red light, illuminating the whole of the train for seven minutes. He had already alluded to the impression that instruments of this kind, when not frequently used, were liable to get out of order. To guard against such a result, two springs were placed parallel to each other, and on the iron rod an oval collar was so fixed, that when the handle was turned down, both springs were opened; in turning the handle, not only was contact made, but the springs were scratched, so that if one spring failed, the other was sufficient for the work. To meet the case of the local and suburban trains on the Great Western, for which composite carriages were used with a break compartment, the apparatus was made portable, so that the guard had only to take out the box as he would any other article, and replace it when required for another journey, the handle alone being left in the carriage as a fixture. This electrical communication was worked on what was called the equilibrium system, with batteries at each end of the train. It could be worked either in that way or by a single battery on the engine, or front van, and the communication was not interrupted by the manipulations of the train on the journey, and any number of carriages, slip coaches, or other vehicles, could be added or taken off the train without disturbing the remaining portion. He thought the outside signal, in addition to the electrical one, was an advantage, for if the bells failed, the disc would show the guards or drivers that a signal had been given, and it would also attract the attention of the station-master or switchman at any station the train might run through; and in cases of danger a message could then be sent to the station in advance, and the train be stopped. Royal saloons always had an outside signal affixed as an extra precaution. In this system he had studied to make the apparatus as complete, simple, and economical as possible, and he thought the cost of it was little in excess of the rope-and-gong system, besides being more effective and cheaper to maintain, for there was great wear of the rope, and, as it must be of the best quality, it was expensive.

At present his system must be regarded as experimental, as it had been fitted only to one train of three carriages; but the success was satisfactory in every way.

In connection with this another experiment was being tried: this was a cage, invented by Mr. Baker, so as to enable the guard to go from one part of a train to another while in motion; and when an alarm was given, he could at once see from which carriage and from which compartment it was given, by the disc being turned. The cage ran outside, on the off-side of the train.<sup>1</sup>

Mr. C. V. WALKER said, as the Telegraphic Engineer to the South Eastern Railway Company, he had for many years carried out a simple and efficient system of train signalling from station to station, which he had had occasion to bring before the Institution, during a discussion upon a Paper which had been read a year or two back.<sup>2</sup> The same description of voltaic batteries and signal-bells, that were used in signal-stations, were now placed in the trains in the guards' vans; with a proper and simple addition to the bells and batteries, to prevent their being affected by the motion of the train, and with apparatus to meet certain other conditions of the system. The arrangement, which had worked so well for a number of years in signal-boxes, was found by experience to work equally well in trains in motion. It was a simple plan, and one easy to keep in order. In the first instance, various experiments (or trial trips) had been successfully made, of which the public had been informed by the newspapers from time to

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<sup>1</sup> Mr. W. J. Baker has since furnished the following particulars in reference to his Safety Cage, in which a guard can pass to any part of a train in motion, either in reply to an electric alarm, to make a periodical inspection of his train, or to collect the passengers' tickets, without stopping the train.

The 'Cage' consists of a strong framework of wrought iron, borne on grooved wheels which run between two parallel rails or guides, fixed for this purpose along the sides of the carriages, the upper rail being fastened to the outer edge of the roof, and the lower rail to the footboard or steps.

The couplings of the rails between the carriages are made to slide about twenty inches, to allow of the compression of the buffers, and have sufficient side play to prevent straining when the train is on a curve. The couplings are self detaching when the carriages are separated or 'slipped.'

A footplate, upon which the guard stands when he wishes to pass along the train, is fixed between the side-frames of the 'Cage,' and the outside is fenced in to prevent the guard from falling off: this fencing and the footplate are attached to the framework by joints or hinges, and can be folded close to the side of the guard's van or compartment when not in use.

To pass along the train, the guard takes his position on the footplate of the 'Cage,' facing the carriages, and pulls himself along by the handles or handrails of the carriages to any part of the train he requires to reach.

As the 'Cage' is kept folded by the side of the van when not in action, it is not available for improper or unauthorized use by any passenger, and the rails alone are of no service to afford a passage along the train.

<sup>2</sup> *Vide* Minutes of Proceedings, Inst. C.E., vol. xxii., p. 203, *et seq.*

time; and since the 12th of July, 1866, the system had been applied, by order of the Board of Directors, to the regular day mail trains between London and Dover,—namely, the 7.25 A.M. mail down, and the 3.45 P.M. mail up. These trains were regularly and permanently fitted with means of communication between passengers and guards, and guards and driver. Within the last few weeks, the same system had been applied to the 8.30 P.M. night down mail train, and the 4.30 A.M. up mail; and the requisite apparatus had been provided for an extension of the system to the other fast trains on the South Eastern line, in completion of the order made by the Board. He considered that simplicity was the chief recommendation of any plan of train-signalling; and that there was no greater difficulty in keeping an electrical system in order from end to end, in so short a circuit as a train, than there was between station and station, whether they were yards or miles apart. Hitherto the duty of coupling up the carriages had been performed by a telegraph clerk at each end of the line; but arrangements had now been completed for that work being done in the ordinary way by the shunters who made up the trains; and for this purpose detailed instructions had been issued.<sup>1</sup> A summary

1 SOUTH EASTERN RAILWAY.  
INTERCOMMUNICATION IN RAILWAY TRAINS,  
PASSENGERS AND GUARDS; GUARD AND GUARD; GUARDS AND DRIVER.

