



DEPARTMENT OF TRANSPORT

RAILWAY ACCIDENT

Report on the Derailment
that occurred on 6th May 1977
at Borough Market Junction

IN THE
SOUTHERN REGION
BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE

50p net

RAILWAY INSPECTORATE,
DEPARTMENT OF TRANSPORT,
2 MARSHAM STREET,
LONDON SW1.
12th July 1978.

SIR,

I have the honour to report for the information of the Secretary of State the result of my Inquiry into the derailment of a suburban passenger train at 04.54 on 6th May 1977 at Borough Market Junction between London Bridge and Cannon Street Stations in the Southern Region of British Railways.

The train, which was the 04.14 Addiscombe-Cannon Street 10-car electric multiple unit (EMU) had been signalled over a crossover between the Up Charing Cross line and the Up Fast (Cannon Street) line when the rear bogie of the eighth car, a motor bogie, became derailed at the facing points of the crossover and was directed towards the Up Charing Cross line. The coupling between the eighth and ninth cars parted and the train came to rest with the eighth car derailed on the Up Fast line, its rear bogie detached and astride the Down Charing Cross line and the rear two cars derailed on the Up Charing Cross line.

The emergency services were prompt in arriving but were not required. No passengers were injured, although the guard was badly shaken. It was dark and the weather was damp at the time of the accident but visibility was good.

DESCRIPTION

The Site and Signalling

1. The layout of the tracks at Borough Market Junction was radically altered in 1976 under the London Bridge re-signalling scheme to that shown in the diagram at the end of this Report. Reading from the north, Platforms 1-3 at London Bridge Station serve the Cannon Street lines converging first into the Down and Up lines and, as they curve northwards onto Southwark Railway Bridge over the River Thames, diverging into Down and Up Slow lines to the east and the Down and Up Fast lines to the west. Platforms 4-6 similarly serve the Charing Cross lines converging into the Down and Up lines just west of the platforms. Platforms 1 and 4 are for Down trains, 2 and 5 are reversible, and 3 and 6 are for Up trains. The main separation of trains for the two termini is now achieved at St. Johns where a new flyover has been constructed but, in order to retain flexibility, an emergency crossover has been retained between the Up Charing Cross line and the Up Fast Cannon Street line commencing at facing Points No. 715.

2. The line approaching Points No. 715 curves right-handed at a radius of 144 m and is carried over Borough High Street on a steel girder viaduct on bridge beams. Beyond the points the line passes onto a brick arch viaduct, the Charing Cross line first continuing the right-hand curve but then curves left-handed. The emergency crossover continues curving right-handed throughout, firstly at 144 m radius to the crossing then at 301 m radius to the first diamond crossing with the Down Charing Cross line at 3,479 m and 490 m over this line and then 208 m, 260 m and 140 m radius towards Cannon Street. The design cant was 15 mm at the switches of Points No. 715 reducing to zero part way along the lead curve. Initially the line falls at 1 in 140 from the London Bridge platforms but then becomes approximately level. The lines are electrified at 750 volts DC on the conductor rail system.

3. The lines are signalled on the track-circuit block system controlled from London Bridge Signal Box with four-aspect colour-light signalling. AWS is not provided in the London Bridge area. No. 5 Platform Starting signal is Signal L98 which reads to L86 on the Up Charing Cross line for signalling trains through the crossover, when a junction indicator is illuminated.

The Track

4. Because of the tight curvatures, the cross-over was laid in 95 lb bull head rail of medium manganese steel in chairs on jarrah hardwood timbers. The switches were of 'E' type with a joggle in the stock rail to give protection to the tip of the switch blade. The turnout was laid on ballast over a brick arch ring viaduct in April 1976. Because side thrust was causing a widening of gauge, 3 gauge ties were added in December 1976 and the crossing timbers were strutted to the viaduct structure.

