MINISTRY OF TRANSPORT & CIVIL AVIATION

RAILWAY ACCIDENTS

REPORT ON THE DERAILMENT

which occurred on

16th August 1953

between

WILNECOTE AND KINGSBURY

in the

LONDON MIDLAND REGION

BRITISH RAILWAYS

LONDON : HER MAJESTY'S STATIONERY OFFICE

1954

MINISTRY OF TRANSPORT AND CIVIL AVIATION,
Berkeley Square House,
London, W.1.

28th January, 1954.

SIR,

I have the honour to report for the information of the Minister of Transport and Civil Aviation in accordance with the Order dated 17th August, 1953, the result of my Inquiry into the derailment which occurred at about 1.15 p.m. on the 16th August, between Wilnecote and Kingsbury on the Derby–Birmingham main line, in the London Midland Region, British Railways.

The 9.28 a.m. Down Express passenger train from Bradford to Bristol, comprising 9 bogie coaches drawn by a 4–6–0 type engine of the "Royal Scot" class, was travelling at about 55 m.p.h. when it became completely derailed on plain, straight track. The train parted between the second and third coaches during the course of the derailment, and the front portion came to rest well ahead of the rear. There was no structural damage to the coaches though the engine fell on its side. An aerial photograph which shows the positions in which the derailed engine and vehicles came to rest has been reproduced at the end of the report.

The train had over 450 passengers but only two required treatment in hospital for concussion and shock, and the driver and fireman, who remained on the engine were unhurt. Emergency arrangements were put in hand promptly and doctors, ambulances and police arrived within a few minutes. A relief train for the passengers was brought near to the site by 3.17 p.m. and left for Birmingham half an hour later.

The derailment blocked both lines and arrangements were made for the diversion of all passenger trains at Wichnor. Though there was little damage to the Up line and it was quickly repaired, it was required for the cranes employed on rerailing the engine and coaches and could not therefore be opened to traffic until 10.42 a.m. on the morning of the next day. The Down line was repaired and opened to traffic at 6.37 p.m. that evening.

The day was fine but not exceptionally hot and I am satisfied that there was no heat distortion of the track.

THE SITE

1. This is a Class A line on which a maximum speed of 75 m.p.h. is permitted. In the Down direction from Wilnecote to Kingsbury, the line runs due South. It is level at first and then rises gently past Whateley Sidings and Cliff Sidings before it falls towards Kingsbury. At the site of the derailment, about 750 yards beyond Whateley Sidings signal box and 390 yards before Cliff Sidings signal box, the gradient is 1 in 460, on straight alignment in a deep earth cutting. On the Down line at Whateley Sidings there is a trailing connection followed by a diamond crossing about 120 yards ahead, and then another trailing connection at the same distance ahead. At Cliff Sidings a trailing connection from the Up line leads to a dock siding through a diamond with a single slip on the Down line. A plan showing the site of the derailment is given at drawing 2.

THE TRAIN

Composition

2. The express train was composed of nine coaches weighing 265 tons hauled by engine No. 45699 Class 6 P "Royal Scot" which weighed 133 tons with the tender. This is a three-cylinder engine with a tractive effort of 26,610 lbs at 85% of the boiler pressure of 225 lbs per square inch, and it is driven from the left hand side. The general dimensions are shown on drawing 1, which also shows the wheel weights as found after the accident. The weight is transmitted from the frame of the engine to the bogie by side bearer pads, and the lateral control of the bogie is by coil springs exerting an initial force of 3·134 tons rising to 4·03 tons at the maximum displacement to one side of 2¾ inches. The brake power of the train as a whole with the steam brake on the coupled wheels of the engine and on the tender, and with vacuum brakes on the coaches, was approximately 73% of the total weight of 398 tons.

3. All the coaches had steel underframes with standard screw couplings and long stroke shock absorbing buffers. The first and third had wooden bodies and the remainder steel panelled bodies on hard wood framing.

The rear portion of the train

4. The rear seven coaches were derailed to the left but were coupled together, with the leading coach 153 yards, and the rear of the last coach 12 yards ahead of a severed rail joint just beyond the first mark of derailment. The coaches maintained direction well, and it was only in the last few yards that the leading coach had drifted so far to the left that the wheels had dropped into the drainage channel, and the side of the coach at the leading end had made contact with the slope of the cutting. The remaining coaches were all leaning to the left, but none were against the cutting face.

5. The only one of these coaches to suffer damage to the bodywork was the leading one. It had a number of windows broken and a few of the seats broke loose. This was an old coach built in 1928 and was of the vestibule type with a centre corridor and one transverse partition. Some of the back-to-back type seats were fastened to the floor only, and not to the side of the coach, and three of these came adrift, though without serious consequences. In modern coaches seats are more securely fastened.

At the leading end of this coach there were signs that it had been severely checked. There was a deep rounded indentation in the rim of the flange of the left leading wheel, the bogie centre pin on the underframe was bent to the rear, and the screw coupling to the second coach had been pulled apart.

The front portion of the train

6. The front part of the train consisting of the engine, tender and two coaches, stopped a clear 116 yards ahead of the rear part, with the second coach on the rails just past the diamond crossing at Cliff Sidings. The first coach was upright and coupled to the second. It was pointing to the left, with its front bogie derailed to the left in the siding. The rear bogie was also derailed to the left.

7. The tender was still coupled to the first coach but was pointing to the right and tilted to the left at an angle of about 30° to the horizontal; it was supported in this position by the loading dock coping which had torn a hole in its side. The right rear buffer of the tender was pressed into the end of the front coach but had not penetrated it.

8. The engine remained coupled to the tender and was more or less in line ahead of it across the Down line. It was lying on its left side at about 15° to the horizontal, being supported at this angle partly by an open wagon on the adjacent siding, and partly by its coupling with the tender, which as already described was held up at the back by the loading dock. The end of the front buffer beam was resting on the right hand rail and the axle of the trailing coupled wheels was over the left hand rail.

