MINISTRY OF TRANSPORT

# RAILWAY ACCIDENT

# REPORT ON THE COLLISION

that occurred on

16th October 1962

between

WATFORD JUNCTION and
WATFORD HIGH STREET STATIONS

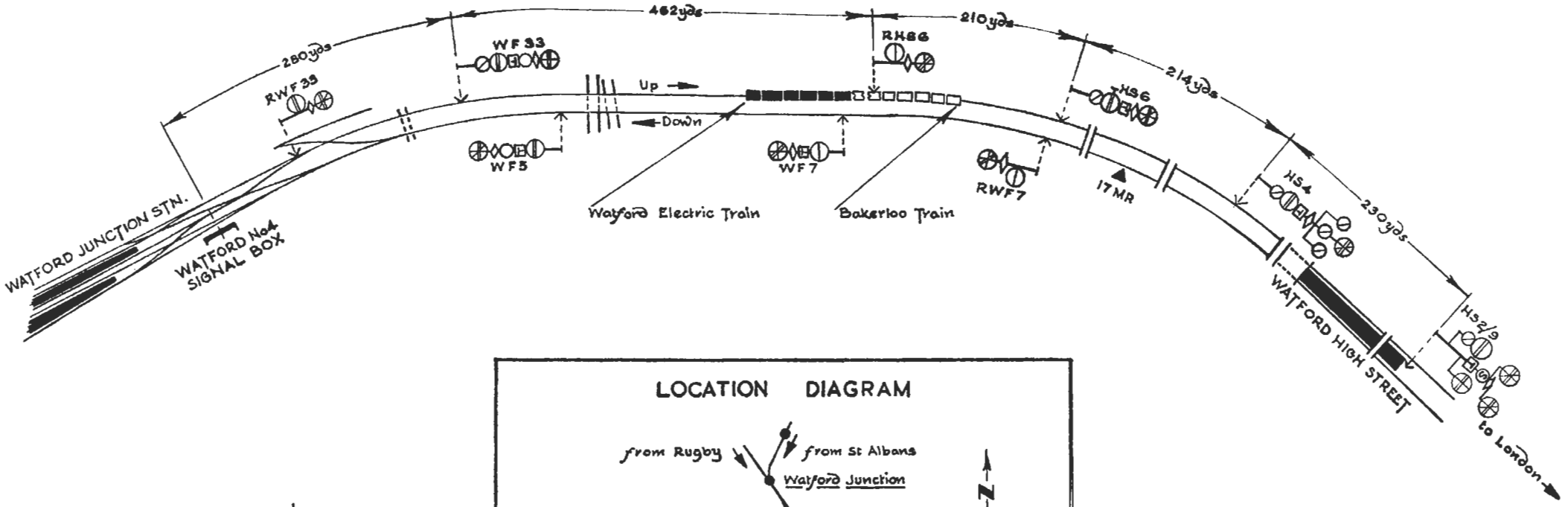
in the

LONDON MIDLAND REGION
BRITISH RAILWAYS

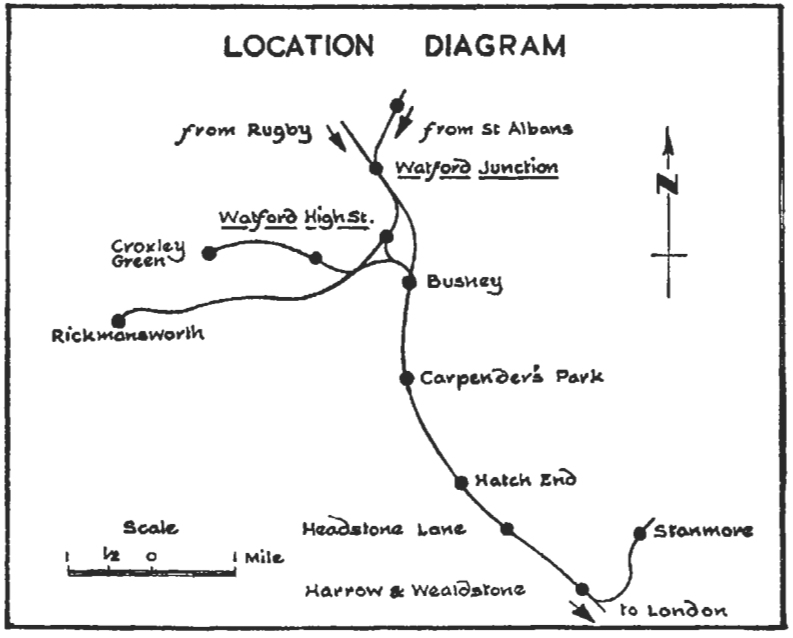
LONDON: HER MAJESTY'S STATIONERY OFFICE
1963

PRICE 1S. 3D. NET

# COLLISION BETWEEN ELECTRIC TRAINS NEAR WATFORD, 16 OCTOBER 1962








8 February 1963

MINISTRY OF TRANSPORT,

ST. CHRISTOPHER HOUSE,

SOUTHWARK STREET,

LONDON, S.E.1.