The Train

5. The train consisted of two 4-car EPB (Class 415/1) units leading, and one 2-car EPB unit (Class 416/2) to their rear. Only the front and rear bogies of the 4-car units and the leading bogie of the 2-car unit were motored. Hence of the 20 bogies throughout the train, the first, eighth, ninth, sixteenth and seventeenth

bogies were motored. The cars in each unit were permanently coupled with centre buffers and link couplings but buckeye couplings were provided between units. The trailer cars of the 4-car units weighed approximately 28 tons with an axle loading of 7 tons, but the motored cars weighed approximately 40 tons, their trailer bogies having an axle loading of $7\frac{1}{2}$ tons and the motor bogies of $12\frac{1}{2}$ tons. Each motor bogie was powered by two 250 HP traction motors. The train was 648 ft long overall, it weighed 353 tons and had a brake efficiency of 74 per cent. The units were provided with track-circuit operating clips in their driving cabs and guard's compartments for use in an emergency. Speedometers were fitted.

The Course of the Derailment and Accident Damage

6. The leading left-hand wheel of the rear (motored) bogie of the eighth car mounted the switch blade of facing Points No. 715 and dropped into the space between it and the cess-side stock rail of the Up Charing Cross line. The car was hauled, derailed, across the Down Charing Cross line and separated from its power bogie. The car struck a girder of the bridge carrying the Charing Cross lines over Cathedral Street, Southwark, and came to rest overhanging the street between the two lines and tilted at an angle of about 15 degrees towards the six-foot side. Its leading bogie was dragged into derailment and its detached power bogie came to rest astride the Down Charing Cross line. The train divided behind the eighth car and the rear 2-car unit came to rest with all its wheels derailed to the six-foot side of the Up Charing Cross line and foul of the Down line.

7. Damage to the train was limited to the rear three cars of the train. The eighth car was severely damaged along its left-hand side when it struck the bridge girder and there was considerable damage to its bogies and brake rigging. Its under-frame and solebar were twisted and its leading head stock was bent. The damage to the rear two cars was less extensive and mainly below solebar level.

8. Seven track timbers were damaged as well as 90 rail chairs. The drive stretcher bar on Points No. 715 was damaged as well as track-circuit cables and two hook switches.

EVIDENCE

As to the derailment

9. *Signalman J. T. Phillips* had been on duty working Nos. 1 and 2 panels in London Bridge Signal Box since 21.30 the previous evening. Because of planned engineering work, the 04.14 Addiscombe to Cannon Street train was programmed to use No. 5 Platform, and it arrived on time. Signalman Hall, working No. 3 panel, actually set the route for the train to proceed from Signal L98 via Points No. 717 and 715 reversed to Signal L82 and Signalman Phillips watched the train depart. He noticed nothing untoward until 04.56, when the driver telephoned him from Signal L78 to say that his train was derailed. All lines were protected by signals at Danger and he sent the 'Obstruction Danger' signal to Blackfriars Signal Box. The driver again called him and asked him to have the traction current switched off as one car was in a dangerous position and he wanted to get a passenger out of it. He had this done, but was unable to contact the driver again to tell him so.

10. *Driver A. Gadd* prepared the train at Addiscombe at 03.13 and, with his guard, carried out a satisfactory brake test on it. The train left on time and arrived at London Bridge also on time where they waited 3-4 minutes. He saw Signal L98 displaying a Red aspect and later a Yellow aspect which he saw change to a Green one, and after receiving the usual bell signal from his guard he drove the train at a steady 15 mile/h towards Cannon Street Station. He told me that his practice was not to accelerate to 20 mile/h because of the 15 mile/h restriction ahead. His normal method of driving was to start off in 'shunt' and then change into 'series' control but to shut off power near Signal L90. He would then re-apply power after he had passed Signal L86 and then maintain it to keep the train moving through the crossover.

