MINISTRY OF TRANSPORT

RAILWAY ACCIDENT

Report on the Collision that occurred on 1st August 1963 at Norton Bridge

IN THE
LONDON MIDLAND REGION
BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE
1964

THREE SHILLINGS NET

Ministry of Transport,
St. Christopher House,
Southwark Street,
London, S.E.1.

With Colonel D. McMullen's
compliments

Publication date: 10 MAR 1964

RAILWAY ACCIDENT

REPORT ON THE COLLISION THAT OCCURRED ON 1ST AUGUST, 1963 AT NORTON BRIDGE IN THE LONDON MIDLAND REGION BRITISH RAILWAYS

Correction

Page 2, Para. 7, Line 4

" signal NB 158 " should read " SIGNAL NB 15 "

Ministry of Transport
February, 1964

LONDON: HER MAJESTY'S STATIONERY OFFICE, 1964

MINISTRY OF TRANSPORT,
ST. CHRISTOPHER HOUSE,
SOUTHWARK STREET,
LONDON, S.E.1.
20th December, 1963.

SIR,

I have the honour to report for the information of the Minister of Transport, in accordance with the Order dated 6th August 1963, the result of my Inquiry into the sidelong facing collision between two passenger trains that occurred at 8.43 p.m. on the 1st August 1963 at Norton Bridge, just north of Stafford on the west coast main line of the London Midland Region, British Railways.

The main line through Norton Bridge, which is electrified on the overhead system at 25kV, has four tracks, the lines from west to east across the formation being the Down Slow, the Up Slow, the Down Fast and the Up Fast in that order. Some 400 yards on the London side of the station there is a double crossover from the Down Slow to the Down Fast and from the Up Fast to the Up Slow.

On a clear and sunny evening just before sunset the 6.17 p.m. Class 1 12-coach passenger train from Euston to Liverpool, Lime Street, which was hauled by a diesel electric engine and was running on the Down Fast Line, overran at Danger the signal protecting the Up line crossover and collided with the near side of the 7.20 p.m. Class 1 6-coach passenger train from Liverpool, Lime Street, to Birmingham, which was hauled by an electric engine and was crossing over from the Up Fast to the Up Slow line under clear signals.

The driver of the Down train had evidently allowed his attention to wander and, having failed to obey the protecting signal at Danger, he did not brake his train, which was running at about 40 m.p.h., until it was too late to stop short of the other train crossing his path, and his train was still running at some 10-15 m.p.h. when the collision occurred. The driver of the Up train was alert and with commendable presence of mind tried to accelerate his train clear of the junction when he saw the Down train closely approaching it, but he had insufficient time to do so and his train was running at only about 25 m.p.h. when the Down train struck its near side towards the trailing end of its third coach.

Fortunately the driver of the Down train was braking hard at the moment of impact and his engine came to a stand only 55 feet beyond the point of collision and so did not plough through the train crossing its path. The third and fourth coaches of this train were struck only glancing blows and were little damaged, but the coupling between the fourth and fifth coaches parted and the fifth coach, which was the guard's working brake, bore the brunt of the collision, its body being forced up off its derailed bogies, tilted over to an angle of 45°, and badly damaged, while the engine and first four coaches ran on for some 155 yards before coming to a stand. The sixth coach was derailed but was little damaged.

Fortunately also the third, fourth and fifth coaches of the Up train had their corridors on the near side. Probably for this reason there were no serious casualties though 29 passengers, most of them in the fifth coach, and the guard of the Up train were hurt badly enough to need hospital treatment. Medical aid was quickly asked for and quickly on the scene; ambulances arrived at 8.54 p.m. and all the injured had been taken to hospital by 9.15 p.m., 13 of them being detained. Only one passenger was detained in hospital beyond the 2nd August and he was discharged on 11th August.

There was considerable damage to the permanent way and some damage to point equipment, and all four lines were blocked, but there was no damage to the overhead electrical equipment or fouling of the overhead wire which had however to be slewed to one side to facilitate repair work, all power supplies between Stafford and Whitmore, some 9 miles north of Norton Bridge, being cut off from 8.50 p.m. until 9.15 a.m. next morning. A steam crane reached the site at 10.35 p.m. and work on clearing the lines continued throughout the night, the Up Fast line being cleared shortly after midnight and the Down Slow at 9.0 a.m. the following morning. The Down Fast line was cleared by 10.45 a.m. and the Up Slow, subject to a speed restriction of 15 m.p.h., by 4.45 p.m. on the 2nd August. The speed restriction was lifted at 2.30 p.m. on the 13th August.

DESCRIPTION

Layout and Signals

1. Norton Bridge is a junction some five miles north of Stafford on the London Midland west coast main line. At the junction the 2-track line to Stone branches off in the Down direction from the 4-track main line. The layout at Norton Bridge, which includes a right-handed double crossover between the Fast and Slow lines and a bi-directional recess line serving the station platform, is shown on Figure 1 of the plan at the back of this Report. This shows also the point of collision, which was at the fouling point between the Down Fast line and the crossover from the Up Fast to the Up Slow line, the two signals immediately protecting the crossover, and the positions in which the two trains came to a stand. The distance from the protecting signal to the fouling point of the crossover is 569 yards.

2. The main lines between Stafford and Crewe through Norton Bridge are worked on the track circuit block system, with multiple aspect colour light signals, continuous track circuiting, and train describers. Automatic Warning System (AWS) equipment is installed at all running signals. Figure II of

the plan shows diagramatically the signals approaching Norton Bridge in the Down direction from Stafford and the positions of certain track circuits referred to in the Report.

3. The Down Fast line from Stafford to Norton Bridge is of continuously welded rails throughout. The gradient is gently rising towards Norton Bridge.

Signal Controls and Indications

4. The signals shown on Figure II of the plan with a prefix NB are of three types:—

(*a*) Semi-automatic signals (e.g. NB 19 and NB 15) that protect the junctions and are normally controlled by the signalman in the Norton Bridge Junction power signalbox, but which can at the signalman's discretion be made to work automatically, when they are normally Green but are controlled to Double Yellow, Yellow or Red by the state of occupation of the track circuits ahead.