WALKER'S



PATENT.

INSTRUCTIONS TO GUARDS, DRIVERS, AND OTHERS.

1. The Guards will have charge of the Electric Couplings, each Guard having one Tender Coupling and at least ten Train Couplings, and a box to contain them.
2. The Shunter or Porter, who makes up the Train, will couple up the Tender to the Train, and the Carriages to each other, before starting; and a Shunter or Porter will also uncouple and return the Electric Couplings to the box at the end of the journey.
3. The Head Guard will be responsible for the proper coupling of his Train before starting; he must, also, at the end of the journey, see that the Electric Couplings are deposited in the box provided for the same.
4. The Driver, or whoever separates Engine from Tender, will uncouple; and will recouple when he replaces them.
5. Each Guard will have in his Van at least four coils of insulated wire, for use when unfitted Carriages are added to a fitted Train. The Shunter or Porter will lead the wire over the roof of the unfitted Carriage, and twist tightly the bare copper ends on the spiral connecting hooks of the next fitted Carriages.
6. The **Switch** in each Van is to be set and **bolted** by the GUARD himself, as soon as the Train is coupled up for a journey. The **Index** in the rear Van is in all cases to point **downward**. The Index in all **intermediate** Vans is in all cases to point **upward**.
7. The Index in the **front** Van is to point **direct** to the Engine, when the Engine is **fitted** up; or to point **downward**, when an **unfitted** Engine is in use.

of the trips made, from July 12th to November 30th, showed that, out of 244 journeys, in 237 the communication was perfect with both guards, and in the remaining 7 cases, with one guard; and of these 7, there were 4 cases in which the train was started without being fully fitted with the apparatus. This was given in illustration of the ease with which an electric system travelling in a train might be maintained. These were not experiments, but the records of its regular use; and it had been working as well or better to the

8. The **FRONT** Guard has sole control of Engine Signals. With the Index set as in Rule 6, Signals reach the Guards only. The front Guard will set the Index (still pointing in the direction of the Engine), in the first notch of the upper brass segment, when Signals are to reach the Driver. All Signals made in the Train will then reach the Engine, ringing the Bell, but not raising the Semaphore Arm.
9. To raise the Semaphore Arm and ring the Engine Bell continuously, the **front** Guard will set the Index pointing **direct** from the Engine to the **Train**. The Arm may also be raised, and Bell rung if the Index is pointed upward, or is set intermediate between these positions. These last two positions are rarely required.
10. As the Train pulls up at the end of its journey, or at a Junction where changes are made, all the Guards will set their Indexes pointing upward. The Index to be kept in this position as long as Vans are not actually working.
11. The following are Guards' Code Signals, to be repeated back, and made by pressing the Knob of the Ringing Key:—
 

<b>One</b> Blow on the Bell	... ..	<b>Danger.—Stop.</b>
<b>Two</b> " " "	... ..	<b>All clear, and Look out.</b>
<b>Three</b> " " "	... ..	<b>Testing Signal.</b>
12. The Driver will hear Signals and Replies; he, and also the Guards, will look out in all cases, and he will pull up only when the Semaphore Arm is raised.
13. The **HEAD** Guard, before the fitted Train starts, will see that no Outside Signal Disc is open. All Guards will have Keys for replacing Bell-pulls and closing Discs. Each Guard will have with him at least half a dozen spare Bell-pulls.
14. When a fitted Carriage travels in an unfitted Train, the Guard of that Train, before starting, will remove all the Bell-pulls into his Van and open the Discs; and will replace them at the end of the journey. The Bell-pulls will be numbered and lettered. Fitted Carriages, not in work, are to stand with Discs closed and Bell-pulls in.
15. Should a Passenger withdraw a Bell-pull, the Bells in the Guards' Vans will continue ringing till the Train stops, and an outside Signal Disc will open and indicate the compartment from which the Signal comes.
16. Should a Passenger Signal be made, the Guards will act on their instructions as to stopping the Train. The name and address to be taken, in full, of any one who makes a false or idle alarm; failing this, of all Passengers in the compartment.
- 17.—Should anything appear defective on the Engine, the Driver will report to the Guard. Should anything be defective in the Train or Engine, the Head Guard will report to the Telegraph Department at the journey's end, who will advise the Telegraph Engineer. The Guard will also enter it in his Report of the Journey. Guards will see that the wires and all apparatus in their trains are not tampered with; but they are not required to interfere with the batteries or wires.

(*By Order*) C. W. EBORALL,  
General Manager.

SUPERINTENDENT'S OFFICE,  
London Bridge November, 1866.