9. The bodywork of the first and second coaches was virtually undamaged and there was no displacement of the interior fittings.

The second coach

10. The damage to the underframe and wheels of the second coach showed that it had been derailed though it was on the track when it stopped. The outer tyre faces of the right hand wheels of the leading bogie had been scrubbed clean and both the left hand wheels had been dented on the flange. These dents were noticeably heavier than the many scratches and rubs on all derailed wheels, and on both wheels the dents were towards the inner tyre face. On the rear bogie the leading wheel on this side had a similar dent to that just described but much deeper, and the trailing wheel behind it also had a dent on the flange.

The first coach

11. The first coach suffered more damage in the underframe and bogies. The leading axle was bent, causing the wheels to be ¼ inch out of truth. Both wheels of this axle had heavy bruises and score marks, those on the right hand wheel being mainly on the outside face and tread chamfer. Above this axle the right hand solebar and left hand diagonal of the underframe had been badly strained and rubbed by the wheels being forced to the right or the underframe being pulled to the left. The bogie frame was also distorted to the right.

12. Examination of the rear bogie showed signs of wear on the rubbing plates on one vertical face of the bolster. This bolster is pivoted to the coach underframe and is attached to the bogie frame by swing links which allow a few inches of lateral play. It floats between two cross members of the bogie frame and is furnished with two rubbing plates on either face which bear against the leading cross member in the direction of travel and provide the necessary sliding surface when lateral motion between bogie and bolster takes place. The heads of two pins in one of the cross members of the bogie frame were protruding about 3/16 inch and had worn shallow, saucer shaped, depressions less than ¼ inch deep in the rubbing plates. However the pins did not project sufficiently to jam the bolster at any point within the limits of travel in the bogie frame, nor were there any signs that jamming had taken place. Furthermore on this journey the badly fitting pin heads, which were on the trailing cross member, were not in contact with the bolster which had been bearing against the leading cross member.

13. On the left leading wheel of this bogie there was a deep scratch or score about 7 inches long starting in the radius of the flange and ending near the rim. On the opposite wheel there were two scratches, one across the tread and one from the rim of the flange to the radius, about 1¼ inches apart, and roughly parallel. The marks on the two wheels were in corresponding positions.

14. A portion of rail broken from the track was threaded through the underframe of this coach but did not penetrate the floor.

15. All the coaches of the train, with the exception of the third, had received a works overhaul during the past 12 months, and the third coach was not due for overhaul at the time of the derailment. The springs of the first three coaches were tested after the derailment and were found intact, though the left leading springs of the second and third coaches deflected 14% more than the designed amount. The tyre profiles of all the coaches were satisfactory.

The engine and tender

16. The engine was little damaged and it was clear that it had not fallen on to its side until the last few yards of travel, and there were very few marks on the coupled or bogie wheels. The left hand frame plate had been deflected inwards about ⅛ inch between the driving and trailing coupled wheels; otherwise it was true. The tender received more damage and it was evident from the heavy scores and abrasions on its wheels that it had become derailed before the engine, and that its wheels had fouled the rails of the diamond crossing. It was also noticed on the day after the accident that the flange of the left trailing wheel had a rough bright appearance. The left hand frame plate was bent outwards by ¼ inch at the ends and ⅜ inch at the middle.

17. The engine had run nearly 42,000 miles since it had received an intermediate repair at Crewe in January 1953. The tyre profiles were fair; on the engine there was most wear on the left hand leading wheel of the bogie, and on the tender the left leading and middle tyres and the right trailing tyres were more noticeably worn than the other three. The maximum wear at the root of the flange was 3/16 inch.

All the axle boxes were perfectly free in the horns and there were no signs of heating of the journal bearings. The lateral play of the engine axles was nowhere excessive, with a maximum of 7/16 inch at the leading coupled axle where ¼ inch is allowed. The lateral play of the tender axles had, however, increased considerably beyond the designed amount as is shown below:—

	Total play from one side to the other		
	Designed	*Actual*	*Increase by wear*
Leading	⅜ inch	15/16 inch	9/16 inch
Middle	¾ inch	1–3/8 inch	5/8 inch
Trailing	⅜ inch	1–3/16 inch	13/16 inch

18. Important discrepancies were found in the bearing springs of the engine, and in the wheel loadings of the engine and tender. A single central laminated spring is used to transmit the weight to both the bogie axles on each side. The left hand bogie spring had three broken and three cracked plates out of 17, all old fractures, and it deflected 25% more under load than the specified amount, and 13% more than the opposite spring.

On the coupled wheels there was a maximum variation of 10% in the load deflection rate between pairs of springs. It will also be noted that the weight on the left hand driving wheel was 2 ton 1 cwt less than that on the right hand wheel, and that the weight on the right hand trailing coupled wheel was 2 tons 2 cwt less than that on its fellow, the difference being about 20% in each case. The trailing wheels of the tender were also unevenly loaded, the load on the right hand wheel being 1 ton 10 cwt less than that on the left, a difference of 25%.

There was no significant loss in strength of the bogie side control springs and the bogie slide was in good order, though there was ¼ inch free play before the springs came into action.

The Permanent Way

19. The track consisted of 95 lbs R.B.S. bull-head rails with 24 timber sleepers to each 60 foot rail length. Each chair was held to the sleeper by three coach screws and the rails were joined by four bolt fishplates. The track had been laid new in 1943 and at the time of the accident the rails had worn to about 85 lbs per yard. Both sleepers and rails were approaching the end of their life, and proposals had been made for renewal in 1955. The track was well ballasted with broken stone, the whole of this length having been drained, cleaned and re-ballasted in 1951 with mechanical equipment, to overcome the difficulty in maintenance caused by the clay soil, but the ballast was not up to the tops of the sleepers in places. At the same time the track had been regauged, using special chairs and oversized coach screws where necessary. The diamond crossing and single slip at Cliff Sidings had been relaid in 1951 with 109 lbs flat bottom material as part of a renewal programme which included the whole of the Up line over this length.