(*b*) Signals (e.g. NB 153) that are fully automatic in that they cannot be directly controlled by the Norton Bridge Junction signalman and are controlled only by the state of occupation of the track circuits ahead when automatic working through Norton Bridge is in force, but which may be indirectly controlled by the signalman during controlled working because they are influenced by the aspect of a signal ahead that is being directly controlled by him. Signal NB 148, which is a signal of this type, can be put back to Danger by the signalman in emergency by means of a special switch on the signalbox panel. When working automatically Signal NB 148 cannot clear to Yellow after the passage of a train until that train has cleared track circuit 25.

(*c*) Signals (e.g. NB 159) that are fully automatic and are controlled directly or indirectly only by the state of occupation of the track circuits ahead.

All the running signals shown on Figure II are 4-aspect colour light signals controlled to read in sequence ahead from Green to Green or from Green to Double Yellow, to Yellow, to Red: full braking distance for the maximum speed of the line, 90 m.p.h., is provided from the Double Yellow, through the single Yellow, to Red in all cases, and nowhere does a Double Yellow read to a Double Yellow for braking distance reasons.

5. The signal installation at Norton Bridge is of the route relay interlocking type, a route comprising the line from one controlled signal to the next controlled signal ahead, and there is an "entrance/exit" control panel in the signalbox. A route is set up by pressing a button at a point on the panel representing the entry to the route, which may be one of several diverging routes, and by pressing a button on the panel at its exit end: if no conflicting route has been set up, and if the appropriate track circuits are clear, this action detects points along the route, after setting any not in the required position, and clears the entry signal. When automatic working along any of the four through routes is required the route is first set up in this way and a special button marked "A" (for automatic), which is located at a point on the panel next to the signal which is to work automatically, is pressed. To cancel automatic working on any route and to put the controlled signal at its entry back to Danger all that the signalman has to do is to pull the appropriate button marked "A" and then to pull the entrance button. Since the panel buttons are not themselves interlocked or backlocked a controlled signal can be put back to Danger in this way at any time by pulling its button, but the interlocking that prevents any conflicting route being set up is not released until the necessary approach locking release conditions have been fulfilled. Similarly route buttons may be depressed at any time but this has no effect if a conflicting route has already been set up. There is no provision for the pre-selection of routes. The signalling, and the Norton Bridge Junction power signalbox, were brought into use in 1961.

6. The approach locking controls are such that if the Down Fast signals have been working automatically and if a train approaching on the Down Fast line has occupied track circuit 12, which starts 50 yards on the Down side of signal NB 19, the Norton Bridge Junction signalman cannot set No. 58/62 crossover for an Up train to run from the Up Fast to the Up Slow line, after changing signal 15 from automatic working to controlled working and placing it to Danger, until a period of 3 minutes has elapsed. Similarly, if signal NB 10 has been working automatically and a train approaching on the Up Fast line has occupied a track circuit well in rear the signalman, after changing NB 10 from automatic working to Danger, cannot set the route from the Up Fast to the Up Slow line via No. 58/62 crossover until a period of 3 minutes has elapsed.

7. The speed limit through the crossover is 25 m.p.h., and signal NB 10 is approach controlled, when operated for the crossover route from the Up Fast to the Up Slow line, the aspect not clearing until the train occupies the berth track circuit. Occupation of track circuit 25, which starts 44 yards on the Down side of signal NB 15, returns signal NB 10 to Danger.

8. Signalling line circuits are in separate unscreened cable. They are divided into sections not exceeding 2 miles in length in order to limit voltages induced by the traction system to 430 v. only in short circuit conditions. Additional protection to signalling line circuits is provided by the use of specially designed line relays capable of withstanding 1,000 v. AC superimposed without affecting their DC characteristics.

9. The aspect of a controlled signal, even when working automatically, is indicated in the signalbox by a red or green light alongside its location on the panel, but the green light may denote any of the three

"off" aspects (Green, Double Yellow or Yellow) and does not discriminate between them. The aspects displayed by automatic signals, except NB 148 and 149 which have emergency replacement buttons (see paragraph 4(b) above), are not indicated on the panel. The signalman thus cannot check whether the signals are showing the correct aspect sequence.

Effects on Signals of Power Failure

10. Audible warning of a power failure is given in the Norton Bridge Junction signalbox by means of a loud bell. The HR, HHR, and DR Westinghouse miniature relays which control the signals to Yellow, Double Yellow, and Green respectively are of a special slow release type so that any power failure that is of such short duration that an audible warning of it is not given in the signalbox will not affect any signal's aspect.

View from Signalbox

11. The view from the Norton Bridge Junction signalbox is good but the Down lines approaching it are curved and road overbridge No. 17 gives the signalman only a late view of a Down train: it first comes into his view through the overbridge after passing signal NB 15.

Signal Sighting

12. Figure II of the Plan shows the curvature of the line and the points at which the Down Fast line signals first come into a driver's view. Points to note are that it is not until after a train has passed signal NB 19 by 50 yards, and has occupied the first track circuit (TC 12) that approach locks signal NB 15 protecting the crossover, that a driver first sees the next signal, NB 150, which is the signal furthest in rear of NB 15 to be affected should that signal be put back to Danger from Green for any reason, such as for a change of route ahead: and that a driver first sees signal NB 15, unobscured by overhead structures, at a range of 425 yards.

Driver's View of the Crossover

13. From signal NB 15 the driver of a train on the Down Fast line cannot see the crossover, which comes into view from just beyond No. 17 overbridge at a range of about 375 yards.

The Trains

14. The Down train comprised 12 coaches and was hauled by the 2,000 h.p. English Electric type 4 diesel electric engine No. D 215, which had a 1C-C1 wheel arrangement and was fitted with AWS equipment. Its unladen weight excluding the engine was 422 tons, it was equipped throughout with vacuum brakes with DA valves, and its average brake efficiency was 78%. Its engine weighed 133 tons and had a brake efficiency of 64%. The total length of the train excluding the engine was 860 feet. All its coaches except one had steel bodies and steel underframes and were fitted with buck-eye couplings: the other coach, which was built in 1949 and was the 10th from the engine, had a wood-framed body with steel panels and a steel underframe, and screw couplings and hydraulic buffers.