J. P. KNIGHT,  
Out-Door Superintendent.

present day. The connection of the apparatus with the engine was not fully effected quite so early: the arrangements were made, but the fitting was deferred till the passengers were provided for. From November 1st to the 30th, when the engines were fitted, there were 50 cases—that was to say, every case in which a fitted engine ran, in which the communication with the engine was perfect: in the remaining two cases unfitted engines were used. As an illustration of the behaviour of the apparatus on the engine itself,—in the case of one engine, the apparatus was applied and adjusted to its work on September 15th, and had not been touched or examined up to November 30th, having been in working order for eleven weeks without being attended to in any way, and had worked equally well since. The same was the case with another engine for eight weeks, and with a third for seven and a half weeks, these also still being at work. He mentioned this as an illustration, in reply to suggestions that had presented themselves, that it was not so difficult a matter as those unacquainted with the subject imagined, to keep the apparatus in perfect working order, under circumstances of such apparent difficulty. The trains were fitted for public use; but there had been no occasion to use it. There was a bell-pull in each compartment, over which a card was posted, containing the following instructions in three languages, English, French, and German:—

#### “ COMMUNICATION WITH GUARDS.

“When the Bell-pull is fully withdrawn, the Guards will be alarmed—will know whence the alarm comes—and will act on their instructions. If the Bell-pull is partially withdrawn, it shows a signal outside the carriage, which will attract attention at the next stopping place.

“Passengers cannot replace the Bell-pull; and they will be accountable for any false or unnecessary alarm.”

In one instance a passenger pulled the handle in a carriage (in which there was not a card of instructions), as the up-train was coming out of Merstham Tunnel, and the bells rung, as it was arranged they should ring, all the rest of the way to London. It was done by inadvertence, and out of mere curiosity; there was nothing to indicate the object of the bell-pull. This occurred only a few days after the train commenced running, and before the guards had received instructions how to act. The passenger was greatly alarmed, on the arrival of the train in London, when taxed with what he had done. To ascertain that the couplings of the carriages were properly made was a simple operation, requiring only the most ordinary care and attention on the part of those whose duty it was to attend to it. There was a spiral or twisted hook at each end of each carriage and van; it was 8 feet above the rails, and was connected with a wire that passed round the carriage under the eaves of the

roof. The coupling was a spring or spiral of brass wire, with a ring at each end, and enclosed, except the rings, in a tube of vulcanized rubber. The rings were put on the spiral carriage hooks, and the coupling was then complete. The engine was provided with a bell and semaphore. The bell could be rung either with or without raising the semaphore arm; in the former case, which was in the power alone of the head guard, the driver was required to pull up.

Mr. J. W. BAZALGETTE said, while admitting the ingenuity of the apparatus, it did not appear to him to strike at the root of the evil sought to be remedied—that was, the protection thus proposed to be afforded to passengers travelling by railways. To take the case of persons desiring to be protected against robbery or molestation in a carriage, it might be assumed, in the first instance, that the passenger intending to attack another would be possessed of the greater physical strength, and all he had to do was to place himself in front of the party he designed to attack, and prevent him giving an alarm by the signals. Then again, on the other hand, mischievously-disposed persons might stop a train unnecessarily, and do a great deal of injury. He would ask those who had practically considered the subject to say, how the difficulties to which he had alluded could be overcome, so as to make these means of communication of that practical use to the public, in cases of danger, which alone would justify any reliance on them.

Mr. J. P. KNIGHT (Traffic Superintendent of the South Eastern Railway), said that Mr. Walker had to a considerable extent explained the details of the system of signalling in trains adopted on the South Eastern line as far as regarded the telegraph department. He would, therefore, confine his remarks to the operation of the system as regarded the traffic department. Mr. Walker had fitted this apparatus to between forty and fifty carriages, and to about five engines; and he would shortly hand over those trains entirely to the traffic department; he would then be relieved of his present responsibility with regard to the fittings and the coupling up of the trains, and the uncoupling at the end of the journeys. Instructions had been issued to the guards (pp. 102 and 103), embodying every detail necessary for carrying out the system efficiently. Copies of these instructions, mounted and framed, were posted in every guard's van; and, from the experience already gathered, he was quite sure, there would be no difficulty in the working of the communication. The guards would have the charge of the electrical couplings, which were stowed in the boxes in the vans at the end of the journey; and, besides the guards, the shunters, who coupled the trains before starting, would be responsible for the couplings being properly attached. The present provision, which the South Eastern Company had in work, furnished

the passengers with the means of giving an alarm to the guards, and thence from the guards to the driver to stop the train. The moral and deterrent effects of such a provision were not to be disregarded, although, in cases of assault, it might not always be available.

The regulations referred to were now in force, and a copy of them was posted in each guard's van. Special instructions were issued as to the general circumstances under which a train should be stopped. There were parts of the line where it was inexpedient to stop a train—for instance, near a tunnel, or when approaching a station; but still no risk would be incurred by an unexpected stoppage between stations, as the South Eastern line was throughout its entire length worked on the block system.

