LONDON AND NORTH WESTERN RAILWAY.

Ministry of Transport,
7, Whitehall Gardens, London, S.W. 1.

16th December, 1922.

SIR,

I have the honour to report for the information of the Minister of Transport, in accordance with the Order of the 2nd November, the result of my Inquiry into the circumstances of an accident which occurred at about 9.5 a.m., on October 30th, between Walkden and Moorside & Wardley Stations, on the Daisy Hill—Manchester line of the London and North Western Railway.

The train involved was the 7.42 a.m. express passenger from Blackpool to Manchester (Victoria), which is booked to make a non-stop run from Lytham to Salford. As this train was running at a speed of approximately 40 miles an hour, or perhaps rather more, on the up fast line between the two stations mentioned, all four wheels of the leading bogie of the first coach were derailed. After the train had been brought to a stand near Moorside Station it was found that the leading pair of tender wheels was also derailed.

The train was drawn by engine No. 1415, 4—4—2 type, with six-wheeled tender. The total weight of the combination in working order is 89 tons 8 cwt. 1 qr., distributed on the axles from front to rear as follows :—

	tons	cwt.	qrs.
Engine bogie	12	5	0
,, coupled wheels	17	10	0
,, coupled wheels	17	10	0
,, trailing wheels	11	10	0
Tender leading wheels	10	10	1
,, intermediate wheels	10	10	1
,, trailing wheels	9	12	3

Its length over buffers is 57 feet 4¼ inches ; the engine wheel base being 27 feet 9 inches, with the 7 feet 3 inches coupled wheels spaced 7 feet 6 inches apart between centres. It is fitted with the vacuum brake, working equivalent 20 to 21 inches, operating blocks upon the coupled and trailing engine wheels and all wheels of the tender.

The train was made up of six 8-wheeled bogie coaches, as under :—

	Length over headstocks, feet	Bogie wheel base, feet	Weight unladen, tons	cwt.	qrs.
Third van, 1410 ..	54	8	23	10	1
Compo, 944	54	8	25	16	1
First, 243	56	10	28	15	1
First, 99	56	10	27	5	2
Third, 1450	60	10	27	5	1
Third van, 1411 ..	54	8	23	10	1

It was fitted throughout with the vacuum brake operating blocks upon all wheels, the percentage of vacuum brake power to total weight being 69.

The derailment was fortunately unattended with any serious results, there being no personal injuries. The damage to the coaching stock was entirely confined to the front vehicle. The front axle of the leading bogie was bent sufficiently to throw the wheels 1⅞ inches out of gauge, and the right-hand axle box and right-hand leading auxiliary spring were broken. Both sole bars were bent, the left-hand one considerably ; this was also scored by the outside face of the wheel. The leading brake truss bar was broken away from both ends, and the leading brake blocks were also both broken above their point of pivot. The whole bogie frame was twisted out of the horizontal plane. About half the inside retaining ring bolts of the leading left-hand wheel were sheared and all wheels marked and dented on the flanges. The most pronounced marks were on the left-hand leading wheel, the outside edge of the tyre being cut and scored ; on the right-hand leading wheel, which was heavily bruised on the inside face of the flange ; and on the left-hand trailing wheel, the flange of which was bruised on the outside.

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Minor damage was done to the stepboards of the coach and to the draw-gear. The damage to the tender included bending of the leading axle sufficiently to throw the wheels $\frac{3}{4}$ inch out of gauge. The left-hand trailing tender spring was separated from its hangers, and both hornblocks were broken at the bottom. The tender draw-bar was also bent.

All the broken and displaced parts both from the tender and the leading bogie of the first coach, with the exception of the broken truss bar ends and a portion of one of the brake blocks (which could not be found), were picked up on the ballast between a point some 600 or 700 yards on the Manchester side of the point of derailment and the place where the engine came to a stand. Nothing else was found missing from either train or engine, the loose tools of which were all complete.

Just before it came to a stand, the train was divided between the tender and the first coach, a space of about 20 yards separating the two.

Damage to the permanent way included 200 broken chairs and 40 cut or bruised sleepers.

Description.

The railway between Walkden and Moorside Stations consists of four lines of road running approximately from west to east, with the up and down slow roads to the north and the up and down fast roads to the south.

The alignment and gradients of the up fast line between the two stations are as follows :—

Alignment :—

For 24½ chains, tangent.
For 14 chains, curve northward, radius 80 chains.
For 18½ chains, tangent.
For 36 chains, curve southward, radius 80 chains.
For 28½ chains, tangent.
Thereafter, curve northward, radius 75 chains.