20. Permanent Way Inspector A. E. Letman said that the line had been in poor condition and that the clay formation had given quite a lot of trouble until the overhaul in 1951. The present ganger had been put in charge of the line in October of that year and the line had improved. He had no hesitation in saying that the track was now in good order, and that there was nothing to warrant any special precautions. Mr. Letman had made a thorough examination of the track on the 14th July, testing gauge, examining the condition of the fastenings, and assessing the wear on the rails. He found nothing to bring to the ganger's notice, except one or two sleepers which required changing. He walked over the track again on the 23rd July and tested the running from the footplate on the 31st July when he found nothing to note. The ganger had last walked the track on the day before and the sub-ganger on the morning of the accident.

21. The first mark of derailment was found on the left hand rail 510 yards beyond the 27th mile post. There was a shallow diagonal groove across the table of the rail from inside to outside in the direction of travel, 26 feet 5 inches long and deeper at the end than at the beginning. The first chair beyond the groove was marked on the outside but was unbroken; the remaining five chairs before the left hand joint were broken at the outside jaws. Over this rail length the right hand rail was slightly battered with a burr on the running edge, and the left hand rail was slightly worn on the running edge which was very smooth and even. The gauge was ⅛ slack just before the point of mounting and the cross level was correct.

22. At the left hand rail joint 15 feet beyond the end of the diagonal groove the four fishbolts had been sheared off by a sharp impact on the outside nuts, and the fishplates had fallen away. The rail beyond this joint had fallen on its side as all the chairs were broken; it had also been driven forward 2 feet 7 inches and the running on end had evidently received a severe blow. This rail was still connected to the rail ahead of it and was not bent. The right hand rails were in position for two lengths beyond the severed joint, but beyond that the whole track was broken up for the 260 yards to the diamond crossing at Cliff Sidings, and was damaged for 60 yards beyond.

23. On the approach side of the diamond crossing there were marks on the sleepers of derailment to the right as well as to the left. The marks furthermost to the right appeared on the ends of the sleepers of the Up line over a distance of 40 feet, beginning at 57 yards before the first 'V' of the diamond crossing, and again over 10 feet about 22 yards before it. At this diamond the splayed end of the check rail on the Down line opposite the 'V' had been struck and twisted outwards, and the 'V' was bulged and scored on the outside edges of the rails as if wheels derailed to the right had been guided into the back of the 'V' and had been lifted on to the track by it. The rails across the Down line had been violently distorted to the right, and the Up line had been forced outwards. Ahead of the diamond the Down line immediately behind where the engine stopped had been ploughed up and pushed violently to the right, breaking the right hand rail and pushing out the Up line. There was much damage to this diamond crossing generally and to the connection with the adjacent siding, but the flat bottom track had withstood the impacts of the derailed vehicles much better than the bull-head track.

24. The stonework on the return wall of the Cliff Sidings dock was chipped for about 3 feet before the beginning of the coping which had been scored for 40 feet by the tender sliding along it.

25. The track showed evidence of unsteady running for some distance before the site of derailment (*see* drawing 3). At 100 yards past the 27th mile post the right hand rail was rubbed bright along the running edge for about 5 feet. At 133 yards the left hand rail was rubbed bright along the running edge for about 40 feet. From there up to 400 yards bright marks were visible on both rails, the length of each mark varying between 5 feet and 45 feet without any clear pattern being apparent in the relation between the marks on the two rails, though they did alternate to some extent.

The last five of these marks, none longer than 16 feet, overlapped the first two of twelve lateral distortions in the track which started at about 367 yards beyond the 27th mile post. The distortions were small, none exceeding $\frac{3}{4}$ inch, and occurred alternately to the right and to the left of the alignment with an average pitch of about 76 feet. The distortions to the right were less than those to the left as might be expected as the resistance to lateral thrust of the ballast between the Up and Down lines would be greater than that of the ballast on the cess shoulder. The last distortion to the right was at its maximum about 23 feet before the beginning of the diagonal groove, and the last to the left about the end of the groove, the distance of this half pitch being about 50 feet, so far as could be judged owing to the damage.

26. The gauge varied between 5/16 inch tight and 5/16 inch slack, but these extremes were found only in the points and crossings at Whateley Sidings, and over the distorted track where there may have been some spreading of gauge, insufficient to show on the sleepers. There were no clear signs of spread gauge on the distorted length of track except at the left hand rail where the diagonal groove was found. The chairs under the marked portion of this rail had been pushed outwards about $\frac{1}{4}$ inch.

27. The cross levels were measured for rather more than a mile in rear, and considerable variations were found. At the diamond at Whateley Sidings at 26 miles 7 furlongs, the left hand rail was $\frac{3}{4}$ inch high, and beyond the last trailing turnout 80 yards before the 27th mile post, the right hand rail was 1 inch high. Just beyond this mile post, the levels varied from right hand rail $\frac{1}{4}$ inch high to left hand rail $\frac{1}{2}$ inch high in 45 feet. At 330 yards beyond the mile post the right hand rail was $\frac{1}{2}$ inch high, and at 480 yards it was $\frac{1}{4}$ inch high.