11. He told me that his train was travelling at between 10 mile/h and 12 mile/h when he felt a slight jolt and almost immediately a much more severe one; then he saw a flash on the left-hand side of the train. He released his dead man's handle, made a full emergency brake application and, on looking back, saw a car obviously derailed. He got down on the cess-side of his cab and telephoned the signalman who replied, so far as he could remember, "All right driver—all roads are blocked". He then went back through his train and told passengers, of whom there were about 15, to stay where they were. When he arrived at the eighth car he met another driver helping his guard to alight. He telephoned the signalman again to ask whether the current had been cut off, but on seeing a passenger trying to alight from the eighth car, which was swaying, and on the six-foot side where the conductor rail was situated, he left the telephone and asked the other driver to put down a short-circuiting bar and to get the passenger out. By this time the Fire Brigade had arrived.

12. He realised, even in the dark, that his train must have been obstructing the Down Charing Cross line, but he took the signalman's assurance that all lines were blocked; he did not, therefore, consider it to be necessary to put down track-circuit operating clips on the line. He did, however, place three detonators and a red flag on that line as an added precaution.

13. *Guard A. T. Oram*, who was travelling in the guard's compartment at the rear of the eighth car, confirmed his driver's evidence and thought that the train's speed just before the derailment was about 15 mile/h. He also thought that the train was coasting at the moment of derailment. He, too, felt the two jolts and believed that the second one was probably caused by the train becoming divided.

14. He was thrown violently onto an ambulance box and then set about trying to get out of the train. When he did so, his first thoughts were for the passengers, and particularly for a man in the eighth car which was swaying. He watched the driver put down four short-circuiting bars on the Cannon Street lines and then went to help people out of the train, by which time the Station Supervisor had arrived and taken control.

15. *Mr. P. D. Negus*, a Senior Technical Officer of the Chief Mechanical and Electrical Engineer's staff based with the Divisional Traction Engineer at Beckenham arrived at the site of the derailment at about 09.15. He examined the toe of the switches of No. 715 Points and, from the position of the cars and the markings on the cress rail, concluded that it was the power bogie of the eighth car that first became derailed. It was clear to him that the car's leading bogie had become derailed only after the car had run broadside into the bridge girder.

16. He could find nothing wrong with the buckeye couplings that had parted and assumed that they must have become disengaged because of excessive vertical movement. He noted that a piece about 70 mm long had been broken off the toe of the cress-side switch blade of Points No. 715 to a depth of about 9.5 mm, and that the break was old and rusty. There were wheel flange marks on the top of the blade and three 'drop off' marks where a wheel had dropped down between the blade and the stock rail some 420 mm, 460 mm and 520 mm from the tip of the points blade. There were also wheel flange marks on the outside of the blade to a depth of about 40 mm, about one metre after these 'drop off' points, and clear indications where the derailed wheels had struck chairs and a fishplate while dropping between the two rails. In his view, the wheels of the two motor bogies of the eighth and ninth cars had become derailed in this way.

17. The fit of the switch blade to the stock rail appeared to be good, but its top was sufficiently beneath the level of the top of the stock rail for several people to draw his attention to it; and the loss of metal over the first 70 mm accentuated this.

18. The rolling stock was fully examined after the accident and no faults, other than those attributable to the accident, were found on it; the brakes were functioning correctly. The tyre profiles of the power bogies of the eighth and ninth cars were found to be only very slightly worn with very little wear in the roots of the flanges.

As to the maintenance of Points No. 715

19. *Mr. J. L. Newing*, the Divisional Civil Engineer, South Eastern Division of Southern Region, outlined the organisation of his staff. The Area Civil Engineer in charge of the London Bridge area was *Mr. R. C. Gorringe*, under whom there were three Permanent Way Supervisors and eight Assistant Supervisors. Supervisor *J. Tuomey* was based at New Cross with three assistants, including *Mr. J. McGuire*, his deputy, and *Mr. F. W. Skinner*, who supervised nine permanent way gangs including Track Chieftain *Wade's* who was responsible for the length of track where the derailment occurred.

