MINISTRY OF TRANSPORT

RAILWAY ACCIDENT

Report on the Derailment that occurred on 5th March, 1967 at Connington South

IN THE
EASTERN REGION
BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE
1969

MINISTRY OF TRANSPORT,
ST. CHRISTOPHER HOUSE,
SOUTHWARK STREET,
LONDON, S.E.1.
22nd May 1969.

Sir,

I have the honour to report for the information of the Minister of Transport in accordance with the Order dated 7th March 1967, the result of my Inquiry into the derailment of an express passenger and mail train that occurred at about 23.36 on Sunday, 5th March 1967, at Connington South, about 7 miles south of Peterborough on the East Coast Main line of the Eastern Region, British Railways.

The train was the 22.30 from King's Cross to Edinburgh, formed of 11 bogie vehicles, including 3 post office vehicles and 1 sleeping car, and hauled by a Type 5 diesel-electric locomotive. It approached Connington South down the 1 in 200 gradient from Abbots Ripton with power off at a speed of about 75 m.p.h., and when passing over the facing connection leading to the Down Goods line, the rear portion of the train became derailed to the left in the direction of travel.

A division occurred between the seventh and eighth vehicles, the rear four coaches coming to rest almost on their left-hand sides about 200 yards beyond the point of initial derailment. The sixth vehicle, with one bogie derailed, and the seventh, with all wheels derailed and tilted to the left, remained attached to the front portion of the train which came to a stand about 600 yards further on.

I regret to report that five passengers were killed and eighteen injured, two of them seriously. All the casualties occurred in the rear portion of the train.

The emergency services reached the somewhat isolated site without delay and all the injured were on their way to hospital by 00.43.

The derailment was directly caused by the actions of the signalman on duty in Connington South signalbox at the time of the accident, who unlocked and opened the facing points whilst the train was passing over them. No fault or shortcoming of any significance was found in the signalling equipment or in the condition of the track or the train.

The derailment occurred on a dark clear night with a fresh southerly wind.

The Site and Signalling

1. Connington South lies 67¼ miles from King's Cross on the East Coast Main line at a point where the line starts to cross an area of drained fenland extending from this point northwards for about 4½ miles. As the line comes on to the fenland the gradient changes from 1 in 200 falling in the Down direction to level, with the line on a wide low embankment about 6 feet above the surrounding fen. The line speed limit at this point is 90 m.p.h., but there is a restriction to 70 m.p.h. at Holme, about 2 miles to the north. To the south of Connington South there are four tracks, the main lines being flanked by Up and Down Goods lines; to the north there are only three tracks, the Up and Down Main lines and a Down Goods line. The signalbox, which is isolated, being about 2 miles from the neighbouring village of Conington, stands on the Up side of the line with a clear view along the line in both directions, and controls connections between the Main and Goods lines and access to a tip siding on the east of the main line. The layout is shown on the attached plan.

2. Train signalling on the main line is on the Absolute Block System, the adjacent signalboxes being Abbots Ripton, 3¾ miles distant in the Up direction and Connington North ⅞ mile distant in the Down direction. On the Down line approaching Connington South there are Intermediate Block Home and Distant signals worked from Abbots Ripton. These are colour lights, and the IB Home, which is a 4-aspect signal, acts also as Connington South Down Main Distant signal (Y/YY), slotted by lever No. 13, and Connington North Down Main Outer Distant signal (YY/G). Otherwise the signals for the Down direction at Connington South are oil-lit upper quadrant semaphores, those applying to the Down Main line being grouped on a bracket signal post located between the Down Main and Down Goods lines 128 yards south of the signalbox. This post carries the Down Main Home signal (No. 14) and, at the time of the derailment also the Down Main to Down Goods signal (No. 6) both these signals being mechanically operated from the signalbox. Beneath the former, the Connington North Down Main Inner Distant Signal is located; this is an electrically operated semaphore arm, and it is provided with an AWS inductor located 200 yards on the approach side of the signal.

Signal Controls and Interlocking

3. Full standard block controls are provided on the Down Main line at Connington South and before Line Clear can be given by the signalman at Connington South to the signalman at Abbots Ripton the lever of Signal 14 must be locked in its normal position and the berth track circuit unoccupied. Welwyn control is effected through the berth track circuit (TC "G") which extends from a point 200 yards on the approach side of Signal 14 to a point 58 feet beyond the signal, from where a further track circuit (TC "A") extends to beyond the site of the facing connection to the Down Goods line (No. 27 points) which has been removed since the accident.

4. At the time of the accident the mechanical interlocking of the 28-lever frame, which is of the Dutton's pattern with catch handle locking, was conventional. Lever No. 14 was only free to be moved to the reverse position when the three point levers operating points ahead of the signal were in the normal position and the point lock lever (No. 26), which operated the plunger lock on No. 27 points, was in the reversed or locked position. Lever No. 13, which when normal controlled the aspect of the Intermediate Block Home Signal to one yellow, was released by lever No. 14 reversed.

5. The facing point lock lever, No. 26, was also electrically locked in the reverse position and the facing point lever, No. 27, in both the normal and reverse positions by the occupation of track circuit "A". The electric locks were of the solenoid-operated type in which the locking dog falls into the notch by gravity and, in addition, a forcing piece actuated by a stud on the lock tappet is fitted to the dog so that, should it fail to fall fully home, it is drawn down into the locking notch by the final movement of the tappet.

