MINISTRY OF TRANSPORT

RAILWAY ACCIDENT

Report on the Collision that occurred on 15th August 1963 at Knowle and Dorridge

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FOUR SHILLINGS NET

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1964

MINISTRY OF TRANSPORT,
ST. CHRISTOPHER HOUSE,
SOUTHWARK STREET,
LONDON, S.E.1.

SIR, *19th February*, 1964.

I have the honour to report for the information of the Minister of Transport, in accordance with the Order dated 20th August, 1963, the result of my Inquiry into the collision that occurred at about 1.11 p.m. on Thursday, 15th August, 1963, at Knowle and Dorridge Station on the part of the Main line between Birmingham (Snow Hill) and Paddington that lies in the London Midland Region, British Railways.

The signalman at Bentley Heath Crossing signalbox had accepted the 1.0 p.m. Birmingham (Snow Hill) to Paddington Pullman express train on the Up Main line and had received "Line Clear" for it from the signalman at Knowle and Dorridge, the next box in advance and less than ¾ mile distant, and he had then lowered all his signals, including the Distant. The signalman at Knowle and Dorridge did not, however, lower his signals and, forgetting that he had accepted the express, he allowed a shunting movement to pass onto the Up Main line and to proceed along it in the facing direction. He realised his mistake at the last minute and stopped the shunting movement almost opposite his box, but in that position it fouled the clearing point which is 440 yards beyond the Up Main Home signal.

The Pullman express, which comprised nine coaches drawn by a diesel-hydraulic locomotive, was travelling at about 80 m.p.h. as it approached Bentley Heath Crossing box. The driver evidently saw the Knowle and Dorridge Outer Distant signal, which is on the same post as the Bentley Heath Crossing Home signal, at Caution, and he certainly made an emergency application of the brakes. The Outer Distant is, however, only 902 yards from the Home signal, which is not an adequate braking distance from such a speed, and the train passed the latter signal at Danger and collided at about 20 m.p.h. with the leading vehicle of the shunting movement at a point about 377 yards beyond that signal. The special Regulation for the operation of trains where the braking distance beyond a Distant signal is inadequate, which is applicable to the two boxes concerned, had been disobeyed on this occasion by the signalmen.

The express was not derailed, but the leading end of its locomotive was wrecked, and I regret to report that the driver and the two others in the driving compartment, the co-driver and a fireman, were killed. One member of the staff of the restaurant car was severely scalded; he was removed to hospital without delay and was detained. Two other members of the railway staff suffered from shock.

Calls for assistance were made immediately and all the emergency services responded promptly. The collision blocked the Up and Down Main lines but the Relief lines alongside them were not blocked by its debris; the Up Relief line was however blocked for a short time by a wagon from the shunting movement that was propelled on to it. The Pullman train passengers were detrained and accommodated in other services on the Relief lines. Breakdown equipment was called and arrived without delay, and the Main lines were cleared and normal working was restored at 2.35 a.m. on the following morning. In the meantime some Main line services were worked over the Relief lines while others were diverted.

The weather was fine and the rails were dry.

DESCRIPTION

The Site and Signalling

1. The Main line from Birmingham (Snow Hill) towards Paddington has four passenger running lines to Lapworth, some 13 miles to the South, beyond which it becomes double. As shown on the plan, the four passenger lines are, from east to west, the Up Main, Down Main, Up Relief and Down Relief. Bentley Heath Crossing and Knowle and Dorridge lie on the four track section and are, respectively, the last but one and the last box before Lapworth. There are also Goods loops between Bentley Heath Crossing and Knowle and Dorridge; the Up loop lies to the east of the Up Main and the Down loop lies to the west of the Down Relief line.

2. Up to 31st December 1962, the whole of the Main line between Birmingham and Paddington (111 route miles) was controlled by the Western Region, but from that date the section from Birmingham (Snow Hill) to Ardley (54 route miles) was transferred to the London Midland Region.

3. The relevant distances are as follows: —

	Distance from Birmingham	*Intermediate distance*
Birmingham (Snow Hill)	—	
		3 m. 564 yds.
Tyseley	3 m. 564 yds.	
		3 m. 1331 yds.
Solihull	7 m. 135 yds.	
		2 m. 1359 yds.
Bentley Heath Crossing signalbox	9 m. 1494 yds.	
		– m. 1194 yds.
Knowle and Dorridge signalbox	10 m. 928 yds.	
		2 m. 839 yds.
Lapworth	13 m. 7 yds.	

4. In the Up direction from Birmingham the lines are generally on a slightly rising gradient to Solihull whence, in general, they fall gently through Bentley Heath Crossing to Knowle and Dorridge, though between these two boxes the gradient steepens somewhat to 1 in 214. After leaving Bentley Heath Crossing the Up lines swing slightly to the right and then run straight for a short distance before taking a long left-handed curve of 108 chains radius through Knowle and Dorridge. The overall speed limit is 90 m.p.h. but there is a speed restriction of 65 m.p.h. through Tyseley.

5. There is a public level crossing close to and operated from Bentley Heath Crossing box, and there is a road overbridge some 335 yards on the Birmingham side of that box.

6. At Knowle and Dorridge there are platforms on all four passenger lines connected by a foot overbridge at the Birmingham end. The signalbox is at the London end of the platforms and between the Down Main and Up Relief lines, which at that point are some 35 ft. apart. Owing to the curvature and the footbridge, the signalman cannot see a train on the Up Main line until it is closely approaching the platform.

7. About 40 yards on the London side of the Knowle and Dorridge signalbox there is an accommodation overbridge. Over the Main lines it is of brick construction and one of its piers adjoins the ess of the Up Main line. On the London side of this bridge there are crossovers from the Up Main to the Up Relief and from the Down Relief to the Down Main line. There are three separate shunting yards called the New Yard, the Old Yard and the Down Yard. The New Yard is connected to the Up Goods loop which rejoins the Up Main line at a point about 60 yards beyond the Home signal. In extension of the Goods loop there is a short dead-ended siding which is used as a shunting neck for the New Yard. The points in the connection between the Goods loop and New Yard are worked from an adjacent ground frame which is not controlled from the signalbox. The Old Yard is connected to the Up Main line by trailing points, worked from the box, on the London side of the box. The Down Yard is connected to the Down Relief line.