Evidence Regarding the Running of the Train

28. Driver J. L. Griffin had booked on duty at 6.25 a.m. on the morning of the accident, at Bourneville near Birmingham. His first trip was with the 7.20 a.m. train from Birmingham to Derby; he had taken charge then of the 9.28 a.m. Bradford to Bristol express from Driver Rose who had found nothing unusual in the running of the engine or the train on the trip from Bradford to Derby. Driver Griffin found the engine in good order and steaming well; it ran steadily, and he had no comments about the condition of the track except between Elford distant signal and Elford Station where "there had been a bit of bad pitching for some time". He noticed no lurches or rough riding as he passed Whateley Sidings at about 55 m.p.h. but about 200 to 300 yards beyond the signal box he felt a drag on the engine. "It was not a jerk, it was not suddenly, there was just something dragging, the train seemed heavier". After 2 or 3 seconds he thought that some part of the train might be off the track and applied the brake intending to slow the train gradually. After perhaps 10 seconds he heard the first coach jumping up and down and knew it was derailed, though he was sure that the engine and tender were not. The tender then slewed to the left as the train was slowing down, "and fetched the engine off, but we had about come to a stand when the engine went over". He did not look back along the train and was not aware of the train parting, but thought that he had probably applied the brake before the parting took place. He was insistent that the engine and tender did not ride roughly at any point after Elford, and were not derailed until the very end.

Fireman J. Wood's evidence confirmed that of the driver, except that he said "After passing the bridge (160 yards past the 27th mile post) between Whateley Sidings and Cliff Sidings signal boxes the tender seemed to rock over to one side and pulled itself back. After passing the box there is a bridge there, it was somewhere there it was pulling back, the drag". He thought a coach was derailed as he would have felt it more if it had been the engine. Both the driver and the fireman were standing on the engine and not on the tender during the whole of this time.

29. I recalled the driver and fireman some time later to tell them about the track distortions, and explained that in my opinion they could only have been caused by severe lateral oscillation of an engine. They both re-affirmed that they had noticed no signs of the engine nosing from side to side, or rolling as it approached the site of the derailment. They remembered the lurch at Elford but were certain there was no lurch at Whateley Sidings, though they were specifically questioned on this point in view of the bad cross levels found there. Fireman Wood did not associate the motion of the tender which he had described with the derailment of a wheel.

30. Guard W. S. Wilshaw who was travelling in the rear brake which was at the end of the train, said the train ran normally until, after passing Whateley Sidings, he felt a normal application of the brake followed shortly by a severe jerk. He then saw a coach ahead jumping up and down and he was about to apply the brake as the coach in which he was travelling derailed.

The crew of the previous passenger train which had passed the place of the accident about 1½ hours earlier did not experience any unusual lurching during the journey, though the driver said that there were places on this line where he expected a little oscillation, Whateley and Kingsbury being two of them, but they were never serious enough to require a report.

31. Mr. A. J. Champion who was a passenger in the first coach gave a very clear account of his experience. He was sitting about one third of the way from the front facing the engine with Mrs. Champion opposite him. He noticed a lurching from side to side and then there seemed to be a check followed by a surge forward which caused Mrs. Champion to fall over towards him. Next there was a feeling of violent and jerky braking, and he realised that the coach was off the rails. As the coach was slowing down the front seemed to slew to the left and was pointing to the left when it stopped. Mr. Champion had no sensation of the rear end slewing to the right at any time.

Assistant Controller G. Gurling who was travelling as a passenger in the rear half of the second coach said that he felt a "terrific lurch forward and at the same time a bump". He thought the coach travelled between 90 and 100 yards riding on the chairs. Just before it stopped the front part seemed to swing across to the right and then to swing back. When this happened he thought momentarily that the coach would turn on its side. Gurling knew the line well as he had travelled over it almost daily for the past 5 years, but he noticed no undue motion before the lurch forward.

The Course of the Derailment

32. Before a description of the course of the derailment is given, it is as well to define some of the terms used in describing movements of engines on the track. The Pacific Locomotive Committee which investigated the running of certain locomotives in India in 1938 used the following definitions:—

Nosing —Transverse oscillation of the engine on the track about a vertical axis. Pursuing a sinuous path along the track.

Rolling —Transverse oscillation of the engine on its springs, about a longitudinal centre line.

Hunting—The two movements defined above rarely occur separately, but are generally found acting together in varying proportions. The resulting oscillation is described as hunting.

The three following extracts from the Report of this Committee give an indication of the manner in which hunting begins, and the effect on the track:—

"Periodic Nosing is set up by the coning of tyres, by transverse flexibility of the frame and wheel centres of the engine, and by irregularities in line and level of the track under load.

Rolling is set up by track depressions under load, and is affected by stiffness of the springs, by the transverse moment of inertia of the engine, and by the transverse spacing of the axleboxes".

* * * * *

"It is evident that neither track nor engine can be perfect, but the better the one, the less perfect may be the other by a corresponding amount. If the total of the imperfections of track *plus* engine exceeds a certain value the sequence of events, depending on speed, the state of the rail, etc., is first, an abnormal movement of the engine on the track, secondly deformation of the track itself, and thereafter even derailment".

* * * * *

"It is well known that if, on the one hand, engine design is defective, rails may be broken, the gauge may be spread, or the road as a whole may be distorted, although the track itself is good; in such cases, whilst derailment may not result, the engine is exceedingly mischievous in its effects and is therefore unsatisfactory as a vehicle. On the other hand, if the track is badly designed, weak, or inefficiently maintained, the same effects may become apparent, even if the locomotive has been correctly designed and carefully maintained".

33. I am unable to reconcile some of the evidence regarding the running of the train with the material results as measured and recorded after the accident. The pattern of track distortion as found after the derailment could have been caused only by the lateral oscillation of an engine and I am satisfied that this engine was the one of the derailed train. I believe the derailment happened in the following way. While

the train was travelling at about 55 miles per hour between Whateley Sidings and Cliff Sidings the engine was made to nose first to the left and then to the right by the change in cross levels just after the 27th mile post. The nosing of the engine developed into hunting which became so pronounced within the next 50 yards that the coupled wheels began to rub the running edges of the rails bright, at intervals on both rails. The hunting increased, helped by minor variations in cross level which synchronised with the transverse oscillations, and about 320 yards after the change in levels mentioned above, the engine began to distort the track in waves of which the average length was about 76 feet.