20. *Mr. Newing* reported to me the state of the points after the accident had occurred. The sharpest radius of curvature through the turnout was at the points themselves and was found to be 85.3 m instead of the designed 144 m. He did not think that this would be easily discernible by eye. The cant when measured was found to be 23 mm eight sleepers in front of the switch tips, 11 mm at the switch tips, and reducing to zero four timbers beyond. The gauge was 9.5 mm wide, i.e. $\frac{3}{8}$ in wide to 4 ft 8½ in at the switch tips.

21. In addition to the normal sole plate on the first timber and the three gauge ties before the first timber, between the second and third timbers, and between the fourth and fifth timbers, there was an additional sole plate on the fourth timber. Half sole plates had also been inserted beneath the rails with a view to their being welded in situ. They were on the sleeper before the points and on the fifth, seventh, and tenth timbers. *Mr. Newing* told me that the first slide chair supporting the left-hand stock rail had broken several days before the derailment and plans had been made to change it. The second slide chair was also broken but the break was new and it had probably occurred during the passage of the derailed train. The left-hand stock rail was 7 mm above both of these slide chairs and unsupported by them. These are clearly shown in the photograph.

22. There was some side cutting on the ccss-side stock rail but it was not great and there was a loss of head of the stock rail of 3 mm. It was the insertion of the half sole plates, and particularly that on the sleeper prior to the point ends, that had raised the left-hand stock rail above the slide chairs so that it was excessively above the level of the switch blade under traffic.

23. *Track Chageman W. R. Wade* was responsible for Points No. 715. Except for three years' service elsewhere, he had served the whole of his time since 1965 in the Borough Market Junction area and knew the connection well, both before and since its relaying. He inspected the track every other day, alternating with his Leading Trackman, to walk the Cannon Street and Charing Cross lines respectively. They were always accompanied by lookoutmen for protection.

24. Mr. Wade told me that since the hardwood timbers had been used, chair screws had tended to break and the gauge ties had been added to reduce side pressures. Nevertheless, in February 1977, the tie nearest the tips of the points had itself broken. He had inspected the points on Wednesday, 4th May, two days before the derailment, when he found the first slide chair to be broken. One stud bolt was loose and also one on the ninth timber, which he tightened. He also found 11 broken chair screws which he replaced the following day by sliding the timbers through and re-drilling the holes.

25. Mr. Tuomey had already instructed him to insert three more sole plates and an occupation had been planned for the night of Friday, 6th May, for the work to be done. Mr. Wade told me that it was he who decided to insert the fourth sole plate on the sleeper; he also decided to insert all four as half plates and to carry out this work under traffic on the morning of 4th May when he replaced the chair screws. This would tie in with the welder's programme and give time on the Friday night for the broken slide chair to be replaced. At about 10.00 on 5th May in heavy rain they dug out the ballast beds, took out the chair screws, prised up the rails and slipped in the half sole plates. They then tightened down the screws and re-packed the sleepers using shovels and two Kango hammers. They worked for about twenty minutes on this task between trains and finished at about 12.30. Finally the point detection was checked by technicians and found to be correct. He was most surprised to see the voids under the sleepers when he inspected the points after the derailment.

26. *Assistant Supervisor F. W. Skinner* supervised the work of nine gangs including Wade's. The loss of metal from the tip of the switch blade was reported on 22nd January and the points were then listed for special inspection once every fortnight. It was his responsibility to carry this out. Mr. Gorringe had instructed all his assistants to inspect all points in both the normal and reverse positions and to let him know if there was any difficulty with the signalmen in achieving this. Nevertheless, Mr. Skinner told me that it was not always possible to have the route set reversed through the crossover because of the number of trains passing.

27. He inspected the points on the 2nd, 14th and 31st March and on 5th April, during which time there was little further deterioration. When he inspected them on Tuesday, 3rd May, two or three chair screws were broken, but he did not notice that the chair itself was broken. The points were then 6 mm to 9 mm wide to gauge at their tips. He was not aware that it was planned to put in the sole plates and he had given no instructions regarding them. He had been on night duty in the latter half of April until Friday, 30th April, a week before the derailment, when he had resumed day duty.

