MINISTRY OF TRANSPORT

RAILWAY ACCIDENTS

REPORT ON THE COLLISION

which occurred on 8th April 1953 near STRATFORD on the CENTRAL LINE LONDON TRANSPORT EXECUTIVE

LONDON : HER MAJESTY'S STATIONERY OFFICE

1953

PRICE 3s. 6d. NET

ERRATUM.

Page 1, para. 5, line 6.

For " Six " *read* " Seven ".

Page 4, para. 21, 18th line down.

After " driver of " *insert* " train ".

MINISTRY OF TRANSPORT,
October, 1953.

LONDON :
HER MAJESTY'S STATIONERY OFFICE.

MINISTRY OF TRANSPORT,
Berkeley Square House,
London, W.1.

24th September, 1953.

SIR,

I have the honour to report for the information of the Minister of Transport, in accordance with the Order of 9th April, 1953, the result of my Inquiry into the serious collision which occurred at 6.56 p.m. on Wednesday, 8th April, 1953, near Stratford on the Central Line of the London Transport Executive.

2. An eastbound train (No. 59) running under the "Stop and Proceed" rule, collided at a speed of about 20 m.p.h. with a similar train (No. 71) which was stationary in the tube tunnel between Stratford and Leyton. As a result, the second car of train No. 59 was telescoped into the leading car for a distance of about 6 feet. Each train carried between 400 and 500 passengers. I much regret to report that twelve passengers lost their lives; of these, nine were killed outright and three died in hospital later from their injuries. Four passengers and the driver of train No. 59 received serious injuries and were detained in hospital, and 41 passengers were slightly injured or suffered from shock. All the fatalities and the serious injuries occurred in the front two cars of train No. 59.

3. Immediate calls were made for assistance, which arrived in a creditably short time. The West Ham Fire Brigade was on the scene by 7.15 p.m. and was followed closely by doctors and nurses from Queen Mary's Hospital and Whipps Cross Hospital, the St. John's Ambulance Brigade, the Metropolitan Police and the police staffs of the London Transport Executive and British Railways, Eastern Region. Rescue work was extremely difficult due to extent of the damage and in the confines of the tunnel, and that done by all deserves the highest praise. The first stretcher case was removed at 8.20 p.m. and it was not possible to release the last two seriously injured men from the crushed coaches until about 2.15 a.m. the following morning. The conduct of the passengers in these coaches, many of whom gave assistance to the injured, is also much to be admired.

4. No serious arcing took place and there was no fire. The traction current was discharged from the section between Bow and Leyton at 6.56 p.m. either by some part of the damaged coaches short circuiting the electric rails or by the driver of train No. 71 attaching his telephone to the tunnel wires.

5. ~~Fourteen trains~~ became stalled between Bethnal Green and Leyton. Of these, six were at or west of Mile End Station and their passengers were detrained at that station, the operation being completed by 8.10 p.m. The passengers of three trains between Mile End and Stratford were detrained by 9.30 p.m. by way of a fan shaft situated roughly half way between these stations, and which was provided for just such an emergency. Two trains were emptied at Stratford Station, one by 7.0 p.m. and the other by 8.0 p.m., and the uninjured passengers from the rear six cars of train No. 59 walked to that station, arriving there by 7.45 p.m. The passengers of train No. 39 which stalled between train No. 71 and Leyton, and those from train No. 71 walked to the latter station; these two trains were cleared by 9.10 p.m. and 9.50 p.m. respectively.

6. The removal of the wrecked coaches from the tube was a difficult and lengthy operation and consequently it was not possible for normal working to be resumed until 10.0 a.m. on Friday, 10th April. In the meantime services between Liverpool Street and Leytonstone were augmented during the peak periods by special bus services, and on the Thursday evening and the Friday morning additional train services were operated by the Eastern Region, British Railways, between Liverpool Street, Stratford, and Ilford.

7. At the time of the accident the weather was fine and the light was fading.

DESCRIPTION

The line

8. The plan shows the layout of Stratford Station and of the eastbound line from Stratford to Leyton.

The extension to Stratford of the fourth rail electrified Central line was opened in 1946, and from Stratford eastwards to Leytonstone in 1947. The line is in tube to Stratford where it rises to the surface for the purpose of cross-platform interchange with trains of the Eastern Region, British Railways. Beyond Stratford the line again descends underground but it rises to the surface once more at Leyton. Stratford Station is manned entirely by Railway Executive staff.