6. The locks were located at the back of the lever frame, operating on lock tappets attached to the levers themselves above the quadrant plate and were normally de-energised, i.e. in the locked position. Each lock circuit could be completed, provided TC "A" was unoccupied, by means of a foot-operated button switch located on the floor in front of the frame. Emergency releases for the electric locks were located in the instrument shelf adjacent to the levers concerned; access to a release could only be obtained by breaking a paper seal.

The Track

7. The track in the Down Main line approaching Connington South was relaid in 1965, and consisted of 109 lb. FB CWR on softwood sleepers for a distance of about 40 chains, followed by a short length of 110A FB rail on concrete sleepers. It was ballasted with slag to a depth of about 12 inches below sleeper bottom. At the time of the derailment there were three connections in the Down Main line, mechanically operated from Connington South signalbox. In succession these were a trailing lead from the Down Goods line, a trailing crossover between the Main lines, and a facing lead to the Down Goods line which has since been removed. The turnouts, which were all in FB material, were laid on hardwood timbers, but there was a 60 foot length of track on concrete sleepers between the two trailing connections.

8. The facing connection at which the derailment actually occurred was a 1 in 12 left hand turnout with curved and chamfered "D" switches located 32 yards north of the signalbox. It also was relaid in 1965.

The Train

9. The train involved was hauled by "Deltic" Type 5 diesel-electric locomotive No. D9004 and comprised 11 vehicles marshalled as follows:—

1 Brake van, corridor,
3 Post Office sorting vans,
1 Sleeping car, composite,
3 Second class, corridor,
1 Composite, corridor,
1 Second class, brake, corridor,
1 Brake van, corridor.

The total weight of the train, including the locomotive, was 477 tons with a brake efficiency of 78·4 per cent. With the exception of the three Post Office vehicles, the train was buckeye-coupled. The maximum permitted speed of the vehicles forming the train was 90 m.p.h., with the exception of the 5th, 7th and 9th vehicles which were permitted to run at 100 m.p.h.

10. The train had left King's Cross on time at 22.30 and was due to make its first stop at Grantham at 00.26. It was carrying 147 passengers.

The Course of the Derailment and Damage

11. The locomotive came to a stand some 800 yards beyond the facing points with 7 vehicles still attached. The first 5 vehicles were undamaged and not derailed, the 6th derailed one pair of wheels at the trailing end, and the 7th derailed both bogies with the body leaning over towards the Down Goods line.

12. At the rear of the 7th vehicle the buckeye coupling was in the dropped position with the support pin hanging undamaged on its chain. The coupling was in the closed position but the lower portion of the moveable jaw was broken off. The fracture, apart from a small blowhole in the casting which would have formed a point of weakness, was new and had apparently occurred by sudden overstressing. The broken portion of this coupling was found close to the 67½ milepost, near where the 8th vehicle came to rest.

13. The coupling at the leading end of the 8th vehicle was undamaged but with the jaw in the open position. This could have occurred through contact with the ballast. The 8th and 9th vehicles were lying on their sides with the 10th and 11th vehicles leaning over the Down Goods line. The coach bodies were not seriously damaged but most of the side lights on the near side of the 8th and 9th vehicles were shattered. All the bogies were detached and one, the leading bogie of the 8th, came to rest upside down over 100 yards further down the line.

14. Apart from a small bruise on the stock rail side of the tip of the left-hand switchblade of the facing connection, the first distinct signs of derailment were between this switchblade and the stockrail at the last slide chair, effectively the first point at which a wheel could have forced its way down between the two rails. There were marks indicating that at least 5 wheels had followed this course and in doing so had forced the switchblade and stockrail apart, causing the former to be twisted in a clockwise direction, pivoting about

the coachscrews of the slide chairs. It seems probable that this rotation would have the effect of slightly twisting the point of the switchblade despite the resistance of the facing point lock stretcher, but not far enough to allow a flange in its normal path to strike and bruise the tip of the switchblade when in the closed position.

15. There were no signs anywhere of a wheelflange having climbed the running edge and there was no flange marks on the running surfaces of either the switchblade or stockrail. There were, however, some faint marks on the planed side of the switchblade which could possibly have been caused by the flanges of wheels running on the stockrail whilst the switchblade was in a partially open position.

16. There was no damage on the approach side of the facing points and no damage to the facing point lock or point operating mechanism. The left-hand switchblade detector slide had been moved $\frac{3}{8}$ inch beyond its travel in the normal direction. This could be accounted for by the residual twist left in the switchblade which stood about $\frac{3}{16}$ inch away from the stockrail at the top after the accident with the points in the normal position and the facing lock plunger fully home. There was no other damage to the detection and no marks on the home signal detector blade indicating that the signal had been restored to danger against the resistance of the displaced slide.

17. The facing point lock stretcher and first point stretcher were undamaged, but the second was bent consistent with an inward movement of the left-hand switchblade at the point where it was forced apart from the stockrail by wheels dropping between it and the switchblade.

18. The bulk of the damage beyond this point can be reasonably ascribed to the consequential derailment of the rear portion of the train.