28. *Supervisor J. Tuomey* inspected the points on 19th April when Mr. Skinner was on night duty and found that the broken tip to the blade had become no worse. He was unable to check the points reversed but he watched the ccss-side stock rail under traffic from the six-foot side by looking under a train. There was some movement of the stock rail because of the considerable side thrust of trains proceeding towards Charing Cross. He had already made arrangements for sole plates to be added on the fifth, seventh and tenth timbers and had planned a possession to be taken on the following (Friday) night for the work to be done. He had discussed this with Chageman Wade but not with Mr. Skinner whom he assumed knew all about it. He went on holiday on 29th April for a week but, because of illness, did not return to work until 14th May.

29. *Assistant Supervisor J. McGuire* was the senior assistant under Supervisor Tuomey and in charge of his section from 29th April to 16th May when Mr. Tuomey was on holiday. Part of his task was to allocate manpower for weekend work and he had told Mr. Wade that the possession on Friday night, 6th May, had been agreed and he made sure that Wade had received adequate instructions from Mr. Tuomey for the insertion of the sole plates. He also examined Mr. Skinner's section when the latter was on night duty. He did not carry out an inspection during the week of the accident because he knew that Skinner had inspected the line on 3rd May. Nor had he known that Wade had inserted the half sole plates on the Thursday under traffic, which had not been planned.

30. *Mr. R. C. Gorringe*, the Area Civil Engineer, had visited No. 715 Points on 2nd February and 23rd March as part of his regular inspections. He too examined the points from the six-foot side under traffic with the points set normal for the Charing Cross line. He noted no deterioration in the broken switch blade

between the two dates. Mr. McGuire had told him about the fitting of sole plates on the points and he understood that McGuire had discussed this with Chargeman Wade.

31. When I asked Mr. Gorringe whether he was satisfied with the way Mr. Wade had handled the work on Points No. 715 he replied "To be perfectly honest, no." He added that if the points needed the addition of a sole plate in front of their tips then the timbers should have been lowered the depth of the plate so that the relative levels of the stock and switch rails would have remained unaltered. When he looked at the points after the derailment the stock rail was 9 mm above the switch blade. In his opinion, Mr. Wade should have realised this and he, Gorringe, would not have condoned the work being done under traffic because of the difficulty of repacking the timbers properly with the conductor rail energised.

32. He described the turnout as being very similar to No. 26 Points at the same location prior to the new layout being introduced. There had been two derailments on those points in August 1958 and in May 1970 and both were caused by a powered wheel climbing over the switch blade. The problem was a well known one and occurred when the switch blade was worn and the wheel tyres were relatively unworn. He was satisfied, however, that the new points could be maintained in a safe condition with the manpower then available so long as they were properly maintained.

On the need to retain the emergency crossover

33. When the earlier layout at Borough Market Junction was brought into use at the end of the last century, the traffic density was much less than at present and most of the peak hour trains were routed into Cannon Street. As traffic increased the signal spacing was reduced and the maintenance problem became a much more difficult one. It was to avoid conflicting movements over the junction and to ease the maintenance of the track that the new layout was introduced. Initially the emergency crossover was to be abandoned, but it was finally retained to ease the maintenance work on Nos. 1-3 Platform lines and to provide flexibility in the routing of trains when certain failures occurred. It then became necessary to route a few trains each day over the connection to ensure the safe operation of the track circuits.

34. Mr. B. H. Hamment-Arnold, Divisional Movements Manager, told me that it was essential to retain the connection for the reasons given above and that its elimination would impose severe restrictions on the maintenance of the lines in the vicinity of London Bridge Station. About three trains were routed over the connection each day to maintain its track circuits. In addition, during the 13 months since the new layout had been introduced, the crossover had been required for engineering purposes for five 24-hour periods, and for emergency use for a total of 20 hours, making a total of 140 hours use in all.