The eastbound line through Stratford Station falls at a gradient of 1 in 264 in the direction of traffic. Near the end of the platform the gradient changes to 1 in 30 and the line is generally straight for about 200 yards. It first enters a rectangular cut and cover tunnel and then swings to the left, on a 20 chain radius curve, into a 12 feet diameter cast iron tube in which the collision occurred, at a point 307 yards from the end of the platform. Just beyond that point, the gradient eases to 1 in 1,500.

The tunnel is, as is customary on the London Transport Executive system, equipped with two bare "tunnel wires". By pinching these together or by clipping a telephone to them, the traction current is cut off. The telephone enables a driver to speak with the sub station attendant at South Woodford, but the latter cannot ring a driver in the tunnel.

The tunnel is also equipped with lights on the left hand side in the direction of trains, spaced at roughly 100 feet intervals. These are normally not lighted but can be turned on from either Stratford or Leyton. They come on automatically when the traction current is discharged.

The "slack hour" train service averages 12 trains per hour, but in the morning and evening peak periods the headway is 1½ to 2 minutes. The accident occurred towards the end of the evening peak period.

The signalling

9. The line is equipped with the standard signalling of the London Transport Executive. It is track circuited throughout and the track circuits control two aspect (Green/Red) colour light signals automatically (these signals have a prefix A on the plan.) Two aspect (Green/Yellow) repeating signals (prefixed R) are used where necessary and they work automatically with the stop signals. When the track circuits are not occupied by trains, the signals are normally at clear. The occupation of or any defect in a track circuit will, depending on its position, place and maintain the stop signal or the two stop signals immediately in rear at Danger. The proving circuits are of the most up to date design and include an additional safeguard in the provision of two track relays for the berth track circuit.

10. Train stops are provided at all stop signals. They are mounted on the right hand side of the track and comprise an arm which is raised 3 ins. above the rail when the stop signal is at Danger. In that position the train stop makes contact with the trip cock on the train and causes the power supply to the motors to be removed and an emergency brake application. The train stop is operated by compressed air and is controlled electro-pneumatically. A proving circuit checks that the train stop has returned to the tripping position whenever the signal goes to Danger. A rod connected to the head of the train stop has a contact which is included in the relay circuit of the track circuit immediately in advance of the signal, and prevents the track circuit becoming clear unless the train stop has returned to the tripping position. Any defect in, or the fracturing of a train stop will therefore cause the signal at which it is fitted and the signal immediately in rear to remain at Danger.

All the circuits were subsequently carefully checked and found in order.

The trains

11. Trains 59 and 71 each comprised 8 cars, all of which were built between 1923 and 1930. The tare weight and the weight of passengers in each train was 190 tons and about 25 tons respectively, total 215 tons. Each train had a seating capacity of about 310 and was formed as follows :—Motor, trailer, trailer, motor, motor, trailer, trailer, motor. The length of each train was 410 feet.

Emergency electric lighting operated from batteries is provided in all cars and becomes switched in automatically when the main power supply is cut off. In addition each car is provided with one candle lamp. All trains have an electric tail lamp below the left hand window of the trailing driving cab and also carry an oil lamp on the right hand side of the end door as seen from the rear.

12. The braking equipment on trains consists of an electro-pneumatic (E.P.) system combined with a quick acting pneumatic system, both of Westinghouse manufacture. The former system is normally used and provides an almost instantaneous control on the brakes throughout the train ; it is superimposed on the pneumatic system which remains available for immediate use should the electro-pneumatic system fail. A "dead man's handle" operates a valve on the pneumatic system. In an emergency stop both systems apply the brakes fully.

The results of brake tests are given later in paragraphs 44 and 45.

13. A trip cock is provided under the driving cab on the right hand side of each motor car. When a train is running all but the trip cocks under the leading and trailing driving cabs are isolated by means of a lever on the front of the cab. Should a train pass a signal at Danger, the leading trip cock engages the train stop and is knocked backwards ; a valve in the brake pipe is opened, immediately releasing the air pressure to give an emergency brake application.

14. All motor cars are fitted with a control governor, which is a pneumatically operated switch connected to the brake pipe. Until the air pressure rises to a certain figure the switch remains open and prevents the supply of current to the traction motors. The train cannot be started with the trip cock isolated unless the control governor is cut out by the opening of a switch which is in the cab and is normally sealed.

The accident

15. A heavy hook attached to a loose side chain on an eastbound train struck and damaged the train stop at signal A 491 (*see* plan). As a result, that signal and the stop signal next in rear, A 489, remained at Danger. (*Note.*—The side chains are provided for emergency coupling purposes.)