15. The Up train comprised 6 coaches and was hauled by the 3,300 h.p. AEI AC electric locomotive No. E 3021, which had a B-B wheel arrangement. Its unladen weight excluding the engine was 198 tons, it was equipped throughout with vacuum brakes with DA valves, and its average brake efficiency was 78%. Its engine weighed 80 tons and had a brake efficiency of 85% and a maximum tractive effort of 50,000 lbs. at 28% adhesion. The total length of the train including the engine was 450 feet. All its coaches, except the brake coach in rear, had steel bodies and steel underframes and were fitted with buck-eye couplings: the rear brake coach had a wooden body on a steel underframe and had screw couplings and shock absorbing buffers.

Effects of the Collision

16. The Down train's engine first struck the near side of the Up train's third vehicle, a composite corridor coach, at an acute angle some 18 feet from its trailing end, badly damaging the body side panels, windows, and doors on this the corridor side of the coach. It then struck the side of the fourth vehicle, a 2nd Class coach which also had its corridor on the side struck, and did the same kind of damage as it had done to the side of the third vehicle but to a greater degree. The engine then struck the near side leading end of the fifth coach, a brake second, bursting the buck-eye coupling at its leading end, derailing and badly damaging both its bogies, and forcing its body up off its bogies and over to an angle of 45°. This coach also had its corridor on the side towards the colliding engine, which reduced the damage to passenger compartments and the guard's compartment, but both its underframe and its body were extensively damaged. The leading bogie of the sixth coach, a gangwayed bogie brake van, was derailed and its headstock bent but otherwise this coach was little damaged.

17. As a result of the coupling behind the fourth coach parting the engine and first four coaches of the Up train, none of which was derailed, ran on with their brakes automatically applied for some 155 yards.

18. The leading end of the colliding diesel engine was ripped open and there was considerable front end damage done to it, including distortion of the main frame and damage to the leading pony truck. Otherwise the damage to the Down train was negligible and no part of it was derailed.

19. *Relief Signalman C. B. Martin*, on duty in the Norton Bridge Junction signalbox, said that before the approach of the Up train on the Up Fast line the signals on all four through lines were working automatically. He intended to cross this train over to the Up Slow line and at about 8.35 p.m., when he saw from his panel that it was approaching Badnall Wharf, some 3 miles away, he put signals NB 15 and 10 back to Danger in that order and set the route through the crossover, which responded at once. When he did this, and thus locked signal NB 15 at Danger, the Down train, which was running eight minutes early, was approaching signal NB 159: there was a goods train ahead, on the Down Slow line, but it was a long distance ahead and could no longer have been affecting the aspects of those Down Slow line signals visible to the driver of the Down train on the Fast line. He left signal NB 19 and the signals for the Down Slow line to work automatically. He first realised that a collision was imminent when, after the Up train had passed the box at about 15 m.p.h. and had entered the crossover, he saw, on his panel, the Down train occupy the overlap track circuit ahead of signal NB 15 (TC 25) and he at once put all his controlled signals to Danger. By doing so, he stopped a goods train on the Down Slow line clear of the obstruction.

20. Signalman Martin could not say for certain whether or not he operated the special switch putting back signal NB 148 to Danger but thought that he had not done so, and he did not observe whether the Down Fast train had cleared track circuit 25 when it came to a stand after the collision. (In fact the distances are such that the rear of the Down train would have cleared the track circuit before the collision occurred and, since this track circuit provides the overlap for signal NB 148, that signal would have been free to clear to single Yellow automatically if the switch putting it to Danger had not been operated by the signalman.) Martin said that the evening was clear and sunny and still quite bright. There had been no power failure that day.

21. *Extra Porter W. H. Evans*, acting as temporary signalbox lad in Norton Bridge Junction signalbox, saw the signalman put all controlled signals back to Danger as soon as its occupation of track circuit 25 showed that the Down train had passed signal NB 15 at Danger, but did not observe whether the switch for signal NB 148 was also operated. When this occurred the Up train had already run onto the crossover. He confirmed that the evening was clear and sunny and that the previous Down trains were clear of the area. (His Train Register showed the last previous trains on the Down Fast and Down Slow lines as having passed Norton Bridge at 8.34 p.m. and 8.21 p.m. respectively.)

22. *Technician S. D. G. Smithson*, the resident lineman for Norton Bridge and Stafford, reached Norton Bridge Junction signalbox, accompanied by his assistant lineman, at 9.20 p.m. He said that when he entered the relay room it was unoccupied and properly locked and that he touched nothing in it apart from removing the route links of certain signals to lock them at Danger. He then went up to the operating floor where he observed that the switch of signal NB 148 had not been operated. He said that on his way to the signalbox by road he had observed signal NB 19 at Danger and a diesel multiple-unit train standing at it: he had not observed signals NB 150 and 148 but signal NB 15 was at Danger, as was the Slow line signal alongside it (NB 16). After leaving the signalbox Smithson walked back along the track and observed that signal NB 148 was at Yellow and signal NB 150 at Double Yellow, and checked that the AWS inductors were correctly energised in accordance with the aspects shown.

23. *Mr. J. W. Rogers, Divisional Testing Assistant, Crewe*, said that because of the occupation of track circuits by the trains, breakdown train, and debris, he was unable to make any tests beyond those made by Smithson, the results of which and the fact that nothing in the relay room except the route links had been touched he confirmed, until the day after the collision. As soon as he could he fully tested the interlocking in Norton Bridge Junction signalbox, including the approach locking of signals NB 15 and 10 and the associated time releases, and found all to be correct. He then systematically tested the aspect sequence of signals NB 15, 148, 150 and 19 and the AWS equipment associated with them, including the strength of each permanent magnet: he tested the relays involved, both electrically and mechanically, the control circuit wiring for leakage or false energisation, the voltage supply of the signal lamps, and the shunting of the relevant track circuits, and found all to be in good order. He said that all the signal lenses were slightly dusty but that the aspects shown were bright: the focussing of signal NB 15 could perhaps have been improved but was nevertheless quite good. (The focussing of NB 15 was not adjusted until after I had observed the signal from the cab of a diesel engine on the Down Fast line: it was clearly visible at 425 yards and remained so as the train approached it and I would not have criticised its focus.)