Mr. BEARDMORE said, the question was whether, with the experience of the working of the system, the thing was worth the expense and trouble of providing it.

Mr. KNIGHT replied that the results were satisfactory, or the company would not go to the expense of extending the system to other trains. It was, by order of the Board, about to be applied to the tidal trains, and it would no doubt in due time be extended to the principal express trains. He could not say that it would be applied to the omnibus or local trains, where the stoppages were so frequent, and for which a different class of carriage was employed. In the latter case it was very rare that a passenger was alone, or with only one other passenger in a compartment in the neighbourhood of London. It was not proposed to apply the system to other trains than those going long distances without stopping, such as the ones before alluded to. He thought the public would feel a great degree of satisfaction with these arrangements. They would know that there were means at their command to give an alarm if occasion arose. It might very seldom occur. Indeed, in six months there had been only one instance of an alarm given on the South Eastern Railway, and that was by a soldier; but the guard, after having ascertained that it was an uncalled-for alarm, exercised a wise discretion, and did not stop the train.

Captain H. W. TYLER would first address himself to the *cui bono* question, which was at the root of the whole matter. If there was no practical utility in this sort of apparatus, it was certainly not desirable to go to the expense of providing it. He considered the object was not to prevent persons from being suddenly knocked on the head. No apparatus whatever could altogether prevent such a crime as that from being committed. It might as well be expected to organize a system of telegraph from each foot-passenger in Great George Street to the nearest policeman, to prevent his being garotted. Nor was it practicable, with the existing form of carriage, altogether to prevent the possibility of insult or assault by the strong upon the weak, or to do more than provide

a deterrent influence in such cases. The principal object to be attained, in establishing intercommunication in trains, was to provide against danger to the public in cases of carriages catching fire or leaving the rails, or an axle or a tire breaking, or any of those other occurrences which, though they might not often happen, were always attended with considerable danger. He thought the subject might be simplified by dividing railway traffic under two heads, omnibus traffic and express traffic. The cellular system, which had been chiefly adopted in this country—from the old stage-coach—in the construction of railway carriages, and which had been continued over a great part of the Continent, was, in some respects, most unfortunate. It answered comparatively well for those trains which made frequent stoppages; and it possessed advantages in the interests of the companies for omnibus traffic, as the greatest number of people could be loaded into each carriage. By the use of side doors the passengers could get in and out with rapidity; and three different classes of passengers could be accommodated in the same vehicle. But the cellular system was not so well adapted for trains which ran long distances and made few stoppages. In those trains passengers were not so closely packed, or so frequently changed; and it was in those trains that a means of communication with the servants of the companies was more particularly required. Those trains were formerly run with the same carriages as the ordinary trains, but, latterly, railway companies had wisely adopted carriages of superior construction for the long-distance and non-stopping trains; and he thought it unfortunate that a different system of internal division had not at the same time been adopted. A passenger travelled from Charing Cross to Dover, a distance of 88 miles, or from Chester to Holyhead, a distance of 84 miles, or from Euston to Rugby, a distance of  $82\frac{1}{2}$  miles, without stopping, not knowing, when he started, who might be his companion for two hours, or what might happen in the carriage, or to the carriage, in the course of those two hours during which he was to be without any means of communication with the outer world. He need not go over the many instances that had happened to show the want of communication, but he would specially refer to four. The first case which drew attention prominently to the subject was one which occurred on the Midland Railway, in 1847, to Lady Zetland, whose carriage was set on fire by a spark from the engine. And the latest illustration had also been provided on the Midland Railway, where a train caught fire in which he believed Mr. Allport was travelling. He was informed that was only a day or two after Mr. Allport had said how easy it was to stop the Midland trains, and how little necessary it was to adopt any better system of signalling in trains. The two other cases to which he referred occurred to Members of this Institution, and both on the Great