The engine continued to hunt at this period of rather less than one second for each complete movement, which is the natural period for an engine of this size and mass, and to distort the track, until about 140 yards further on the left hand rear wheel of the tender mounted the rail, ran diagonally over the table and dropped outside the track. At the moment of mounting the engine would have been past the end of its nose to the right and at or near the maximum roll to the left; the tender would have been oscillating clockwise and its rear would therefore have been swinging to the left. The derailed wheel was kept close to the rail within the limits of movement permitted by the play between the tender frame, the first and second axles and their wheels, and the rails. The maximum clearance possible between the back of the tyre of this wheel and the outer edge of the rail, with the existing lateral axle play, was about 3 inches. This maximum was only present when the tender was at the peak of its oscillation clockwise, and the rear axle at the limit of play to the left.

34. The derailed wheel broke the chair jaws as it travelled over them, and also sheared the fishbolts of the first rail joint 15 feet beyond where it dropped outside the rail. When this happened the tender would have begun its next oscillation anti-clockwise and the derailed flange would have been close to the outside of the rail. The fishbolts at the joint ahead were not sheared by the derailed wheel flange because the tender was oscillating in a clockwise direction at this point and the path of the derailed wheel went outside the fishbolt nuts, but the joint ahead of that was broken. The derailed left hand wheel continued to ride on the outer jaws of the chairs breaking most of them as it went along and thus loosening the left hand rail. The rough, bright appearance of the flange of this wheel could have been caused by striking the chair jaws.

The first rail joint did not become free immediately, and the first and second coaches passed over it before the fishplates fell away. The joint may have held together for a few moments owing to the fishplates being jammed into the fishing angles of the rails, or the bolts being held by the edges of the rail holes when the rail tilted.

35. The leading bogie wheels of the first coach did not become derailed for some time as they were only 11 and 20 feet respectively behind the derailed tender wheel, and the stiffness of the rail over this length of broken chairs would be sufficient to keep it nearly upright and to gauge. The trailing bogie wheels of the first coach and the leading bogie of the second were probably derailed in the first damaged rail length in the "four-foot" as the left hand rail shifted outwards. The damaged joint became free just after the trailing wheel of the second coach passed over it, and the facing end of the loose rail was then levered up by the weight of this wheel into the path of the flange of the left leading wheel of the third coach, which struck the rail end when it was nearly at axle height. The blow made a deep dent in the wheel flange and rounded off the top end of the rail, driving this rail and the one ahead 2 feet 7 inches forward. The impact transmitted through the bogie to the underframe was sufficient to bend the bogie centre pin, and to check the third to ninth coaches so much that the coupling to the second coach pulled out.

36. The rear seven coaches then ran off the track at the gap in the left hand rail and came to a stop rapidly but fairly steadily in 153 yards, during a period which I calculate as about 13 seconds. The position of the coaches after they stopped has already been described.

37. At the moment that the third coach was checked so severely by the rail end, the right hand wheels of the trailing bogie of the second coach must have been still on the rails with the left hand wheels dropping downwards as the rail under them fell on its side. The wheels of the leading bogie of the second coach and of the trailing bogie of the first coach would have been bouncing over the sleepers a little to the left of the track alignment, and the leading bogie of the first coach would still have been on the rails. The severe jerk of the impact would tend to pull the first two coaches into line, and as the rear of the first coach and the front of the second coach were swinging into line the release of tension when the coupling broke would have permitted them to continue to swing and become derailed to the right, if the transverse movement across the right hand rail happened to coincide with the bouncing of the wheels. It is clear that the second coach was derailed to the right though not so clear that the trailing bogie of the first coach was so derailed.

The full braking which was immediately applied when the vacuum connection between the second and third coach parted, enhanced the tendency to swing out of line. The rear of the second coach had swung 5 feet to the right by the time it had travelled about 183 yards after the parting. In the next 20 yards of travel it would appear that the front bogie of the second coach then swung the same distance to the right, with the rear bogie of the first coach also swinging some lesser distance to this side, just before making contact with the rails of the crossover from the Up line which guided all these bogies back to the alignment. Both sets of wheel marks on the sleepers of the Up line, which show where the maximum deviations occurred, could have been made by the rear bogie of the second coach, but the course of events suggested above agrees more closely with all the evidence.

38. The front part of the train travelled 200 yards after the division before the derailed trailing wheels of the tender were diverted to the left by the diagonal rails of the diamond crossing, pulling off the middle and leading wheels of the tender and also the leading bogie of the first coach. The tender continued off the rails along the crossover road to the siding, pulling the back of the engine to the left and capsizing it. The tender capsized with the engine, and its side fell against the return wall of the loading dock. The rear end of this side then slid along the return wall and the coping of the dock with all tender wheels off the ground, for about 43 feet before coming to rest, still on the coping. The leading coach remained coupled to the tender and the front end followed it to the siding with all wheels of the leading bogie derailed.

39. Both bogies of the second coach which were derailed to the right were guided back to the track by the crossover rails from the Up line, and the right hand wheels were lifted back on to the track by the back of the 'V' of the diamond. At the same time, the left hand wheels struck the end of the check rail opposite the 'V' and were re-railed there. The end of the check rail had been struck and bent outwards and there are marks on all the left hand wheel flanges of the second coach which corresponded with striking it.

The trailing bogie of the first coach must have travelled over the same course if it was derailed to the right before reaching the crossover road. If it was still derailed in spread track as it approached the diamond it would have been held close to the track alignment by the second coach which was derailed to the right, and could have re-railed of itself just before the crossing when it reached the flat bottom track, which was less damaged than the preceding bull-head track. This bogie was not on the rails when it stopped, having been pulled off to the left when the front of the coach followed the tender towards the siding; it cannot, however, have been derailed to the left as it travelled over the diamond, for it would then have been deflected to the left by the diagonal rails.