*18th February* 1963.

SIR,

I have the honour to report for the information of the Minister of Transport, in accordance with the Order dated 17th October 1962, the result of my Inquiry into the collision between two electric trains that occurred at 7.40 a.m. on the 16th October on the Up electric line between Watford Junction and Watford High Street stations in the London Midland Region, British Railways.

In fog, the driver of the 7.38 a.m. Watford Junction to Euston, 6-coach multiple unit electric train of the London Midland Region failed to exercise the requisite care after his train had passed a colour light signal at danger where a subsidiary signal was displayed to authorise him to proceed with caution, and allowed his train to collide about 400 yards ahead at a speed of 10-15 m.p.h. with the London Transport Board's 7.35 a.m. Bakerloo line electric train to Elephant and Castle which was stationary.

The London Midland Region train, which is of main line stock size, was little damaged, but the lighter and smaller Bakerloo train was crushed at the rear and the last coach crumpled the end of the one in front. Two passengers in this coach were trapped and severely injured; five other passengers complained of shock or minor injuries. The emergency services were called promptly and ambulances and the Fire Brigade were at the site within 10 minutes; great care was necessary however in freeing the two trapped passengers so as to avoid causing them further injury, and they were not finally released until three hours later.

The accident occurred shortly before the morning peak service, and there was much dislocation to traffic since it was necessary to remove electric power from both Up and Down lines during rescue and recovery operations. These were not completed until 6.0 p.m. when normal working was resumed. A number of main line trains were stopped out of course during the morning at stations between Watford and London to lift passengers, and additional services were also provided on the main lines. The bus service in the Watford area was reinforced in the course of the day to carry travellers between Watford Junction, Watford High Street and Bushey to connect with the abridged electric services.

## DESCRIPTION

### *The Line*

1. The London Midland Region two-track electrified line from Watford Junction to Euston and Broad Street diverges from the main line alignment immediately south of Watford to pass through Watford High Street station, and returns to it at Bushey, whence it runs adjacent to the main line. Electric power is provided on the direct current, two conductor rails, system similar to that on the London Transport lines, and the route is used by Bakerloo line trains between Watford Junction and Queen's Park on the outskirts of London, where the Bakerloo line tube to Elephant and Castle separates from the London Midland Region lines. At Watford High Street there is a branch to Croxley Green with connections to it also from the London direction. The general speed limit on the electrified line is 60 m.p.h. but between Watford Junction and Watford High Street where the accident occurred there is a lower limit of 35 m.p.h.

2. The distance from Watford Junction to Euston is 17¾ miles, and between Watford Junction No. 4 and Watford High Street signalboxes, ¾ mile. The gradient in the Up direction, towards London, is falling at 1 in 260 on leaving Watford and then at 1 in 84 in the area of the accident, about half-way between the boxes and near the repeater for High Street No. 6 signal. The formation changes from bank at the scene of the accident, to a sidelong slope before a cutting on the approach to High Street. It is fairly enclosed by houses on one side and trees on the other. The running time for electric trains over this short section is 2 minutes from a start at the Junction station to the start again after a halt of about 15 seconds at High Street station.

### *The Signalling*

3. The signals on the Up line between Watford Junction No. 4 and Watford High Street signalboxes together with other relevant information are shown on the diagram on the facing page. All these signals are searchlight colour lights, and are on the left hand side of the line at a height of 10 to 11 feet above rail level. The relevant Up line signals are Watford Junction No. 4 advance starter (WF 33), 280 yards ahead of the signalbox which is in turn about 110 yards ahead of the platform starting signals: the repeater (RHS 6) for the High Street signal No. 6, 462 yards ahead of WF 33: HS 6, 210 yards ahead of RHS 6: HS 4, 214 yards ahead of HS 6: and HS 2/9, High Street Up platform starters for the routes to London and to Croxley Green, 230 yards ahead of HS 4. High Street box is 107 yards ahead of these signals. WF 7 is a Down line signal 30 yards on the Watford Junction side of RHS 6.

4. The signalling on the electrified lines is of an unusual type designed to provide for "Stop and Proceed" train operation. This method of operating which allows drivers to pass signals at Danger under special caution is a departure from the statutory requirement for space intervals between passenger trains but it was specially authorised for the route between Watford and Camden (near Euston) in December 1937.

5. The lines are equipped with continuous track circuits which control the signals. The stop signals are, in general, two-aspect searchlights; a few at each end of the route are controlled signals, of the others some are automatic and some semi-automatic which work automatically when the lever which controls them is reversed. Those between Watford Junction and High Street are of the latter type. Four feet below each stop signal there are two signal lamps of which the upper one shows a red light and is known as the marker light, and the lower one a small yellow light when illuminated. There is a train stop on the track at each stop signal.