Western Railway, in March, 1865. On the 21st of that month Sir Charles Fox was travelling up from South Wales with a brother engineer: he was suddenly awoke, at half-past three o'clock in the morning, near Goring, by the fracture of the tire of the wheel over which he was sitting. The passengers in the other compartments of the carriage joined with him in a vain chorus of shouting. The front guard was unaware of what had happened, and heard nothing. But a guard in the fifth, and another guard in the seventh and last carriage, felt a shock from running over portions of the tire or wheel upon the rails. They vainly endeavoured, for 6 miles, to attract the engine-driver's attention by waving their hand-lamps, and by suddenly applying and releasing their breaks, though they heard nothing of the shouts of the passengers. The engine-driver thought the train went heavily through the Pangbourne cutting, and gave his reversing lever another notch, under the belief that the wind was strong against him. Looking round afterwards to ascertain whether all was right, he could see nothing wrong with any of the carriages, and was only induced at length to pull up by noticing the hand-lamp of one of the guards. On the 24th of the same month Mr. Baker, the Engineer-in-Chief of the London and North Western Railway, travelled with his wife and a fellow of Trinity College, Cambridge, in the same carriage from Leamington to London. The train was composed, when they left Reading, of an engine and tender, a break-van, and four carriages. They rode in a composite carriage behind the leading van. An axle of that carriage gave way shortly after the train left Reading, and they were bumped and jolted along for the whole distance of 34 miles to London in that condition. The different passengers in the carriage waved hats, coats, rugs, and handkerchiefs out of the windows, swung the doors backwards and forwards, shouted, and did all they could to attract attention. Mr. Ransford, who rode in the last compartment of the same carriage, shook his handkerchief, as he said, frantically in a signalman's face, as he passed him. But the signalman saw nothing wrong. Mr. Baker's arm was broken by being struck against a signal-post at the side of the line in the course of his exertions to attract attention, and Mr. Ransford's hand was severely injured in the same manner. But neither the engine-driver, nor the two guards, nor the numerous switchmen whom they passed, became aware of anything being wrong. Fortunately, it was only as the train entered the Paddington station that the carriage left the rails, and no further injury, beyond a severe shock to the nerves of the passengers, was sustained. It would, however, be worth while to read the description of Mr. Baker's feelings on that occasion, as given by him when he took his evidence officially after the accident. Mr. Baker said: "We had thus upwards of half an hour of awful

suspense, during which we expected every moment to be dashed to pieces; and I may add, that I most seriously regretted the absence of any means of communication with the guard, so that he might stop the train and release us from our perilous position." The question was, then, whether passengers being at all times liable—though they were, he admitted, of comparatively rare occurrence—to accidents of this description, it was not worth while to provide some apparatus to be used in case of need by the passengers for those trains which ran long distances without stopping? He thought, himself, that the running of such trains without some provision of this sort was indefensible, and his opinion was confirmed by the higher authority of the report of the Sub-Committee of General Managers, who reported on this subject from the Clearing House in March, 1865. Mr. Forbes was the Chairman, and Mr. Allport, Mr. Seymour Clarke, Mr. Cawkwell, Mr. Eborall, Mr. Grierson, Mr. Moseley, and Mr. Archibald Scott were Members of that Sub-Committee. They stated in their Report as follows:—"The Sub-Committee is, however, of opinion, that it is desirable, if practicable, to give passengers by express or other trains running for a considerable distance without stopping, the means, in cases of emergency, of attracting the attention of the guard, and of enabling him to stop the train at the next station or under the protection of the next fixed signals; and they recommend that no effort should be spared on the part of the Railway Companies to attain this object, it being borne in mind that, in order to give the public the full advantage of the communication upon the long through trains, many of which traverse several lines of railway, it is absolutely necessary that all the Companies should adopt the same plan." That was the deliberate opinion of the eminent railway managers whose names he had mentioned, and he thought that it at once disposed of the *cui bono* question. It being held, then, on such high authority, that it was desirable to adopt some means of communication in trains, the next question was, which was the best means of effecting it? He had examined great numbers of inventions of different descriptions, and had come to the conclusion that the voltaic current was, upon the whole, the best means that could be employed. Mr. Preece was early in the field, and deserved all praise for the labour and attention he had given to the subject. Captain Tyler feared, for some time, that there would be no rivals, as other electricians were so long coming forward. He was happy to find there were now others in the field equally eager to adopt something of their own, and he hoped, out of this array of electrical science, some bright sparks would yet be evolved. The experience in this country of this matter was, as yet, limited to what had been done on the South Western, the South Eastern, the Great Western, and a few other lines; but the experience

which had been obtained in France extended over a much greater area and a longer period. The only difficulty, but the most important problem in all voltaic apparatus for this purpose was, the mode of coupling between the carriages. That which was exhibited by Mr. Preece had received ample trial on the Northern Railway of France, and had been used with such success, that the French Government had invited all the railway companies to adopt the same system. It was now in use on almost all the lines in that country, as a means of communication between guards and drivers. It had worked so satisfactorily for that purpose, that the system was being further adopted for the use of the passengers.

There were many who considered it was better to enable the passengers to communicate with the guards only, and not with the engine-drivers. But he thought it more important, on the other hand, that the passenger should be able at once, when anything was wrong, to attract the attention of the engine-driver. It was the driver only who had, and must have, the control of the train while it was in motion. And it was of extreme importance, in the case of such an occurrence as the breaking of an axle or a tire, or of a carriage leaving the rails, that the driver should have the earliest possible intimation, so as to enable him to act according to the best of his judgment. It did not, by any means, follow that whenever a passenger made a signal the train was to be immediately brought to a stand. It was not always expedient to stop a train suddenly. Such a course would, under some circumstances, be attended with the worst consequences. But when the attention of the driver was awakened to any mishap, he would shut off the steam, and slacken the speed suddenly or gradually, as appeared to him best, so as eventually to stop the train in the manner best suited to each particular case. Absolute perfection could not be expected in this, any more than in any other apparatus. Neither the engines nor the carriages were perfect; but that was no reason for not using them. All that could be expected was, that it should be reasonably good, and that system could only be adopted which appeared to be best adapted to the object in view.