Gradients :—

For 22 chains, 1 in 120 falling.
For 11 chains, 1 in 89 falling.
For 4 chains, 1 in 119 falling.
For 19 chains, level.
For 13 chains, 1 in 131 rising.
For 51 chains, 1 in 245 rising.
Thereafter, 1 in 545 falling.

Approximately mid-way and on the level straight section of road between the two stations there is a length of water trough laid on all four roads. The railway lies in cutting for the greater part of the distance between the two stations and is crossed by six overbridges, of which one near the east end of the water troughs carries the Bridgewater Collieries Railway over the line and the remainder are road bridges.

A short distance west of Moorside & Wardley signal box the up fast line is crossed by a trailing through connection from the down slow line.

Measured from the centre of Moorside signal box, the approximate distances to the various points concerned are as follows :—

Western end of water troughs and road overbridge	1,876	yards	west.
Point of derailment	1,696	,,	,,
Bridgewater Colliery Railway overbridge	1,469	,,	,,
Eastern end of water troughs	1,396	,,	,,
Road overbridge	1,127	,,	,,
Road overbridge	687	,,	,,
Road overbridge	347	,,	,,
Diamond crossing on up fast line	80	,,	,,
Road overbridge	17	,,	
Point where engine of train came to a stand	10	yards	east.

The permanent way was laid in 1912 with steel rails, weighing 95 lbs. per yard, in 45 foot lengths.

Chairs are of cast iron, weighing 56 lbs., fastened to sleepers with 2 spikes and 2 tree nails, and the rails are secured in the chairs by tapered uncompressed oak keys.

Joints of the rails are fastened by 2 fish plates, weighing 33 lbs. per pair, with four steel bolts and four self-locking nuts.

The sleepers are of Baltic timber, creosoted, 9 feet by 10 inches by 5 inches, except the joint sleepers, which are 12 inches wide instead of 10 inches. All sleepers are laid transversely, and the distance from centre to centre varies from 2 feet to 2 feet 5 inches.

The bottom ballast is of stone pitching 9 inches thick, originally laid at a depth of 12 inches below the bottom of the sleepers, but since considerably increased owing to making up.

The top ballast up to the level of the sleepers is of broken stone.

The water troughs consist of iron channel section fastened to wooden uprights, secured by through bolts to the transverse sleepers. The normal water level is about $1\frac{3}{4}$ inches above rail level, and the average width of the trough is about 16 inches, the maximum overall width of trough and supports being 2 feet 11 inches.

REPORT.

I. *Circumstances of the derailment.*

Fireman and acting driver William Critchlow, who was driving the train concerned, described in his evidence such details of the accident as came within his knowledge at the time. His train was running under clear signals as he passed Walkden, and his engine took water at the troughs as usual. Neither he nor his fireman, Gee, noticed anything amiss as they passed over the troughs. Critchlow first became aware that his train was drawing heavily after passing the distant signal (about 530 yards from the point of derailment) for Moorside box, and, looking at the vacuum gauge, saw that it had dropped to 18 inches from its previous reading of 21 inches. The speed at this time he estimated as between 35 and 40 miles an hour. Critchlow then looked back along the train and, seeing the leading coach swaying, came to a stand as soon as possible. Before he succeeded in doing so, however, the derailed coach had struck the diamond crossing over the up fast line, which resulted in the deflection of its leading end to the right, and in the parting of the train between the tender and the first coach.

Fireman Gee had little to add to his driver's statement. Having completed the work incidental to taking water from the troughs, he began to fire his engine, but had only thrown one shovelful when he became aware of the drag of the train, and, looking back from his—the right—side of the footplate, saw some passengers waving from the front coach, which was swaying. Gee described their position at the time as being between the two bridges near the signal cabin, *i.e.*, about 350 yards from the point at which the engine eventually stopped. Seeing that something was wrong, he called out to his mate to stop, but Critchlow had already turned back to make the full brake application when Gee called out to him.

John Probert, the guard, noticed that after the train left the water troughs the speed slackened, and that as it was passing Moorside distant signal or thereabouts the vacuum in his van read about 15 inches. He then opened the window on the right-hand side and looked out. Just before he did so the vacuum was completely destroyed, and the train soon afterwards came to a stand.