8. The relevant signals at Bentley Heath Crossing and Knowle and Dorridge are lower quadrant semaphores and they are shown on the plan. It will be noted that, on the Up Main line, the Bentley Heath Crossing Distant has its own post and is 1,148 yards on the approach side of the Home signal, which is 105 yards on the approach side of the signalbox. The Starting signal is beyond the signalbox. Knowle and Dorridge has two Distant signals, which are motor-worked and operated by one lever; the Outer Distant is located on the same post as and below the Bentley Heath Crossing Home signal, and the Inner Distant is on the Bentley Heath Crossing Starter post. The Knowle and Dorridge Home signal is 902 yards beyond the Outer Distant, 335 yards beyond the Inner Distant and 399 yards on the approach side of the signalbox. All the signals and points are worked from mechanically interlocked frames in the respective boxes. There is no interlocking between the Distant signals of the two boxes, but the Knowle and Dorridge Distant signals cannot be lowered until the respective Bentley Heath Crossing stop signals above them have been lowered.

9. The Up Main line is track circuited from the Bentley Heath Crossing Home signal up to and through Knowle and Dorridge, and the track circuits control the signal levers in the usual way. The line is equipped with the former Great Western Railway type of Automatic Warning System. On the Up Main line the Bentley Heath Crossing ramp is 440 yards on the approach side of the Distant signal, and the Knowle and Dorridge ramp is just beyond the post carrying its Outer Distant and the Bentley Heath Crossing Home signal; there is no ramp at the Inner Distant signal. Train working on the passenger lines is by standard 3-position block instruments, and on the Up Goods loop between Bentley Heath Crossing and Knowle and Dorridge by a permissive instrument.

10. On the Up Main line, the Knowle and Dorridge Outer Distant comes into full view from the footplate at a distance of about 230 yards, as the locomotive emerges from the overbridge mentioned in paragraph 5. The Inner Distant comes into full view from the level crossing and the Home from a point about 50 yards on the approach side of the Inner Distant.

The Train

11. The nine Pullman coaches of the express were built in 1923. They weighed 361 tons and the brake power available, with 25 ins. vacuum, was 383 tons or 106% of the weight of the train. All the coaches were equipped with Buckeye couplings and had direct admission valves, or the equivalent, in the vacuum brake system. The locomotive was a Class D 1000 diesel-hydraulic with C-C wheel arrangement; this type of locomotive has two 1350 H.P. Maybach engines and Voith transmission, and weighs 108 tons in working order. It is equipped with a compressed air brake which can be operated as a direct air brake applied to the engine wheels only by a self-lapping driver's brake valve, or in conjunction with the automatic vacuum braking system, by use of the driver's vacuum control air valve. When operated in this way the engine brake is applied through a proportional valve which regulates the braking on the locomotive in accordance with the reduction in train pipe vacuum. The locomotive is also equipped with G.W.R. type of A.W.S. pick-up equipment and with a speedometer in each driving compartment. The brake power available on the locomotive was 82 tons or 76.6% of its weight. The total brake power available on the train was therefore 465 tons or almost 100% of its total weight. The length of the train was 657 ft.

12. This type of locomotive is of lightweight integral construction in which thin plate is used and is appropriately stiffened to enable the structure as a whole to withstand the loading to be imposed on it. This technique was originally applied to aircraft construction from which it has been developed for use in coach and locomotive construction. The underframe is built up round two solid drawn

Plate I. Leading end of diesel locomotive after withdrawal of carflat. Note the distorted buffers.

Plate II. Loaded carflat, the leading vehicle of the shunting movement.

steel tubes of 6½ ins. outside diameter and 0.192 in. thickness, running from one end of the locomotive to the other. Lateral steel plates of 5/32 in. thickness are threaded on to the tubes and longitudinal plates of similar thickness are inserted between the lateral plates, and the whole is welded together into a honeycomb-like structure to which the deck, which is of the same thickness as the steel plates, is welded and the buffers are bolted. The superstructure consists of a light framework of 0.104 in. thick bent steel sections covered with a 0.080 in. thick steel plate skin, and it is welded to the underframe. The locomotive has no bulbous projection in front of the driving compartment, entry into which is from a transverse corridor which is immediately behind it and has outside doors.

The Shunting Movement

13. The shunting movement consisted of a steam pannier tank engine with a 20 ton brake van, one empty "carflat" and one loaded "carflat", in that order from the engine on the Birmingham side, and one loaded 20 ton hopper wagon on the London side. The engine and the vehicles together weighed about 118 tons and were 203 ft. long. The "carflats" had been converted from bogie passenger coaches and they had steel underframes with heavy solebars and buffer beams.

The Damage

14. The express struck the loaded carflat at a point about 22 yards short of the signalbox. The brake van and the empty carflat were derailed and the body of the latter, and the van were thrown off the track. The loaded carflat, with the steam engine and hopper wagon, was pushed forward for about 64 yards. The rear bogie of this carflat was derailed and either it or one bogie of the empty carflat became wedged against the brick pier of the accommodation overbridge; only one pair of wheels of the front bogie of the loaded carflat was derailed. The force of the impact was, however, sufficient to cause the solebars to buckle (see Plate II opposite), and it was also sufficient to distort the buffers of the diesel locomotive upwards (see Plate I opposite). The buffing faces thus formed an inclined plane on which the carflat buffers, themselves distorted upwards by the buckling of the solebars, were forced upwards and allowed the headstock to be driven through the comparatively light framework of the driving compartment, forcing the instrument panels etc. against the back partition and into the transverse corridor behind it.

15. The two carflats and the brake van were wrecked but neither the steam engine nor the hopper wagon was seriously damaged. The coupling between the engine and the hopper wagon fractured, and the wagon was propelled by the impact through the crossover to the Up Relief line and about half a mile along that line towards Lapworth.

16. Neither the diesel locomotive nor any of the Pullman coaches were derailed, the Buckeye couplings holding throughout. Some of these couplings were, however, damaged. The heavy coaches also received some other damage, but it was not substantial.

17. The damage to the permanent way and signalling equipment was slight. The rails were found to be scored from the approach side of the Knowle and Dorridge Home signal to beyond the point of collision. The score marks were light except over a distance of 169 ft. at the Birmingham end of the platform, a distance of 2 ft. near the centre of the platform and in the vicinity of the point of collision, where they were heavy.