6. For a stop signal to clear (after the lever has been pulled, in the case of a semi-automatic) the track circuits between it and the next stop signal in advance, and also the overlap track circuit ahead of that signal must be clear. In addition, the signal in advance must be at Red with the train stop in the raised position. When a stop signal shows a proceed aspect neither the marker light nor the small yellow light is illuminated, but when it shows red the marker light is also illuminated unless and until four conditions are fulfilled. The first three conditions are that the signal lever must be reversed (for a semi-automatic signal): the first overlap track circuit beyond the signal must be clear: and the approach track circuit must have been occupied for a certain length of time. This time varies from signal to signal but the limits are generally between 60 and 80 seconds, and the intention is that an approaching train shall have been at a stand at the signal for nearly one minute before the time expires. When these conditions have been fulfilled the train stop at the signal is energised to become lowered, and when it is down (the fourth condition) the red marker light is extinguished and the small yellow light is illuminated. This authorises the train to proceed slowly forward to the next signal under the complete control of the motorman who must be prepared to stop it short of any obstruction. One long whistle must be given before proceeding past the signal.

7. A telephone is provided at each semi-automatic stop signal and is connected to the signalbox which controls it on an omnibus circuit; the instructions are that the motorman must telephone the signalman if the small yellow light signal is not illuminated within one minute of his stopping at the signal, and act in accordance with the signalman's instructions.

8. The instructions for automatic stop signals, where there are no telephones, are that if the small yellow light does not become illuminated the train may proceed after a halt of 3 minutes under the complete control of the motorman who must be prepared to stop it short of any obstruction.

9. The Distant signal indication on this system is provided by "Repeater" signals which are controlled by the aspect of the stop signals to which they refer and by the occupation of the relevant track circuits. They are equipped with three-aspect searchlight colour lights and are placed on the approach sides of their respective stop signals at braking distance; they show green when the stop signal is showing a proceed aspect: yellow when the stop signal is at Red but the line is clear to the overlap point beyond it: and red when the line is occupied within the overlap of the stop signal. In this last respect they are unlike normal Distant signals. Four feet below each Repeater signal and offset about 10 inches to the left of the signal post there is a marker light which shows red when the Repeater signal is at red, and which is extinguished when the Repeater shows a proceed aspect. On arriving at a Repeater signal at red the driver may proceed slowly after having stopped for one minute, and be prepared to stop short of any obstruction. There is no small yellow light at a Repeater signal and there is no train stop on the track, nor is there a telephone.

10. When signals are spaced close together and there is no separate Repeater signal, the stop signal on the approach side is equipped with a three-aspect searchlight colour light and the controls on the main yellow aspect are similar to those for a Repeater.

11. The two signalboxes are equipped with levers for the control of points and signals, but as already stated the Up line signals between the boxes are semi-automatic, except the controlled platform starting signals at Watford Junction, and the instructions are that the signal levers shall be normally maintained in the reversed position. Each signalbox is equipped with an illuminated diagram and train describers. To help the signalman to take note of congestion on the line during rush hours there is also a special indication for each track known as the "more than 2 indicator", which is illuminated when there are more than two trains on the line between the signalboxes. This is the number of trains which the main signal aspects permit of being between the boxes at one time, and the indicator therefore shows whether any trains have proceeded under the Stop and Proceed arrangements outlined in paragraph 5.

*Instructions*

12. The Instructions for working trains on these lines are incorporated in a special book which is issued to all drivers as well as to other staff, when they begin training on the line. Instructions 73 (a) (b) and (f) had some bearing on the accident and they are quoted below:

"73 (a) If from any cause a Danger aspect continues to be exhibited in the main light or lights of an automatic signal or semi-automatic signal, when working automatically, the red Marker light, where fixed vertically under the main light or lights, will automatically change to a

small yellow calling-on aspect, as shown above, after a train has been brought to a stand at the signal for ONE MINUTE, and the train stop has been operated to the "OFF" position. When this calling-on aspect is exhibited, the Motorman may proceed forward slowly towards the next signal, having his train under complete control and prepared to stop short of any obstruction. One long whistle must be given before proceeding past the signal.

(b) On semi-automatic signals, a plate bearing the letter "T" (black on white ground) is fixed to the post of the signals. This indicates a telephone is provided at or near the signal, and in the event of a Marker light not changing from red to yellow after ONE MINUTE the Motorman must proceed to the telephone applicable to that signal, advise the Signalman that the train is waiting at the signal and act in accordance with the Signalman's instructions.