24. *Driver E. James*, who was alone in the cab of the electric engine hauling the Up train, said that his train was running on the Up Fast line at 80 m.p.h. under clear signals when he observed a signal displaying a Double Yellow aspect, and that he had reduced his speed to 20 m.p.h., by his speedometer, as he ran into Norton Bridge. Signal NB 10 cleared from Red to Green with, as he expected, a route indicator for the crossover from the Up Fast to the Up Slow line, as he passed the signalbox. He was running through the crossover at 18 m.p.h. with his controller shut when he saw the Down train closely approaching into imminent collision with his train and he at once accelerated, in what proved to be a vain attempt to draw his train clear of the crossing in time. He estimated his speed at the moment of collision at 22 m.p.h.

25. *Passenger Guard J. O'Mara* said that, as guard of the Up train, he was travelling in the brake compartment at the rear of the 5th coach. He felt the train accelerate suddenly as it ran through the crossover and estimated its speed at the moment of collision at 20-25 m.p.h.

26. *Driver E. Upton*, the driver of the steam engine hauling a goods train on the Down Slow line which was passed by the Down train as it left Stafford, said that he was running at about 20 m.p.h. under clear signals until he was brought to a stand, through a normal Double Yellow and Yellow sequence of aspects, at signal NB 16 at Danger. He said that he did not observe any of the Down Fast line signals except NB 15 which was at Danger. He spoke highly of the signalling on both Fast and Slow lines and said that the effect on him of bright sun in his eyes was to shorten the range at which he could recognise which colour a signal was displaying. He had had no trouble from the sun on this occasion and was under the impression that it had already set.

27. *Fireman P. J. Denson*, who was firing to Driver Upton on the Down goods train, said that while the train was running between Stafford and Norton Bridge he was firing for part of the time but otherwise observed the Down Slow line signals and experienced no difficulty in doing so from the sun, which he described as "shining but not so bright". He noticed the diesel multiple-unit train standing at signal NB 19 at Danger and observed that the Down Fast signal beyond it (NB 150) was showing a Double Yellow, but he did not observe signal NB 148.

28. *Driver A. Gregory*, driver of the Down train, is 62 years old: he has been a driver for 21 years and has been driving main line diesel engines since December 1960. He assumed duty at Camden at 5.20 p.m. after some 6 hours sleep, from which he woke refreshed: his previous duty had ended at 8.15 a.m. when he had had a meal at the hostel and then gone to bed. He said that his journey as far as Milford and Brocton, some 3½ miles short of Stafford, was uneventful. The brakes of his train were in good order and he had used them several times, and his AWS equipment was working normally: when he took over engine D 215 at Camden a fitter told him that the equipment had been out of order but had now been put right. At Milford and Brocton his train was turned onto the Slow Line and at the signal in rear at Yellow he correctly got a horn and at the diverting signal, which cleared to Green as he approached it, he correctly got a bell, but he said that thereafter the AWS equipment on the engine gave no indication at all, remaining silent at all signals, and although he did not touch the re-set button after he last got an indication there was no automatic brake application at caution signals. At Stafford his train was turned back onto the Down Fast line as he had expected, past a signal at Yellow, and he remembered getting a Green signal at the end of the platform. (This was the last signal before NB 159).

29. Driver Gregory was emphatic that, when running between Stafford and Norton Bridge and despite his having the sunshade down and his sitting in different positions, he found the sun "very troublesome", though its effect was to reduce the range at which he could read a signal's aspect rather than the range at which he could first sight it. He agreed that during his approach to Stafford the sun had been very bright and directly ahead of him, but said that being higher in the sky it had given him no trouble and he was insistent that the sun was a nuisance to him after and not before he passed Stafford. He did not ask his second man, with whom he had not worked before, to keep any special lookout.

30. Although he was well acquainted with the line Driver Gregory's recollection of the number and positions of the signals between Stafford and Norton Bridge was not too clear, but when I took him through them in turn he was insistent that, after getting a Green aspect leaving Stafford, he got a Double Yellow at signal NB 159 and at each signal thereafter up to and including NB 148, a total of seven consecutive Double Yellows, at none of which did the AWS equipment give any sort of warning: he said that AWS faults of this kind were quite common, occurring as often as once or twice a week, but that they righted themselves and that he did not therefore report them. He had no difficulty in reading the signals although, because of the sun, the range at which he did so was less than usual. He said that this sequence of Double Yellows gave him the impression that there was a train ahead and that he ran on at 40 m.p.h. expecting all the time that the next signal would be at Yellow. When I pointed out to him that the trains ahead on both Down lines were too far away to affect the signals seen by him he remained firm that each of the signals was at Double Yellow and that something must have been wrong with the signalling. He was unable to explain why his AWS equipment after the accident was at black and yellow i.e. was displaying an aspect that showed that the last indication given was a horn which had been cancelled.

31. Driver Gregory said that he last observed his speedometer when passing signal NB 148, the speed being just under 40 m.p.h., and that the next thing he saw, at a range of about 50 yards, was the Red aspect shown by signal NB 15: he was positive that there had been no Single Yellow between the last Double Yellow and NB 15, and could give no reason, other than the sun, why he had not observed signal NB 15 earlier than he did, though he did say that the signal's aspect was "dim". He said that he at once made a full emergency brake application and later saw the Up train crossing his path: he thought that his train was about to stop when it struck the train ahead. I explained to Driver Gregory that special brake tests had shown that his train should have stopped a long way short of the crossing, if he had applied the brakes when he said he did, even if its speed had been much higher than 40 m.p.h., and I put it to him that he might have failed to observe the signal at Danger and braked only when he saw the train ahead cross his path, but he remained emphatic that he had observed signal NB 15 and had braked at once, though he was unable to explain why his train had not then stopped in time.

32. Driver Gregory said that he was in good health and had no family or financial worries. He was accustomed to driving English Electric type 4 diesel engines and this one had developed no faults that might have distracted his attention. He said that he was accustomed to running over this part of the line under clear signals.

33. *Fireman A. Mackereth*, who was second man in the cab of the Down train's engine, said that he had been a fireman for two years, had not previously assisted Driver Gregory, and had run over this stretch of line only a few times. He remembered Gregory complaining about the sun, which he said was "quite strong", both before and just after leaving Stafford but did not think it necessary to help him with the signals since he seemed to have the situation well under control. He confirmed that the train's speed approaching Norton Bridge was 40 m.p.h. by the speedometer: at this point he was sitting sideways in his chair, watching the driver and just about to go back into the engine room to make one of his periodic routine checks, when he heard the driver say "What has happened here?" and saw him make an immediate emergency application of the brake. He said that he himself then looked up and saw, at a range of about 75 yards, the signal at Danger. As the train ran forward with the brakes applied he saw the train ahead and started sounding his horn, and when his engine was about a coach length short of the point of collision he jumped clear: he estimated his train's speed at this point at 15 m.p.h.