Mr. Housley, Assistant Superintendent of Motive Power, was, with Mr. Openshaw, Assistant Signal Engineer, a passenger in the third coach of the train at the time. He noticed that the train appeared to be drawing heavily as they left the water troughs, but did not suspect that any derailment had taken place, though he realised that there was something amiss. When the train came to a stand, however, Mr. Housley saw what had happened, and at once walked back with Mr. Openshaw to find the scene of the derailment. This was easily traced to the point already described, where Mr. Housley found a piece broken out of the "running on" (trailing) end of one of the left-hand rails. The fracture proved to have originated at the trailing joint bolt hole, and developed in three main directions as follows:—One running backwards in the web towards the trailing end from the lower left-hand quadrant of the bolt hole at an angle varying from about 30 deg. downwards to 0 deg. with respect to the rail table; the second running backwards in the web from the upper left-hand

quadrant of the bolt hole at an angle of about 45 deg. upwards for the first half of its length and thereafter along the under side of the rail head ; and the third running forward in the web and head from the right-hand upper quadrant of the bolt hole at an angle of about 45 deg. upwards, terminating at the rail table about 4½ inches from the trailing end. The missing portion of the rail was therefore in two main pieces, one a fragment of the trailing end of the web and the other including a length of the rail head with a piece of the upper half of the web attached. The former piece was found by Mr. Openshaw in the left-hand six-foot, about 2 yards in the direction of the traffic from the broken end of the rail. The broken portion of the head was not found until the next day, by the sub-ganger, about 60 yards on the Manchester side of the broken rail, in the six-foot between the two slow roads. Mr. Housley concluded his statement of the conditions as he found them in the following terms :—

> " There was a fish plate bolt lying in the four-foot, the nut of which was in the opposite side in the six-foot, as were also three washers. The bolt was out of the end hole in the direction of traffic and lying practically opposite the bolt hole. The inside fish plate was splayed open and showed a distinct fracture through the second bolt hole. The key in the chair next to this was out and lying alongside of it. Five sleepers from this joint in the Manchester direction there was a distinct mark on both rails where the wheels had slipped down ; the chair on the sixth sleeper on the left-hand side was broken. From this point to where the train came to rest there were very distinct marks down the middle of the four-foot until arriving at the lead into the sidings, where the wheels were put across to the opposite side. At this place there were clear marks showing where the pair of tender wheels had become derailed. The trailing pair of tender wheels had also been derailed, but had rerailed themselves before the engine came to rest."

2. It is evident from the foregoing, and also from the marking on the sleepers, that the initial derailment took place a few yards beyond the point of fracture in the rail. The broken piece of rail head showed a pronounced burr upwards at the trailing end and a heavy bruise at the fractured end. There was no corresponding bruise at the end of the rail head from which the piece was broken away, and the bruise on the latter was therefore almost certainly caused after it had separated from the rail. It shows every indication, in fact, of having been run over, and there can be little doubt that its presence under one of the leading wheels of the train caused the derailment. It is possible that the bruise on the flange of the left-hand trailing wheel of the leading bogie was caused by contact with the broken piece of the rail head. The other markings on the wheels, which have been described in detail above, were probably caused when they struck the crossing near Moorside Station. There can be little doubt that the derailment of the tender wheels and the other damage to the tender were due to the striking of this crossing by the derailed coach bogie and the subsequent parting of the train. The markings on the permanent way showed that after the leading bogie left the rails the head of the first coach was deflected to the left, the bogie running parallel to the track with the right-hand wheels bearing against the water trough, which had been splintered, and the left-hand wheels running upon the outer edge of the chairs, many of which were broken in consequence. Soon after leaving the water trough the coach appears gradually to have tilted to the right, with the right-hand wheels of the leading bogie taking a slightly sinuous course in the four-foot, the left-hand wheels running just clear above the formation and only occasionally touching structures, such as signal wire cover boards, etc., in the six-foot. Subsequently the left-hand wheels again dropped and scored the ballast outside the sleepers. The derailed coach wheels continued to travel in this manner until the connections at Moorside were reached, when the coach was deflected, and the parting of the train already referred to took place just before the train came to rest.

3. Some comment is called for in respect of the considerable distance (just under a mile) which the train ran after the initial derailment took place. It appears that, as is in fact natural, the derailment was first realised by the passengers in the leading coach, and that the communication chain was pulled at some moment prior to the brake application being made by the driver. Fireman Gee stated in his evidence that one of the passengers spoke to him after the accident and said that the driver had been careless in not stopping sooner, and that another passenger asked him if he had not noticed that the communication chain had been pulled, adding that he ought to have done so.