Evidence

19. The driver of the train was *Driver B. Oakton*, stationed at King's Cross. He described his approach to Connington and said that after a signal check at Huntingdon, which had reduced his speed to about 15 m.p.h., the train had reached about 80 m.p.h. by Abbots Ripton. He then closed the controller and allowed the train to coast down the 1 in 200 bank towards Connington. He did this deliberately to see whether the train would maintain its speed down the bank. It did not do so and its speed had dropped to about 75 m.p.h. on reaching the foot of the bank. Driver Oakton clearly recollected the signal aspects at Connington South and was confident that both the Home signal and the Distant for Connington North, beneath it on the same post, had been green up to the moment they passed out of view. Shortly afterwards there was a sudden application of the brakes, with the vacuum falling to 5 inches for a few moments and then to zero.

20. *Secondman P. A. Wheaton* confirmed his driver's evidence as to both speed and signal aspects and described how, as the train came to a stand he could see that the train had become divided and partially derailed. He went forward immediately to protect the Up line and reported the situation to the signalman at Connington North.

21. In charge of the train was *Passenger Guard J. Wright*, stationed at Grantham. He carried out a careful inspection of the train before leaving King's Cross and found all in order with the running gear of the train. In particular he was satisfied that the coaches were correctly coupled and that the support pins were in position on all the buckeye couplings. This was confirmed by *Carriage and Wagon Examiners D. A. Reddie and E. A. Lloyd* who had both inspected the stock for the train at Hornsey Carriage Sidings.

22. As far as Huntingdon, where Wright had observed the signal aspects when the train was checked, the journey was uneventful. He did not observe the signal aspects at Connington. Wright was travelling in the last vehicle of the train and was bruised and dazed when it was tilted over in the course of the derailment. He had some difficulty climbing out of the van because the lights were out and he was unable to find his handlamp, but he then ran to the signalbox which he could see about 200 yards distant. When he got near the box he called "Are you there, Bobby" and the signalman came to the window. He then shouted to him to call for the Fire Brigade, Ambulances and Doctors. As Wright went up the steps into the signalbox he heard the signalman sending the emergency bell signals and when he entered the box the signalman had just got on to Control by telephone. Wright himself then informed Control of the situation before returning to the wrecked train to assist the injured passengers. He did not notice anything strange about the signalman's behaviour, but then he himself was in a shocked state and thinking only about the urgent need for help.

23. The signalman on duty in Connington North signalbox, to whom the secondman reported the derailment, was *Relief Signalman H. G. Thaxter*. He had given the "Line Clear" for the train at 23.28 and received the "Train Entering Section" signal at 23.34. Very shortly after this he heard a noise and his signal indicators went to "wrong". He at once telephoned the signalman at Connington South and asked him the position of his signals, which were visible from Connington South, and whether anything was wrong. The reply was to the effect that the signals were in order, but the train appeared to be coming to a stop. A few minutes later, Thaxter received the "Obstruction Danger" signal from Connington South and at about the same time the secondman arrived and reported the derailment.

24. *Signalman A. J. Frost* was on duty at Connington South. He was 20 years old and had been appointed a trainee signalman one year prior to the accident, in March 1966. After training, he took up Signalman's duties, first at Connington North and subsequently, after promotion to Class 2, at Connington South where he had worked since August 1966. He was described to me by Mr. E. Howell, Divisional Movements Manager at King's Cross, who had interviewed him at the time of his first appointment as a signalman and again on transfer to Connington South, as an intelligent young man with a good knowledge of rules and regulations.

25. Though, in giving evidence at the railway investigation which preceded my Inquiry, he first said that he had not heard the noise of the derailment and had been unaware of it until the guard of the train arrived outside the signalbox, he told me that he had, in fact, both heard and seen the derailment but explained that he was so shaken that he took no immediate action. He confirmed that he had spoken to the signalman at Connington North and told him that the train appeared to be coming to a stop, even though he was aware it was derailed. He did not, in fact, take any emergency action until the guard reached the signalbox some four minutes after the derailment took place.

26. I questioned Frost closely on his actions during the passage of the train and he was insistent that he had not restored the Home signal to Danger until the tail of the train had passed the signalbox and he had seen its tail lamp, though he admitted that he had irregularly sent the "Train out of Section" signal to Abbots Ripton before the train was past the clearing point. When giving his evidence Frost was composed and rational and explained that the long pause between his becoming aware of the derailment and starting to take the laid-down emergency action was due to his horror at what seemed to have happened.

27. Connington lies in the area for which *Permanent Way Inspector J. G. Abbott* was responsible. The last time he had walked through the section prior to the derailment had been on 27th February and he had found the track in first class condition, without appreciable error in cross level or alignment, no side wear and no signs of movement in the sleepers. Mr. Abbott was called out when the derailment occurred and described the condition of the track as he found it. The derailment had apparently occurred at the facing points but he could find no indication that the switches had been split and he could see no explanation for the derailment. A careful recheck of the cross levels on the approach had revealed no differences greater than one sixteenth of an inch except at an insulated joint in the preceding trailing connection where there was a difference of a quarter of an inch. He noted a bruise on the tip of the left-hand switchblade and saw that the blade itself was twisted and standing away from the stockrail about $\frac{3}{16}$ inch. He then saw that the switchblade was being tilted away from the stockrail by a piece of cast iron, broken off a chair, wedged underneath it and when this was removed the switchblade fitted almost perfectly.