(f) In every case when a train is allowed to proceed past a signal at Danger in accordance with preceding clauses (a), (b), . . . . , of this Instruction, as the case may be, it must be realised that the signal is at Danger possibly due to the presence of a train ahead, a broken or misplaced rail or an obstruction on the track. *It is, therefore, of the utmost importance that the greatest caution should be exercised by Motormen.* One long whistle must be given before proceeding past the signal".

*The Trains*

13. The London Midland Region multiple unit electric train consisted of six coaches of all-steel construction, with a total weight of 212 tons and length over buffers of 121 yards. The brakes were of the Westinghouse automatic, compressed air, type with an efficiency of 76%. The train was arranged in 2 sets of 3 coaches each with a motor coach weighing 47 tons at the leading end of each set followed by two trailer coaches weighing 29 and 30 tons respectively. The London Transport Bakerloo train was composed of seven coaches of all-steel construction with a total weight of 174 tons and length over buffers of 122½ yards. It was equipped with the electro-pneumatic and Westinghouse brake with an efficiency of 65%. The leading set of four coaches had motor coaches at the ends weighing 27½ tons each and two trailer coaches in between weighing 26 and 20½ tons respectively, and the trailing set of three coaches comprised two motor coaches weighing 27½ tons each and a trailer coach in between weighing under 18 tons. This trailer coach had been built in 1927 to a less robust design than the others, all of which had been built in 1938.

14. The Bakerloo train which is of tube stock dimensions is of smaller cross-section than the London Midland train. Its height above rail level is 9 ft. 6 ins. as compared with 12 ft. 8 ins. of the other and it is 1 ft. narrower. The floor level at the driver's position is 2 ft. 6 ins. above rail level as compared with 4 ft. 5 ins. on the London Midland train. The two tail lamps on the Bakerloo train are at 2 ft. height above rail level, and because they are placed so low the lenses are made so as to direct a part of the beam upwards at an angle of approximately 50°.

*The Damage*

15. There was comparatively little damage to the London Midland Region train, the three front windows of the driver's compartment were broken and the end bodywork was pressed in slightly, with damage to the bus line and control connectors, but the driver's compartment itself was not wrecked. The front bogie head stock was stove in and the lifeguards bent, and the brake rigging at the front end was bent and broken.

16. The damage to the light Bakerloo stock was much more severe. The massive buffers of the London Midland Region train crumpled the end bodywork of the rear coach and the frame of the leading London Midland Region coach overrode the lower and lighter frame of the Bakerloo coach, which was then struck end on by the front bogie of the London Midland Region coach. The force of the impact was such that the rear Bakerloo coach telescoped the more lightly built trailer coach ahead, bending the sole bars and the metal bodywork inwards to trap the two passengers, a married couple, who were seated near the back of the coach. Endeavours to separate the two coaches in order to free the passengers had to be made with great care in order to avoid movement of distorted bodywork which might cause further injury. There was no derailment.

## Report

*The Accident*

17. There was no important conflict of evidence, and the events that led up to the collision were clearly described. It occurred before the peak period of morning traffic, but the two trains involved were nevertheless the 10th and 11th respectively to have left Watford Junction station since 7.0 a.m., and after then six more trains were programmed to leave the station over the electric line before 8.0 a.m. The Bakerloo train was stationary when the collision occurred, with the rear end about 30 yards on the approach side of Signal RHS 6, having closed up to the 7.29 a.m. 3-coach Watford to Croxley Green train which was standing at Signal HS 6.

18. Trains had been running to time in spite of the fact that Signal HS 4 had failed at Red shortly after 7.0 a.m., and the fog, though thick in patches, had not dislocated traffic. *Signalman T. J. Riley* at High Street box noticed at about 7.7 a.m. that Signal HS 4 did not clear, and finding it difficult to get the lineman who was engaged elsewhere on signal maintenance, applied for a hand signalman to flag

trains past the signal. Knowing that some time would elapse before the hand signalman could get into position, he sent a message to the staff at Watford Junction station through the signalmen at Watford No. 4 signalbox to the effect that drivers should be informed of the failure and should be told to telephone him promptly on arriving at the signal, without waiting one minute for the small yellow call-on light to appear. He would then be in a position to authorise them to pass the signal at danger and proceed with the greatest caution as soon as he was satisfied from the indications on his illuminated diagram that the line was clear to the signal ahead (the platform starter), and thus avoid an accumulation of small delays which could upset traffic. He thought that the drivers of all the six trains which approached Signal HS 4 after the message had got through to Watford telephoned him from that signal and that no calls had been made from signal HS 6. His relief arrived shortly after the accident and Riley then went to the site and conducted some of the passengers to the station.

