LONDON PASSENGER TRANSPORT BOARD.

MINISTRY OF TRANSPORT,
Metropole Buildings,
Northumberland Avenue,
London, W.C.2.
22nd July, 1938.

SIR,

I have the honour to report for the information of the Minister of Transport, in accordance with the Order dated 17th May, 1938, the result of my Inquiry into the accident which took place near Charing Cross station on the electrified "District" line of the London Passenger Transport Board, at about 9.55 a.m. on that day.

Shortly after leaving Charing Cross an east-bound Circle train (No. 59) collided with the rear of an Ealing-Barking train (No. 21) which was standing at a signal in the tunnel about midway between Charing Cross and Temple stations; the speed of the Circle train was about 20 miles an hour. Telescoping took place between two cars at the rear of the Barking train; the rearmost mounted the underframe of the car in front of it, penetrating its body for about 15 ft., and rising till its top was in contact with the tunnel roof girders. The damage to the rolling stock is described later.

The Barking train was crowded, and the Circle train was comparatively lightly loaded. I regret to report that six passengers were killed, or died in hospital shortly after the accident, while 43 passengers and two of the trainmen received injuries, or complained of shock at the time; one of the Board's officers received electrical burns shortly after the accident. Hospital treatment was necessary in 33 cases, and 14 of the injured were detained overnight; the number still in hospital a week later was seven.

The accident came about through a "false-clear" signal indication, rendered possible by a wrong connexion made during the previous night, in the course of minor alterations to wiring.

II.—*Rescue arrangements.*

2. There was no avoidable delay in rendering assistance. Attention was given to the injured by a doctor and a nurse who were among the passengers, and doctors from Westminster and Charing Cross Hospitals reached the scene quickly. Assistance was also given by ambulance workers among the Board's staff, and from the St. John Ambulance Association. Some of the Board's senior officers reached the spot within 20 minutes of the accident, and the breakdown gang arrived from Wood Green at 10.30 a.m. The Fire Brigade also attended promptly, and gave great assistance in the rescue work.

The first of the injured passengers reached Charing Cross Hospital at 10.30 a.m., 35 minutes after the accident. But owing to the difficulties inseparable from work in a constricted space, with makeshift illumination, the work of freeing some of the passengers entrapped by the telescoping was slow. Not only had the steel side panelling of the cars to be cut away, but the car of which the top was in contact with the tunnel roof had to be raised still further with jacks, crushing in its top, to free passengers pinned below its underframe; as a result the last of the injured was not released until about 12.30 p.m.

Current was not cut off from the conductor rails immediately after the collision. Consequently the lights in the trains continued to burn, except in the two telescoped coaches, and the passengers remained calm. At 10.20 a.m. the current was cut off on the westbound line, to facilitate the work of the rescuers. Unfortunately a portion of the steel panelling of one of the damaged coaches accidentally fell, or was knocked, into contact with a conductor rail of the east-bound line at about 10.23 a.m. Violent and alarming arcing, sustained for several seconds, resulted from this short circuit, and the current on that line was accordingly cut off at once. The interruption of the current put a stop to arrangements which had been made to move a continuous line of trains up to the site of the accident, on the westbound line from Temple station and on the eastbound line from Charing Cross, in order that passengers might reach those stations without walking along the track. This, and the consequent extinction of the lights in the trains, delayed detrainment of the uninjured passengers which was not completed until about 11.0 a.m.

III.—*Description of site and signalling.*

3. As shown on the attached plan, the accident took place on the eastbound line between Charing Cross and Temple stations, about 307 yards east of the former. The line between the two stations is level, and lies in tunnel, or more accurately in cut-and-cover; there are two ventilation openings which admit daylight to the line a short distance east of Charing Cross station. The point of collision was in the tunnel, about 73 ft. beyond the easternmost of these, and is approached by an eastbound train round a right-hand curve of 20 chains radius.

At the point where the collision took place the positive conductor rail lies between the side wall and the running rails, on both lines; the negative rails lie centrally between the running rails. Both are insulated, the pressure between them being 600 volts; in normal conditions the positive rail is about 450 volts above, and the negative about 150 volts below earth potential. Damage to the track was limited to a slight displacement of the positive rail, and the breakage of a few of the insulators on which it is supported. This established a connection between the positive and earth, with the result that in the section concerned the negative potential fell to 600 volts below earth.

Apparatus is provided whereby the conductor rails can be made "dead" in an emergency. For this purpose there is a pair of bare wires for each line, carried on insulators on the side walls at a suitable height; if these are connected or pressed together a circuit breaker in the substation opens automatically, cutting off current from the corresponding section of line, eastbound or westbound. On the eastbound line the section concerned extends from Charing Cross station (exclusive) to Mansion House, and on the westbound line from Mansion House to Charing Cross station (inclusive); these are fed from a substation at Charing Cross.

4. A brief description of the signalling arrangements is given on the plan. All the stop signals are equipped with train stops; should a train pass a signal at Red, a trip cock on the leading vehicle is opened by contact with the arm of the train stop, causing an emergency brake application. The clearance points for the signals, that is to say the points beyond which the whole of a train must travel before they can clear from Red to Green, are shown on the plan. In addition, the controls are so arranged that a stop signal will not clear after the passage of a train unless the train stop at the next signal ahead has risen to the operative position, and apparatus is provided at several points on the line to prove that the trip cocks on passing trains are ready for action.

The whole of the signalling apparatus is so designed that any failure in its operation will be in the direction of safety. As an example, interruption of the current supply to the track circuits or to the various relays, caused by a broken wire, will cause the signals to remain at Red, even though the line ahead may be clear; similarly the train stop arms are lowered electrically but rise to the operative position by gravity, or by spring action, in the event of current failure.

Signal cabin EH at Charing Cross is only opened when it is desired to use the crossover there for the reversal of trains. It contains a locking frame of 10 levers, of which one (No. 8) is used as a king lever. There is mechanical interlocking between the levers, which are of normal size; control of the relays which operate the signals and train stops is effected by circuit breakers, or rotary switches, behind the levers, and connected to them by rodding. When the cabin is open the levers of the running signals have to be worked for each train passing. To close the cabin, the running signal levers are first pulled over, and then the king lever, the last operation altering the electrical connections so that the signals can work automatically; it was closed when the accident occurred.

There is an illuminated diagram in the cabin indicating whether the track circuits in its neighbourhood are occupied or not, on which the indications of the running signals are repeated.

IV.—*Description of Trains.*

5. Both trains were composed of the open bogie stock with longitudinal and cross seats ordinarily in use on the Board's lines, the cars having sliding side doors, windows at the ends as well as at the sides, and glazed end doors for passage along the train in emergency. There were six cars in the leading

train (No. 21) and five, originally the property of the Metropolitan Railway, in the overtaking train (No. 59). The former had a tare weight of 169·2 tons and the latter of 152·7 tons; the overall lengths were 300 ft. 4 ins. and 263 ft. 5 ins. respectively. All the cars were equipped with the Westinghouse quick-acting brake, the brake percentage varying between 80 per cent. and 85 per cent. on train 21, and between 79 per cent. and 87 per cent. on train 59. The trains had central buffing and drawgear, the couplers on train 21 being of the vertical plane side locking type which has been in use for many years on the District Railway, while train 59 had Buckeye couplers, as used on the former Metropolitan line. Each car had in addition a wide buffer, or rubbing block, above the coupler, and just below the threshold plates of the end doors; these rubbing blocks are alternately sprung and "dead."

Particulars of the cars are given in the following table:—

Car No.	*Weight tons*	*Age years*	*Underframe.*	*Body.*
Train No. 21 (stationary).				
4337 (m)	33·9	9	Steel	Steel.
1047	20·8	33	Steel and Wood	Wood frame, Steel panels.
4129 (m)	33·6	24	Steel	Steel.
8023	23·9	6	Steel	Steel.
8760	23·8	33	Steel and Wood	Wood frame, Steel panels.
4028 (m)	33·2	26	Steel	Steel.
* *	Point of Impact		* *	
Train No. 59 (overtaking).				
2564 (m)	46·7	15	Steel	Wood frame, Steel panels.
9564	21·8	17	do.	do.
6542	22·7	33	do.	do.
9556	21·8	17	do.	do.
2573 (m)	39·7	15	do.	do.

The motor cars are shown thus (m).

6. There was no emergency (battery) lighting in the trains, present practice on the Board's sub-surface lines differing in this respect from that on the deep level tube lines. A lighted hand lamp is carried by each motorman and guard, and in each car there is a candle lamp for use in emergency, fixed in a fairly prominent position. There is also a fire extinguisher in every car, and steps for descent to the track are kept in each motorman's compartment. The trains carry a single oil tail lamp of the usual pattern; on the "District" stock of which train 21 was composed this lamp is fixed on the right hand side of the end door, as viewed from the rear.

V.—Damage to rolling stock.