28. After the switches had been unlocked and reversed, Mr. Abbott noted marks on the planed side of the switchblade which could in his opinion have been made by wheelflanges but he was unable to see how they had got there since he could see no trace of a flange having climbed the rail at any point. He also saw the marks on the foot of the switchblade which he thought might have been caused by the tyres of wheels dropping between the stockrail and switchblade.

29. The most recent examination of the facing points before the derailment had been made by *Technician A. H. Dewberry* only two days earlier, on 3rd March. He carried out a full test of the locking and detection and found all in order. He confirmed that the three slots in the detector blades were well and truly lined up and there was no sign of slackness in any of the fittings.

30. Immediately after the derailment the facing points and the associated locking and detection were examined by *Chief Signal and Telecommunications Inspector A. D. Roulstone*. He found the point lever, No. 27, in the normal position and the facing point lock lever, No. 26, in the reverse position. The seals on the emergency releases for the electric locks were intact. On the track the facing point lock plunger was fully home but the tip of the left-hand switchblade was standing perhaps $\frac{1}{8}$ inch away from the stockrail. Looking from the end, Mr. Roulstone observed that the switchblade was twisted in a clockwise direction, being in contact with the stockrail at the foot. The effect of this twist was to have caused the detector blade on the closed switch to move beyond its normal travel a distance of about $\frac{3}{8}$ inch. He was satisfied that if the detection had been in this condition before the derailment it would not have been possible to pull off the Home signal and, moreover, it would not have been possible to restore the Home signal to Danger with the detector blades in the position he found them without causing distinct score marks on the signal slide. He found no such marks and had reached the conclusion that the signal had been restored to Danger before the derailment occurred.

31. Mr. Roulstone was quite unable to account for the derailment. He was sure the points had not been "split" and as far as he could tell they had been locked when the train passed over them. He described the actual condition of the lock as tight, with a clearance in the notch of less than the permitted allowance and he was of the opinion that even if the points had stood open as little as a thirty-second of an inch, the signalman would not have been able to lock them. He also noted that at this particular point on the track there was a tendency for wheelflanges to follow the right-hand or six-foot rail, which was shown by an area of high polish on the running edge. In the ordinary way therefore wheelflanges would have passed well clear of the tip of the left-hand switchblade.

32. A careful examination of the derailed vehicles was made by *Mr. P. C. Barker, Carriage and Wagon Assistant to the Divisional Maintenance Engineer*. He described the damage to the vehicles and stated that he had found no defects that might have been contributory to a derailment. One vehicle, the 8th, was three months overdue for lifting, but its tyre wear was within the limits and its flanges well up to gauge. He had paid particular attention to the buckeye couplings between the 7th and 8th vehicles, at which point the train had become divided, and was satisfied that the division had been a consequence and not a cause of the derailment. The broken lower jaw of the rear coupler of the 7th vehicle had been caused by sudden over-stressing, and the satisfactory quality of the material had been confirmed by a metallurgical examination. The fracture had started at a small blowhole in the casting which formed a point of weakness. Mr. Barker thought the support pin had come out during the disturbance of the derailment and that the vehicles had been properly coupled before the derailment.

33. The scene of the derailment was also visited by *Mr. J. D. Swindale*, of the British Railways Research Department at Derby, who examined both the track and the derailed vehicles. He was unable to account for the derailment, but having observed and identified the marks on the foot of the switchblade, described

by Mr. Abbott, as caused by the dropping of at least 4 wheels between the stockrail and switchblade, and having noted the presence of cycloidal marking on the outer face of certain tyres, reached the conclusion that the trailing bogie of the 7th vehicle was the first to be derailed, and that the nearside wheels of this bogie and of the leading bogie of the 8th vehicle had dropped between the stockrail and switchblade.

34. Mr. Swindale had also calculated, from the closeness to the web of the marks on the foot of the switchblade, that the latter must have been twisted through an angle of 25 to 30 degrees at the point where the wheels had dropped. Judging from the lack of damage to the stretcher bars and the flexibility of the switchblade however, he did not think this twist would have resulted in the tip of the switchblade opening far enough to allow a wheelflange to pass on the wrong side, but it might have opened far enough to receive a bruise on its tip from a wheelflange running right across on the left.

35. During his examination of the leading bogie of the 8th vehicle, Mr. Swindale observed a degree of unbalanced tyre wear indicating that this bogie had been hunting, but he was sure that the riding of the 8th vehicle could not have affected the vehicle ahead which was the first to become derailed.

36. The fact that this particular vehicle had a tendency to hunt was confirmed by the evidence of passengers who described it as riding badly, with a distinct lateral oscillation, but *Mr. C. Scutt, Chief Mechanical and Electrical Engineer*, British Railways Eastern Region, was of the view that hunting, on its own, was most unlikely to be a cause of derailment. He regarded it rather as a nuisance, aggravated by tyre wear and tending to give a very uncomfortable ride.