40. When the back of the engine was pulled to the left by the tender and the engine began to tilt to the left, the leading bogie wheel dug into the track as it went to the right, violently distorting the track and breaking the right hand rail. As the engine toppled further to the left the bogie wheel lifted again and the engine then continued to topple to the left and swing to the right while it slid forward, more or less on its side until it stopped about 40 feet ahead. The engine travelled about 65 yards from the place where the sideways pull of the tender began.

41. It was suggested to me that the derailment started at the rear bogie of the first coach, the diagonal marks on the tyres of both leading wheels of this bogie being interpreted as marks of derailment. It was put forward that the faulty fitting of the bolster of this bogie might have caused it to jam to one side, and that this would have increased the lateral flange forces during a lurch. The explanation for the derailment spreading forward to the leading bogie, and then to the tender, was the surge forward when the train parted, combined with the unsteadiness of the derailed trailing bogie of the first coach and the derailed second coach, the rear of which swung towards the Up line.

However, the surge forward took place immediately after the train parted and before the second coach had swung an appreciable distance to the right, and I see no reason why this surge should have caused the derailment to spread forward from the trailing bogie of the first coach to the leading bogie. Nor do I believe that the derailment would thereafter have spread forward while the front part of the train was going slower and slower on undamaged track unless the end of the first coach swung so far to one side as definitely to twist the leading bogie off the rail. There is no evidence that this happened.

There were no signs that the bolster had jammed. Even if it had, the effect on the safe running of the vehicle on straight track would have been very small indeed.

42. Furthermore, I am satisfied that the diagonal marks which gave rise to this theory were made some time later after the wheels in question had become derailed. They were deep scratches and were probably caused by the derailed wheels scraping across the heads of coach screws or bolts in the fastenings of the diamond crossing. It is most unlikely that there would have been any detectable marks of derailment on the pair of wheels which were derailed first of all. The right hand wheel ran off the rail into the "four foot", and the only mark that could have been made would have been a rub on the outer face of the tyre where it ran off the rail. On the left hand wheel the pressure between the smooth, slightly worn, running edge of the rail and the flange at the moment of derailment could not have caused a deep scratch in the flange.

I do not therefore accept this theory.

43. It might have been possible for the results seen at this derailment to have been produced by the leading bogie of the first coach being the first to become derailed on the distorted track, though there was no unusual reason for this bogie to oscillate, as there was for the tender, which had considerable side play in its axles and was directly influenced by the hunting engine. I think it most unlikely that the leading wheel of a bogie would have remained close enough to the outside of the rail after becoming derailed, to hit the nuts of the bolts. Also the right hand diagonal at the leading end of the underframe would have been heavily scored by the right hand derailed wheel, and this did not happen. It would be contrary to experience for the trailing wheel of a carriage bogie to have derailed first in such circumstances without a well defined cause being present. Furthermore, the position of the marks on the return wall of the loading dock coping where the side of the tender first scraped it, suggests that the tender followed the crossover road to the left very closely, whereas, if the tender had been pulled off at the diamond crossing by the movement to the left of the leading bogie of the coach behind it, it would have struck the loading dock wall further forward. I believe therefore that this bogie was not the first to become derailed.

The time that elapsed during certain periods of the derailment and the speed of the train at certain points are given in Table I.

Conclusions

44. I am satisfied that the engine was hunting on the approach to the point of derailment and for some distance past it, and that this hunting distorted the track. It is clear that the diagonal mark on the left hand rail was caused by a wheel flange and it may be assumed that this wheel was the first to become derailed. It is also clear that this wheel did not belong to the engine, although derailments caused by hunting generally begin at the leading coupled wheels. The side to side motion of the rear of the engine caused the tender to oscillate; and this oscillation, which was enhanced by the side play arising from the wear in the axle box bearings, and by the distortion of the track, caused intermittent lateral pressure between the flanges of the four end wheels and the rails. I believe that this pressure became excessive at the rear left hand wheel during a clockwise movement, due to an exceptional combination of the various lateral forces acting on the tender at a critical moment, and caused this wheel to mount the rail.

45. I am of the opinion that the hunting was caused in part by a significant variation in cross levels near the 27th mile post, followed by lesser variations in cross levels which coincided in their effect with the hunting period of the engine, and in part by the uneven loading of the engine bogie and coupled wheels, which, combined with the side play in the tender axles, made it less stable.

The evidence of the driver about the steadiness of the engine is at variance with the physical evidence of hunting as shown on the track. Though the distortions were small, the hunting of the engine, which Driver Griffin did not notice, must have been appreciable to have caused them. But he also did not notice the lurches which the engine must have made over the uneven track at two places at Whateley Sidings. In view of his positiveness that there was no untoward motion of the engine as it travelled towards the point of derailment, I find it less difficult to discount his further evidence that no wheel of the tender was derailed until after the division of the train.

Remarks and Recommendations

46. Neither the faults in the engine and tender, nor those in the track were such as to be dangerous in themselves, and I believe that the train would have passed safely over the track if it had been going a little slower or a little faster, or if the engine had been pulling harder. Nevertheless, a critical combination of the effects of these faults gave rise to this derailment.

Track

47. I formed the impression that the Permanent Way staff gave considerable attention to the gauge and to the fastenings which, on this old track, had begun to give trouble, but were not so concerned about variations in cross level. It may be that the two bad spots at Whateley Sidings had developed since the Permanent Way Inspector's last footplate trip, and would have received attention as soon as they were detected; but I think it probable that some of the lesser variations in cross level had existed for some time, since certain of the rails gave the appearance of uneven running. For instance the different character of the wear on the left hand and right hand rails at the place of derailment showed that flanges had been bearing against the left hand rail only. These lesser variations in cross level may not have seemed important enough to merit special attention when considered separately, but when considered in relation to one another, as was possible when measurements were taken after the accident, their importance became clearer. It was not difficult to detect a pattern in the alternating cross levels, of about 35 – 45 feet from one rail to the other.