7. In train 21 the chief damage was sustained by the two rear cars. No. 4028 had the motorman's compartment at its rear end crushed in, its floor being forced up and buckled as a result of serious distortion of the headstock; the guard was travelling in this compartment. At the leading end of this car the steel bodywork was very badly crumpled and distorted for about 3 ft. in forcing its way through car No. 8760 in front, the underframe of which it over-rode; portions of the roof of No. 8760 were driven through the end windows of No. 4028, on each side of the central gangway, penetrating for about 15 ft. The leading bogie of No. 4028 was forced back about 9 ft. when the overriding took place, carrying away some of the gear below the car floor; one pair of its wheels left the rails, this being the only derailment caused by the collision.

The rear 15 ft. or thereabouts of the body of car No. 8760 was wrecked by the penetration into it of the underframe and body of No. 4028, its own underframe being bent downwards. The two telescoped cars kept substantially in line, and there was no serious fouling of the westbound track. As mentioned earlier, the operation of tearing away the steel side panelling of No. 8760 from the wood body framing on the accessible side, in order that the passengers might be released, was a lengthy one.

The greater part of the energy of the impact was evidently expended in telescoping these two cars, for the train as a whole was only driven forward for some 35 ft. although it was standing with the brakes released, and the damage to the front four cars was not serious. No. 4129 had both headstocks slightly bent, causing the floor to rise a little at the ends, jamming one of the end doors. The side and end windows, and the transverse draught screens, were broken where the telescoping took place, and also at the rear end of car No. 4028, but otherwise the only breakage of glass occurred in the leading car, where one draught screen was smashed; there was no jamming of the side doors except in cars 4028 and 8760.

8. In train 59 the structural damage was trifling by comparison. At the leading end of car No. 2564 the underframe was bent downwards slightly and the motorman's compartment was wrecked, the end panelling of the car breaking away from the roof and being tilted backwards; the motorman had a fortunate escape. At the rear end of this car and at the leading end of No. 9564 the headstocks were bent, the floor of No. 2564 being lifted sufficiently to jam the end door; the side doors of this car were also partially jammed. Elsewhere in the train the damage was confined to breakage of glass in the transverse draught screens and the end doors and windows, caused by passengers being thrown into contact with them. This extended throughout the train, none of the cars being free from it; in all 16 draught screens, one end fixed window, and one end door window were found to be broken, besides those in the motorman's compartment. A few side windows were cracked, and one was intentionally broken after the accident.

Report.

VI.—*False signal indication.*

9. It will be convenient to deal first with the circumstances which brought about the "false-clear" indication of signal EH.9, situated at the eastern end of Charing Cross station. The collision and the events immediately preceding it, and the subsequent short circuit and arcing, are dealt with later.

Until recently direct current was used for the track circuits and associated apparatus on the District line. Modern practice favours the use of alternating current for this purpose, as it has been found that under certain abnormal conditions direct current apparatus may be affected by stray currents from the traction system. A change to alternating current is being made by degrees in the interests of safety, and the apparatus at Charing Cross had been altered a few days before the accident, on the night 7th-8th May, when a new relay room was brought into use. Such work has to be done during the comparatively short period when trains are not running, between 1 a.m. and 5 a.m., and in consequence much remained to be done in the way of tidying and cleating the new cables; it was in this tidying process that a wrong electrical connexion was made during the night before the accident.

10. The circuit breaker worked by No. 9 lever has six terminals, three above and three below the rotating spindle by which the contacts are opened and closed; a sketch of it is included on the accompanying plan. If correctly wired, the three terminals in the bottom row should have connected to them one wire, two wires, and one wire, in that order from left to right; one of the two wires on the centre terminal is a connexion from the adjacent circuit breaker of No. 8 lever. When an examination of the wiring was made shortly after the accident by the Chief and Assistant Signal Engineers, Messrs. Every and Dell, they found that the wire from No. 8 circuit breaker was attached to the right hand bottom terminal of No. 9, instead of to the centre one next to it.

The effect of this transposition was to provide an alternative path, only available with the king lever (No. 8) reversed, for the current energising the relay by which signal EH.9 is cleared from Red to Green. Normally this current cannot flow unless two other relays, connected with track circuit H and with track circuits G and GG, are energised, which can only happen if those three track circuits are unoccupied. But the alternative path accidentally provided bridged the contacts of the relay connected with track circuits G and GG; in consequence, signal EH.9, though correctly turning to Red when a train leaving Charing Cross

entered track circuit H, would clear to Green as soon as it left that track circuit, instead of remaining at Red while the train traversed track circuits G and GG, that is to say until it had passed within the protection of the next signal ahead, No. 823.

It will be appreciated under these abnormal conditions signal EH.9 would clear with signal 823 still at Green, and hence before the train stop at that signal had risen. The control of signal EH.9 by which this is prevented in ordinary circumstances is effected by means of the relay of track circuit GG, the contacts of which had been bridged by the wrong connexion, and hence this safety arrangement was rendered ineffective.

11. At my request a watch was kept upon the running of trains between Charing Cross and Temple stations for an hour, covering the time of the accident, on 23rd May; 32 trains passed during this period. It was found that signal EH.9 remained at Red for periods varying between 37 and 59 seconds behind departing trains, some of which were checked or stopped at signal 823. Track circuit H was occupied for periods varying between 11 and 28 seconds, the average being 17¾ seconds; this corresponds to the duration of the Red indication of signal EH.9 with the wiring wrongly connected. Comparisons of the times for each train show that before the accident the signal must have been clearing to Green about 30 seconds earlier than it should have done, on the average.

12. When the change-over from direct to alternating current took place on 7th-8th May the signal controls were tested, and found to be correct, by Chief Signal Inspector F. Baker, and therefore the mistake in the connexions of No. 9 circuit breaker must have been made subsequently. The first occasion on which the circuit breaker wiring was touched after the change-over was during the night before the accident, when a gang of 24 men, under the charge of Chief Lineman A. G. Beer, was working at and near Charing Cross; only one of these men, Signal Installer E. Eeles, was employed in the cabin, the rest being engaged in altering the position of signal and telephone cables at various points between Temple and Westminster stations.

Chief Lineman Beer had held that post for four months; he was formerly a power-signal lineman for three years, previous to which he had four years' experience as a lineman-installer. He had been in charge of the alteration of the signalling system at Charing Cross since it started, seven or eight weeks before the accident, but had not previously supervised work of a similar nature. According to his statement, the work in progress along the line, which entailed cutting cables and jointing them after they had been shifted to their new positions, needed constant supervision, especially as the men engaged on it had not worked under him for long. Eeles, on the other hand, had been with him since the Charing Cross alterations began; he did not hesitate to allow him to continue the work of tidying up the relay room and cabin wiring without supervision, for he had been so engaged, with satisfactory results, for several nights, and had been employed in running the new wiring previously. He knew in general what Eeles would be doing during the night for he was in the cabin with him when he started work at about 1.0 a.m., and he was aware that he would have to deal with the connexions of the circuit breakers as well as with others belonging to the illuminated diagram. He did not think that Eeles could possibly make a mistake for the new wiring was all labelled and, in the case of a wire from No. 8 circuit breaker to No. 9 which had to be replaced, there was the existing temporary connexion to guide him. He looked on Eeles as a thoroughly reliable worker, and had never thought it necessary to warn him that a mistake in reconnecting wires was possible if more than one terminal was unscrewed at a time.

Beer said that when the cable work was finished for the night, towards 5.0 a.m., he went into the cabin and was told by Eeles that everything was correct there. The latter then left the cabin, and he followed him, to make sure that no tools had been left foul of the line and so forth, and that all was in order for the first train of the day to pass. He was aware of the Signal Department rule that a test must invariably be made after any alteration, and had been present when Chief Inspector Baker made such a test after the change-over, nine days previously. But in spite of this he did not make a test of the signal controls as a check upon Eeles' work; he admitted that he ought to have done so, but said

that it did not occur to him that Eeles might have made a mistake in the straightforward work which he had been doing. He agreed that such a test would have been a simple matter, not taking more than a few minutes, and that even without a test he could have seen that signal EH.9 was clearing prematurely if he had remained in the cabin watching the track circuit and signal indications on the illuminated diagram as the first train went by. He was not in any hurry to get away from Charing Cross, and in fact stayed there while several trains passed, seeing that all tools had been returned, and that all his men were out of the tunnels.

13. Signal Installer Eeles, who had been employed by the Board for 12 months, stated that he had helped to instal the new wiring, and that when the change-over took place he made a number of the connexions, the wires having been previously labelled for him; the rewiring of Nos. 8 and 9 circuit breakers then carried out was not done by him. On 17th May he was occupied until about 4.0 a.m. in making fresh connexions, already labelled, to the illuminated diagram. He then started to sort out the wires running from the relay room to the lever circuit breakers, in order that he might cleat them together tidily. They had been temporarily bundled together and he had to disconnect several from their terminals to disentangle them; most of them required to be shortened as well. He also substituted a length of lead covered wire for a braided wire which had been used as a temporary measure to connect Nos. 8 and 9 circuit breakers.

He said that he had plenty of light by which to work, and he was certain that he had unscrewed only one circuit breaker terminal at a time, then replacing any wires which he had detached and screwing up the terminal before passing to another; he maintained that this was his regular practice. For this reason he felt sure that he had left the connexions of No. 9 circuit breaker exactly as he found them, and that the braided wire which he replaced must have been on the right hand lower terminal originally, not on the centre one, its proper place. He remembered that the attachment to No. 9 circuit breaker of the end of the new wire leading from No. 8 was the last connexion he made before finishing his night's work at about 5.0 a.m. He said he was not hurried in any way, for his homeward train did not leave Charing Cross until 5.20 a.m., and there was still enough to be done in the cabin to occupy him for several nights.