CONCLUSIONS

35. The derailment was caused by the left-hand wheels of the sixteenth and seventeenth bogies in the train, which were power bogies, climbing the closed switch blade and becoming derailed along the Up Charing Cross line. I believe that the bogies were under power just before this occurred, whereas the train was probably coasting when the previous power bogies successfully negotiated the points.

36. The reason the wheels became derailed was because the stock rail had been raised by the insertion of a half sole plate on the last sleeper before the points for which Track Chargeman Wade must bear the full responsibility. There is no evidence that Driver Gadd was exceeding the speed limit, and I do not believe that he was.

REMARKS AND RECOMMENDATIONS

37. I must accept Mr. Hamment Arnold's view that it is essential to retain the emergency crossover to ease the track maintenance problem in the London Bridge area and to provide flexibility in the case of a failure of other sets of points or of trains in the area. Unfortunately, because of the proximity of the viaduct, the turnout cannot be increased in length to improve its alignment, or increase the radius of curvature, but a realignment is being made to flatten the curve through the turnout.

38. Track Chargeman Wade was the chargeman of a static gang and to some extent therefore decided what work was to be done following his own track examinations. He lacked the close support of either his Supervisor or Assistant Supervisor. Mr. Tuomey was ill following a short holiday and Mr. Skinner had been on night duty when plans were made for the sole plates to be added. Mr. McGuire, Mr. Tuomey's deputy, who stood in for Mr. Skinner and who planned the work with Mr. Wade, failed to tell Mr. Skinner what was planned and failed to brief him on his return to normal duties on 30th April. There seemed to be some lack of supervision of Mr. Wade for which Mr. McGuire, in Mr. Tuomey's absence, must remain responsible.

39. Guard Oram took no action to protect the lines in rear of his train, and Driver Gadd's first thought was to telephone the signalman for him to protect the lines; he took with him his flags and detonators but forgot his track-circuit operating clips. A special design of clip has been introduced on Southern Region which is safe to use on a conductor rail system and train crews have not yet generally formed the habit of using them. But to be useful they must be applied immediately after an accident as laid down in British Railways Rule Book Rule M2.1.1. The use of these clips provides immediate protection even on reversibly signalled lines and this point should continue to be stressed to all train crews.

40. None of the inspectors reported that they had inspected the points in the reversed position when set for the crossover, and it seems that this was hardly ever done in spite of Mr. Gorrings's instruction. This matter requires more careful co-ordination with the operating staff in future.

41. One factor in this derailment was the tendency of the track to move laterally under side thrust which resulted in a local sharp radius of curvature. This should be checked more regularly so that the alignment can be corrected before such radii occur.

42. The points themselves incorporated rolled manganese steel rail on jarrah hardwood timbers with additional gauge ties, and yet the side thrust from the normal traffic was sufficient to cause slide chairs and their chair screws to break requiring continuous maintenance. Even reinforced as described, the turnout, using traditional components, was only maintained in a safe condition with considerable difficulty. If the addition of the sole plates does not have the desired effect, I recommend that consideration should be given to laying a 'slab track' using flat bottomed rail and robust fastenings in order to considerably ease the maintenance problem and to improve the safety of the connection.