Rules

18. Owing to inadequate braking distance beyond the Distant signal of some signalboxes, the Western Region have a special Regulation in their Block Regulations which are still applicable on the whole of this Main line. The special Regulation is No. 4A and, among the boxes at which it is required to be applied, are those where a Distant signal is less than a thousand yards from the Home signal and the gradient is falling. It is therefore required to be applied at Knowle and Dorridge in accepting trains on the Up Main line from Bentley Heath Crossing.

19. This Regulation requires the signalman at Knowle and Dorridge to obtain "Line Clear", or "Line Clear to Clearing Point Only", from Lapworth before he gives full "Line Clear" to Bentley Heath Crossing for a train. If the signalman at Knowle and Dorridge has received only a warning acceptance from Lapworth, or if he has received "Train Out of Section" for the last train, and/or providing the line is clear to the clearing point beyond his Home signal, he must not send full "Line Clear", but he may send the signal "Line Clear to Clearing Point Only" to Bentley Heath Crossing (six beats 2-2-2). Having received the latter signal, the signalman at Bentley Heath Crossing must keep all his signals at Danger until the approaching train has passed within the Distant signal.

20. The Regulation also requires the signalman at Knowle and Dorridge to arrange for the signalman at Bentley Heath Crossing to keep his Distant signal at Caution for a train that is to be stopped at the Knowle and Dorridge signals. Again, the signalman at Bentley Heath Crossing is required to keep a close watch on the Knowle and Dorridge Distant signals and, if they do not act properly, to advise the Knowle and Dorridge signalman immediately.

Narrative and Evidence

Narrative

21 A Pullman service is run on this line from Mondays to Fridays (both inclusive) and it comprises a train from Wolverhampton and Birmingham (Snow Hill) to Paddington and back to Birmingham in the morning, and from Birmingham at 1.0 p.m. to Paddington and back to Wolverhampton in the evening. The service is normally worked by one 8-coach diesel-electric train set; the coaches are externally blue in colour and the train is known as the Blue Pullman.

22. The set is normally serviced at Swindon during week ends, but it had to be taken out of service at Paddington on the afternoon before the accident. In order to allow for such contingencies, two standby sets of ordinary Pullman coaches are kept ready for use, one at Derby and the other at Old Oak Common, near Paddington, and these act as reserves for other Blue Pullman services also. The Old Oak Common set was used for the Down Service from Paddington to Wolverhampton on the evening before the accident. The same set was in use on the morning services on the day of the accident, and it was also in use on the 1.0 p.m. express from Birmingham to Paddington which met with the accident.

23. The train left Birmingham (Snow Hill) on time and it had a normal run until it was closely approaching Bentley Heath Crossing box; by then the speed would have reached about 80 m.p.h. (see paragraph 61). The signalman at Bentley Heath Crossing had obtained full "Line Clear" for it from Knowle and Dorridge and had lowered all his signals, including the Distant. The Knowle and Dorridge signalman had, contrary to the Regulations, given full "Line Clear" to Bentley Heath Crossing before obtaining "Line Clear" from Lapworth, though he later obtained this "Line Clear"; he did not, however, lower any of his signals. From all accounts, it seems that the driver of the express must have seen the Knowle and Dorridge Outer Distant as soon as it came into view at a range of about 230 yards, on passing through the road overbridge, or very soon afterwards, and he certainly made an emergency application of the brakes. The train did not however stop at the Home signal and it was, according to most witnesses, including a train spotter on the accommodation overbridge, still travelling at about 30 m.p.h. when it struck the shunting movement some 377 yards further on; another train spotter thought the speed at impact was 20 m.p.h.

24. The shunting movement was being made by the engine of the 10.15 a.m. Goods train from Bordesley Junction (near Birmingham) to Knowle and Dorridge, which had arrived at 10.40 a.m. The movement was under the control of the train guard and a shunter. The train had run from Bentley Heath Crossing to Knowle and Dorridge on the Up Goods line. After some shunting had been done in the New Yard, the engine with the brake van attached was taken to the Old Yard to pick up the two carflats and then to the Down Yard to pick up the hopper wagon. These vehicles were all to be taken back to the New Yard. They were therefore taken out of the Down Yard on to the Down Relief line, then taken via crossover no. 48 to the Up Relief line where they stood for about 3 minutes waiting for shunting signal no. 39 to be lowered. When this signal was lowered they were taken via crossover no. 36/37 to the Up Main line. While proceeding along the Up Main line the fireman saw a red hand signal exhibited from the signalbox; he told the driver, who stopped the movement with the engine more or less under the accommodation bridge and the leading (loaded) carflat roughly opposite to the signalbox. The driver released the brake, and then he saw the Pullman express approaching. He realised at once that a collision was inevitable and told his fireman to jump, and he himself also jumped to the ground. The guard and the shunter, who were on the open verandah at the leading end of the brake van, also saw the express approaching and jumped clear just before the collision occurred.

Evidence of Train Men

25. *Guard T. W. Beddow*, who was in charge of the Pullman express and was travelling in the brake van at the rear end, said that the train had reduced speed through Tyseley to comply with the restriction, and that it had then accelerated; he thought that it was running at its normal speed when approaching Bentley Heath Crossing. Just before the brake van reached the signalbox he heard the vacuum valve in his van lift and saw the needle of the vacuum gauge fall to zero and remain at zero, and he knew that an emergency application of the brake had been made. He therefore applied the hand brake and had got it full on a few seconds before the collision, which he thought occurred at about 30 m.p.h. Afterwards Beddow, having ensured that the necessary protection had been provided, went to the signalbox; the signalman was on the telephone, but turned round and told him that all the lines were protected. Beddow said that he had worked as guard on this particular train set from Paddington to Wolverhampton on the previous evening, and that it had been stopped correctly at places where it had been required to stop.

26. *Guard W. V. Atkin*, who was travelling spare in the brake van, generally confirmed Beddow's evidence. He said that as soon as he heard the vacuum valve lift he went to the offside window, opened it and looked out; the brake van was then opposite a food store just beyond Bentley Heath Crossing. He added that the collision was not heavy.

27. *The Pullman Car Conductor, C. T. Bailey*, who was riding in the 5th coach from the front, said that he suddenly felt a rather heavy application of the brakes which indicated to him immediately that something was wrong. Then, he said, "there was a sort of release, then a grip, release, grip, release, grip and then a particularly sharp stop." Mr. Bailey went on to say "when the first application came on, the things on the table were moving forward gradually with each jerk; they shot forward when we had the final jerk and the whole lot went on to the floor." He had not noticed the position of the train when he felt the initial brake application.