Eeles agreed that he had informed Beer at the end of the night's work that all was in order; since Beer had given him general instructions what to do, he did not tell him in detail what connexions he had made. He said that Beer had looked into the cabin once or twice during the night, but Beer did not recollect doing so.

VII.—*Events leading up to the Collision.*

14. Though the mistake in the wiring was made in the early morning, the premature clearing of signal EH.9 had no untoward effects until trains had been running for about 4½ hours, for it happened that there was no congestion on this section of the line till towards the end of the morning peak. The accident took place at 9.55 a.m., the time being established by the recorded opening of the circuit breakers of the eastbound line in Charing Cross substation, as the result of a short circuit caused by the derailment. It may be mentioned here that since the circuit breakers sometimes open when a momentary overload occurs, it is the custom to make three attempts to close them by hand; on this occasion they opened again about half a minute later, but remained closed when then replaced until current on the eastbound line was cut off by the use of the tunnel wires, at 10.23 a.m.

15. An unsatisfactory feature of the case is that although a motorman noticed that signal EH.9 was clearing wrongly 18 minutes earlier, at about 9.37 a.m., and reported this on arrival at Temple station some three minutes afterwards, no action was taken to warn the motormen of following trains to run through the section with extreme caution until the defect could be remedied; similar reports were made at Temple by the motormen of later eastbound trains, the last a few seconds after the accident. To determine the responsibility of various members of the staff in this respect it is necessary to consider the movements of several trains, westbound as well as eastbound, besides the two involved in the collision. A difficulty arises in determining the times at which these reached or left Charing Cross, for the nearest points at which times were recorded are

Victoria station to the west and Mansion House to the east, where they are booked to the nearest half minute; all clocks on the line are synchronised. The following table shows the trains concerned, with the names of the trainmen who gave evidence; the Charing Cross times must be regarded as only approximate, for there may have been material variations in the running after leaving Victoria and Mansion House respectively and in the length of the stops made at the two intermediate stations. A closer investigation of the train movements immediately before the accident is made later.

Eastbound Line.

Train.	Cars.	Victoria. (*recorded* departure).	Charing Cross. (*estimated* departure).	Motorman.	Guard.
53	6	9.31½	9.36½	Longley.	Blake.
		* * *	* * *		
		* * *	* * *		
24	8	9.41	9.46	Butler.	—
		* * *	* * *		
52	6	9.45	9.50	Read.	—
34	8	9.46½	9.51½	Berry.	Kenton.
21†	6	9.48	9.53	Holbourn.	Diprose.
59†	5	9.49½	9.54½	McLean.	Parks.
49	6	9.51	9.56	Mead.	—

† In collision.

In addition to the trains mentioned, there were six between No. 53 and No. 24, and two between No. 24 and No. 52, but their times are not material.

Westbound Line.

Train.	Cars.	Mansion House. (*recorded* departure).	Charing Cross. (*estimated* arrival).	Motorman.	Guard.
53	6	9.47	9.52	Longley.	Blake.
16	6	9.48½	9.53½	Norman.	—
19	6	9.50	9.55½	Samways.	Stubbings.
39	6	9.52½	(Stopped at site of accident).		

VIII.—*Movements of Eastbound Trains.*

16. The evidence of the motormen and guards named above was as follows: —

Train No. 53 (*eastbound*)

Almost immediately after leaving Charing Cross on the eastbound journey, Motorman Longley saw the tail light of the preceding train at no great distance ahead. He stopped immediately, for about a minute, while the train ahead moved away, after which he ran forward slowly to Temple station; signals 823, 825.A and 825.B had cleared before he reached them. On arrival at Temple he sounded the whistle to attract the attention of the station staff. Station Foreman Foskew came up to the cab, and Longley said to him "Get on to Charing Cross at once, tell them that their starting signal has failed in the off position (i.e., at Green) for me." Foskew replied "They wondered at Charing Cross why you had stopped," but Longley did not tell him that he had nearly run into the train in front.

Guard Blake remembered that signal EH.9 was at Red when the train entered Charing Cross. He thought that the rear of the train was not far beyond that signal when Longley made the sudden stop in the tunnel. He went to the motorman's cab at Temple station to see what had happened and heard the conversation between Longley and Foskew, which probably took place at about 9.40 a.m.

Train No. 24 (*eastbound*).

17. As Motorman Butler approached Charing Cross he was stopped by signal 817.A. When he entered the station signal EH.9 was at Red, but it cleared before he stopped and this struck him as unusual, for the fact that signal 817.A had been against him indicated that the previous train was not far ahead. As he rounded the curve after leaving Charing Cross he saw signal 823 at Red, with the previous train only just beyond it, silhouetted against the lights of Temple station, and about a train's length in front of him. He stopped at signal 823 till it cleared, and then ran forward into Temple station, where he

sounded the whistle. He told Foskew, who went to him, that there " was something wrong with the Charing Cross signals, as the starter seemed to come off too quick " and he said that Foskew replied that he would telephone about it; this was at about 9.49 or 9.50 a.m.

Butler also stated that he said to Foskew " When I got round the bend I found the next train about six or eight car lengths in front of me," but Foskew denied that this was so when giving his evidence later.

Train No. 52 (*eastbound*).

18. Motorman Read found signal EH.9 at Green when he entered Charing Cross. Shortly after leaving the station, and just before he reached the eastern ventilation opening, he saw a red light in the tunnel ahead. For a moment he thought it was signal 823 and then he realised that it was closer to him, though more or less on the same alignment, and that it was the tail light of a train. He made an emergency brake application and also reversed in order to stop as quickly as possible; he thought that his train almost touched the one in front, and that it would have done so if the other had not started to move. He waited until signal 823 cleared, perhaps half a minute later, and then ran forward to Temple. On arrival there he called Foskew and told him that he had nearly run into the train ahead; he also asked if the guard of that train had mentioned that his train had been touched. Foskew replied that he had reported the matter and that he had had similar complaints from other motormen. This appears to have been at about 9.54 a.m.

Train No. 34 (*eastbound*).

19. Motorman Berry also found signal EH.9 at Green when he entered Charing Cross. Just after starting from there, while in the daylight from the ventilation opening by the signal cabin, he saw Motorman Longley signalling to him from train 53, which was then returning from Mansion House on the westbound line, and immediately afterwards he caught sight of the tail light of train 52 a short distance away; he thought it was moving slowly away from him. He stopped at once and then drew ahead to signal 823, which was at Red, where he stopped again, for about 15 seconds. When that signal cleared he ran forward slowly to Temple, signals 825.A and 825.B clearing as he approached them. As he was entering Temple station the lights in his train went out for a moment, as if the substation circuit breakers had been opened and closed quickly. He then reported what had happened to Foskew, who replied that the staff at Charing Cross had the matter in hand.

Guard Kenton was not certain where the rear of the train was when Berry made the first stop after leaving Charing Cross, but thought that the last car was about level with the platform ramp; he thought that the stop and the subsequent one at signal 823 were both of about 30 seconds duration.

Train No. 21 (*eastbound*).

20. Motorman Holbourn said that he was stopped at signal 817.D before entering Charing Cross, and that signal EH.9 was at Red when he drew into the platform. He was certain that there was no westbound train standing in the station when he entered it, for he remembered seeing Inspector Barnes on the westbound platform, near the service telephone box, looking away from him towards the eastern end of the station. After leaving the station, when he had passed the second ventilation opening and was about a train's length away from signal 823, he saw the tail light of train 31, nearer to him than the signal; the train was moving away, and he thought that its two last cars were on the near side of the signal. He stopped at once, some 20 yards away from the signal, and then drew up to it, coming to a stand about 4 yards in rear of it. He had released the brakes, ready to move forward, and thought he had been stationary for about half a minute when he was thrown to the floor by the collision. After relighting his hand lamp he got down on to the track and stopped westbound train 39, which he saw leaving Temple station. He could not remember if any trains had passed previously on the westbound line, after he left Charing Cross.

Holbourn then went back along both trains and saw that train 49 had drawn up in rear of train 59, which had collided with his own. He found that there was a doctor in train 59, and conducted him to the telescoped cars; he said that there were no signs of undue alarm among the passengers though some were

calling out for assistance, and that the lights were burning except in the two seriously damaged cars. When the arcing took place, a little later on, he climbed up into a car of train 59 to get at the tunnel wires of the eastbound line; he broke a window to reach the wires, as he found it difficult to open one of the side doors.