34. Fireman Mackereth said that he observed a signal at Green when leaving Stafford but was emphatic that, although he remained in the cab between Stafford and Norton Bridge and appreciated that it was his duty to keep a good lookout, he had no recollection of observing any other signals until he saw the one at Danger: this was despite the fact that at the Regional Inquiry he had said that he had observed two other signals at Green. He said that the AWS equipment had been working as far as Stafford and that after that it had made no sound at all, but when pressed he said that he "was not positive" on the latter point. He was emphatic that he saw the signal at Danger, his attention having been drawn to it by the driver's remark, and that an emergency brake application was then at once made.

35. *Passenger Guard C. J. Prescott*, guard of the Down train, said that after the train left Stafford past a signal that he observed was Green, he was busy making out his journal and saw no further signal. The speed of the train approaching Norton Bridge was between 30 and 40 m.p.h. He recognised the brake application as being an emergency one and estimated the speed at impact at about 10 m.p.h.

36. *Electrician J. A. Whelan*, of Camden Motive Power Depot, said that after engine D 215 had completed its previous trip he gave its AWS equipment a standard test, as a result of a complaint by its driver. He found that at No. 2 end the bell rang correctly for a Green signal but that this was at once followed by a brake application and a horn. He found that this was the result of a loose wire, which would cause the energisation of a relay and the discharge of the condenser. He made this good: No. 1 end was already in good order. When he had finished working on the equipment he gave both ends a standard test which proved satisfactory and he then sealed it in the operating position. He confirmed that his mate told Driver Gregory that the AWS equipment had been out of order but was now working correctly.

37. *Mr. V. Vosper, Shedmaster at Stafford*, said that after the accident the AWS equipment indicator was at black and yellow. The equipment was sealed and in the operating position. He made various tests and found the equipment to be in good order, with the bell, horn, and indicator working correctly.

38. Shortly before I opened my Inquiry I was shown a letter from a *Driver A. Hazeldine* in which he said that when driving an Up train on 14th August 1963 he passed a succession of Green signals approaching Norton Bridge on the Up Fast line and then found that the next two signals were at Yellow and Red respectively, no Double Yellow having intervened. He complained that the signals were defective. As a result I called in evidence *District Relief Signalman J. S. Peer* who had been on duty in Norton Bridge Junction signalbox at the time. Peer explained that he had made a mistake in regulation and had put a signal back to Danger after Driver Hazeldine's train had approach-locked it: at the moment when he did this the train had already passed the signal that, by his action, was put back to Double Yellow having been at Green and the next signal would thus be correctly at Yellow when the driver first observed it.

Experiments and Tests

Signalling Equipment

39. A small static switch interlocking system, employing tape-wound nickel-alloy magnetic cores as the basic switching element in place of relays, is under test in a small portion of the Norton Bridge control area. The static equipment is working in a protective series arrangement with the conventional equipment, for the period of the test. The signalling of the trains involved in this accident was therefore under the direct control of conventional relays throughout.

40. In my view the tests of the signalling equipment carried out on the day after the accident were comprehensive and thorough. Since the integrity of the signalling had however been called in question by Driver Gregory I asked for an examination to be made of the signalling relays controlling the Yellow and Double Yellow aspects at signals NB 15, 148 and 150 and they were thoroughly checked in the laboratory at Crewe. After the completion of these tests Mr. E. G. Brentnall, the Chief Signal and Telecommunications Engineer, London Midland Region, was of the opinion that a Double Yellow indication could only have appeared at signal NB 148, with signal NB 15 showing Red and with no other aspect at that signal illuminated, under an incorrect condition that could only have been caused by:—

(*a*) the false energisation of the cable conductors controlling 148 HHR relay, the impossibility of which was shown by the fact that all the relevant cables had been tested and found to be correct;

(*b*) the 148 HHR relay remaining energised after its previous operation owing to a mechanical or magnetic saturation fault, the impossibility of which was shown by the laboratory tests;

(*c*) the false energisation of the relay or relays controlling the Red and Yellow aspects at signal NB 15 (15 HR and 15 HIPR), the possibility of which was disproved by the fact that NB 15 was correctly at Danger; or

(*d*) 15 HR relay making both top and bottom contacts at the same time, which the laboratory tests had shown to be impossible.

Mr. Brentnall went on to say that successive Double Yellow aspects at the five signals leading up to NB 150 could only have been caused by the DR relays controlling the Green aspects failing to energise: the relays had been thoroughly examined and found to be in working order. He emphasised that the coincidence of five of these relays failing to energise when they should have done on the same occasion was extremely remote.

41. I am quite satisfied that all the signals were displaying the correct aspects: NB signals leading up to NB 150 were at Green when they came into view from the Down train, and NB 150 was at Double Yellow, NB 148 at Yellow, and NB 15 at Red.

Signal Sighting

42. According to the Royal Observatory the inclination of the sun above the mean horizon at Norton Bridge at 8.43 p.m. on 1st August 1963 was 1½°, and its bearing was such that, from the points at which the signals first come into a driver's view, it would be to his left at an angle to his line of sight to the signal concerned as follows:—

Signal	NB 159	11°
,,	NB 157	11°
,,	NB 155	15°
,,	NB 19	25°
,,	NB 150	Sun below the immediate horizon
,,	NB 148	25°
,,	NB 15	58° and below immediate horizon

A.W.S. Equipment

43. In my view the tests of the AWS ground equipment that were made after the accident showed conclusively that that side of the equipment was in order.