The question whether there is any just cause for complaint on the grounds of inattention to this signal turns mainly upon the exact time which elapsed between the pulling of the chain by the passengers and the brake application made by the driver. It is impossible to determine this with any degree of accuracy. There can be no doubt that the reduction in vacuum noticed by the enginemen and by the guard was due to the pulling of the chain in the leading coach. None of the men concerned, however, associated for the moment the effect with the cause; the driver's first thought being that the drop resulted from the operation of the water pick-up apparatus, which is vacuum worked in these engines, and the guard thinking that the driver had made the application owing to a possible permanent way slack. It was to verify this assumption, no doubt, that he lowered his window to look at the road. Such previous experience as the men concerned had had of the pulling of the communication chain led them to expect a considerably larger drop in vacuum than they observed on this occasion. The extent of the opening to the train pipe caused by the movement of the chain operated valve in this stock is normal, *i.e.*, $\frac{9}{16}$ths of an inch, and a test made upon the train concerned on the morning after the accident, with the engine in position and the small ejector working, showed a reduction in vacuum, when the chain was pulled, from an initial figure of 20 inches to 5 inches in about 52 seconds. This test was repeated in successive coaches with the same result.

From the result of these tests it is fair to assume that the communication chain brake valve system was in an efficient working condition at the time of the derailment, and there is therefore no reason to suggest that any defect in this apparatus resulted in the train having been brought to a stand later than would otherwise have been the case. Nor do I think that the suggestion of inattention on the driver's part to the indication so given can be substantiated. It is no doubt possible that, if he had not in the first instance suspected that the drop in vacuum was due to the operation of the water pick-up apparatus, the driver might have realised the circumstances somewhat sooner. On the other hand, there seems to be no doubt that he applied the brake himself some time before the train pipe opening due to the pulling of the chain had had its full effect; in fact, the reading of the vacuum gauge when he did so suggests that an interval of only a few seconds had elapsed since the signal was given by the passengers, and that they did not take action so soon after the initial derailment as perhaps they thought at the time.

II. *Rail fracture.*

George Wood, the ganger employed on the length concerned, is a man of 32 years' service, for 14 of which he has been a ganger, and is responsible for a mile of the quadruple track in this area. On the morning in question he started from Walkden at 6.55 a.m. to walk his length, going out along the down fast road and returning along the up slow road. He noticed nothing which required attention, excepting a few keys which had fallen out and which he replaced. He was still at Walkden, after his return from his inspection, when he was told of the derailment by one of his gang who had all been working in the Walkden Goods Yard. Wood then proceeded to examine the broken rail and came to the conclusion that the fracture of the rail head and of the upper portion of the web was fresh, but that the fracture of the lower part of the web was old. After he had removed the old rail he found that several chairs under it were broken, including the joint chair at the trailing end, the fracture of which appeared to be quite new. He then brought a new rail from Walkden and put it in. Both old and new rails were full length, 45 feet, and no cutting, or adjustment of the road, was required before placing the new one in position.

It will be observed from this evidence that Wood did not, in the course of the morning inspection of his length, walk along the line (the up fast) in which the rail fracture occurred; there is therefore no positive evidence of its condition prior to the passage of the derailed train. Wood, however, stated that four trains passed over this road within 40 minutes early on the morning of the 30th, and it is therefore improbable that any fracture existed in the rail head when he walked his length. The crack in the web extending backwards from the trailing bolt hole, which appeared to be old, did, no doubt, exist at the time, but this could not have been observed without removing the fish plate, by which it was entirely covered.

Wood gave it as his opinion that the rail was broken by the train which was derailed. There can at any rate be no doubt that this train dislodged the broken

and before it fell clear; the remainder of the train running without mishap over the consequent gap at the joint.

The fact that a loose fastening of this kind, which cannot have developed suddenly, in one of the joints on an express road should have existed without having been observed and corrected is unsatisfactory. There appeared at the Inquiry to be some diversity of practice between gangers as to their actual procedure in walking a length consisting of four lines of road. In some cases it seems that the men make a practice of crossing diagonally from time to time between the various roads; an ineffective proceeding and dangerous to the man concerned. In other cases they walk in the six-foot, observing the roads upon either side of them. Generally speaking, there appeared to be a lack of system and of a definite understanding that all four roads should be walked once in 24 hours, though no doubt this is in many cases done. It appears to be necessary that with four lines of rail the length should be walked over four times, that is, twice up and down, every day, nor does it seem that there should be any difficulty in this respect, since gangers in charge of a section consisting of four lines of road have only about half the length which is allotted to gangers having only two lines of road to superintend. I suggest that such steps should be taken by the Company as may be necessary to ensure that this is done.

I have the honour to be, Sir,

Your obedient Servant,

G. L. HALL,
Major.

The Secretary,
Ministry of Transport.