28. *Driver F. E. Wenham*, a tutor driver, had driven the Up Pullman express from Wolverhampton to Paddington and the return Down trip to Birmingham on the morning of the accident. The locomotive used on the up trip was removed at Paddington and another was attached for the return trip which also worked the train involved in the accident. He said that both trips were uneventful except that he had trouble with the locomotive on the return trip, though he was able to keep time; also, that in the Up direction, he had received a horn (caution indication) at the A.W.S. indicator at the Bentley Heath Crossing Distant signal when the signal itself was clear.

29. Wenham stated that in his opinion the brake power available on this particular set of Pullman coaches was not good and was not nearly so good as on the Derby set of Pullman coaches (see paragraph 22), or as on the Blue Pullman train; he also did not think that it was as good as the brake power on a train comprised of ordinary passenger stock. He said that he had not previously reported this because "everyone who works that train knows it and makes allowances", but on 19th August, four days after the accident, he submitted a report on the Down trip which included the words "Brake power did not seem to come up to normal standards". He said however that he had not had any trouble in stopping the train correctly, but he added that another driver had overshot the platform at Solihull when working this set. (Subsequent investigations disclosed however that on that occasion the Derby train set was in use).

30. Wenham went on to say that in normal circumstances the 1.0 p.m. express from Birmingham would have reached a speed of about 80 m.p.h. at Bentley Heath Crossing. He said that normally, after passing the Bentley Heath Distant at Clear, the Knowle and Dorridge Distants were also clear, but he recalled that some years back on three occasions in one week he had found the Knowle and Dorridge outer Distant at Caution because, he thought, of some work on the level crossing gates. The Inner Distant and the Home signals were on each occasion clear.

Evidence of Signalmen

31. *Signalman W. E. I. Taylor,* who was nearly 65 years of age, had been a signalman for 40 years, and had worked at Bentley Heath Crossing since 1948. He came on duty at that box at 6.0 a.m. on the day of the accident, and his duty was up to 2.0 p.m. He said that, having accepted the 1.0 p.m. express from Solihull and received "Train Approaching" from Solihull, he asked "Line Clear" for it from Knowle and Dorridge at 1.6 p.m. and was given full "Line Clear" immediately. He received "Train Entering Section" from Solihull at 1.8 p.m. and he then closed the level crossing gates (there was no road traffic about) and cleared all his signals. He said that the train passed at 1.10 p.m., at its normal speed, and that he gave "Train Entering Section" to Knowle and Dorridge at the same time. He had not thought that the brakes of the train were being applied as it passed his box, and it was not until it was passing the Starter that he noticed that it was slackening speed.

32. Taylor said that, provided the signalman at Knowle and Dorridge had operated his signal levers, the Outer and Inner Distant signals of that box came "off" when he, Taylor, cleared his Home and Starter signals respectively. Sometimes, however, the signalman at Knowle and Dorridge was a little late in operating his levers, and the Distants then did not come off with his stop signals. On such occasions it was Taylor's practice to remind the signalman at Knowle and Dorridge by "buzzing" him on the telephone. On this occasion the Outer Distant signal did not come off but Taylor said that he had not noticed this and consequently he did not "buzz" the Knowle and Dorridge signalman. He said that it was near the end of his duty and that after clearing his signals he went to the toilet to get a broom to sweep up. When he came out he noticed that the Knowle and Dorridge Outer Distant was still at Caution, but the train was then approaching the road overbridge and it was too late to "buzz" Knowle and Dorridge.

33. I questioned Taylor closely about his knowledge of the reason for the special Regulation 4A, and it was evident that he did understand that it was applied at Knowle and Dorridge because of the short braking distance from that box's Outer Distant to the Home signal, on the falling gradient. He recalled that on occasions some years ago, when trains were worked by steam engines, the Knowle and Dorridge Outer Distant had not come off because of a defect in the electric motor. The trains for which it should have been cleared had, however, managed to stop at the Home signal.

34. Taylor said that he had signalled the 10.15 a.m. Goods train (see paragraph 24) to Knowle and Dorridge on the Up Goods loop at about 10.30 a.m. After that he had sent an engineering special along the same route at 11.37 a.m. He had not, however, received "Train Out of Section" for either train.

35. *Signalman E. O. Jones* was 55 years of age, had been a signalman for 27 years and had worked at Knowle and Dorridge since 1948. He came on duty at 6.45 a.m. on the day of the accident and his duty was to extend to 2.45 p.m. He had been on the same duty each day that week. Jones said that the 10.15 a.m. Up Goods train arrived on the Up Goods loop at about 10.40 a.m. After working in the New Yard, under the control of a shunter, the engine and brake van were taken to the Old Yard to pick up the two carflats and then to the Down Yard to pick up the hopper wagon. After that they were to be returned, along the Up Main line, to the New Yard; in preparation for this movement, he took them out from the Down Yard and shunted them on to the Up Relief line where they stood at signal no. 39.

36. Jones said that he was offered the 1.0 p.m. express train by the signalman at Bentley Heath Crossing at 1.7 p.m. and that he accepted it at once at full "Line Clear". He did not, however, enter these signals in the Train Register at once. He agreed that he had not asked "Line Clear" for the train from Lapworth before accepting it from Bentley Heath Crossing at full "Line Clear" but he said that he obtained the "Line Clear" from Lapworth immediately afterwards; (the Train Register at Lapworth shows, however, that the request for "Line Clear" from Knowle and Dorridge was not made until about three minutes later). Jones explained that it was his custom to give "Line Clear" to Bentley Heath Crossing first and then to ask for "Line Clear" from Lapworth, and that he did this knowing that Regulation 4A applied at his box and forbade it (see paragraph 41). He went on to say that it was not always possible to clear the signals for an Up train immediately after giving "Line Clear" to Bentley Heath Crossing because of movements on the Down Main or other lines for which signal levers needed to be pulled in priority. He did not, however, clear his signals for the Pullman train on this occasion although there was no other train movement at the time, and the reason he gave was that he was "concerned with the shunting

movement". This movement was, he said, a regular one and was done sometimes before and sometimes after the passage of the Pullman train.