21. As Guard Diprose was too seriously injured to attend the Inquiry I interviewed him at his home, on 10th June. His evidence supported that given by Holbourn regarding the stops made just before the accident, and he said that there had been several checks on the journey from Victoria to Charing Cross. He had inspected the tail lamp at Charing Cross, and found it was burning properly. From there he travelled in the motorman's compartment at the rear end of the last car, as several passengers were standing in its front vestibule, his usual place. Soon after the train stopped at signal 823 he saw train 59 emerging from the tunnel into the daylight below the eastern ventilation opening, 70 yards away, running at normal speed. He watched its approach, fascinated, and wondered whether it would stop before colliding. He could distinguish the motorman's actions, and saw him first release the dead man's handle of the controller and then turn round, putting up his hands to shield his head. There was no time for him to give any warning, for the collision must have taken place about four seconds after he first saw the following train. He had a vague recollection of a westbound train passing while his own was standing at signal 823, but was not certain about this.

Train No. 59 (*eastbound*).

22. Motorman McLean was slightly injured in the accident and was imprisoned in his wrecked driving compartment for some time; he appeared to be still suffering slightly from the effects of shock when he gave evidence at the Inquiry. He said that he applied power in the normal way on leaving Charing Cross, and began to look out for signal 823 before he reached the eastern ventilation opening; he could not remember whether any westbound train passed just then. He had no clear recollection of seeing the tail light of train 21, and said that he had no idea that anything was wrong until he entered the patch of daylight, by which time the speed of the train was 20 or 25 m.p.h. He remembered seeing what he described as a "hazy red object" in front of him, which he recognised as the end of a train about 25 yds. away, just as he was passing from the daylight into the tunnel. He immediately released the dead man's handle and made a full brake application and then turned towards the door at the back of the driving compartment to avoid being crushed between the controller and the brake hand wheel behind him. He managed to get into a compartment in which the motor generators of the control equipment are housed, but the door between that and the passenger accommodation was jammed by the collision; he succeeded in forcing it open just before the lights were extinguished when current was cut off, 20 minutes later.

Guard Parks was travelling at the rear end of the last car. He said that signal EH.9 was at Green when the train entered Charing Cross. After leaving the station he noticed nothing unusual until he felt the shock of the collision; so far as he could tell, there was no brake application just before it occurred. He was badly shaken, and when he recovered he saw train 49 coming to a stand a few yards behind his own. He said that after the crash the lights of his train went out twice for a short time, and then came on again. He did not remember whether any westbound train passed just before the accident.

Train No. 49 (*eastbound*).

23. This train was following train 59 fairly closely, for Motorman Mead said that he was checked by the signals between Westminster and Charing Cross, though he did not actually stop at any of them, and signal EH.9 was at Red when he entered the station. Just before he stopped he heard a loud report from the substation, which is close to the eastbound platform, and at the same time he saw the gap indicator below signal EH.9 light up. This device, which indicates to motormen that they are approaching a "dead" section, must not be passed while alight, for otherwise the gap between separately fed sections of the conductor rails would be bridged by the train, thus making the forward section alive again, possibly with disastrous results. By the time the signal to start was given by the

guard the gap indicator was extinguished and signal EH.9 had cleared. Mead continued to watch the gap indicator closely, in case it should light up again, but it did not do so, and he heard no further sound of a circuit breaker opening in the substation. Though he received no other warning, this occurrence had made him rather suspicious, so he started from the station more slowly than usual and consequently had no difficulty in stopping when he saw the tail light of train 59; he brought his train to a stand about 6 yards in rear of it.

IX.—*Visibility of tail light of Train No.* 21.

24. At my request an experiment was made on the morning of 22nd May to ascertain at what distance the tail light of a 6-car train standing at signal 823 could be seen by the motorman of a following train. An ordinary oil tail lamp, giving a good but not an exceptional light, was used for the test, and Motorman McLean accompanied me in the driving compartment of the following train. There was no train on the westbound line, and I found that when the tail light came into view round the curve it could be clearly seen through the intervening shaft of daylight from a point not far in advance of Charing Cross signal cabin, at a distance of 415 feet. As it was evident that a westbound train would have prevented the light being seen from that point, the train in which I was travelling moved forward at a crawl and was stopped again when I judged that the tail light ahead would have become visible if there had been a westbound train passing. This took place just as the train emerged from the tunnel into the daylight below the eastern ventilation opening, and at the same moment McLean exclaimed "This is where I thought there was something wrong", or words to that effect; the distance from that point to the tail light was 153 feet. Signal 823 was then still invisible, being hidden by the train in front, which was accordingly sent away. When its light could be seen the position which it occupied in the mouth of the tunnel ahead was on the same level as that previously occupied by the tail light, and not far to the right of it; the brilliance of the two lights was approximately the same.

Observations made subsequently show that when there is no train on the westbound line, signal 823 first becomes visible to the motorman of an eastbound train round the curve at a distance of 481 feet, just before the eastern ventilation opening is entered; a passing westbound train prevents signal 823 being seen until the tunnel is re-entered, beyond the ventilation opening, the sighting distance being reduced to 345 feet.

The four points mentioned above, at which the tail light of a train standing at signal 823, and the signal itself, become visible with the westbound line clear and when it is occupied, are shown on the plan.

X.—*Movements of Westbound Trains.*

Train No. 53 (*westbound*).

The eastbound journey of this train, during which Motorman Longley reported the failure of signal EH.9 at Temple station, ended at Mansion House where the train reversed. Longley said that on the westbound journey he had a clear run between Temple and Charing Cross stations. He passed train 52 standing at signal 823 and very shortly afterwards saw train 34 leaving Charing Cross. In a sense it eased his mind to see a repetition of what he had reported, for he had been wondering how he could prove that he was correct. When his train met train 34 he signalled to its motorman, Berry, to indicate that there was something wrong ahead, and he remembered that when he did this the leading ends of the two trains were in the daylight, below the ventilation opening immediately east of Charing Cross station, and close to the signal cabin there. When he stopped at the platform he found Inspector Barnes waiting for him. His first words to Barnes were "Look! The signal is still doing it, failing in the off position"; he also told him that he had nearly collided with the train ahead on his eastbound journey, and Barnes said that he would "see to it".

Longley thought that his station stop was longer than usual, perhaps as much as a minute, on account of his conversation with Barnes. He did not remember seeing eastbound train 21, and felt certain that it was not in the station when

he got there, and that it did not enter while he was talking to Barnes. He said that although he had tried to warn motorman Berry, of train 34, it did not occur to him to give a warning to the motormen of trains which passed him after he left Charing Cross, for by that time Inspector Barnes knew what had happened. He had a lighted hand lamp in his compartment.

Guard Blake did not notice what eastbound trains passed when he was at or near Charing Cross on the westbound journey. During the stop there he asked a porter if Inspector Barnes was about, but took no further action on learning that he was at the other end of the train speaking to Longley. He thought that the station stop lasted for 40 or 45 seconds, and gave the time of arrival at Charing Cross as 9.52½ a.m.

Train No. 16 (*westbound*).

26. Though this train left Mansion House 1½ minutes after train 53, the interval between them was reduced on the journey to Charing Cross. Motorman Norman could not remember whether he had to wait at Temple Station for signal 826 to clear. He was checked by signal EH.1, which cleared before he reached it, and had to stop momentarily at signal EH.2; signal 822.A cleared as he approached it, and signal 822.B was at Green when it came into his view, at short range. From this it is evident that Longley's train, No. 53, must have left Charing Cross just before Norman arrived there.

Norman saw an eastbound train standing at signal 823, or possibly moving slowly, but could not remember what head code it bore, so was unable to identify it. He also saw another eastbound train leaving Charing Cross when he was passing below the western ventilation opening, and said that this was a Circle train; he thought that one of its cars was painted red and cream, a combination formerly adopted for the ex-Metropolitan stock used on such trains. It occurred to him that this train was unusually close behind the one which he had seen at signal 823, and he looked back to see if the latter was still visible, but it was concealed from him by the curve. He was under the impression that his was the last westbound train to pass before the accident took place.

Train No. 19 (*westbound*).

27. Motorman Samways said that signal 826 was at Green when he ran into Temple station, and that the four signals situated between Temple and Charing Cross were also at Green when he sighted them; he could not remember what eastbound trains he passed on the journey. He did not hear the sound of the collision, and was unaware that his was the last westbound train to pass before it occurred.

Guard Stubbings did not notice train 21 during the journey from Temple to Charing Cross but remembered seeing train 59. He was travelling at the leading end of the last car and thought that he was about midway between the two ventilation openings when the fourth and fifth cars of that train passed him. A few seconds later, when he was in the daylight below the western opening, he heard a crash, and the sound of breaking glass; he thought that something might have happened to his own train so went through the car to the rear end of it before it came to a stand at the platform, to see if any windows had been broken.

XI.—*Evidence of Traffic Staff.*

28. Stationmaster Barrand and Inspector Barnes were on the westbound platform at Charing Cross when train 53 left the station at 9.36½ a.m. on its eastbound journey, and they noticed that it stopped before it had travelled far. This might have happened for several reasons, such as a circuit breaker opening on the train, or the trip cock striking an obstruction on the line, or a passenger applying the brake by means of the emergency valve with which all cars are equipped. Barrand went towards the eastern end of the platform to see what was wrong, but the train started again before he reached it. Barnes thereupon telephoned to Temple station and gave instructions to Porter Hopkins for the motorman of the train to be questioned when he arrived there.