19. *Station Foreman W. H. Sabin* confirmed that he had received the message about HS 4 being at fault and he said that he had told all train crews to telephone promptly to the signalman from the signal. He had five terminal platforms to supervise and he did not always speak to the drivers of the Bakerloo trains before they changed ends but he then told the guards who advised the drivers on the train telephone. He was sure that he had given the message to drivers of London Midland trains which are not equipped with driver to guard telephones, and he remembered telling Driver Sedgwick of the 7.38 a.m. train, whom he knew by sight. He was sure that he had told Sedgwick that signal HS 4 had failed and had been precise in mentioning the signal number.

20. *Driver J. W. Butler*, of the 7.29 a.m. 3-coach train to Croxley Green, the train directly ahead of the Bakerloo line train, said that he was told about HS 4 being out of order. He approached WF 33 slowly under a caution indication and before he stopped at it he saw the small yellow light appear. He did not thereafter stop his train but proceeded cautiously to RHS 6 which was at Red, and stopped there for a minute in accordance with the rules. He then went forward slowly until he stopped behind the previous train, a London Midland Region one which was standing at HS 6. After that train had moved ahead he also went forward to HS 6, telephoned the signalman, and in due course was told to proceed. He telephoned again from HS 4 and was again authorised to proceed. As his train was entering High Street station it stopped due to the current being cut off.

21. Butler thought that the visibility had allowed him to sight signals WF 33 and RHS 6 at about one coach-length distance (20 yards) but he saw the train ahead at more than twice that distance as soon as he had passed RHS 6. He said that he had worked on the electric line for a number of years and that he seldom had had to proceed on the small yellow call-on light, less than once in a month was his estimate. When asked why he did not stop his train at signal WF 33 for one minute even though the small yellow was exhibited, he maintained that the instructions did not require him to do so. He did not remember whether he had whistled or not as he passed the signal.

22. *Guard F. Curtis* of the 7.29 a.m. train confirmed that he had been told that HS 4 had failed. He saw RHS 6 at Red when they stopped at it from his position in the third coach and he could see the train ahead when they stopped again between RHS 6 and HS 6. When the train arrived at HS 6 he saw the driver get down to the telephone and he then went to the driving compartment at the rear of the train from where he saw the Bakerloo train approach to within about four-coach lengths. His train went forward slowly after a stop of about two minutes.

23. *Guard Motorman H. A. Stewart* was at the controls of the 7.35 a.m. Bakerloo train under the supervision of *Motorman H. Carter*. Both men said that the Guard told them on the train telephone that HS 6 had failed and Carter said that he asked him to repeat the number. The train stopped at WF 33 for about half a minute before the small yellow light appeared and then went forward slowly to RHS 6. After stopping at this signal the train again went forward and was stopped behind the Croxley Green train about 90 yards ahead of the signal. (The tail of the Bakerloo train was then about 30 yards on the approach side of signal RHS 6). Stewart said that the Bakerloo train was struck about 30 seconds later; Carter thought that the time was less. The brake was only lightly applied when the accident happened.

24. *Guard L. G. Morrison* of the Bakerloo train was sure that he had been told by the Station Foreman that HS 6 had failed and he passed this message on the train telephone to his motorman. His position was near the front of the rear car and he was at it when the collision occurred. He did his best to calm the few passengers in the coach and then tried to attract the attention of the motorman of a Down train, which had stopped on the other line at signal WF 7 opposite his train, to open the power operated doors by the release catch on the outside of the coach. The motorman did not understand but after a short while Driver Sedgwick from the London Midland Region train which had run into his train released the doors for him. He then went to the coach ahead where the two passengers were trapped to give all the help he could. Morrison remembered that the fog was not very thick and that he could see the houses on the side of the line. He confirmed that he switched on the tail lamps before leaving Watford and that he had checked that they were alight. He did not hear any whistle or sound of brakes before the collision.

25. *Driver A. Sedgwick* of the 7.38 a.m. London Midland Region train, which collided with the Bakerloo train, was passed for driving electric trains over this line in June 1962. Before then he had been a steam driver for a year and had not worked over the electric line except the short length between Watford Junction and High Street en route to Croxley Green. He is 34 years of age and his eyesight is good. By his answers, he showed me that he understood the signalling and knew the meaning of the marker light and the small yellow aspect. He said that he had been told before leaving Watford Junction

station that there was a signalling failure at High Street but he was sure that the actual signal had not been specified. His understanding was that when he stopped at a signal he would telephone without delay to the signalman. His train left on time but had to proceed under Caution towards WF 33; at this signal he saw the small yellow light appear as the signal came into view when he was still about three coach lengths away and he did not stop his train, passing the signal at a speed of 10-15 m.p.h. His train continued down the falling gradient and he kept the brakes rubbing to keep the speed down. He saw RHS 6 and the outline of the Bakerloo train at the same moment at about one coach length's distance and made an emergency application of the brake; he thought at first that his train would stop but then, according to him, the wheels picked up and the train slid into the Bakerloo train.