But, after all, the question of communicating between different parts of a train while in motion was, in his opinion, less important than that of circulation; and when he spoke previously of the construction of express-train carriages, he could not but feel, that if means of passing through the trains from end to end on these long journeys were available, much of the evil that at present existed would at once be avoided. It was principally in consequence of the want of the means of circulation, that so much apparatus of communication was required. There were two ways of providing circulation in a train—external and internal. The limited space that existed on many of the railways between the

carriages and the works at the side of the line rendered external circulation out of the question. He had expected to hear something more of the cage, about which Mr. Spagnoletti had spoken as a means of external circulation. But after having gone carefully into that subject, he had found that there was, in many cases, no room between the sides of the carriages and the works not only for a cage or a protected passage, but even for a man to pass with safety. And even if there were sufficient space, he thought that such a means of circulation would prove to be highly objectionable in this country, for several reasons. It would afford opportunity for access from one part of a train to another to persons by whom passengers would not wish to be visited, and this would be particularly objectionable in night trains. Few passengers would sleep comfortably if they knew there was a gallery outside along which villains might travel, and the passage by which could not be effectually controlled at all parts of the journey. The murderer of M. Poinsoit was believed to have entered the carriage and escaped from it along the footboards. In the case of internal circulation, it would, on the other hand, be easy to provide against improper intrusion. The guards of the train would themselves circulate safely, would control the passengers effectually, and would be able to afford any relief that might be required. The practical question was this:— Was it possible and desirable in those trains which only stopped at long intervals to adopt some means of communication between the passengers and the servants of the companies? He did not hesitate to answer that question in the affirmative, and to add, that circulation was even more required than mere communication. He thought also, it would be a great benefit if, in connection with improved carriages adapted for through-circulation, sleeping accommodation were provided in the night trains between England and Scotland, and between London and Holyhead. When he was in Italy, considering the question of the Italian route for the Eastern mails, he proposed to the Government officers and the officers of the railways to provide sleeping-carriages for the long journey through that country. He was at first met with the remark, that the English, the most enterprising people in Europe, and the foremost in railway improvement, had, as yet, provided no good means for sleeping in trains. But the Italian government afterwards consented to supply sleeping-carriages for the journey with the Indian mails to Brindisi at moderate charges. He submitted that on long night journeys like those from London to Edinburgh, or to Aberdeen, it would be a great boon to travellers to be able to sleep comfortably on the road. They could do so on American, Indian, and Russian railways; and the French sleeping *coupés*, at an extra charge, were much in request. But in that respect we were at present woefully behindhand; and he thought it a subject worthy

the attention of railway managers, in connection with that of providing communication and circulation in railway trains, with carriages better adapted as regarded convenience and safety for long journeys.

Mr. J. W. BAZALGETTE said, no doubt all would admit, that it was desirable to have communication in trains between guards and passengers; but at the same time, it must be allowed, that the system of signals at present provided, or recommended, did not secure the personal safety of the passengers in case of sudden attack. The causes which gave rise to these inventions were not trains catching fire, as such instances were the exception, but the more common danger to unprotected passengers. There could be no question it was to provide for the personal safety of the passengers that these inventions were first proposed; and he submitted, if that object was not effectually secured, these inventions were up to this time failures. He thought it most desirable that attention should be directed towards providing against the more common sources of danger, rather than the exceptional ones, so that the public might not be resting their safety, in cases of emergency, upon a broken reed.

Mr. T. E. HARRISON, as one of the original Committee, to whom it was remitted by the authorities of the Clearing House to report on the subject of communication between guards and drivers and between passengers and drivers, would state that that Committee came to the conclusion, after the examination of a great number of plans, to adopt that which had been generally in use ever since as a means of communication between guards and drivers, the simple rope and bell, worked by the guard from his van. It had been said that was an expensive plan, but he did not regard it as such; it was simply a question of wear and tear of rope; and the pounds, shillings, and pence part of the question was an exceedingly small one. As a means of communication between guards and drivers, he believed it to be by far the simplest and most effective that could be adopted, and infinitely preferable to electric communication. He might state that the apparatus by which this mode of communication was now carried out was identical with a model submitted to that Committee fifteen years ago, by Mr. Fletcher of the North Eastern Railway, under his directions; the model of the bell being made at the Great Northern Railway Company's shops. This was afterwards used on the Great Northern and other lines. When the report, drafted by Captain Huish, was submitted, Mr. Harrison urged upon the Committee that, instead of the rope being carried on a level with the foot-boards of the carriages, it should be passed along the roofs of the carriages, so that any person could easily get hold of the rope from the inside of the carriage, and communicate direct with the driver. The opinion, however, entertained by the