A little later Barnes was rung up from Temple station by Hopkins who told him that the train concerned was No. 53 and that its motorman had said that "The signal was on". This did not satisfy Barnes and upon asking Hopkins "What signal, and what does he mean?" he received the reply "That's what the driver says". He was puzzled by this information but did not think that there could be anything seriously amiss, for the eastbound traffic continued to run smoothly. He told Barrand what he had learned, and they thought that possibly Motorman Longley had seen signal 823 at Red and had mishandled the controller when slowing down, releasing the dead man's handle accidentally and so stopping a considerable distance short of the signal. As train 53 was due back from Mansion House at 9.50½ a.m. they decided to question the motorman on his return; Barrand then left Barnes on the platform, and went to attend to other duties. Barnes also informed Assistant Controller Peters, at Earl's Court, of the occurrence; Peters said that he received this message at about 9.42 a.m. though he did not make a note of its time, and also a second one, some two minutes later, telling him of the inconclusive answer which Barnes had received from Temple station and that Motorman Longley would be interrogated when he got back to Charing Cross. Later, at about 9.51 a.m. so far as he could recollect, Barnes received a further telephone message from Hopkins to the effect that the eastbound starting signal was "working sluggish". This conveyed nothing to him and as train 53 was due he left the telephone box and went out to meet the train and to question Motorman Longley.

29. During this time Station Foreman Foskew was in charge of Temple station, and was on the eastbound platform there; Porter Hopkins was on the westbound platform, where the telephone is situated, and messages between these two men were transmitted by shouting across from one platform to the other when opportunity served, that is when there was no train in the way. Foskew received Barnes' instructions to question Motorman Longley in this manner, but said that when train 53 arrived Longley gave him no time to do so, exclaiming as soon as he went to the driving compartment "Get on to Charing Cross, tell them their starting signal has failed in the off position". Foskew replied that he had had instructions from Charing Cross to enquire why the train had stopped, and said that Longley made no mention of having narrowly escaped a collision.

After the departure of train 53 and of a westbound one which was in the station at the same time, Foskew called across to Hopkins and told him to telephone this message to Charing Cross. He was almost certain that he used the same words as Longley regarding the signal, namely that it had "failed in the *off* position". But Hopkins either heard him imperfectly or misunderstood him, for he was certain that Foskew said "failed in the *on* position", and he telephoned to Charing Cross accordingly. As the terms "On" and "Off", derived from semaphore signalling practice, denote "at danger" and "clear" respectively, the significance of Longley's report was thus completely altered before it reached Inspector Barnes.

30. Some 10 minutes later, when train 24 arrived, Foskew received from Motorman Butler a report similar to that which he had had from Longley, namely that there was something wrong with the Charing Cross starting signal, which was clearing too quickly, but he denied that Butler also told him that he had seen a train a short distance ahead in the tunnel. After this train had left, he again called across to Hopkins and told him to telephone this information to Charing Cross; he could not remember the exact words he used to Hopkins regarding the signal, but thought they were "failing at the off". Hopkins, however, said that the instructions given to him were "To ring up Charing Cross and ask them why nothing had been done because trains coming in were still reporting the same defect". But he admitted that when telephoning he phrased the message differently, saying ". . . the drivers are reporting that the signal is working sluggish", though he could give no reason for making this alteration.

Foskew maintained that the first time he heard that a collision had been narrowly averted was when train 52 (Motorman Read) arrived, very shortly before the accident occurred. He told Hopkins to send this information to Charing Cross, but the latter again passed on the message in less urgent phraseology, merely saying that motormen were still complaining that the signal was not working properly. This message was not received at Charing Cross by

Barnes, who had left the telephone as described later, but as it appears to have been sent about the time that the accident happened, and therefore too late to be of service, it was not a material factor in the case.

31. Foskew was aware that the failure of a signal in the "off" position was most unusual, and might have serious consequences; he said that such an occurrence had never been reported to him before. But in spite of this he did not inform the Traffic Controller, though there are instructions that he is invariably to be advised when anything out of the ordinary takes place. He admitted that he ought to have done so as soon as the matter was brought to his notice by Motorman Longley, but said that he thought that as the staff at Charing Cross had initiated the enquiry about Longley's unexpected stop they would also take the necessary action with the Controller. Despite the important nature of the successive reports about the signal which he received from motormen, it did not occur to him to telephone to Charing Cross himself, although he was in charge of Temple station at the time. His excuse for not doing so was that as many passengers were arriving by each eastbound train, he did not want to leave that side of the station to telephone from the westbound platform. He added that he thought Hopkins quite capable of transmitting the messages correctly, and that though Motorman Butler reported that the signal at Charing Cross was still giving a false indication some 10 minutes after Longley had made a similar complaint, this did not cause him either to suspect that the first message to Charing Cross might have been misinterpreted, or to ask Hopkins how he had worded it.

32. As a result of the actions of Foskew and Hopkins, the first authentic information regarding the signal failure which reached Inspector Barnes was that given to him by Motorman Longley when train 53 returned to Charing Cross, at about 9.52 a.m. Barnes said that up to then he had been under the impression that the signal mentioned by Hopkins over the telephone was No. 823, for he had seen that signal EH.9 was apparently working correctly, turning to Red as trains left and clearing later. Consequently when Longley told him that he had had a "false-clear" indication from the last-named signal, and that his stop just beyond the station had been made to avoid a collision with the train ahead, he could hardly credit his statement, and questioned him further about the occurrence. As soon as he fully understood what had happened he left Longley and went to telephone to the Controller; he was doing so when Longley's train left the station. He stated that the conversation with the Controller did not take more than about 15 seconds and that he then rushed across to the eastbound platform to warn trains on that line; he said that he would have done this in any case, even if the Controller had not suggested it. The route he took was up the stairs to the booking hall at street level, where he stopped for a few seconds at the booking office to tell Stationmaster Barrand what had happened, and down the stairs to the other platform.

When it was suggested to him that he could have saved time, and might have been able to warn Motorman McLean or Guard Parks (train 59) that signal EH.9 was not to be relied on if he had crossed the permanent way to get to the eastbound platform instead of going by the booking hall, he said that he was certain that there was no eastbound train in the station when he finished his conversation with Longley, or when he came out of the telephone box after speaking to the Controller, and that he knew that he could get across by the bridge before one arrived. Therefore, as train 59 had already left the station by the time he got to the eastbound platform, he inferred that it must have done so while he was talking to Longley. He admitted that he could have told Longley to use his handlamp to stop any eastbound train entering the station, but said that the position did not appear to him to call for such drastic action. In explanation of this, he repeated that the eastbound traffic had been running smoothly, so far as he knew, since the incident which Longley had reported, for he had had no message from Temple station to make him think otherwise; also, signal EH.9 had apparently been working properly, though he had only observed it casually, owing to the impression which he had formed earlier that the signal at fault was No. 823, which was not dispelled until Longley's return. Therefore he had come to the conclusion that the "false clear" failure which Longley reported must have been of a temporary nature, affecting his train only.

33. Though Barnes suggested that his conversation with the Control Office was a very brief one, Assistant Controller Peters stated that he was occupied with another call when Barnes rang up, so he was unable to answer him at once. The call was dealt with in the first place by an assistant, Rushton, to whom Barnes said that he wanted to speak to Peters. Peters thought that it was at least half a minute, and possibly as much as a minute, before he was free to attend to Barnes. When he learnt from him what Longley had reported he realised that the message was an important one, so recorded the time of the conversation, 9.54½ a.m. He said that he told Barnes, who did not seem to be agitated, "to go over at once to the eastbound platform and keep the signal under special observation". An attempt was then made to speak to the Charing Cross stationmaster, in order to instruct him to open the signal cabin and so bring the signals under manual control, but no reply could be got from Charing Cross for some little time.

XII.—*Electrical short circuit after the collision.*

34. The Board's rule relating to switching off traction current in case of emergency is as follows:—

> 242.—(*a*) When serious arcing or fusing occurs on a train or in the cables supplying the current rails or in the connections thereto, current must be switched off to enable the defect to be remedied. Current must also be switched off when a derailment or collision has occurred if there is risk of arcing between the current rails and the cars.

Since there was no sign of arcing immediately after the accident Motorman Holbourn did not use the tunnel wires to switch off the current, and as soon as senior members of the staff arrived on the scene arrangements were put in hand to move trains up to the spot on both lines to simplify detrainment of passengers, but these movements could not be completed.

Particulars of the arcing which took place later on were given to me by Mr. G. Yorke, District Superintendent, Northern Line. He had received severe burns, and could not attend the Inquiry, so I interviewed him at his home on 10th June, after he had been discharged from hospital. He reached the scene of the accident at about 10.15 a.m. and found that there was a space of a few feet between the front of train 59 and the rear of train 21. Using his electric torch, he stepped from the "six-foot" into this space to feel the tail lamp of the latter train, and found it still warm; in doing so he trod on some debris lying close to the right hand running rail. He then went to the telescoped cars and was asked by members of the staff at work inside, trying to release the injured, if any crowbars were available. When on his way back to Charing Cross to obtain these from a platelayers' store he was asked by Mr. Webb, the Outdoor Superintendent, whom he met by the space between the two trains, to see whether access to the injured was possible through the doors on the left hand side of the cars. In passing between the trains to do this he stepped on the same debris as previously, and saw an arc start close to his feet. He rushed away from it instinctively, turning to watch it when alongside the leading car of train 59. When it was extinguished he went on to Charing Cross, where it was found that he had had an extremely narrow escape, most of his clothing below the waist having been burnt away, though he was unconscious of this until his attention was drawn to it.