I consider that the variations in cross levels were not dangerous in themselves, though the two variations at Whateley Sidings would have very soon become so if not put right. However, the alternations in cross level along the straight track leading to the point of derailment, which were more or less in phase with the nosing period of an engine at express speed, were objectionable, and their presence was indicated by the signs on the rails of uneven running. I recommend that the attention of Permanent Way Staff be drawn specially to this aspect of the case.

The engine and tender

48. Engines of this design have been running for many years on express trains and have an excellent reputation for steadiness. The condition of the engine was fairly good, and the play in the journals and axle boxes was no more than was to be expected, but the variations in loading on the wheels of the engine and tender were greater than they should have been. I think that the uneven loading was present before the derailment; the springs and their attachments were not damaged, there was no vertical distortion of the frame of the engine or tender, nor did the variations in loading conform with the stresses on springs which could be expected as the engine was capsized. As it is the general rule not to weigh engines between shop repairs unless they are reported as riding roughly, this engine had not been weighed since it left the shops in January.

49. The condition of the left hand spring of the bogie was bad but the breaks were not visible until the spring was dismantled, except one on the short top leaf, and the wheel loading transmitted through the spring was still appreciable. Springs also are not tested between shop repairs unless engines are reported for attention.

50. On the tender considerable lateral play had developed between the wheels and the frame, and this must have reduced the steadying effect of the tender on the engine, and enhanced the amplitude and severity of any lurch or oscillation.

51. I think that the defective bogie spring and the uneven loading of the wheels were faults which should have been checked and put right. More frequent weighing of engines may be desirable so that partially broken or weak or maladjusted springs may receive timely attention, and it might also be considered whether the tender brasses should be changed more often to prevent development of undue lateral play in the axles.

I have the honour to be,

Sir,

Your obedient Servant,

W. P. REED,

Colonel.

The Secretary,
Ministry of Transport and Civil Aviation.

TABLE I.

TIME AND DISTANCE TABLE

	Place	*Distance in yards past 27th milepost*	*Speed in m.p.h.*	*Time taken by train in seconds*	*Remarks*
A	End of change in cross levels near 27th mile post	47	55		The figures of speed and time can only be approximate. They are calculated on a speed of 55 m.p.h. at the time of derailment and a steady retardation by both portions of the train after it parted.
B	First bright mark on running edge	100	55		
C	First distortion to right	367	55	A to C = 12	
D	Beginning and end of diagonal mark of derailment	510 519	55		
E	First rail joint after mark of derailment	524	55		
F	Front of engine when rear tender wheel derailed	537	55	C to F = 6½	
G	Front of engine when train parted	587	55		
H	Front of third coach after it stopped	677	Nil	E to H = 13	
J	Maximum swing to the right of the second coach	710 to 723 745 to 748	30 26		
K	First 'V' of diamond crossing at Cliff Sidings	767			
L	Front of engine when derailed tender wheel was deflected at diamond	789	27	F to L = 10½	
M	Last 'V' of diamond crossing at Cliff Sidings	792			
N	First contact made by tender with loading dock return wall	817	12½		
O	Front of engine after it stopped	854	Nil	F to O = 20½ L to O = 10	

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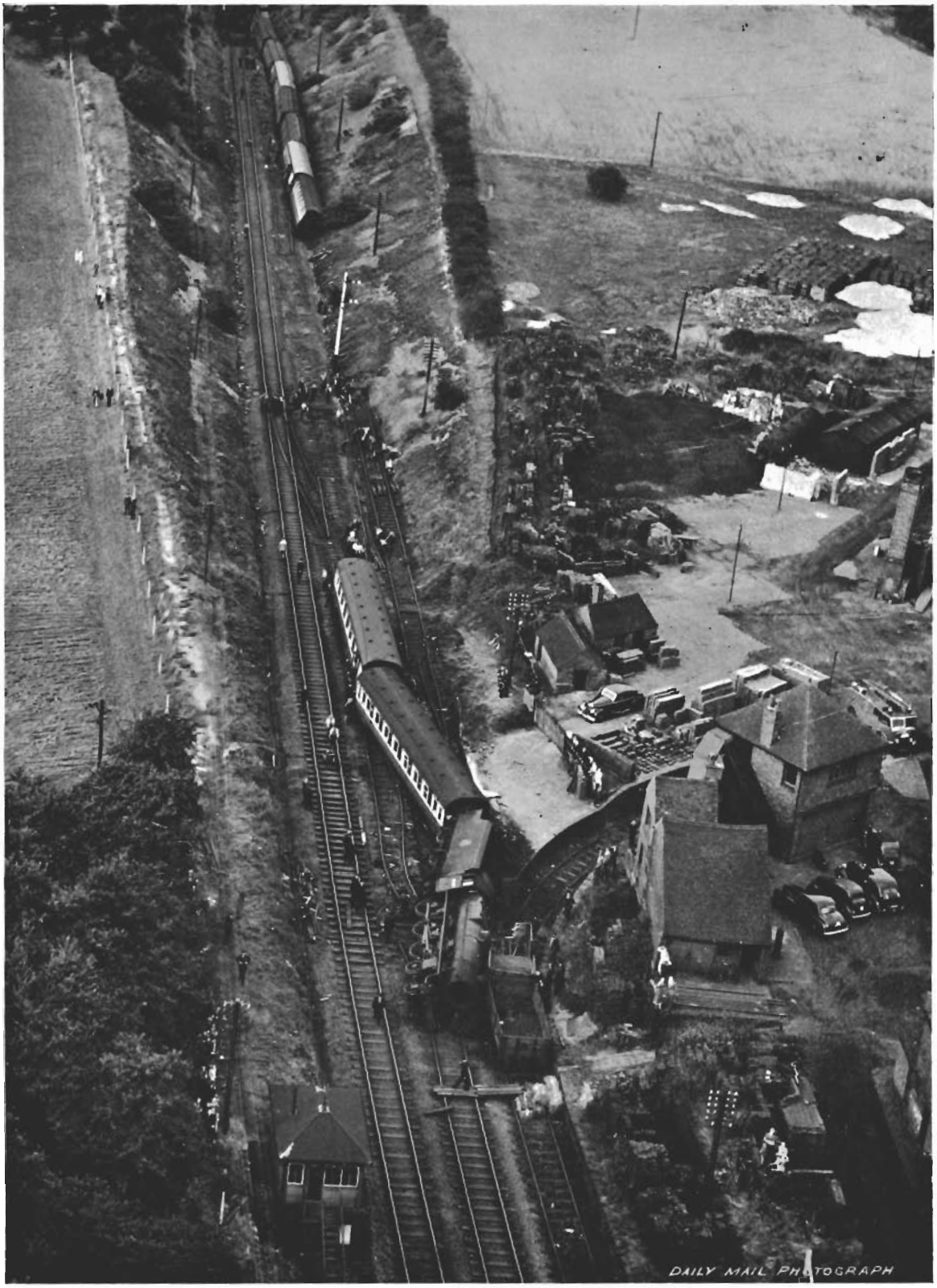
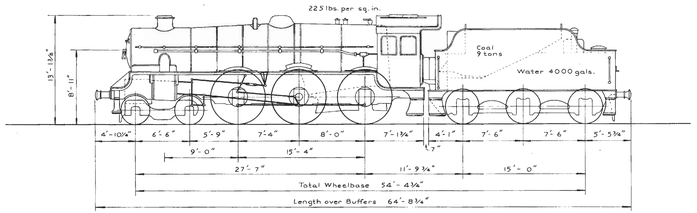