37. Jones said that he then completely forgot that he had accepted the Pullman train. He could not recollect whether he had reversed the crossover from the Up Relief line to the Up Main line and cleared signal no. 39 for the shunting movement before he gave "Line Clear" or afterwards; but whichever was the case, he allowed the shunting movement to proceed. He then received, at 1.12 p.m., "Train Entering Section" from Bentley Heath Crossing for the Pullman train. He realised at once that he had made a mistake and he attempted to stop the shunting movement by using a red flag at the London end of the box, but the movement did not stop until the leading vehicle was opposite to his box.

38. I questioned Jones closely about his actions and he was adamant that he had not cleared the signals for the Pullman train and then put them back to Danger to give precedence to the shunting movement, and from tests that I made I am satisfied that it is most unlikely that he could have done this. He was equally adamant that it had not been his intention to keep his Up signals at Danger for the Pullman train while he allowed the shunting movement to pass into the New Yard; to have done so would have been a very serious breach of block, and it would also have detained the train. He was insistent that the reason for his mistake was merely that he had completely forgotten that he had given "Line Clear" for the Pullman train; the only explanation that he could give was, again, that he was concerned with the shunting movement. He said that he might have accepted the "Is Line Clear" signal for the train automatically, and without thinking.

39. Jones said that he had been more busy than usual that morning because there had been two extra trains, one at 8.0 a.m. and the other at 11.30 a.m. He added that he could not always find time to record block signals at once and that sometimes he had to record them 5-10 minutes afterwards, but he could not explain why he had failed to record any block signals at all for the two trains before the Pullman, the first of which had passed some 25 minutes previously, or why, when he later made the "Line Clear" entry for the Pullman train, he did not leave spaces in the book for them.

40. Regarding the position on the Up Goods loop line, Jones said that when the 10.15 a.m. Up Goods train entered it he placed his permissive block instrument to "Train on Line" with the indicator showing "one train in section". When the engineering special (see paragraph 34) entered the loop he turned the indicator to show two trains in section, and when it was sent forward he replaced the indicator to show one train in section. He explained that the Goods train must have been shunted into the New Yard to allow the engineering special to go forward. He also explained that, because his permissive block instrument was still at "Train on Line", he had not blocked back to Bentley Heath Crossing on the Up Goods loop to allow the shunting movement to go into the New Yard.

41. I questioned Jones further about his statement that he normally gave full "Line Clear" to Bentley Heath Crossing before obtaining "Line Clear" for the train from Lapworth. He said that he fully understood the purpose of Regulation 4A and he explained that he only did this if there was no train in the section to Lapworth; he knew that it was contrary to the regulations. If there happened to be a train in section to Lapworth, he would give only "Line Clear to Clearing Point" (2-2-2) to Bentley Heath Crossing, and the Train Register showed that he had in fact given this signal on three occasions on the previous day.

42. Jones said that he was in good health and was not tired. He maintained that he had nothing on his mind and had no domestic trouble of any kind; when asked if he had any financial embarrassment he replied "None at all, the reverse is the case".

Other Evidence

43. *Mr. G. W. Taylor, Station Master Knowle and Dorridge*, was in his office on no. 1 platform when he heard a train pass, which he realised was the Pullman express. It seemed that the train was travelling more slowly than usual, but he did not hear the sound of the brakes being applied. He heard the collision and immediately went out of his office, saw that steps were being taken to protect the lines and then went to the signalbox, arriving there at 1.15 p.m. He saw that the signal levers were all normal and that Signalman Jones was doing his duty and appeared to be quite calm. Jones told him that he had advised the control and the emergency services, and he then himself ensured that this had all been done. He did not question Jones about the accident.

44. Mr. Taylor went on to say that he usually visited the box once or twice a day. He had been in it between 9.0 a.m. and 9.30 a.m. on the morning of the accident and had found Jones to be quite normal. He regularly inspected the Train Register book and had found no irregularity. He said that he had had a high opinion of Signalman Jones's work.

45. *Mr. R. J. B. Hale, District Inspector Birmingham*, had been in charge of this district for some 14 months. He said that he had frequently visited Knowle and Dorridge box, knew Signalman Jones and had a high opinion of his work and capabilities. Mr. Hale explained that when he visited a box he first checked the position of the levers and the block instruments and that he also usually looked back through the pages of the Train Register for a period of about a week to see whether there were any obvious irregularities or omissions. He went on to say that he periodically withdrew the Train Register books from adjacent boxes and did a comparative check over a period of about three months. He had done this to the Knowle and Dorridge and Lapworth Train Registers and had not found any irregularity; he had not however made any check specifically to ascertain whether Regulation 4A was being carried out correctly and he did not know that Jones was in the habit of disobeying it. Mr. Hale added that the boxes at Knowle and Dorridge and Bentley Heath Crossing were provided wtih gradient diagrams and that the distances of signals from their respective boxes were marked on the signalling diagrams. The signalman therefore knew the lines on which Regulation 4A was required to be applied.

46. *Running Foreman C. E. Kenhard*, said that he had seen the two drivers and the fireman of the express train, all of whom were killed, at Birmingham just before the train left, and that they appeared quite normal. The fireman had been with Driver Wenham on the previous Down trip and had made no mention of any trouble with the locomotive. Mr. Kenhard did not see Driver Wenham himself.

47. *Carriage and Wagon Inspector G. Evans* said that he had carried out an external examination of the stock of the Pullman express at site after the accident and again in the sidings at Tyseley. He said that the brake blocks were in good condition and were well run in, and that the metal was blue close to the wheel which indicated that it had been heated in an emergency brake application. Mr. Evans went on to say that he had an engine attached and had the brakes operated three times. On each occasion 25 ins. of vacuum was created on the engine and 24 ins. of vacuum was registered in the brake van. On two occasions the vacuum was destroyed on the engine, once quickly as in an emergency application and the other time slowly, and on the other occasion it was destroyed by operating the valve in the brake van. On all occasions the brakes became applied effectively. He measured the residual stroke of the pistons when the brakes were fully applied and found that it varied between 3 ins. and 6½ ins. Mr. Evans said that the brakes of this train had been adjusted on 13th August, two days before the accident, at Old Oak Common. In his opinion the brakes of some of the coaches could have been adjusted somewhat better, but he considered that the train as a whole had effective brakes.