The arc was caused by a detached piece of steel panelling coming into contact with the negative conductor rail and the right hand running rail, between which there was a potential of 600 volts. It was extremely violent, a loud roar accompanying it; in the opinion of several observers it lasted for about 15 seconds, until the current was cut off. Besides Motorman Holbourn, whose action has been mentioned, two other members of the staff used the tunnel wires for this purpose. The time when this was done was recorded as 10.23 a.m. in the substation.

Mr. Webb stated that a slight fire was started by the arc. He found some wood among the debris smouldering after it had ceased, and oil which had leaked from the damaged tail lamp of train 21 was burning. He had no difficulty in putting it out with a fire extinguisher obtained from the front car of train 59; there was some smoke from it, and from burnt paint on the rear end of train 21.

Current had already been switched off on the westbound line by means of the tunnel wires, at 10.20 a.m., on Mr. Webb's instructions, to facilitate the movements of ambulance men and other helpers.

XIII.—*Conclusion.*

35. I have no hesitation in accepting the statement of Chief Signal Inspector Baker that he made a thorough test of the controls of the signals at Charing Cross after the new relay room was brought into use and the signalling system was changed from direct to alternating current, on 7th-8th May. It follows from this that the mistake in the wiring of No. 9 circuit breaker, which allowed signal EH.9 to clear prematurely, must have been made during the night before the accident when Signal Installer E. Eeles replaced the short connexion leading from No. 8 circuit breaker while tidying the new wiring and fixing it permanently. It is difficult to understand how he came to make the mistake in face of his assertion that he never removed more than one terminal screw at a time; but it is possible that he pulled the end of the temporary braided wire off the centre terminal without removing its screw entirely and, after replacing this wire by a lead covered length, connected it at a later stage when the right-hand terminal screw had been removed. Whatever the true explanation may be, responsibility for this mistake must be borne by Eeles; he is 36 years of age, and had been employed by the Board for a year.

36. But inasmuch as Eeles was not competent to test the signal controls after he had finished his night's work, this should undoubtedly have been done by the man under whose orders he was working, Chief Lineman A. G. Beer, in accordance with the recognised practice when any alteration of signalling circuits has taken place. Whether Beer had noticed during the night what work Eeles was engaged upon, and what wires he was connecting or shortening, is immaterial. Even though he believed Eeles to be a conscientious worker, and capable of carrying out a straightforward task satisfactorily, it was clearly his duty, as the responsible man in charge of the alterations which were going on, to satisfy himself that nothing had been done to impair safety. It would have taken him no more than a few minutes to make a test that would have revealed the mistake, after obtaining from Eeles details of the work which he had done, instead of accepting his assurance that all was in order.

Though the omission was in no sense deliberate, and can be ascribed to thoughtlessness and perhaps to preoccupation with the details of the work done by other members of his gang, it was clearly the primary cause of the accident, for which Chief Lineman A. G. Beer must consequently bear a large share of responsibility. He is 31 years of age and had been in the service of the Board and its constituent undertakings for 12 years. His previous record is a good one, as is shown by his comparatively rapid advancement to the post of Chief Lineman, which he had held for four months.

37. It may be accepted that the tail light of train 21 was alight when the collision occurred; I regard the evidence of Guard Diprose and of Mr. G. Yorke on this point as conclusive. But in assessing the measure of Motorman McLean's responsibility for the accident it is necessary to take into account the result of the experiment which was made on 22nd May to determine how far away such a light could be seen; the visibility of signal 823 also has a bearing on the matter. When giving evidence McLean, who was still in a shaky condition, could not remember whether he had seen the tail light or not, nor could he recollect if a westbound train passed just before the collision. Nevertheless it is clear that train 19 must have passed on the westbound line just then, for Guard Stubbings saw McLean's train in the tunnel between the two ventilation openings, and heard the collision a few seconds later, when below the western one; Guard Diprose also vaguely remembered this train passing while his own was stationary. Hence McLean's view of the tail light ahead was restricted to about 153 feet, a distance which his train would cover in little more than four seconds at 25 m.p.h. Even so, if he had immediately realised that the light in front of him was a tail light, an emergency application of the brake might have stopped the train within the distance available, or would at any rate have made the impact a trifling one.

I feel certain that McLean's failure to apply the brake instantly was due to momentary confusion of the tail light with that of signal 823, which would have become visible at practically the same spot in normal circumstances, with no train passing on the other line. Motorman Read had been similarly confused for a moment a little earlier, and McLean's exclamation when the incident was reconstructed a few days later, that he felt at that point that there was something unusual, was significant. As mentioned in paragraph 24, there was no great difference in the direction of the two lights, which were at about the same elevation and, on the occasion of the test, of similar brilliance. In such circumstances a moment's hesitation was not unnatural, and I accept McLean's statement that he did not become aware of the presence of train 21 until he re-entered the tunnel, when he saw it as a vague outline a short distance ahead, faintly illuminated either by the daylight from the ventilation opening or by the headlight of his own train. On these grounds I consider that McLean can be relieved from any responsibility for the accident.

38. Perhaps the most regrettable feature of the accident was the failure on the part of the traffic staff to take preventive action, for which there was ample opportunity. If Station Foreman A. W. Foskew had carried out the instructions which reached him to ascertain why Motorman Longley stopped unexpectedly he would have learnt that a collision had nearly taken place, and in any case he certainly ought to have realised the serious implication of Longley's information regarding the "false-clear" indication given by signal EH.9. A man of his seniority and experience might have been expected to assure himself that the message reporting so serious an occurrence was sent correctly. If it was essential to employ Hopkins, a comparatively inexperienced porter, to transmit it, Foskew ought to have made certain that he understood what he was to say, but I am surprised that he did not telephone himself in view of the importance of the matter; his excuse that he thought it inadvisable to leave the eastbound platform for this purpose was extremely feeble, for he could easily have exchanged places with Hopkins for a few minutes.

Moreover, even the reminder that the same dangerous conditions still prevailed which Motorman Butler gave him some ten minutes subsequent to Longley's complaint did not cause Foskew to take such urgent action as the occasion warranted. His personal attention to the matter even then, at about 9.49 or 9.50 a.m., would probably have averted the accident, but he contented himself with sending a message through the same unreliable channel as before, without even asking Hopkins how he had phrased the earlier one, or whether he was certain that the recipient had understood it. Again, even the third report, made by Motorman Read, with the added information that a collision had been narrowly avoided, did not rouse Foskew into vigorous action, ineffectual though this would then have been in all probability.

Consequently responsibility for the accident must be shared with Chief Lineman Beer by Station Foreman A. W. Foskew. Indeed, I am of opinion that the negligence of which the latter was guilty is more serious than that displayed by Beer, for on none of the three occasions on which a dangerous failure was reported to him did he take the trouble to follow up the matter personally or to assure himself that remedial measures were being taken. He is 45 years old, and has been employed by the Board or its constituent undertakings for 19 years, during the last 13 of which he has held the post of Station Foreman; his record hitherto has been good, and in justice to him it should be added that after the accident he showed commendable initiative in organising and conducting rescue work.

39. With regard to Porter Hopkins, he may have misunderstood the first message which Foskew told him to telephone to Charing Cross, confusing the words "off" and "on," and so completely altering its purport. But he had no excuse for garbling the second message, substituting the meaningless information that a signal was "working sluggishly" for the statement that a defect previously notified, though wrongly as it happened, was still being reported by motormen. It is not possible to say whether a correct rendering of this message would have produced different results, but in any case I look on Porter Hopkins as deserving some blame for his carelessness. He is 29 years old and had been in the Board's service for 12 weeks, five of which had been spent at Temple station; he was also employed for a period of 6½ months in 1937.

40. The actions of Inspector Barnes up to the time when Motorman Longley returned to Charing Cross from Mansion House cannot be criticised. He took prompt steps to ascertain why train 53 had stopped shortly after leaving the station on its eastbound journey, and as that might have come about for a variety of reasons there was nothing in the incident to arouse his suspicions. Unfortunately it did not occur to him to insist on speaking to Foskew when he got a more or less unintelligible message from Hopkins, or to endeavour to get into touch with Longley while he was at Mansion House, but, having regard to the fact that the eastbound traffic was running smoothly so far as he could see, his decision to wait until he could speak to Longley on his return was not an unreasonable one.

But I am not satisfied that he acted with equal promptitude later, when he learnt the true state of affairs from Longley. It may be taken for granted that the accident would not have happened if Motorman McLean had been told to run cautiously through the section from Charing Cross to Temple, because the Green indication of signal EH.9 was unreliable, and it is therefore necessary to consider how much time was available for this, after Barnes had received Longley's report. The timetable set forth in paragraph 15 suggests that train 59 did not leave the station until 2½ minutes after train 53 reached it, and hence that there was ample time for Barnes to warn McLean, but the Charing Cross timings cannot be regarded as absolutely correct; they may be inaccurate to the extent of perhaps a minute in either direction. As Barnes maintained that he lost no time in crossing to the eastbound platform, and suggested that no eastbound train passed while he was doing so, or while he was telephoning to the Controller, it becomes desirable to look closely into the length of the interval which elapsed between the arrival of Longley's train and the departure of McLean's.