I have the honour to be,

Sir,

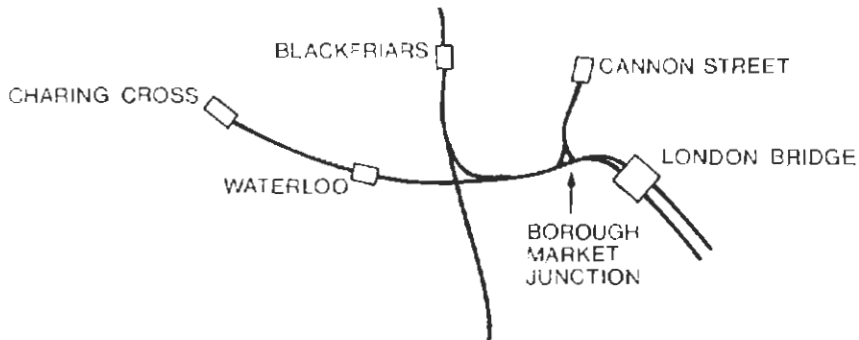
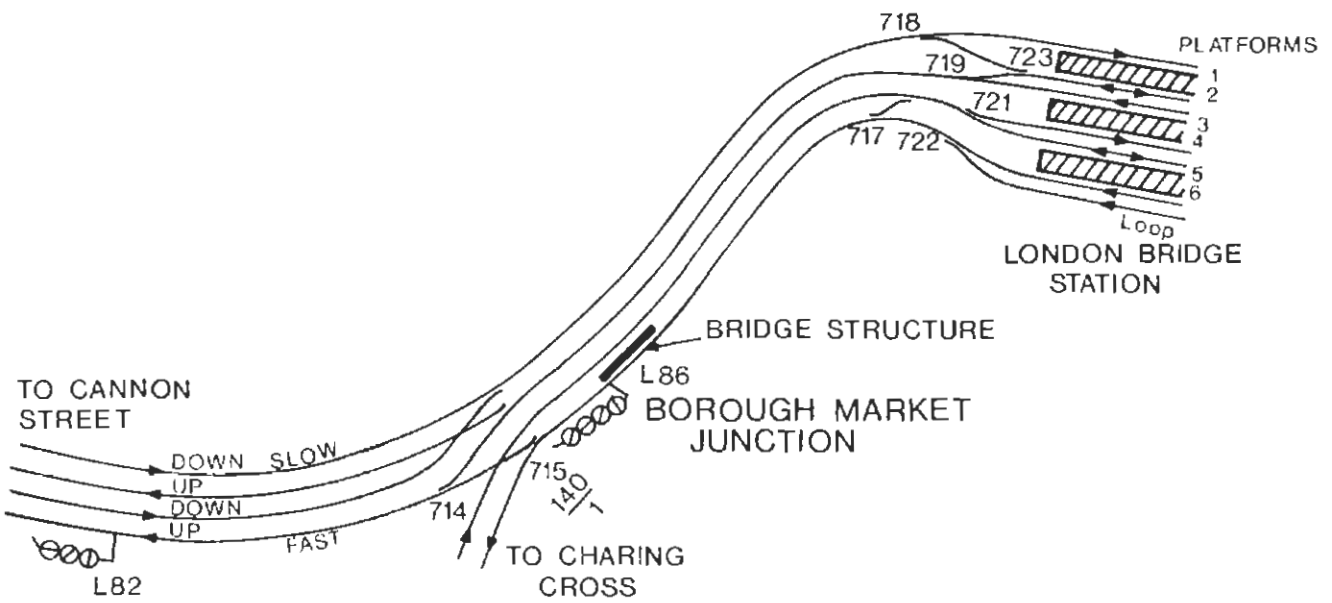
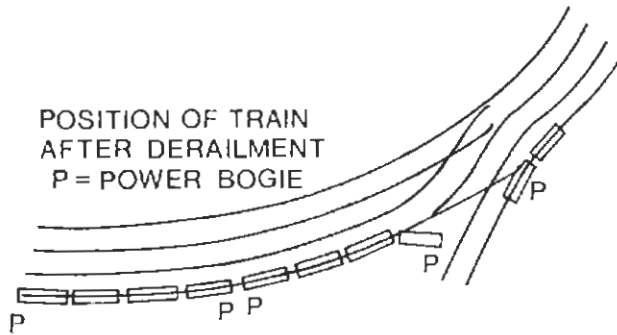
Your obedient Servant,