48. Evidence was also given to the effect that the interlocking and the electrical controls on the signalling at Bentley Heath Crossing and Knowle and Dorridge were tested after the accident and found in order. The A.W.S. ground equipment was also tested; the ramp at the Knowle and Dorridge Outer Distant was in order, but a cable had become disconnected from the ramp at the Bentley Heath Crossing Distant, the effect of which would have been for a Caution Indication to be given on the locomotive when the signal was clear. The A.W.S. equipment at the leading end of the locomotive was smashed and no test was possible, but the equipment at the other end worked correctly when tested, though the bell was somewhat weak.

Tests and Other Investigations

49. At my request special arrangements were made to ensure that the brake gear of the Pullman express was not adjusted in any way when the train was taken to and from the workshops at York for repair, or when it was in the shops. After the repairs had been completed a series of brake tests were made on this train with an engine of the same class as the one involved in the accident. I attended the tests. Four high speed runs were made and in each run a test brake application was made in the vicinity of Bentley Heath Crossing box. On the first three runs the application was made from a speed of 80 m.p.h. as recorded on the engine speedometer, and on the last run the speed was 81 m.p.h. Intermediate speed readings were also made during each stop at certain points. The point of the brake application in each run was indicated by a detonator placed on the rail, the position of the detonator being adjusted to simulate different reaction times of the driver of the Pullman express involved in the accident to the signal indications he received. The response of the train brake was checked by stop watch in the rear brake van, the timing being taken from the visible explosion of the detonator under the engine wheels until the needle of the vacuum gauge in the van fell to zero.

50. The results of the tests were as follows:—

Run no. 1

The brake application was made at a point about 125 yards beyond the overbridge on the Birmingham side of the Bentley Heath Crossing box which represented a reaction time of approximately 3 seconds after the driver obtained the first unimpeded view of the Knowle and Dorridge Outer Distant signal. The brake application was a full emergency one, the stopping distance was about 1,304 yards and the stopping point was 80 yards short of the point of impact.

Run no. 2

The brake application was made at a point about 125 yards in advance of the A.W.S. ramp for the Knowle and Dorridge Outer Distant signal, which corresponded to a reaction time of approximately 9 seconds after the first unimpeded view of the Distant signal, and one of 3 seconds after passing the A.W.S. ramp. The brake application was again a full emergency one, the stopping distance was about 1,331 yards and the stopping point was 200 yards beyond the point of impact; the recorded speed at that point was 35 m.p.h.

Run no. 3

The intention was for an initial service brake application to be made at the same point as for run no. 1, and to be followed by a full brake application immediately a clear view was obtained of the Knowle and Dorridge Up Main Home signal. The driver, however, had difficulty in adjusting his application valve to provide the required service brake application. Too much vacuum was destroyed and the valve in the rear brake van lifted, which resulted in a full emergency application. The stopping distance was about 1,300 yards and the stopping point was 84 yards short of the point of impact.

Run no. 4

A second and successful attempt was made to apply the conditions intended for run no. 3. The stopping distance from the point of initial application was about 1,623 yards and the speed when passing the point of impact was 40 m.p.h. The stopping point was 239 yards beyond the point of collision.

51. The braking of the train during the test runs is shown on the graph at Appendix A. In all the runs, the stop was smooth with no surging, and articles on a table did not move forward (see paragraph 27).

52. In runs nos. 1 to 3 inclusive the vacuum valve in the brake van lifted, but it did not lift in run no. 4. The time interval between the exploding of the detonator and the falling of the brake van gauge needle to zero was 5 seconds in run no. 1, 8 seconds in run no. 2, and 11 seconds in run no. 4; it was not observed in run no. 3.

53. The rails were slightly damp with dew for the first test run, but were dry for the remaining tests. In tests nos. 2 to 4 inclusive the rails showed a continuous rubbing of the head throughout the length of the brake application. This mark was quickly removed by subsequent trains running between the test runs. There was no sign of heavy markings on the rails comparable with those found after the accident (see paragraph 17).

54. The speedometers on the engine used for the tests were calibrated and found to have errors not exceeding the permissible $\pm$ 2%.

55. Earlier tests made over the same section of the line with the Derby Pullman train (see paragraph 22) gave braking distances from 80 m.p.h. of 1,052 yards with 10 coaches and 946 yards with 9 coaches (as on the train involved in the accident). Tests carried out in 1960 on a Blue Pullman train gave a braking distance from 80 m.p.h. of 1,093 yards on level track. The braking distance from 80 m.p.h. on the B.T.C. "S" curve is 1,470 yards, again on level track.

56. At my request a detailed cross check was made of the Train Register books in Bentley Heath Crossing, Knowle and Dorridge and Lapworth signalboxes for the period 16th July to 15th August 1963. This covered over 4,000 line entries in the Knowle and Dorridge book and the equivalent of over 26,000 individual times. The following irregularities by Signalman Jones were found:—

	Number of occasions
Individual times omitted	114
Regulation 4A contravened	9
Complete entries for the passage of a train omitted	38
Train times recorded, but no such train ran	3
Other irregularities	38

There were also many instances where the actual times recorded varied widely from those shown in the books of the adjacent boxes. It should be noted that this check could not bring to light all cases of Regulation 4A being contravened because bell signal times are recorded to the nearest minute, and the same times may have been recorded, and correctly recorded, for receiving "Line Clear" from Lapworth and giving it to Bentley Heath Crossing, though in fact it may, contrary to the Regulation, have been given before it was received.

Conclusions

57. The primary cause of this accident was the action of Signalman Jones in obstructing the Up Main line after having given full "Line Clear" for the Pullman train. Whether he gave the "Line Clear" and then set the route and cleared the signal for the shunting movement, or vice versa, is uncertain, but I think that he must have given "Line Clear" first; whichever he did was highly irregular. Jones, who had a clear record, was a good witness, and I accept without question his statement that he did not deliberately keep the signals at Danger for the Pullman train to enable the shunting movement to be made. He frankly admitted his serious mistake which he said occurred because he completely forgot the "Line Clear" he had given. He could explain his forgetfulness only by saying that he was concerned with the shunting movement and that he may have given full "Line Clear" automatically. The shunting movement was, however, a regular one and I can see no reason why it should have concerned him so much. It seems that his unthinking action in replying to the "Is Line Clear" automatically is more likely to be the cause, and it may be that it was his admitted habit of disregarding Regulation 4A that allowed him to work so automatically. If he had obeyed that Regulation he would have obtained "Line Clear" from Lapworth before giving it to Bentley Heath Crossing, and it is unlikely that he would have given these additional bell signals automatically and without thinking. It should be mentioned here, however, that if Jones had adopted the correct procedure he could have been given "Line Clear" for the train by the signalman at Lapworth, and he would then have been entitled to give full "Line Clear" to Bentley Heath Crossing.