Committee at that time was, that it was not desirable to have direct means of communication between the passengers and the driver, and for that reason, the rope had been used ever since by being passed along at the level of the footboards. Travelling so much as he did, he had met with a great number of casualties. He had been in several collisions; engines had run off the line, and on one occasion he had travelled with a madman; and he did not believe in any of those cases the communication between the passengers and the drivers would have been of the slightest use. He agreed with Captain Tyler that in cases of accident it was more important for the passenger to be able to communicate with the driver direct than with the guard, because the communication to the former ought to be as instantaneous as possible; but he believed the cases in which such communication might be useful were chiefly confined to those which had been mentioned,—fire, and the breaking of an axle or tire. During the fifteen years that the rope-and-bell system had been in use on the east coast, only two or three instances occurred in which it was found to be of any use at all—one being in a case of fire. He thought any elaborate system of communication between passengers and guards to meet any imaginary cases, such as those of robbery or murder, would be utterly and totally useless; and if only attention were paid to cases of fire, the breaking of an axle, or any casualty occurring to the carriage, that provision would practically be made for all those cases for which it was necessary. He believed, if it was desirable to effect communication between passengers and the engine-man, instead of all these elaborate arrangements, which might not always act when wanted, it might be done by following out the simple rope-and-bell communication, as it was now in use, the rope being carried along the roofs of the carriages, instead of at the level of the footboards. He was afraid railway companies were going to a large expense in fitting electric apparatus to the trains, and in his opinion a great amount of ingenuity had been exercised in providing for an evil which did not exist.

Mr. W. H. PREECE, in reply upon the discussion said, he had inquired of various railway companies the cost of carrying out the rope communication between guard and driver; and he found that on the Great Northern, a length of 42 miles of rope was consumed in ten months, at a cost of £187; in addition to which men were employed to look after it. He believed the cost for this bell-and-rope communication on the Great Northern lines was not less than £500 per annum; and he had no hesitation in saying that his electric system could be maintained on that line at considerably less cost.

He would not enter into the *cui bono* question, because that did not form part of his Paper, but, passing to the discussion in [1866-67. N.S.]

general, he might observe that the electric system of communication he had brought forward was not an experimental one. It was now a pure matter of fact, inasmuch as it had been practically carried out on the South Western Railway for more than two years, had been in use on the Midland for seven months, and also on the Great Northern Railway Companies' trains to Inverness for more than eight months. The general result was, as far as the question of carrying out the means of communication between passengers and guards, guards and guards, and guards and drivers by means of electricity was concerned, that it was a comparatively simple and economical matter. Neither its first cost, nor the cost of maintenance was great; in fact, on the whole working of a railway, there was no part of the general management which was likely to cause so little trouble or expense as an electric communication between passengers and guards. Mr. Allport stated that this system had been worked on the Midland line and had been abandoned. It was arranged by the Committee of Managers that they should select the most promising system and try it. The Great Northern and Midland took up this system, and trains were fitted with the apparatus, but not under his control. They ran for six or seven months entirely out of his control, and to the present moment he could not get a report from the Midland as to the results of the working. He believed, however, that during the six months the apparatus was in working, it got out of order only three times; and that it was eventually abandoned, not from the failure of the apparatus, but from the difficulty of keeping a few exceptional carriages together upon such a large system as that of the Midland. He thought any system, mechanical or otherwise, that would continue in perfect order for that period without attention, must be regarded as thoroughly practical and efficient. It had been mentioned that, on one occasion, the bells started ringing and could not be stopped till the train reached London. That might be true; but he pointed to it as one of the safeguards of the system, because in the ordinary rope-and-bell system, if the rope became deranged in time of danger, no alarm could be given. In his system, however, if anything went wrong with the apparatus it gave tongue at once, and it was obliged to be put in order before it could be silenced. It was admitted that the system worked well on the South Western, although after completing the experiments but little personal attention had been given to it. The whole thing had been handed over to the Traffic Department under Mr. Archibald Scott. If the system worked well on one line, there was no reason why it should not work well on every line.

It had been asked of what use was the apparatus, seeing it was so seldom used? But it must be recollected that before a system of this kind had been established there was a succession of occur-

rences which awakened the mind of the public to the necessity of providing as far as possible against their repetition—and since then there had been nothing of the kind. It must therefore be conceded that at all events, the introduction of the system had had some deterrent effect. It would, of course, be preferable that no necessity should ever arise for calling the apparatus into action, and he believed the deterrent effect was one of the greatest evidences that could be produced of its efficiency. The several systems alluded to during the discussion were all modifications of the principle he had propounded, the system of electric equilibrium; but with, what he considered, needless accessories.

He would say, in conclusion, as a practical electrician, although he might give a prejudiced opinion, he saw no difficulty whatever in carrying out this, or any electrical, system. He did not think the public, the press, or parliament would be contented without something of the kind. He had, however, simply performed his duty as an Engineer to those who had employed him, and had endeavoured to mould that force of Nature with which he was best acquainted to carry out those requirements which he had been called upon to fulfil.