A. G. TOWNSEND-ROSE,
Lieutenant Colonel.

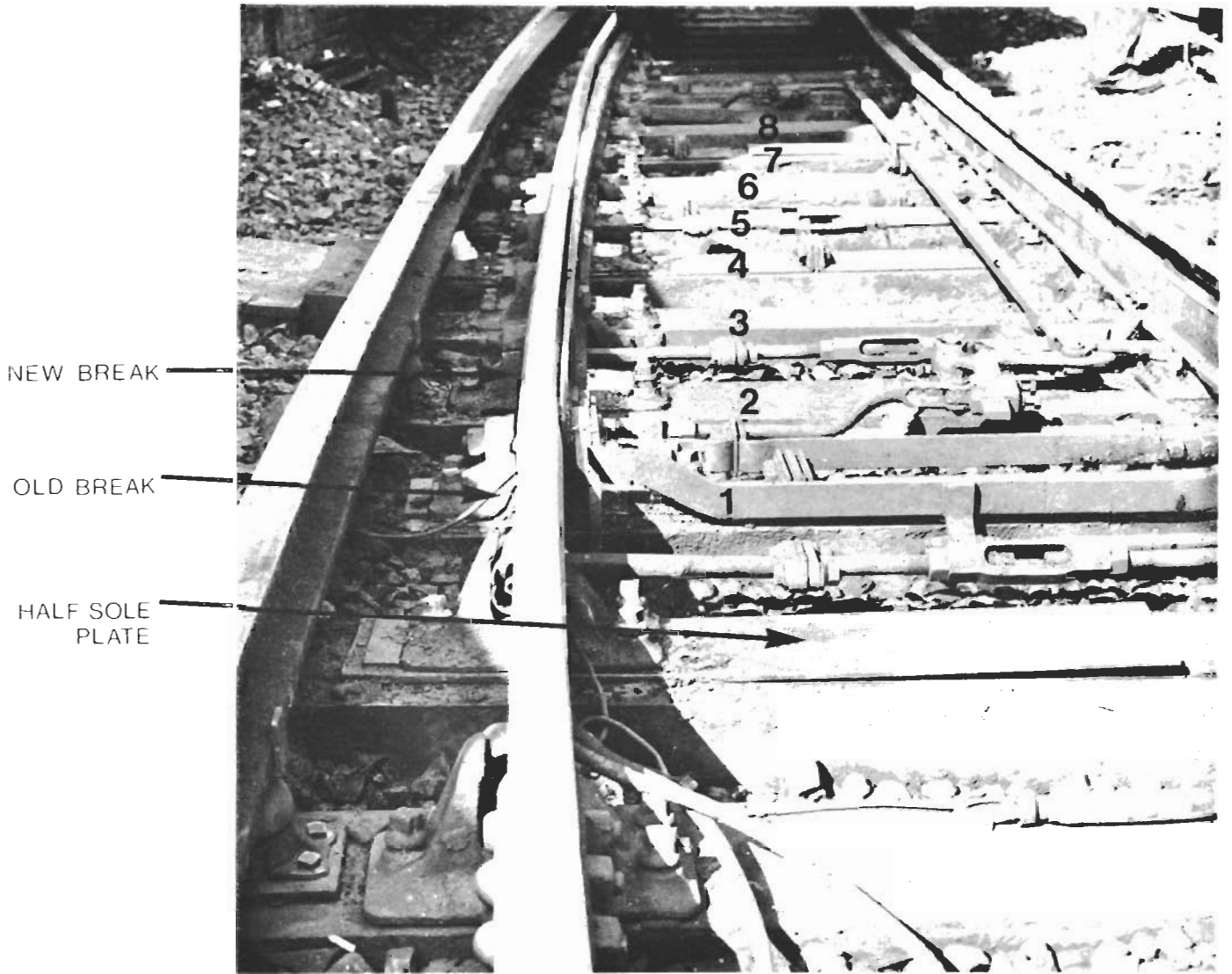
The Permanent Secretary,
Department of Transport.

DERAILMENT AT BOROUGH MARKET JUNCTION - 6 MAY 77

NOT TO SCALE



LOCATION DIAGRAM



POINTS No. 715 - AFTER DERAILMENT