26. When questioned as to why he did not stop at WF 33 Sedgwick maintained that the Instructions did not require him to stop if he was given the small yellow light and he was emphatic that this light was showing when the signal came into view. When asked what he thought when he saw the light, he said that he associated it with the advice he had received of a signal failure and not with the possibility of the line ahead being occupied. He admitted that he had no justification for adopting this view, but repeated that he would not have done so if he had not been told about the signal failure. Because of what he thought he was looking ahead at his own level for the next signal and did not notice the Bakerloo train as quickly as he might have done if he had been looking down. (It is to be noted that, seated at the controls, his eyes would be about 9 ft. 6 ins. above rail level. If he were looking for the signal which was, in fact, 10 ft. 4 ins. above rail level he would therefore have been looking above the level of the Bakerloo train ahead.) After the collision Sedgwick descended and applied his short circuiting bar to the conductor rails; this caused a flash to open the circuit breakers and cut off power. Thereafter he helped in rescue work.

27. *Guard J. J. Cullen* of the 7.38 a.m. train said that the station foreman told him after he had changed ends at Watford Junction station that HS 4 was out of order and that he told the foreman to tell his driver. He was not able to observe signals on the journey and was taken unawares when the collision took place. He went back to Watford No. 4 box which was only 200 yards in rear to report the accident after speaking to his driver and watching him put down the short circuiting bar. He thought that the speed at the time of the accident was 10-15 m.p.h. and that the brakes were applied just before the accident happened.

28. *Motorman P. J. Smith* of the Down Bakerloo train from Elephant and Castle to Watford which stopped at Signal WF 7 opposite the Up Bakerloo train, said that he saw the London Midland Region train approach and hit the Up train. He did not hear any whistle or see the sparks of a heavy brake application; his motor generator was working, however, and his windows were closed and he said that he might not have heard an extraneous noise. It was also suggested to me that the dampness of the fog might have reduced the tendency for a heavy brake application to cause sparking between brake block and wheel. Smith secured his train and went to the telephone at WF 7 but did not get a reply from the box so went to a nearby house where the resident made an emergency call. Smith and *Guard A. V. Roberts* then helped to transfer passengers from the Up train to their own. It was afterwards verified that the telephone at WF 7 was in order and it is probable that Smith did not wait long enough for the signalman in Watford Junction No. 4 box to answer, when he rang.

*Relief Arrangement*

29. Rescue and relief arrangements were made quickly and energetically. The breakdown lorries of the London Transport Board which could get close to the site by road arrived at 9.20 a.m. and the rescue work was supervised by *Mr. B. S. Williams, Line Engineer (Metropolitan and Bakerloo line)* of the London Transport Board in conjunction with the Fire Services. After the two trapped passengers had been released work was begun on preparing the Bakerloo train for movement. This was completed at 4.25 p.m. when current was restored.

*Examination and Tests*

30. *Mr. F. J. Pardoe, Rolling Stock Engineer*, who arrived on the scene about an hour after the accident, said that examination of the track showed skid marks 18 ft. 6 ins. long where the leading wheels had been made to skid by the brake gear becoming jammed in contact with the Bakerloo train, but no signs of the London Midland Region train having skidded before the collision. There was also a mark 28 ft. long on the centre, negative, rail caused by the rear coupling of the Bakerloo train which had been broken and forced down in the collision. This indicated that the Bakerloo train had been pushed forward this distance or a little more in the collision. Mr. Pardoe thought that the speed of the collision, if the brakes of the London Midland Region train were fully applied at the time, must have been not less than 15 m.p.h. for the trains to have moved this distance and for the amount of damage that occurred to have taken place. In tests which were made after the accident in similar conditions at the site a 6-coach train stopped in 73 ft. from 15 m.p.h. There was no sign of skidding after the emergency brake application during these tests. The brakes of the 7.38 a.m. train were tested shortly after the accident and were found to be in order.

*Signal Failures*

31. The evidence about the accident brought to light two faults in the signalling; one was that signal HS. 4 had failed and the other that the small yellow aspect under signal WF 33 at Red became illuminated before approaching trains had come to a stand at the signal. *Signal and Telecommunications Inspector C. W. Cullum* said that the failure of signal HS 4 was finally traced to the disconnection

of one of the leads at the thermal timing relay. It kept the signal at Red. At signal WF 33 the thermal timing relay which should operate to lower the train stop and clear the small yellow aspect 70 seconds after the approach track circuit to the signal, which is 110 yards long, has been occupied, if a main proceed aspect cannot be given, was found to be inaccurate. During a number of tests Mr. Cullum found that the delay was reduced to 38 seconds after four quick operations; he said that a reduction in the time of operation was a feature in the working of thermal relays when they were not given time to cool down between successive operations. He found however that this relay operated after only 56 seconds when cool, and he therefore changed it. Mr. Cullum said that there had not been a failure of a thermal relay previously since 1945 and that the general limit of variation of the relays was of the order of 5 seconds from the stipulated time. He added, when asked, that the most frequent cause of signal failure was in the train stop equipment, through the detection circuit not being made when the train stop had been lowered. This of course was a failure on the safety side: it might happen four or five times in a year.