"Stop and Proceed" working was operated (*see* paragraph 17) at 6.12 p.m. and two porters were posted at Stratford to advise drivers and guards of trains that signal A.489 was remaining at Red. At that time it was not known to anyone at Stratford that signal A 491 also would not clear to Green. Train 71 was the twelfth train to pass signal A 489 at Danger. It proceeded into the tube and stopped behind the preceding train (No. 39) which was standing at signal A 491. Shortly afterwards, train 39 moved forward past the red signal. As train 71 was about to draw ahead to the signal, it was struck heavily in the rear by train 59 and was driven forward about three feet.

The Damage

16. The damage to the two trains was extensive and greatly exceeded that ever experienced in any previous accident to tube stock. The leading driving cab of the first car of train 59 was wrecked and the headstock was forced down with such violence that the whole end of the car was lifted and became jammed between the track and the roof of the tube, buckling itself in the process. This had two results—firstly, the whole of the energy of the train was dissipated at that point instead of some, at least, being expended in pushing train 71 further forwards ; and secondly, the lifting of the front end caused the rear end to be lowered, enabling the buffer of the second car to ride over that of the first car and to telescope into it for a distance of 6 feet. In doing so, the headstock of the second car collapsed and the floor buckled in the shape of an inverted "V", 4 feet high. It was there that most of the serious casualties occurred. The drawing at Appendix E illustrates the damage to these two coaches.

The headstock at the rear end of the second car of train 59 was also forced downwards and the same action occurred to one or both of the headstocks on the next three cars. In all these again there was some floor buckling and body distortion.

The trailing cab of the last vehicle of train 71 was wrecked. Both headstocks were bent downwards, as they were also in the next three cars. The floors of all these vehicles were buckled, and body distortion took place.

RULES

17. It has been mentioned that trains were running under the "Stop and Proceed" rule. This practice is authorised by Statutory Order on the lines of the London Transport Executive to make it possible to continue to run the service when a failure either of a train or of signalling equipment occurs. It is applied at automatic signals without telephones (such as signal A 489 at Stratford) on the initiative of the driver, when the signal remains at Red.

Generally the Rules require a driver to wait at such a signal one minute and then to PROCEED CAUTIOUSLY as far as the line is clear or to the next stop signal AT SUCH SPEED AS TO ENABLE HIM TO STOP SHORT OF ANY OBSTRUCTION, having regard to conditions such as curvature and the occupation of the line ahead by a train. The need for caution is emphasised by the use of capital letters.

Extracts from the "Stop and Proceed" Rule (No. 55(*g*)) and from other Rules which are relevant are given in Appendix A.

EVIDENCE

18. The staff of trains 39, 71, and 59 were as follows :—

Train 39	R. H. Goodin	driver
	S. J. Bass	guard
Train 71	A. T. Bryan	driver
	H. E. Dell	guard
Train 59	J. S. Besley	driver
	P. J. Newling	guard

They described the events up to the time of the accident as follows :—

19. *Train* 39. Soon after stopping at Stratford, a porter told driver Goodin that signal A 489 was remaining at Danger and that he could pass it. Not being satisfied, Goodin asked the "station master" (actually a station inspector) who confirmed the porter's instructions. Nothing else was said by either the porter or the inspector. Goodin, after communicating with the guard, passed the signal and was tripped ; he then reset the trip cock and proceeded slowly into the tunnel. He saw the tail lamps of a train ahead at a distance of 12 – 15 yards and stopped "within a foot" by putting on the brakes fully and releasing the "dead man's handle". The tunnel was quite clear and he had no difficulty in seeing the tail lights. Shortly afterwards the first train moved away and Goodin drew his train ahead to signal A 491. After waiting the prescribed time, he passed that signal at Danger also and was approaching Leyton when the power was cut off and the train rolled to a stand.

20. Guard Bass said that when the train arrived at Stratford a porter told him that the train could start and pass signal A 489 at Danger after waiting three minutes. Goodin spoke to Bass on the train telephone and then started the train which was tripped at the signal. Bass confirmed that the speed down the tunnel was very slow. Soon after arriving at signal A 491 he heard another train (No. 71) behind.

He went to the rear end of his train to check the tail lights and saw it approach "fairly slowly" and stop 5 – 6 yards away. He spoke to its driver. When train 39 stopped on account of the loss of current, the emergency train lighting came on.