58. Jones said that, on account of the density of traffic, it was sometimes 5-10 minutes after the passage of a train before he recorded the bell signals in the Train Register. He could not, however, explain how he had come to omit all entries in the Register for the two trains before the Pullman train, the first of which had passed some 25 minutes earlier. Whether or not there was any connection between these ommissions and his mistake over the Pullman train, is a matter for conjecture. At my request, Jones was examined medically and he was declared fit.

59. It is clear from paragraph 56 that Jones had, during the previous month, been lax in recording bell signals in the Train Register. It is difficult for a Station Master to detect many of the types of irregularities found in the detailed check of the Registers that was made afterwards, although Mr. Taylor should, I think, have noticed some of the omissions of individual times, as they had averaged nearly four a day. Mr. Hale, the Divisional Inspector, would also not have detected many of the irregularities on his occasional visits to the box, but he should, when he cross-checked the Registers of Knowle and Dorridge and Lapworth, have noticed many of them, and particularly the disregard of

Regulation 4A. If he had noticed even some, they might have suggested that all was not well and led to a more thorough check, which would have brought to light the true state of affairs and enabled steps to be taken to correct it.

60. Signalman Taylor of Bentley Heath Crossing must bear some share of the responsibility for this accident. Having received full "Line Clear" for the Pullman train from Knowle and Dorridge he was in order in clearing all his signals, including his Distant signal. He, however, also understood that Regulation 4A was applicable at Knowle and Dorridge because of the short braking distance beyond the Outer Distant signal of that box. That Regulation did not specifically require him to remind the signalman at Knowle and Dorridge if the lowering of the latter's Distant signals was delayed, but it did imply that such action should be taken, and Taylor said that he normally took it. Instead, however, he went to get a broom to sweep up (it was 45 minutes before he was due off duty). If he had been alert and had noticed that the Outer Distant signal did not come "off" when he lowered his Home signal, and had reminded the signalman at Knowle and Dorridge about this, the latter might have been able to save the situation by getting the shunting movement clear of the Up Main line.

61. I do not attach any blame for this accident to the engine crew of the Pullman train, all of whom were killed. I am satisfied that the train must have been travelling at about 80 m.p.h. as it approached Bentley Heath Crossing with the Distant and Home signals of that box at Clear, and the Knowle and Dorridge Outer Distant at Caution. Whether the driver reacted somewhat slowly and did not make a full emergency application of the brakes until the engine had passed over the A.W.S. ramp, as in test run no. 2 (see paragraph 50), or whether he first made a service application and followed this by an emergency application when he saw the Inner Distant and Home signals against him, as in test run no. 4, is uncertain, but all the evidence points to the first alternative as being the more likely. Both Guards Beddow and Atkin said that the vacuum valve in the rear brake van in which they were travelling lifted, as it did in test runs nos. 1 to 3, but not in test run no. 4, and that the needle of the gauge fell quickly to zero, and this indicates clearly that an emergency brake application was made. Beddow said that this occurred just before the van reached the Bentley Heath Crossing signalbox, while Atkin saw that the van was more or less opposite to a food storage shed, which is approximately 100 yards beyond the box, when he opened and looked out of a window. Atkin must however have taken at least 4 seconds, representing a distance travelled of about 160 yards, to reach and open the window, which indicates that the van must have been near, but not appreciably beyond, the halfway point between the Distant signal and the box when they noticed the application (the distance between that signal and the box is 105 yards). It also indicates that the van was 20-30 yards beyond the A.W.S. ramp which is beyond the signal and ends 80 yards short of the box.

62. The times recorded in test runs nos. 1 and 2 for the vacuum gauge to fall to zero from the time the brake application was made were 5 seconds and 8 seconds respectively. At 80 m.p.h. the train would have taken 5½ seconds to travel a distance equal to its length (219 yards). If on the occasion of the accident the time for the gauge to fall was 5 seconds, it would mean that the application was made some 20 yards beyond the spot where the guards noticed it; if the time was 8 seconds the application would have been about 100 yards on the approach side of that spot, and some 50 yards short of the Distant signal. If, however, it had been made at the latter point, the train would have stopped just before it reached the shunting movement (see graph at Appendix A). The application must therefore have been made between that point and the halfway point between the Distant signal and the box. On the assumption that it was made near the halfway point, the braking of the train has been plotted on the graph at Appendix A, and it indicates a speed of impact of 22 m.p.h. If the application had been made sooner the impact speed would have been less. Some of the witnesses estimated that speed at 30 m.p.h., but one train spotter put it at 20 m.p.h., and I think that he was probably nearer the mark. From the damage caused I do not think it could have been much less than 20 m.p.h., and the above facts establish that it could not have been much more than that speed.

63. The fact that the speed of the Pullman train at the time of the collision was less than the speed of the test train when passing the point of impact in run no. 2 (35 m.p.h.) also indicates that the reaction time of the driver of the Pullman train was less than the time simulated in that test run, and that he had braked sooner. Again on the assumption that the application was made about halfway between the Distant signal and the box, and this is now I consider a safe assumption, the reaction time of the driver in applying the brakes was a fraction over 7 seconds after the signal came into view. This does not altogether surprise me because the Knowle and Dorridge Distants should have been found "off" after the Bentley Heath Crossing Distant had been seen at "off". I feel sure that the driver must have noticed the Knowle and Dorridge Outer Distant at Caution. If he had not done so and had acted only after hearing the siren at the de-energised A.W.S. ramp, he would not, in my opinion, have made the application any sooner than it was made in the test run. It may be that he could not believe his eyes when he saw the Distant against him and it may even have flashed through his mind that it was out of order, as was the A.W.S. ramp at the Bentley Heath Crossing Distant signal. But he must have been sufficiently alert when the siren reinforced what he had seen to react very quickly indeed and make a full application in less than 1 second. To have avoided the collision it would have been necessary for him to react in less than 5 seconds after the signal came into view.