*Training of Drivers*

32. In view of Driver Sedgwick's short experience as an electric train driver on this line I asked *Motive Power Inspector J. Eastaff* what training Sedgwick had been given. Mr. Eastaff said that the training on a conversion course such as this consisted of 15 days in the Chief Mechanical and Electrical Engineer's depot at Stonebridge Park learning the technical features of the power unit, and two weeks with his instructors on the line. During these two weeks learner drivers would be shown the signals, and the way in which they work would be explained. Drivers were also issued with the "Book of Instructions" and were required to learn them. No special efforts were made to illustrate the stop and proceed procedure, though the significance of the marker light and the small yellow aspect was fully explained. When asked to comment on Driver Sedgwick's statement that he had allowed himself to be misled as to the significance of the small yellow aspect after being told that a signal ahead had failed, Mr. Eastaff said that the conditions in which this subsidiary signal would be given had been clearly explained and that Sedgwick had no grounds for his assumption that a main proceed aspect had not been given only because of the signal failure ahead.

33. In regard to the evidence that drivers had not stopped at WF 33 because the small yellow aspect had been given before their trains reached the signal Mr. Eastaff said drivers had never asked him about such a situation but that he would certainly have expected them to have stopped their trains in such circumstances, as he interpreted the Rule.

## Conclusion

34. Prime responsibility for this accident rests on Driver Sedgwick who failed to exercise the necessary care after passing signal WF 33 at which he received the small yellow aspect. I have no reason to doubt his statement that he had been instructed in the meaning of this aspect and that he knew it. His assumption that he did not receive a main aspect at the signal because of a failure and that the line was clear to the signal ahead, was unjustified, as he admitted.

35. I attach little importance to the misunderstandings which may have arisen over which particular signal between Watford Junction and Watford High Street had failed. This information to drivers was for the purpose of encouraging them to use the telephone at a stop signal without delay, and there was no justification for any of them assuming that the line ahead of any signal showing the small yellow aspect might be unoccupied. In fact, at this time of busy traffic, the assumption should have been to the contrary, since, with the "stop and proceed" facility given by the signalling on this line, the effect of a failure would have been to cause trains to close up to one another on the approach to a faulty signal, so setting up the conditions for "stop and proceed" at preceding approach signals.

36. The premature clearing of the small yellow aspect at signal WF 33 may well have contributed in some degree to the accident, since if it had not cleared until Driver Sedgwick had stopped his train he might have been driving more slowly as he approached the train ahead. This premature clearing was contrary to the conditions under which the system of train operating in force on this line was authorised, and I refer to this again in succeeding paragraphs.

37. Instruction 73 (a) of the London Midland Region Instructions for this line is not as clear as it should be and does not state unequivocally that a train approaching a stop signal at red must stop for at least one minute, even if the small yellow aspect should appear prematurely. I am informed that it is being suitably amended.

## Remarks and Recommendations

38. The misjudgment which gave rise to this accident would probably not have taken place but for the special "stop and proceed" system in force, and it is desirable therefore to consider the need for retaining this unconventional system on the electric line to Watford.

39. The desire to adopt "stop and proceed" on the open line arose first at the turn of the century when the earliest automatic signals were installed, so that if a signal should fail at danger trains might proceed cautiously to the next signal and so avoid unnecessary delays. With the space interval system of operating, generally known as the Absolute Block, which is the normal statutory requirement for passenger railways, authority to proceed at an automatic signal at danger is given, when appropriate, by the signalman on request over the telephone from the driver. If the telephone has failed a driver may proceed in certain circumstances, on his own responsibility under extreme caution as far as the line is clear after a suitable wait. Subsidiary signals are provided under main signals to "call-on" trains at extreme caution into an occupied section only in the vicinity of stations to enable trains to enter occupied platforms, and in a few other well-defined situations. Moreover, subsidiary signals are controlled by the signalman.

40. The special development of "stop and proceed", however, as applied to the Watford Electric line included the automatic clearing of the "call-on" aspect (the small yellow) when a stop signal was working automatically, together with authority to pass repeater signals at Red after a halt of one minute. This arrangement was deemed necessary for the intensive passenger train traffic on the line. It meant, in effect, that a type of working akin to "Permissive Block" took place when the leading train of a series became delayed. In order to make sure that a train did in fact stop at a stop signal at danger before proceeding, train stops were incorporated in the system (though the relevant one worked prematurely on the occasion of this accident), thus reducing the liability to misjudgment of speed by the driver as the train closed up to the one ahead. The approval of the Minister to this system of working was given on 2nd December, 1937. One of the conditions of approval was that there was no freight traffic over the line except between Watford Junction and High Street boxes; "stop and proceed" is not permitted when freight trains are in this section.