DAILY MAIL PHOTOGRAPH

DRAWING No. 1

ENGINE No. 45699 (CLASS 6P)



								Totals
Diagram	9-15-2 / 19-11-0	9-15-2	20-0-0	20-5-0	19-15-0	Tank empty 4 Tons Coal	12-4-0	11-2-0	7-7-0	30-13-0
	Total 79-11-0					Diagram	18-5-0	17-10-0	17-18-0	53-13-0
Actual 18/8/53	9-16-0 / 19-7-0	9-11-0	21-14-0	19-7-0	20-2-0	Tender reassembled light 21/8/53	9-6-0	9-15-0	7-2-0	26-3-0
	Total 80-10-0									

R.H. SIDE

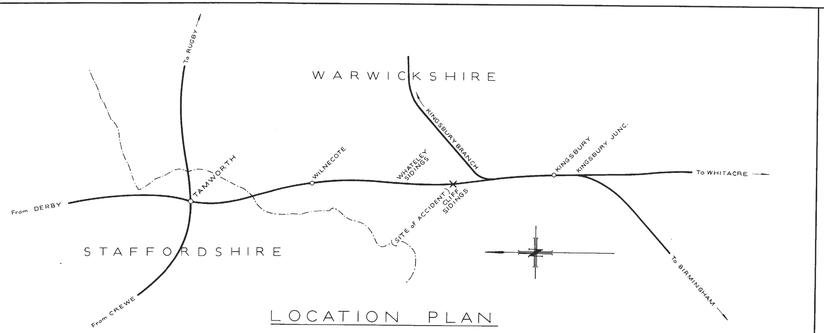
										Totals
Diagram	39-15-2	4-17-3 / 5-3-0	4-17-3 / 4-19-0	10-0-0 / 10-15-0	10-2-2 / 10-14-0	9-17-2 / 9-0-0	Tender reassembled light 21/8/53	5-1-0 / 7-15-0	5-4-0 / 8-19-7	2-16-0 / 5-5-2	13-1-0 / 22-0-0
Actual 18/8/53	40-11-0						Assumed weight of Tender with 4 tons 10 cwt. coal & 3000 gal. of water				
Actual 18/8/53	39-19-0	4-13-0 / 4-17-3	4-12-0 / 4-17-3	10-19-0 / 10-0-0	8-13-0 / 10-2-2	11-2-0 / 9-17-11	Tender reassembled light 21/8/53	6-19-0 / 4-5-0	8-6-2 / 4-11-0	6-15-2 / 4-6-0	22-1-0 / 13-2-0
Diagram	39-15-2										

L.H. SIDE

LONDON MIDLAND REGION

DERAILMENT BETWEEN WILNECOTE AND KINGSBURY

16th. AUGUST, 1953.



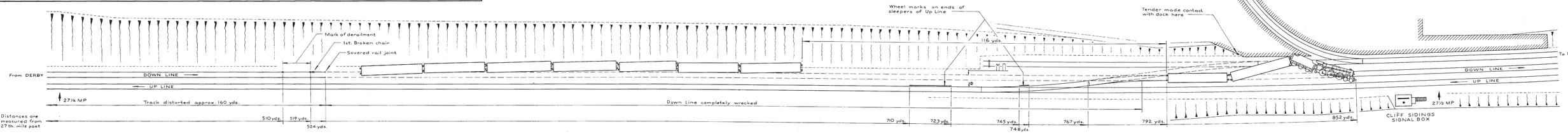
LOCATION PLAN

DRAWING No. 2

GENERAL PLAN

SCALE :— 40 FEET TO 1 INCH

FEET 100 50 0 100 200 300 FEET



O.W.W.