Mr. C. H. GREGORY, V.P., in closing the discussion, remarked that Mr. Preece, a very able electrical Engineer, had evidently devoted considerable attention to the subject he had brought forward; and the system he had worked out for establishing communication between passengers and guards appeared to have succeeded on the South Western Railway. However, one slight failure had occurred in the apparatus erected in the room, and worked by the able and careful hands of Mr. Preece himself; and it would probably occur to those present, that if certainty of action could not be secured under such favourable circumstances, failures would be still more likely to occur when the connections had to be made in actual practice on railways by the rougher hands of railway porters. He had no wish to disparage the beautiful mechanism that had been brought before them; but he thought it was a serious question, whether any apparatus, however ingenious, whose delicacy rendered it liable to failure, might not by giving false confidence be a cause of danger at the critical moment. As far as experience went at present, it seemed that any such system was rarely called into operation, and its functions would appear to be mainly to deter people from crimes in railway trains. But, assuming efficiency in the details of any system, the practical question would still remain, whether its adoption was necessary and generally desirable? What he might say on this question was so much better expressed in the Report of the Sub-Committee of the Railway Clearing-House in 1865, that he would read the portion of that Report preceding the extract which had been given by Captain

Tyler, and which more fully conveyed the views of the Committee on the general question submitted to their consideration. It was as follows:—

“ 12. Upon the more important question as to whether in the interest of the public safety the means of communicating with the guards should be placed at the disposal of the passengers, the following extract from the Report of 1853 expresses so accurately the objections to such an arrangement that this Sub-Committee cannot do better than give it a place in this Report. It is as follows:—‘ When discussing and weighing the inferences naturally deducible from the facts and information which it had collected, the Committee gave its attention, in the first instance, to the important question of giving to passengers the power of communicating with the guard. Without overlooking the possibility of such an arrangement being occasionally of service, the Committee have been unable to persuade themselves that it would not lead to greater disasters than it could, on any view of the matter, prevent. Unless the guards and engine-drivers had orders to stop the train whenever a passenger made a signal, the privilege would be useless to the latter. It however requires little acquaintance with railway travelling to be convinced that its dangers would be greatly increased if the train were to be stopped wherever and whenever a passenger, under the influence of fear or levity, chose to make a signal.’

“ 13. The views expressed by the Clearing House Committee in 1853 were adopted by the French Railway Commission of 1861. That Commission was composed of many eminent men, among whom were members of the French Government and Legislature, and engineers of the highest standing, and it was presided over by M. Michel Chevalier. These gentlemen, appointed by the government conducted an inquiry upon a matter as to which the public feeling was strongly moved by the murder of M. Poinso, and not in any way interested in the question as regarded either the convenience, cost, or responsibility of the Railway Companies, felt it their duty from the very first to discard all idea of giving the passenger any power of communication, and they reported as the result of their inquiry into this subject, that such a communication would involve greater danger than advantage. The members of the present Sub-Committee, having given the matter much attention, and having anxiously endeavoured to find some efficient plan for effecting a communication between passenger and guard, are not able to come to a conclusion essentially different from that resulting from the preceding inquiries both in England and France. Nor can they satisfy themselves that this communication is generally desirable or could safely be allowed, except in very special cases, and then only under a stringent law controlling its use by the public. The fact of it being practically impossible that a guard, upon receiving a signal from a passenger, can go at once to the assistance of that passenger, materially limits the use and value of such a communication, for not even the most strenuous advocates for furnishing it can contemplate that the guard in charge of a train should, upon receiving a signal, and without being in a position to judge as to the urgency of the case, then and there stop the train. The inconvenience and positive danger resulting from such a course are too obvious to need further comment.

“ 14. Upon a general review of the information and facts obtained by the present inquiry, the Sub-Committee is obliged to report that none of the means of communication submitted to it are, in their present condition, such as could be relied upon and recommended for general adoption, and that in no case would it be desirable, even if possible, to establish a means of external communication by footboards.”

He had thought it due to the Committee, as none of them were

present to speak for themselves, that their general conclusions should be recorded, and these conclusions would be entitled to consideration as coming from some of the leading managers of railways. Whatever might be the views of the Meeting on the general question, he believed all would agree that Mr. Preece's Paper was an interesting and valuable one, and had well earned the thanks of the Institution.

Mr. W. H. BARLOW asked permission to read a short extract from a note he had received from Mr. Allport on the subject of the rope-and-bell system of communicating in trains. Mr. Allport wrote :

“ Prior to 1858, the cord and bell had been tried upon four trains ; and in October of that year the system was applied to all the passenger engines, carriages, horse-boxes, vans, &c., at a total cost of nearly £1,500. The communication has been in operation on 575 trains daily since 1858, or 189,139 trains yearly ; and during the whole period it has been used only three times. In one case a fire occurred in the train, which, however, the driver had observed before his attention had been called by the guard. The second case was merely a hot axle. The other was the breaking down of a carriage, which happened close to a station where the train had to stop. So that in eight years, with upwards of 1,500,000 trains, it had only been twice useful.”

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