41. The need for "stop and proceed" has become less, so far as failures are concerned, over the years with the improvement in signalling equipment and technique and in the detection of broken rails, and it should be unnecessary to retain it on this ground. So far as working the system for traffic purposes is concerned, there are obvious hazards from possible misjudgment by drivers, though the Watford Electric line has had a very good record of safety until this accident. A few weeks after the accident, however, on the 5th December, another "stop and proceed" collision occurred in thick fog on this line at Willesden New Station. On this occasion a London Midland Region electric train which was standing at the platform was struck by another similar train which had been correctly brought to a stand at the signal in rear, about 220 yards distant, and had then passed it under the authority of the small yellow aspect. The driver of the colliding train fully understood the conditions and admitted that he had simply misjudged visibility in the thick fog and that his speed of about 10 m.p.h. or a little more was, in the circumstances, too high.

42. In order to form a view of the extent to which "stop and proceed" is used I asked for the opinions of a number of experienced drivers on this line to be obtained about proceeding under the authority of the small yellow aspect. I was informed that the concensus of opinion was that a driver would expect to be given this aspect about two or three times in the year except in fog when, depending on the thickness of the fog, he might have to work his way forward under the authority of the small yellow aspect with extreme caution on a number of occasions during each trip, knowing that he was closing up to another train. These are the very circumstances in which "stop and proceed" is most vulnerable.

43. I therefore discussed with the railway officers whether the traffic requirements of the line could not be met after eliminating the marker lights and small yellow aspects, and the red aspect in repeater signals. The authority to proceed to drivers of trains stopped at signals could then be given on the telephone by the signalman, when the circumstances warranted, as is done on other stretches of the line which have continuous track circuits and colour light signals. I was assured however that the cost of such alterations would be very considerable as it would be necessary to provide telephones at the many automatic signals and to extend the track circuit indications for long distances to the few boxes on the line which are always open. If a comprehensive telephone system and full indication of track circuits were not provided the capacity of the line would be reduced at critical times since the signalman would not be in a position to authorise a driver to pass a signal at danger. The officers felt that they could not accept this, not only on grounds of present peak traffic densities, but also because the re-arrangement of timetables following on the completion of the main line electrification to Euston would involve a reduction in the number of main line stops between Euston and Watford, thereby adding traffic to the electric line. They considered that the safety record of the electric lines had been very good until these two recent accidents and that a heavy expenditure on signalling was not justified.

44. The officers proposed as an alternative to my suggestions that an alteration should be made to the electrical controls so as to ensure that the small yellow aspect could not be exhibited until a train had been brought to a stand at a stop signal. This would be effected by providing a plunger on the signal post which would have to be depressed by the driver to complete the timing circuit of one minute for energising the controls for the train stop and the small yellow aspect. It would be necessary for the driver to get down from the train to reach the plunger. A minor change would be required to the Instruction which requires the guard to go back to protect the rear of the train in fog or falling snow after a detention of one minute, as the waiting time for "stop and proceed" would now always be rather more than one minute, and they proposed to authorise a wait of two minutes. In addition they proposed to install at each semi-automatic signal an "A" sign which would become illuminated when the controlling box was closed and the signal was working automatically. Finally it was proposed to improve the omnibus telephone system where necessary so that not more than three to five signal post telephones at the worked and semi-automatic signals were on one circuit and that each such circuit was used only to link signal post telephones with the signalbox.

45. The Railways' proposals are by no means far-reaching but they do strengthen the "stop and proceed" procedure at its weakest point. I have no doubt that the need for a driver to get down from the train and depress the plunger, and then wait for one minute before being given the small yellow aspect, will impress upon him that he is proceeding into an occupied section. The "A" signs and improved telephone communications are also valuable improvements. I recommend that these proposals be accepted in view of the cost of more drastic alterations, but I hope, when the time comes to renew the signalling, that a conventional system will be provided.

46. In regard to the premature working of the timing relay at signal WF 33 I am informed that these relays are tested every two months and that it is rare that they are found to vary from their designed timing by more than a few seconds. Under the arrangements now proposed the premature working of the relay will be of less significance since the timing effect will not commence until the train has been stopped and the driver has got down from it and has depressed the plunger.

47. My final recommendation concerns the training of drivers. So long as "stop and proceed" is to continue I consider that every driver under training should be given a demonstration on the line under service conditions of this operation so as to bring its meaning home to him.

I have the honour to be,

Sir,

Your obedient Servant,

W. P. REED,

*Colonel.*

The Secretary,

Ministry of Transport.

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