64. I am satisfied that the brakes of the Pullman train were in the same condition when the test runs were made as at the time of the accident. The results of these tests showed that Tutor Driver Wenham was not justified in saying at my Inquiry that the brakes of the Pullman train were not good, but that he was perfectly correct in saying that they were not as good as those on the Derby Pullman train or the Blue Pullman. I am entirely satisfied that the Pullman train involved in this accident, old though it was, had good and efficient brakes.

65. The heavy scoring of the rails (see paragraph 17) found after the accident was not repeated on the test runs. The scoring could have been caused by some skidding of wheels for short distances resulting from the rather heavier braking on the engine of the Pullman train involved in the collision than on the engine of the test train or from the brake blocks of the train not being fully bedded down after having been adjusted two days earlier. This skidding might also have accounted for the jerking movement felt by Mr. Bailey, the Pullman Car Conductor.

Remarks and Recommendations

66. This accident was the result of the human failure of a signalman of long standing and considerable experience who, possibly because he had developed an irregular habit in his block working, unthinkingly accepted the Pullman train and then allowed a conflicting movement to take place, and did not realise his mistake until it was too late. The box is equipped with modern block instruments and controls and the lines are track circuited, but none of these safeguards could prevent such a failure.

67. The main defence against the development of irregular habits must lie in the self-discipline of signalmen themselves. It is not always possible for supervisors to detect them by watching the men at work or by examining the Train Register books when visiting boxes and, as has been mentioned in the reports on a number of accidents in recent years, they can be detected only by the careful cross-checking of the Registers of adjacent boxes. The Registers of two of the boxes concerned in this case had been checked, but evidently without sufficient care. I am aware that the British Railways Board has from time to time emphasised the need for the cross-checking of Registers, and I am glad to know that, as a result of Colonel Reed's Report on the accident between Desborough and Glendon in July last year, the General Managers of the Regions have been reminded about this important point. In addition to being a means of detecting irregular habits, the periodical cross-checking of Registers must, I am sure, have the psychological effect of discouraging their development.

68. The semaphore Distant signal on the Up Main line for Bentley Heath Crossing is about to be replaced by a colour light and I am glad to know that, as a feature of the work, an electrical control will be included that will prevent it from being cleared until the Knowle and Dorridge Distant signals have been cleared. In the meantime, the signalbox Instructions at Bentley Heath Crossing have been amended, and they now prohibit the signalman from clearing the Distant signal until he has seen that the Knowle and Dorridge Distants have been cleared. Such measures, and particularly the control on the Distant signal, should certainly prevent accidents of this kind on sections of the line where Regulation 4A is to be applied owing to the close spacing of signalboxes and, in view of the high speed services now running on these lines, I recommend that consideration should be given to their adoption at other boxes also.

69. I recommend also that consideration should be given to the re-wording of Regulation 4A to cover cases where it may be impracticable to adopt either of the above-mentioned measures, and that it should specifically require a signalman to take some positive action in the event of the signalman in the box next ahead not clearing his Distant signal after giving full "Line Clear".

70. In order to know whether Regulation 4A is to be applied at his box, a signalman has to study the gradient and signalbox diagrams, and calculate from the latter the distance between the Distant and Home signals. I therefore recommend further that when this Regulation is to be applied, the fact should be stated in the signalbox Instructions. This would have the additional advantage of enabling specific distances and gradients to be omitted from the Regulation, which could then be applied to signalboxes as considered necessary, regard being given to the higher train speeds now attained by the use of powerful diesel locomotives.

71. I have described the frame construction of the diesel locomotive in paragraph 12, and I have mentioned in paragraph 14 that the buffers were distorted upwards by the impact. They thus formed an inclined plane on which the buffers of the next vehicle, also distorted upwards by the buckling of the solebar, rose and enabled the headstock of that vehicle to be driven through the comparatively light framework of the driving compartment. I have discussed this matter with the Chief Mechanical Engineer of the British Railways Board, and I am glad to report that consideration is being given to a means of strengthening the frame of this type of locomotive in order to prevent buffer distortion in collisions at such comparatively low speeds.

I have the honour to be,
Sir,
Your obedient Servant,
D. McMULLEN,
Colonel.

The Secretary,
Ministry of Transport.

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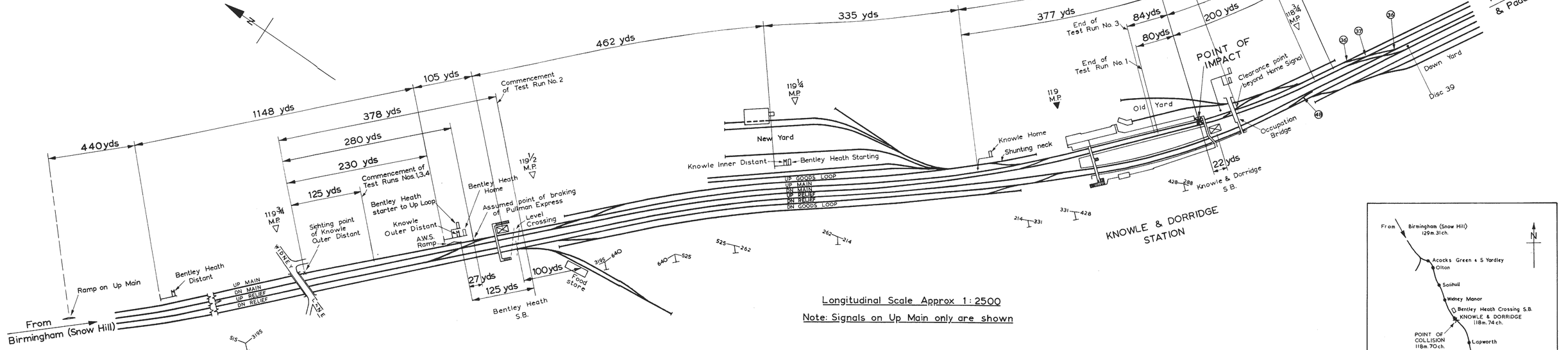
COLLISION AT KNOWLE & DORRIDGE 15th August 1963



Longitudinal Scale Approx 1: 2500

Note: Signals on Up Main only are shown

LOCATION DIAGRAM

BRAKING GRAPHS OF PULLMAN EXPRESS

TEST RUNS

APPENDIX A.