41. The following deductions can reasonably be made from the evidence of the various motormen and guards.

(*a*) Holbourn (train 21) stopped at signal 817.D before entering the station, showing that train 34 (Berry), which was composed of eight cars, had not then passed its clearance point. This was just after Longley and Berry had passed one another in the western ventilation opening. After emerging from the tunnel there, a westbound train, running under clear signals, takes from 19 to 28 seconds to come to a stand at the platform, according to observations which I have made. When Holbourn entered the station he saw Inspector Barnes waiting to meet Longley, therefore his stop at signal 817.D can only have been momentary, and his train and Longley's must have entered the station together. Until Holbourn's train (six cars) was practically at a stand at the platform, its rear end was within the clearance point of signal 815, so train 59 (McLean) must still have been west of that signal, and thus at least 1,570 ft. away from its stopping place at the eastbound platform. Even if it had been close to signal 815 at that moment, it could not have stopped at the station till about a minute later; moreover, neither McLean nor his guard, Parks, made any mention of a signal check between Westminster and Charing Cross, so it is likely that signal 815 had cleared before their train approached it. From this it is clear that Longley and Holbourn must have reached Charing Cross a minute *at least* before McLean did so; to this must be added the length of McLean's station stop, say 15-20 seconds, in order to arrive at the time that was available to warn him.

(*b*) Norman's statement that train 16 (westbound) was checked by signals when approaching Charing Cross, and was momentarily stopped at signal EH.2, shows that it was following train 53 (Longley) fairly closely. Signal 822.A only cleared for him when he was near to it, and as the clearance point of that signal is alongside the platform, near its western end, this shows that at that moment Longley's train was not entirely out of the station. Therefore if Norman's statement that he passed a Circle train (i.e., No. 59) in the western ventilation opening be accepted, it follows that McLean and Longley must have started from the station almost simultaneously, in which case Barnes would have had no opportunity of warning the former.

But I am convinced that Norman was mistaken in his identification of the train in question, for the following reason. An eastbound train takes about 15 seconds to travel from the western ventilation opening to the point of collision.

When Norman was in that opening the rear of his train (six cars) was still east of the clearance point of signal 826 and hence the following westbound train (No. 19) cannot have left Temple station. Train 19 passed the point of collision before the accident took place, and I have found that the time taken by westbound trains to clear that point after starting from Temple is between 47 and 51 seconds.

Thus it is obvious that the train which Norman saw at signal 823 must have been No. 34 (Berry) and the one which he passed when entering Charing Cross must have been No. 21 (Holbourn). It is probable that his identification of the latter as the Circle train involved in the collision, that is to say as No. 59, arose from his belief that his own was the last westbound train to pass before the accident.

(*c*) When signal 826, at Temple station, cleared after the passage of train 16 the front of that train (six cars) must have been close to signal 822.B. Norman's evidence indicates that the last named signal cleared just before train 16 reached it, showing that Longley's train had then just left the station. I find that westbound trains pass completely beyond the clearance point of signal 822.B about 20 seconds after they start from the platform.

Samways (train 19) found all signals between Temple and Charing Cross at Green when they came into his view. His guard, Stubbings, at the front of the sixth car of the train, heard the collision when he was in the western ventilation opening, which he would reach in from 56 to 60 seconds after starting from Temple, according to my own observations of trains running under similar conditions. I have also found that eastbound Circle trains reach the point of collision 30 seconds after their start from Charing Cross. Hence it is clear that McLean left Charing Cross about 28 seconds *after* Samways left Temple.

Also, Samways found signal 826 at Green when he entered Temple station, probably 20 seconds earlier. Thus it is clear that the time which elapsed between Longley's *departure* from Charing Cross and that of McLean cannot have been less than the sum of these periods of 20, 28 and 20 seconds, or 68 seconds in all, and may well have been greater.

42. The foregoing analysis shows that there was ample time for Inspector Barnes to warn McLean if he had acted at once, before speaking to the Control Office; the evidence of Assistant Controller Peters indicates that a considerably longer time than the 15 seconds suggested by Barnes was spent over this conversation. I cannot accept Barnes' contention that no time was lost by crossing over to the eastbound platform by way of the booking office, and by summoning the stationmaster, and I feel that even after hearing what Longley had to say he did not appreciate the dangerous possibilities of the situation, or realise how essential it was that eastbound traffic should be checked at once.

Admittedly he had previously been under the impression that the signal at fault was No. 823, but he seems to have been regrettably slow in readjusting his ideas when Longley told him what had actually occurred. His statement that he thought the " false-clear " failure of signal EH.9 might have been a transitory one, affecting Longley's train only, hardly bears examination, for just before Longley arrived he had received Hopkins' second message from Temple indicating that the failure previously reported still persisted, whatever its nature. I suspect that his further statement that he would have warned eastbound motormen of his own accord, even if the Controller had not suggested it, was an afterthought. Moreover, not only was McLean allowed to leave without a warning, but none was given to Motorman Mead who was driving the following train, No. 49, which arrived as the substation circuit breakers opened for the second time, about half a minute after the accident and therefore about a minute after McLean's departure.

Consequently I have come to the conclusion that Inspector F. H. Barnes had an opportunity of preventing the accident, but that when confronted with an unexpected situation he did not rise to the occasion in the manner to be expected of a man in his position; for this reason I consider that he must bear some share of the responsibility for the accident. He is 45 years of age and has 28 years' service, during the past 11 of which he has been a Station Inspector; he has an excellent record.

43. The motormen of eastbound trains who have been mentioned, namely Longley, Butler, Read, Berry, Holbourn and Mead, are all to be commended for their alertness in avoiding collision with the trains which they unexpectedly found ahead of them in the tunnel. Holbourn's promptness in stopping westbound train 39 after the accident, and in taking steps to cut off the current later when the short circuit occurred, also calls for remark, as does Mead's caution after his suspicions had been aroused by finding the gap indicator alight at Charing Cross; but for this the collision might have been followed by a second, a couple of minutes later.

XIV.—*Remarks and Recommendations.*

44. This accident comes as an unwelcome reminder that the introduction of apparatus to take the place of an operator, or to guard against his mistakes, increases the responsibility of the maintainer to a corresponding extent. Indeed, the more elaborate a signalling system becomes, the more essential is it that scrupulous care should be exercised in its installation and maintenance, and particularly in the work of testing after any alteration has been made, however trifling it may be.

I feel certain that this lesson has not been lost upon the Board's staff; it is one capable of general application.

45. I have found it necessary to criticise the conduct of two senior members of the station staff. Their omission to take the immediate action demanded by a signalling failure having dangerous potentialities suggests that perhaps it is not sufficiently recognised that on a system which is automatically signalled for the most part, and which therefore has relatively few signalmen, the duties of the platform and station staff extend beyond those connected with the marshalling of passengers and the expeditious despatch of trains. They also have responsibilities in connexion with the safety of operation, and it is desirable that all concerned should be reminded of this.

The relevant portion of the Board's Rule 81 (*n*), which deals with the action to be taken in case an automatic signal becomes defective, reads:—

> Except in the case of an automatic signal failing in the Danger position, the Signalman at the box in rear or the Station Master at the station in rear must be informed of the circumstances, and he must stop all trains proceeding toward the signal concerned and advise the Drivers accordingly.

Strict and immediate compliance with this Rule would have prevented the accident, and I recommend that the Board should amplify it in such terms as will make it perfectly clear that there must be no hesitation in warning motormen to run with extreme caution if any suspicious or irregular behaviour of a signal is observed or reported.

46. The arcing caused by the short circuit accidentally set up was undoubtedly most alarming, and suggestions have been made by passengers and others that the traction current ought to have been switched off immediately after the accident. I have quoted the Board's rule on the subject and consider it adequate under present conditions. The ability to move trains up to one which is disabled or derailed in order to facilitate the detrainment of passengers is a matter of convenience only and should not be rated too highly. But the maintenance of lighting in a train after an accident, or in one which is held up for a long time in a tunnel, is a most important factor in the avoidance of panic and for this reason I think it is important that the traction current should be kept on, if not otherwise inconsistent with safety; I refer later to arrangements which are contemplated to render the lighting independent of the traction current.

In the present instance I have ascertained that if the traction current had been switched off on both lines immediately the collision took place 11 trains would have been brought to a stand, with lights extinguished, between Charing Cross and Mansion House; the number might possibly have been increased to 19, which were between Victoria and Mansion House at the moment, if it had happened that the conductor rail gaps at Charing Cross were bridged by trains when the Charing Cross-Mansion House section was made "dead". The arcing

was purely fortuitous, and I suspect that if it had not occurred the suggestions that the traction current ought to have been switched off at once would not have been made.

A decision has been made by the Board, however, to instal lighting in the tunnels of the District and Metropolitan lines, similar to that existing on the Tube lines, which is automatically switched on as soon as the traction current is cut off. I recommend that when this work is completed the circumstances in which traction current is to be cut off should be reconsidered, for trains will not be thrown into complete darkness thereby.