Subsequent Investigations

37. From the evidence given at the public hearing of my Inquiry on 14th March 1967, it was not possible to establish any clear cause for this derailment. Even though Signalman Frost had been inconsistent in some of his statements and had denied having irregularly and prematurely restored the Home signal to Danger when other evidence made it clear that he had in fact done so, there was nothing in the evidence to suggest that he had caused or contrived the derailment. The fact that the facing points were found locked and bolted in the normal position after the derailment with the operating and locking mechanism undamaged, led me and the railway officers concerned to assume that they had remained so during the whole passage of the train, and that the cause of the derailment must lie in some technical fault in the track or in the vehicles of the train that had not been revealed in any of the examinations made up to that time. Accordingly, I asked the General Manager, British Railways, Eastern Region, in co-operation with the British Railways Research Department at Derby, to put in hand further thorough examinations of both the track on the approach to and at the point of derailment and of the vehicles involved to establish whether there were any hidden defects that could have contributed to a derailment and to carry out a series of tests to determine whether there was any indication of a previously unforeseen interaction having taken place between wheel and rail which might conceivably have caused the derailment.

38. The results of these tests, which were exhaustive in character, were entirely negative, and it thus became necessary to examine in detail the possibility of the facing points having been unlocked and open at the moment the train passed over them, thus causing the derailment. For this possibility to be established it was necessary to determine whether there was any way in which the mechanical and electrical locking on the points could have been circumvented and to show that, if they were in fact opened under the train, the resulting derailment would have given rise to the actual marks and distortions observed on the track immediately after the derailment.

39. Because the point operating and point locking mechanisms were found undamaged after the derailment, the only way in which the switchblade could have been moved away from the stockrail was by the movement of lever No. 27 in the frame. The mechanical and electrical locking on this lever is described in paragraphs 4 and 5 above and for it to have been possible for the lever to be moved at all, this locking must first have been rendered ineffective. As far as the mechanical locking is concerned, there was no indication that this had been interfered with in any way and it was thus certain that levers No. 13, 14 and 26 must have been restored to the normal position before the catch handle of lever No. 27 was raised.

40. With regard to the electrical locking, unless this was interfered with in some way, it would have been necessary to complete the restoration of levers No. 13, 14 and 26 to the normal position and start the movement of lever No. 27 away from the normal position while it was still possible to energise the electric lock, i.e. before the train occupied TC "A". In calculating the time available for this sequence of operations it is necessary to establish three things, the distance on the approach side of the Home signal at which the aspect ceased to be visible from the footplate of the approaching locomotive, the speed of the train, and the delay between the occupation of TC "A" and the cutting of the electric lock circuit by the track relay.

41. In giving their evidence, both Driver Oakton and his secondman were insistent that they had watched the aspect of the Home signal up to the moment it passed out of their field of vision. Subsequent tests showed that the Home signal was visible up to the point where the leading wheels of the locomotive were 36 feet 10 inches from the signalpost and that the Distant arm below it remained in view for a further 10 feet. The speed of the train, again based on Driver Oakton's estimate and after allowing for a speedometer error observed on this locomotive, was 73 or 74 m.p.h., say 108 feet per second. The time taken for the train to travel from the point at which sight of the Home signal was lost by the driver to the commencement of TC "A", 58 feet beyond the signal, was thus 0·88 seconds. To this time must be added the time taken for the track relay to drop and interrupt the electric lock circuit. In the opinion of the Chief Signal and Telecommunications Engineer of the Eastern Region this time would not be greater than 0·95 seconds.

42. It follows, therefore, that if the derailment was an accident, the result of a number of unplanned actions on the part of the signalman made without malicious intent, the whole series of movements from the irregular and premature restoration of the Home signal lever to the commencement of the movement

of the facing point lever must have been completed within a time of something less than 2 seconds, during which time the electric locks on both the facing point lock lever and the facing point lever must have been energised in succession by means of the foot-operated switches.

43. At my request the Chief Signal and Telecommunications Engineer arranged for a number of tests to be carried out to determine the time taken to complete the various sequences of lever movements involved. Since the facing points at Connington were removed and the locking altered after the derailment, these tests were carried out in Arlesey signalbox on the East Coast Main line, where the locking frame is of the Dutton's type as at Connington and has catch handle locking. The levers used were No. 30, a spare, to represent the Home signal lever, No. 41, a facing point lock (which, unlike No. 26 at Connington, stands normally in the locked position), and No. 42, a facing crossover from the Up Fast to Up Slow line.

44. The various tests carried out were as follows, the time being measured with a stop watch:—

Test No. 1. This timing commenced with the signal lever reversed but with the catch handle already lifted. It was replaced to normal and the facing point lock lever reversed to unbolt the points. The point lever was then moved from normal to full reverse. The fastest time achieved was 4·3 seconds with an average of 5·4 seconds.

Test No. 2. As for test No. 1, but with the point lever moved approximately 4 inches from the normal position only. The average time taken was 3·2 seconds.

Test No. 3. Starting as for test No. 1, but the time was measured up to the lifting of the catch handle on the facing point lock lever only. This was carried out with this lever in both the normal and reverse positions, the latter to simulate more precisely the conditions at Connington. The average time taken was 1·5 seconds.

Test No. 4. As for test No. 3, but additionally the facing point lock lever was moved to the full normal position and an allowance made for the lifting of the catch handle of the point lever (actually held by the locking under these conditions). The average time taken was 3·0 seconds.