44. When tested superficially after the accident the AWS equipment on engine No. D 215 was found to be working correctly. At my Inquiry however Driver Gregory was adamant that, after giving a horn indication at a signal at Caution and a bell at the next signal, which was at Clear, when leaving Milford and Brocton, the equipment gave no indication at all at a succession of signals some of which were Green but at least two of which must have been at Caution. In effect he alleged that the equipment had developed simultaneously a No. 3 fault (in the AWS code: "Nothing received" at a Clear signal) and a No. 7 fault ("Nothing received", and no brake application, at a signal at Caution). As he said that the last indication was a bell at a Clear signal and the indicator after the accident was at black and yellow, Gregory also in effect alleged that the equipment had simultaneously developed a No. 11 fault ("Indicator not changing to all black") though I understand that it is not absolutely impossible for an indicator flag to move under the shock of a collision and I am inclined to give him the benefit of the doubt on this point. His evidence that the equipment had made no sound after Milford and Brocton was supported though not very convincingly, by his second man. To remove any possible doubt about the equipment's condition therefore, I asked the Officers of the Railways Board to arrange for a full laboratory examination of its components to be made.

45. First the equipment was tested practically and as a whole and was found to work correctly. Each component was then separately tested, being dismantled where necessary, when it was found that everything except the Relay Unit and the EP Valve were in a satisfactory state. As regards these latter components:—

(*a*) contact pressure on one spring of the EP Relay was very weak; if this contact had in fact failed to make properly, the horn would have been sounded and the brake applied; and

(*b*) the drop-away current of the horn section of the EP Valve was very low; if this had failed to drop away the horn would not have sounded at a Caution signal but the brake would have been applied, since it is controlled through a separate valve which was in a satisfactory state, unless or until re-set by the driver pressing the re-set button.

In this connection it is of interest that during the first six months of this year there were 42 reported failures of AWS equipment in diesel engines in London Midland Region: during this period the number of diesel engines fitted with the equipment rose from 225 to 316 and they were running over 363 fitted route miles with 1253 inductor installations. Only one of the reported failures was said to be a No. 7

fault and on examination it was found that the horn was defective. I think it significant that the Railway Officers who investigated this report thought it likely that the fault was really a No. 6 ("Brake without horn" at a Caution signal) and that the driver had re-set his brake unthinkingly.

Driver Gregory's Health

46. When medically examined after the accident Driver Gregory was found to be in good health and to have good colour vision.

Brakes

47. At my request braking tests were made with a train similar to that hauled by D 215. At speeds of 40, 50 and 56 m.p.h. emergency brake applications were made at a point on the Down Fast line 50 yards on the approach side of signal NB 15. Stopping distances were as follows:—

Speed	*Stopping Distance*	*Distance from fouling point of crossing at which engine came to a stand*
40 m.p.h.	254 yards	365 yards
50 m.p.h.	383 yards	236 yards
56 m.p.h.	445 yards	174 yards

On examination after the accident it was found that the right hand rear brake cylinder assembly on the second driving wheels of engine D 215 was defective, no movement being transmitted to the brake blocks. I understand however that this defect would have had very little effect (about 1¼%) on the braking performance of the 12-coach train as a whole. Brake cylinder reserve strokes were satisfactory throughout the train and the brake blocks were in good condition: the stock was returned to service without any renewals having been thought necessary.

Time and Space

48. A firm framework for estimates in time and space is provided by the facts that:—

(*a*) at the moment of collision the Up train's engine had reached a point some 350 yards past signal NB 10, and that

(*b*) when the Up train's engine passed signal NB 10 the Down train must still have been on the approach side of track circuit 25 or the signal would have been put back to Danger in the Up train driver's face.

The positions relative to each other of the two trains at the critical times can thus be deduced with reasonable accuracy.

49. Assuming that the Up train's average speed from when it passed the signal to when the Down train struck it was 20 m.p.h. (see its driver's evidence) it must have passed the signal some 36 seconds before the collision occurred. At that moment the Down train cannot have been less than 525 yards short of the point of collision. Assuming that the Down train's speed just before its brakes were applied was 40 m.p.h. (see Driver Gregory's evidence supported by that of his second man), that its speed at impact was 15 m.p.h. (assessed from damage to the two trains and the positions in which they came to rest), and that one full application of the brakes was made (as Gregory stated though not at the point he said) my estimate of the Down train's actual position when the Up train's engine passed signal NB 10 is that it was some 560 yards short of the point of collision i.e. some 165 yards short of Bridge No. 17.

50. The driver of an engine similar to D 215 running on the Down Fast line gets his first view of a train on the Up Fast line that is just about to enter the crossover when he is 53 yards short of Bridge No. 17. When Driver Gregory reached this point however the Up train would still have been only some 60 yards beyond signal NB 10 and out of his view: the Up train probably came into his view when he was some 25 yards short of Bridge No. 17 and it was then still short of the start of the crossover. The Railway Officers re-enacted for me these movements of the two trains relative to one another and I watched from the cab of the Down train's engine the Up train turn to cross its path. Lineside structures obstruct the driver's view of the crossover until his engine is some 15 yards beyond the bridge but, in my opinion, if Driver Gregory had been fully alert and looking out along the line he should have observed that the Up train was on the crossover, and realised that it was on a collision course, within the seven seconds after running under the bridge in which he would have to apply the brakes if the train was to be stopped in time. (If the Down train's speed exceeded 40 m.p.h. it should have been immediately obvious to him, as soon as he saw it, that the Up train had turned to cross his path but the margin for braking would have been more than proportionately reduced).

Conclusion

51. The causes of this accident were that the Down train passed signal NB 15 at Danger and that the train's brakes were not thereafter applied until too late for it to be stopped short of the Up train crossing its path.

52. Driver Gregory alleged that a succession of signals leading up to NB 15 were wrongly displaying Double Yellow aspects, but of these only the alleged Double Yellow at signal NB 148 could have given him any kind of excuse for his failure to stop at signal NB 15, and then only if it had misled him into

approaching the latter signal too fast to stop at it after observing it at the full sighting distance. This, by his own account, it did not do since he was running at only 40 m.p.h., from which speed the braking distance is much shorter than the distance at which the signal should have been observed. Similarly, the alleged failure of the AWS equipment on the engine gave him no kind of excuse for his failure to observe NB 15 in time to stop at it. The equipment is provided as an aural aid to a driver in his observation of signals and not in any way a substitute for his visual vigilance: if its alleged failure should have had any effect on his vigilance on this occasion it should have increased it.

53. I can see no excuse for Driver Gregory's failure to observe signal NB 15 in time to stop at it. At the moment when it first came into his unobstructed field of view the sun was well to the left of his line of sight to the signal and below the immediate horizon, and it is hard to see how he could have been bothered by it. The signal is well sited and was showing a clear Red aspect, and he should have observed it, framed by the structures, at a range of not less than 400 yards which would have given him an ample braking distance. The driver's first duty is to keep a good lookout and to observe each signal in turn, and Driver Gregory, except in so far as he got very little help from his second man, must bear the full responsibility for passing the signal at Danger.