47. In any following collision which occurs in the dark, the adequacy of the tail light of the leading train is a matter demanding consideration, and surprise has been expressed that the Board is content to use an oil tail lamp on its sub-surface lines. It would be a relatively simple matter to equip the trains with a fixed electric tail light, either as an independent fitting or by adaptation of the lights now used as a head code, although an oil lamp would have to be used as well, as a precaution against failure of the train lighting arrangements. But there is a risk in such a course which is not immediately obvious. It is necessary in certain contingencies to resort to emergency working, in which a train may have to run cautiously through a section which is or may be occupied. An example is afforded by the circumstances attending this accident, for Motorman McLean and those following him ought to have been warned to proceed with caution to Temple until the signal failure had been investigated and corrected; again, a disabled train may have to be propelled by a following one. If a motorman running under such instructions expects to find a brilliant tail lamp marking the position of a train ahead, and that train is standing with its lights out owing to some electrical failure, there is a possibility that the comparatively feeble oil light may not be noticed, with disastrous results.

In the present case the tail light was not inadequate, but was confused with a signal light, and a similar incident had occurred a few minutes previously. What is required, therefore, is a method of marking the rear of a train which is sufficiently distinctive to be immediately recognisable as such; the light used should be independent of the traction current supply for preference. The matter is one which the Inspecting Officers have had under consideration with the Board for some time, and it is being investigated afresh by the Board as a result of this accident; it is one of considerable importance, for the tail light may properly be regarded as the last defence of a stationary train, if protection by signal or otherwise has failed. The Board should be requested to report their final proposals without undue delay.

48. The absence of serious damage in the overtaking train (No. 59) was probably largely due to the heavy construction of its leading car, No. 2564, weighing 46 tons. It is also possible that the Buckeye couplers with which this train was equipped, following the practice of the former Metropolitan Railway, helped to prevent overriding and telescoping of its cars. That type of coupler and the "District" type in use on train 21 are both of the vertical plane pattern, having no restraint against vertical disengagement, but the Buckeye appears more likely to jam under an oblique thrust, and so to resist disengagement.

Except in the two telescoped cars most of the injuries to passengers appear to have been due to broken glass. As mentioned earlier, many of the transverse glass draught screens and some end windows were smashed in train 59 as a result of passengers being thrown violently against them; there was far less damage of this nature in train 21, owing to the absorption of the impact by telescoping. Passengers occupying the longitudinal seats nearest to the doors are very close to these draught screens, with which their heads are likely to come into forcible contact as the result of a violent stop; there was ample evidence of this having occurred in train 59. Therefore I think it desirable that all transverse glass, whether in draught screens or in end windows, should be of the safety variety, either laminated or toughened, to reduce the risk of serious cuts. I am glad to report that the Board have decided to substitute safety glass by degrees for the plate glass now used in such positions in their existing rolling stock.

With regard to the question of emergency lighting in the cars, for use when the traction current is cut off, I am informed that it would not be economically practicable to equip the existing District and Metropolitan stock with secondary

batteries and low voltage lights for this purpose, as is done on the Tube trains. The tunnel lighting which I have mentioned will improve matters in this respect, and I refer below to the arrangements to be made in future stock.

49. The Board authorised an extensive programme of rolling stock renewal some little time ago, affecting the District and Metropolitan lines as well as the Tubes, and deliveries are now being made. The new cars have several features which may be mentioned here. Steel is used almost exclusively in the body-work. The couplers are of an improved pattern affording security against vertical disengagement, and a construction of the headstocks has been adopted which will reduce the risk of overriding in the event of collision; also the end doors have been so constructed that they are unlikely to jam through buckling of the floor in such circumstances. All transverse glass is of the safety variety. The cars are lit by low voltage current, provided by a motor generator, and there are secondary batteries in the lighting circuit of sufficient capacity to keep a portion of the lights burning for a considerable time after the traction current has been cut off. The trains also have twin electric tail lamps, and as these are fed from the train lighting circuit they will remain alight on a train which is brought to a stand with its traction wiring " dead " on account of some electrical fault.

50. In conclusion, I think it appropriate to mention that several of the witnesses commented upon the absence of panic among the passengers in the two trains after the collision, even when the lights were finally extinguished. Indeed, I have been informed by a passenger who was travelling in the leading coach of the stationary train that as soon as the lights came on again when the circuit breakers were finally replaced, half a minute after the collision, practically all the occupants of the car settled down to read their newspapers and betrayed no curiosity as to what had happened. I cannot but feel that the maintenance of the lighting for as long as possible contributed to their calmness.

I have the honour to be,
Sir,
Your obedient Servant,
E. WOODHOUSE,
Lieut.-Colonel.

The Secretary,
Ministry of Transport.

(11926—54) Wt. 2049—3350 625 9/38 P. St. G. 379/13

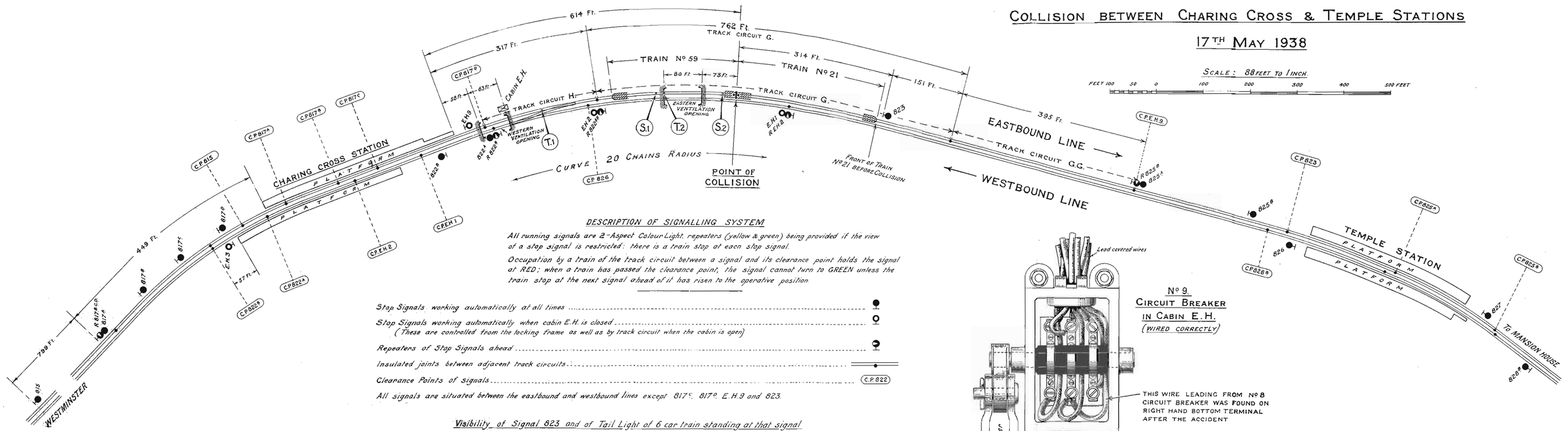
LONDON PASSENGER TRANSPORT BOARD District Line

COLLISION BETWEEN CHARING CROSS & TEMPLE STATIONS

17TH MAY 1938

SCALE : 88 FEET TO 1 INCH.

FEET 100 50 0 100 200 300 400 500 FEET



DESCRIPTION OF SIGNALLING SYSTEM

All running signals are 2-Aspect Colour Light, repeaters (yellow & green) being provided if the view of a stop signal is restricted: there is a train stop at each stop signal.

Occupation by a train of the track circuit between a signal and its clearance point holds the signal at RED; when a train has passed the clearance point, the signal cannot turn to GREEN unless the train stop at the next signal ahead of it has risen to the operative position.

Stop Signals working automatically at all times ●

Stop Signals working automatically when cabin E.H. is closed ○
(These are controlled from the locking frame as well as by track circuit when the cabin is open)

Repeaters of Stop Signals ahead ◒

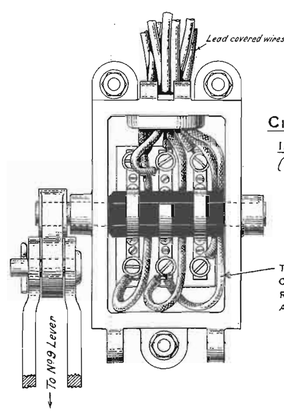
Insulated joints between adjacent track circuits ═

Clearance Points of signals (C.P. 822)

All signals are situated between the eastbound and westbound lines except 817C, 817D, E.H.9 and 823.

Visibility of Signal 823 and of Tail Light of 6 car train standing at that signal

	If Westbound Train is passing :-	
at S.1	*Signal 823 can be seen 345 feet away, at*	S.2
" T.1	*Tail Light " " " 153 " " "*	T.2



Nº 9 CIRCUIT BREAKER IN CABIN E.H.
(WIRED CORRECTLY)

THIS WIRE LEADING FROM Nº 8 CIRCUIT BREAKER WAS FOUND ON RIGHT HAND BOTTOM TERMINAL AFTER THE ACCIDENT