45. For the derailment to have occurred without interference to the electric locking, the sequence of operations described at Test No. 4 above would have to have been completed in something less than 2 seconds, and in order to determine more accurately whether these movements could have been made in the time available, a further series of tests was later carried out at Connington South with artificial loads to simulate the original connections on levers Nos. 26 and 27. These tests showed that, provided the Home signal lever had been returned to the full normal position by the time the leading wheels of the locomotive were not less than 4 feet on the approach side of the signal (if it had been moved sooner, the change of aspect could have been seen by the enginemen) it was just possible by extremely rapid and premeditated movements of the levers for the facing point lever No. 26 to be restored to the normal position and the facing point lever No. 27 to be moved sufficiently to render the electric lock ineffective before the occupation of track circuit "A" by the leading wheels of the locomotive caused both levers to become electrically locked. It was not possible however to achieve this at every attempt during the tests, despite the assumption that the Home signal lever had been restored to normal at the earliest possible moment on each attempt. Moreover, if the signalman did succeed in circumventing the locking in this manner, he must then have had stood, holding the point lever a short distance from the full normal position to prevent the re-engagement of the electric lock, for a further 7 seconds before the trailing bogie of the 7th vehicle of the train reached the facing points and the derailment commenced. Even in the event of his being able to complete the lever movements in the short time available, there was thus still ample time for thought, during which phase safety could have been assured at any moment by pushing the lever back to the full normal position whereupon the electric lock would have re-engaged. If the derailment was caused in this manner, I cannot accept that it was an accident.

46. The only reasonable deduction, however, from the tests carried out at Arlesey is that there was only time to complete the lever movements described at Test No. 3 above before the train occupied track circuit "A", and thus the unlocking and opening of the facing points could only have been the result of a premeditated series of actions which involved tampering with the electric lock on the facing point lever.

47. There are several possible ways in which an electric lock of the type installed at Connington can be rendered ineffective, by electrical means, i.e. by energising the lock when the controlling track circuit is occupied, either by an irregular electrical supply to the solenoid or by operation of the sealed release provided, or mechanically, either by disconnecting the lock tappet from the lever or by artificially holding up the locking dog when the lock is de-energised. A close examination of the electric locks on both levers No. 26 and 27 and their associated sealed releases revealed no positive indication that any tampering had taken place, but it was found that, in the case of the lock on lever No. 27, the "force down" device was broken and it was possible to raise the locking dog to the unlocked position by the insertion of a table knife or other similar flat metal object along the side of the lock tappet without movement of the latter. If the lock was tampered with in this manner, this could not have been done until after No. 14 signal had been cleared, because the lock on lever No. 27 was proved to be effective in No. 14 signal electric lock circuit. However, once the Home signal was pulled off there remained ample time to render ineffective the lock on lever No. 27 before the train reached Connington South.

48. Apart from demonstrating that it was possible for the signalman to unlock and open the facing points during the passage of the train, it was also necessary to show that such an action would have resulted in the derailment occurring in the manner in which it did, before it can be deduced that this is how the derailment actually occurred. A careful re-examination of the bogies of the derailed vehicles confirmed the existence of the cycloidal marks mentioned by Mr. Swindale in his evidence on the wheels of the trailing bogie of the 7th vehicle and of both bogies of the 8th vehicle, and careful study of the marks on the foot of the switchblade established that at least 5 wheels had passed between the stockrail and switchblade. From this

it could be concluded that the initial derailment was of the trailing bogie of the 7th vehicle, and that only this bogie and both bogies of the 8th vehicle actually took the wrong road at the facing points. The remainder of the train must therefore have passed normally over the facing points before being dragged into derailment by the vehicles ahead.

49. A series of tests were therefore arranged to establish the time taken for a switchblade on mechanically operated points to move from the closed position to the point at which a wheelflange would pass the wrong side of it and to show that the switchblade was sufficiently flexible to permit its restoration to the closed position between the trailing bogie of the 8th vehicle and the leading bogie of the 9th vehicle.

50. The timing tests were also carried out at Arlesey on No. 42 facing crossover using a "Teledeltos" time recorder. They revealed that the normal time for the full throw of 4 inches from normal to reverse was 0·6 seconds, and that the time taken for the initial $1\frac{1}{2}$ inches to the point at which a flange would take the wrong road was 0·25 seconds, assuming the wheelset to be running close to the right-hand rail at a maximum clearance from the left-hand switchblade. When reclosing the points from this position, the switchblade would only have to travel about half an inch to reach a position in which a flange would pass on its right side, assuming once again that the wheelset was running close to the right-hand rail. This movement occupied a time of only 0·05 seconds.

51. Slow speed tests were then carried out in the Permanent Way Yard at Hitchin, on a specially laid turnout of the same design as the one at Connington, using coaching stock of similar dimensions, to determine how far a wheel running on the switchblade must be from the tip for it to be possible to start to open the points and whether the switchblades were sufficiently flexible to permit the closure and relocking of the points while a wheel or series of wheels was running on the stockrail and bearing on the planed side of the switchblade. These tests showed the extreme flexibility of the planed section of the switchblade and that it was possible to obtain a full throw of the switchblades with a wheel 8 feet 6 inches from the tip and an opening of 2 inches with a wheel only 4 feet 6 inches from the tip. Similarly it was possible to close but not to lock the points with a wheel the wrong side of the switchblade only 10 feet 6 inches from the tip. It was thus possible to restore the switches under the trailing bogie of the 8th vehicle before it became derailed at the "wide-to-gauge" point and before the leading wheelset of the 9th vehicle reached the tip of the switchblade, leaving ample time to relock the points during the passage of the last 3 coaches over the points, whilst their wheels held the distorted switchblade snugly against the stockrail thus facilitating the entry of the facing point lock plunger.