54. Nothing came to light in any of the tests of the AWS equipment to suggest that bell indications were not being correctly given at Green signals and I accept that this part of the equipment was working correctly. It is clear also that the AWS did not develop a No. 7 fault: there was certainly no wrong-side failure of this equipment. Driver Gregory must therefore have pressed the re-set button after his engine passed over the AWS inductors 200 yards short of each of the signals NB 150, 148, and 15 or the train would have been stopped three times by the automatic application of its brakes. This he denied doing but unthinking cancellation is by no means unknown among drivers and he might well not remember afterwards that he had done so. What I find much less explicable is his failure to react to the horn indication at these three signals if in fact it was sounded. His mind was clearly not on his job as his train approached the signal at Danger and I think it likely that he had let his attention wander soon after leaving Stafford, but I find it hard to believe that he was so abstracted that three successive horn indications, at fairly short intervals and after a succession of bells, would not have brought him to his senses. His mind may possibly have been so far from its duty that it failed three times to grasp the fact that the horn had been sounded but, since the state of the AWS equipment was such that it may have developed a No. 6 fault, I feel that Gregory should be given the benefit of the doubt on this point and I accept that the horn may not have been sounded at the three signals and that Gregory may have cancelled the braking unthinkingly: a possibility may be that he did so at the last two signals on hearing or seeing the indicator change from black and yellow to black on passing over the inductor.

55. Why and when Gregory first let his attention wander are matters for speculation but I think it significant that he insisted at my Inquiry on the sun's being troublesome to him between Stafford and Norton Bridge. The facts about the sun's position set out in paragraph 42 above show clearly that it cannot really have bothered him at this stage of his journey but he clearly had been bothered by it at some time. A likely length of line for this to have happened was that between Colwich and Stafford where the sun, which would already have been low in the sky but still bright, would frequently have been straight ahead of him and shining into his eyes. It may well be that the sun put Gregory under some strain approaching Stafford and that the relaxation of strain when this nuisance was removed contributed to his loss of attention. If this was so his mind when it returned to his job might well hark back to the last part of the journey that it really remembered. (I can however see no reason why he should have associated this stretch of line with a succession of Double Yellow aspects: I have checked that the previous train over this stretch was well ahead of him and that he was then running under clear signals.)

56. Another factor conducive to his letting his attention wander was the fact that he was used to running over this length of line under clear signals: a clear signal when leaving Stafford may have given him a false expectation of a clear run. The smoothness of running over continuously welded rails and the comfort of a warm cab may also have played their parts.

57. What actually happened is uncertain, but I do not accept that Driver Gregory applied the brakes as he said he did, whilst still approaching signal NB 15. The braking tests showed clearly that if he had done so his train would have stopped well short of the point of collision. I attribute Fireman Mackereth's evidence in support of Gregory on this point, and some other points, to a misplaced sense of footplate loyalty.

58. In my view the deductions in time and space in paragraphs 48-50 above suggest two possible reasons for the late application of the brakes:—

(*a*) Driver Gregory may have failed to observe signal NB 15 at all and have run on past it, unaware that anything was amiss until he saw the Up train turn to cross his path, when he braked immediately but too late to stop short. At my Inquiry Gregory was emphatic that he had observed the signal at Danger and I formed the opinion that he really believed that he had done so. A possible explanation of this might be that his experience told him that the signal must have been at Danger when he passed it and that, racking his brains as he must have done after the accident to explain it and unwilling to admit even to himself that a man of his experience could possibly have missed the signal, he convinced himself that he must have seen it, and must

on seeing it have taken the appropriate braking action. I put this possibility to Driver Gregory but he would not accept it: nevertheless it fits the facts as his own story cannot do. It does however postulate that Gregory was very unalert and not concentrating as he approached and passed the signal but showed quite a high degree of alertness when the Up train came into his view.

(*b*) Driver Gregory may have seen with his eyes the signal at Red as he approached it but, his mind not being on his job, he may for the moment have failed to grasp its message. Shortly afterwards the import of what he had sub-consciously seen may have been consciously appreciated and his trained reaction then made him apply the brakes at once, irrespective of any observed danger ahead. Cases of such a momentary unawareness of a signal's meaning were noted by a Working Party of the Air Ministry Flying Personnel Research Committee that was set up recently to investigate the problem of "unawareness" in relation to mistakes made by people engaged in air and ground control tasks. The Working Party drew attention to the number of these cases of "momentary unawareness" that they had encountered and one of the examples they gave in their Report* was very similar to this case: a driver who had passed a signal at Danger was quoted as having said afterwards that he "was aware of a red light but somehow its implication did not dawn on (him)". If this is what happened Gregory would clearly have very little difficulty in persuading himself afterwards that he had observed the signal correctly and acted on that observation.

*Flying Personnel Research Committee Memorandum FPRC/Memo. 171.

Neither of these possibilities in any way excuses Driver Gregory's failure properly to observe the signal.

Remarks and Recommendations

59. As I have shown in paragraph 52 above, even if the signal sequences had been presented incorrectly and the AWS equipment had failed completely, as Driver Gregory alleged, there was still no excuse for his failure to observe signal NB 15 at Danger and to stop short of it. I have nevertheless had the signalling at Norton Bridge and the AWS equipment on the engine tested very thoroughly and have referred to these tests at some length in this Report. I have done so because the integrity of the equipment had been called in question publicly by Driver Gregory and his allegations had therefore to be publicly refuted or upheld. It was for the same reason that I put to the test, and in the event disproved, the allegations made in all good faith by Driver Hazeldine that another part of the Norton Bridge signalling had failed in a similar way on another occasion.

60. If traffic is to be moved at speed and safely it is of the greatest importance that all drivers should have complete confidence in the integrity of the signals to whose guidance and commands they run. The signalling system should not only be absolutely reliable but should be known by all drivers for certain to be so. Rumours of the unreliability of signals can gain wide credence if not positively refuted and I hope that the Railway Officers concerned will give wide circulation among their enginemen to the results of the signalling and AWS tests made in this case. The integrity of the signalling at Norton Bridge and the fact that the AWS equipment did not develop a danger-side failure were fully proved.