52. The actual times available for these movements to occur during the passage of a train at 108 feet/second would be 0·32 seconds between the leading and trailing bogies of the 7th vehicle and 0·12 seconds between the trailing bogie of the 8th vehicle and the leading bogie of the 9th vehicle. There was thus sufficient time for the points to be opened and reclosed in the manner described, the whole cycle of operation occupying about 1 second.

53. A further test was carried out at the British Railways Research Department at Derby to establish whether the residual twist observed in the tip of the switchblade after the derailment would have resulted from the distortion of the blade when the derailed wheels dropped between it and the stockrail. A similar set of switches was set up with a lever arrangement to apply a twist to the switchblade at the point where the derailment would have occurred and the angle of twist measured at a point 18 feet from the tip. To do this without undue strain on the equipment, most of the spacing blocks between the switchblade and stockrail were loosened or removed (in the actual derailment, they were smashed). The maximum twist obtained was 23 degrees and there was a corresponding twist at the tip which caused the detection to move $\frac{1}{4}$ inch out of line. When the torque was removed, $\frac{1}{8}$ inch of this displacement remained, but it was still possible to close the switches and insert the facing point lock plunger.

54. These tests confirmed that the damage and distortion observed on the track at Connington were consistent with the facing points having been opened between the bogies of the 7th vehicle of the train and reclosed in front of the leading bogie of the 9th vehicle and that these movements could have been completed within the times and distances available.

Conclusions

55. I am satisfied that this derailment was caused by the unlocking and movement of a pair of facing points at a time when a train was passing over them. The signalling equipment was in order and the points could only have been opened as a result of deliberate irregular actions on the part of Signalman Frost, who was alone in the signalbox at the time and thus solely responsible for the derailment. I am unable to accept the evidence that Frost gave at my Inquiry, when he was insistent that he had not restored the Home signal to danger until the train had passed and he had seen its tail lamp, because the state of the detection after the derailment showed conclusively that the signal was at Danger at the moment when the derailment occurred. Nor can the facts of the derailment be explained by a statement he made subsequently, when being interviewed by a police officer, that he had unlocked points accidently whilst swinging on the levers as the train went by and, realising what he had done, had panicked and grabbed the point lever by mistake. The tests carried out at Connington South and described in paragraph 45 above showed that this explanation cannot be true.

56. Only Frost knows exactly what happened in Connington South signalbox on the night of the derailment, but the most probable sequence of events was as follows. After accepting the train from Abbots Ripton and obtaining "Line Clear" for it from Connington North, he rendered the electric lock on lever No. 27 inoperative in an irregular manner, possibly in the way described in paragraph 47. As soon as the train occupied track circuit "G", 200 yards on the approach side of the Home signal, he restored lever No. 13, controlling the Distant signal, to normal and then stood holding lever No. 14 in the reverse position with the catch handle raised. As soon as he was sure the head of the train had reached the Home signal

he restored the lever to normal and at once started to unlock the facing points by raising the catch handle of lever No. 26. As demonstrated by test No. 3 carried out at Arlesey, these movements could be completed in 1·5 seconds, the time available for it being just under 2 seconds dependant upon the actual position of the train at the moment the Home signal was put back to Danger. Frost then had ample time to complete the movement of the facing point lock lever, thus leaving the facing point lever unlocked both electrically and mechanically and so free to be moved.

57. The locomotive would by this time have just about reached the facing points, but it was not until the 7th vehicle had reached the points, some 4 seconds later and altogether 9 seconds after the locomotive passed the Home signal, that the left-hand switchblade was moved away from the stockrail far enough to allow a wheelflange to take the wrong road. As discussed in paragraph 48, only the trailing bogie of the 7th vehicle and both bogies of the 8th actually passed the wrong side of the switchblade, the switchblade being away from the stockrail for about 1 second only. This would be done by a rapid movement of No. 27 lever from the normal position to midstroke and back to normal.

58. The remainder of the train then passed normally over the facing points, the successive wheels holding the switchblade hard up against the stockrail, even though it was distorted and twisted as a result of the six derailed wheels dropping between it and the stockrail. It was thus a simple matter for Frost to relock the points by pulling No. 26 lever, though the distortion in the detection would have prevented him from pulling off the Home signal, which in any case would be locked by the block release. The situation would then have been as it was found after the derailment.

59. It may be thought that the fact that track circuit "A" commenced 58 feet beyond the signal and hence the points remained unlocked for perhaps 2 seconds after the signal had passed out of the driver's view should be regarded as a weakness in the locking at Connington South, thus presenting an opportunity for such a derailment to be staged. Electrical and mechanical locking of points and signals is provided, however, as a protection to a signalman, to prevent his unwittingly setting up an unsafe situation as a result of his forgetfulness or carelessness. It is not intended to be proof against deliberate circumvention or malicious interference, nor is it necessary or practicable that it should be so.