61. Whether or not the AWS horn was sounded, the fact that Driver Gregory must have cancelled the AWS brake application when closely approaching signal NB 15 at Danger shows that his action, at least at this signal, must have been unthinking. It thus underlines the danger that can arise when a driver develops an automatic AWS response and drops into the habit of unthinking cancellation, thereby depriving himself of much of the equipment's help. In semaphore signal territory the problem is unlikely to arise since AWS inductors are placed at Distant signals only and these are usually far apart, except at places where drivers are most likely to be alert. In closely signalled colour light signalling territory however the situation is different. Between Stafford and Norton Bridge, for example, the distance between successive signals averages only some 940 yards and the driver of a train running through the section at only 40 m.p.h. will receive an AWS indication every 50 seconds: at a speed of 60 m.p.h. he will get two indications a minute. In such conditions it is necessary to guard against the development of an automatic AWS response and supervisory staff should, in my view, be warned to watch out for this bad habit among drivers running through colour light territory: one symptom, which has been observed, is the use of the cancelling button after bell indications.

62. The best safeguard against unthinking cancellation seems to me to lie in the driver's own self-discipline against the development of a bad habit. He can however be helped considerably in this by the intelligent siting of the re-set button. In siting it the best possible compromise must be achieved between making cancellation too easy and making it too difficult: if the button is too close to the driver's hand in its normal driving position automatic cancellation is encouraged, but if too complicated a movement is needed useless irritation may be caused. On different classes of engine the siting of the button differs but I have no criticism to make of the button's siting on engines of the class involved in this case, where the driver had to lift his hand from the controller handle to press a button some 13" above it and slightly further forward: Driver Gregory's bad habit clearly did not stem from any weakness in the design of his engine's cab.

63. The siting of the signals at Norton Bridge is very good and the safeguards that are included in the signalling system are comprehensive and up-to-date. Except through gross irregularity no single person other than the driver of a train can by his own single act or omission cause such an accident on this line, and the AWS equipment was superimposed on the visual signals expressly to guard against such human failures by drivers. The circumstances of this accident indicate however that even under these conditions a human failure can occur.

I have the honour to be,

Sir,

Your obedient Servant,

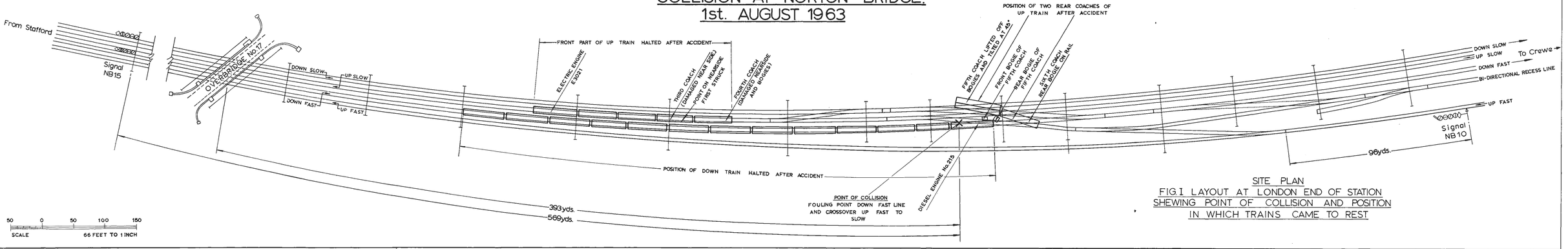
J. R. H. ROBERTSON,
Colonel.

The Secretary,
Ministry of Transport.

Printed in England for Her Majesty's Stationery Office
by Wm. Dresser & Sons Ltd., Darlington.

Wt. 3408 K.12

COLLISION AT NORTON BRIDGE.
1st. AUGUST 1963



SITE PLAN
FIG.I LAYOUT AT LONDON END OF STATION SHEWING POINT OF COLLISION AND POSITION IN WHICH TRAINS CAME TO REST

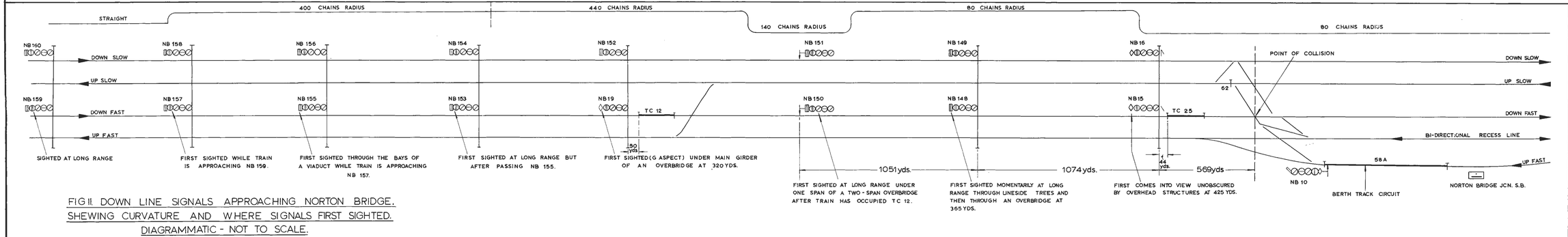
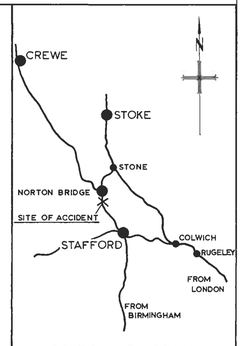


FIG II. DOWN LINE SIGNALS APPROACHING NORTON BRIDGE. SHEWING CURVATURE AND WHERE SIGNALS FIRST SIGHTED. DIAGRAMMATIC - NOT TO SCALE.



LOCATION DIAGRAM

Published by
HER MAJESTY'S STATIONERY OFFICE

To be purchased from
York House, Kingsway, London, W.C.2
423 Oxford Street, London, W.1
13A Castle Street, Edinburgh 2
109 St. Mary Street, Cardiff
39 King Street, Manchester 2
50 Fairfax Street, Bristol 1
35 Smallbrook, Ringway, Birmingham 5
80 Chichester Street, Belfast 1
or through any bookseller

55-9999