60. I am satisfied that the locking and signal controls provided at Connington South were adequate for the safe working of the line and that no alteration or addition to them is necessary or could be justified on the grounds of the circumstances of this derailment.

Remarks

61. In recent years there has been only one case in any way similar to the Connington derailment. This was the derailment of a Glasgow–Euston sleeping car express at Douglas Park, near Motherwell, on 26th May 1949 which was also caused by a signalman irregularly opening facing points under the engine, fortunately without serious consequences. Colonel Walker, in his Report on the accident, revealed that the earlier railway practise of taking up references and enquiring into the character of prospective signalmen was no longer followed, and he recommended its re-introduction.

62. In 1950 certain procedures were laid down for checking the characters of new entrants to railway employment and for obtaining references. These procedures were amended in 1952, and, as far as the Eastern Region of British Railways is concerned, they have been followed since that time. In the case of Frost, his reference was taken up in January 1965, with the Royal Marines, with whom he had been serving, and while it was stated that he was below their physical standard, no comment was made which could suggest any other failing. His physical fitness for railway work was verified at that time by the Area Medical Officer. Before being accepted for a signalman's position he was interviewed or reported on regarding his capabilities and suitability by the Station Manager at Peterborough, two Divisional Signalling Inspectors and two Signalling School Supervisors and was seen personally by the Divisional Movements Manager, as described in paragraph 24, before taking up his duties as a signalman.

63. Nothing in Frost's behaviour during his employment as a signalman up to the time of the derailment at Connington had given rise to any doubts as to his reliability and, even after the derailment, the part he played in it remained unsuspected for a considerable time. Though it was revealed later that Frost had been discharged from the Royal Marines suffering from "hysteria and immature personality" these facts were not in the possession of the railway management at the relevant time and, in my opinion, the procedures adopted in the selection and appointment of Frost as a signalman show that the railway management is fully aware of the need to take all reasonable steps to satisfy themselves that a man selected for a signalman's post can be trusted to work in a responsible manner without supervision, and cannot fairly be criticised.

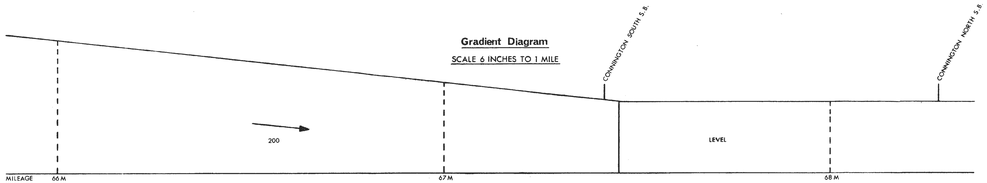
I have the honour to be,
Sir,
Your obedient Servant,
I. K. A. McNaughton
Lieutenant Colonel.

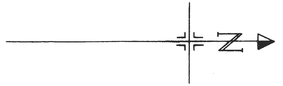
NOTE:—Signalman A. J. Frost was tried on charges of manslaughter and endangering the safety of railway passengers at the Huntingdon Autumn Assizes held at Nottingham in November 1968. After a trial lasting 11 days, Mr. Justice Fisher instructed the Jury to acquit Frost on the charges of manslaughter and sentenced him to two years imprisonment for unlawfully operating the signal and points mechanism of the Connington South signalbox so as to endanger persons being conveyed on a railway, on which charge Frost had changed his plea to Guilty.

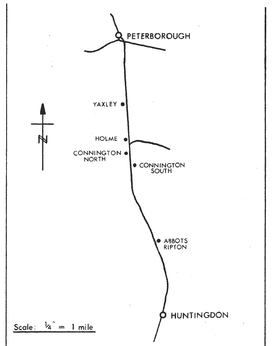
The Secretary,
Ministry of Transport.

(125326) Dd. 154058 K9 7/69 Hw.

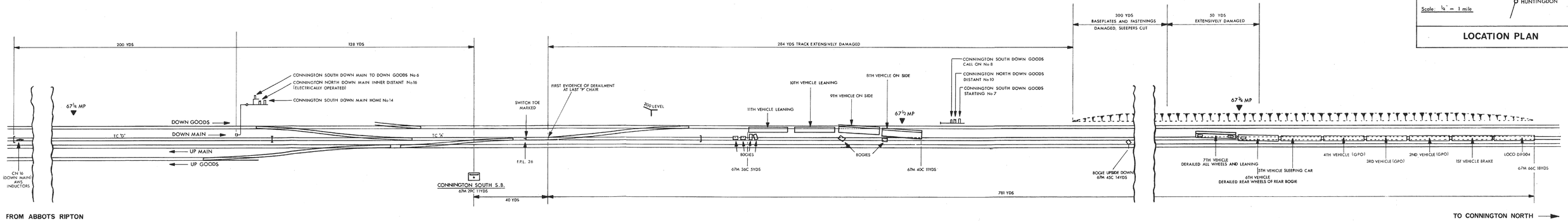
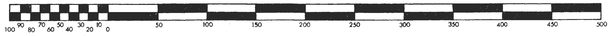
DERAILMENT AT CONNINGTON SOUTH — 9TH MARCH 1967







LOCATION PLAN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