21. *Train* 71. Driver Bryan was also told by a porter as soon as he arrived at Stratford that signal A 489 was remaining at Red and that he could pass it after waiting one minute. The porter had no flags and said nothing else. Bryan communicated with Guard Dell and then started the train. It was tripped at signal A 489 ; he reset the trip cock and proceeded down the tunnel at less than walking pace, applying the E.P. brake continuously. The first he saw of the train ahead (No. 39) was a reflection "through the haze". He said "it seemed as although there was a haze throwing a light on the train itself." Then he saw the tail lamps at a distance which he estimated at 50 feet. He was certain that he saw first the oil and then the electric lamp. Finally the whole back of the train itself came into view. He stopped his train gently and without difficulty 3 – 4 yards from it, and he kept the brake at the "holding" position.

The guard of the train ahead spoke to him and then Bryan spoke to Dell and asked him to check the tail lights. As he turned away from the telephone there was a loud crash and a blue flash and the cab was filled with smoke, dirt and dust. He said "it was like one of our sandstorms, you could not see anything—not clearly". The impact, however, did not appear heavy but the train was shot forward and he was thrown backwards. Bryan immediately clipped his telephone to the tunnel wires to cut off the current and to speak to the sub station attendant, and told him not to restore the pressure until he received further instructions.

Bryan then walked through to the back of his train and was surprised to find Dell alive and no passengers seriously injured. He saw the driver of 59 trapped in the wrecked front of the train, realised he could do nothing and so he went back to the front again and told the sub station attendant that help was required. The emergency lights were on in the train.

On being questioned about the haze he experienced, Bryan described it as a heat haze like that from a "tractor that has been overworked". It was not smoke and he did not think it was dust. When asked if it affected his view of the tail lamps he replied "probably so—perhaps. But it did not really affect my vision to that extent".

Bryan said that the seal on the control governor cut-out switch, which was found broken after the collision, was in that condition when he took the train over that afternoon. He had entered it on the "trouble card".

22. Guard Dell had checked that the train tail lights were burning brightly at Bethnal Green and Mile End. At Stratford he was given the same information as that given by the porter to Bass. His subsequent account of events was generally similar to Bryan's. The train went down the tunnel with extreme caution, at a fast walking pace. Dell had just left the guard's compartment at the front of the last car to go to the rear end of the train to see the tail lights again when the "terrific" impact occurred. He went to the back and saw the damage and the injured driver of train 59, and he tried to go forward to tell Bryan, but a jammed door on the third car prevented him from doing so. He then endeavoured to go back along the tunnel towards Stratford but could not get past the front of train 59. Consequently he again went forward and met the driver who helped him to break down the door.

The injured driver of train 59 had told him it was very hazy and smoky when he was "coming down", also that he only saw one tail light. Dell said that at that time there was much haze, but he thought it was caused by the collision. He had not noticed it before.

23. *Train* 59. Driver Besley came on duty on 8th April at 3.40 p.m. after 15 hours rest. He had worked the same turn the previous day after a full day's rest. Besley was seriously injured in the collision and I was unable to take his evidence until 6th August.

He stated that Train 59 was checked at nearly every signal from Liverpool Street to Stratford but he did not pass any of them at Danger under the "Stop and Proceed" rule. When he stopped at the 8-car mark at Stratford, a porter told him "the signal has failed—you are to pass it at Danger". No mention was made of "Caution", of other trains being ahead or of the trip cock or "tripping" at the signal. The porter said that the guard was also being informed by another porter, and consequently Besley did not speak to him on the train telephone. After what he thought was a normal stop of about one minute, he received the bell signal and started the train. He passed signal A 489 under Rule 55(g), was tripped and stopped in about 2 yards. He had applied the E.P. brake just before reaching the signal, a procedure frequently adopted by some drivers to reduce the jerking of the train. He reset the trip cock, waited for a minute or more for the air pressure to be recreated, released the brakes and then turned the controller two notches to start the train. He shut off power and allowed the train to coast into the tunnel cautiously, applying the E.P. brake gently to control the speed which he said was constant at 5 – 8 m.p.h.

He said that suddenly he encountered a bank of thick dust about 6 – 7 feet in depth. He saw it only when he reached it and after passing through it he saw train 71 about 2 yards ahead. He released the "dead man's handle" and made a full brake application but the collision occurred simultaneously.

Besley was certain that the train was tripped at signal A 489. When resetting the trip cock he got down from the cab through the end door, and he said that at that point the track was ballasted (*Note*—at that time the ballast extended only 3 feet beyond the signal and beyond the ballast the sleepers were laid on an open concrete foundation with a drain in the centre). The seal of the control governor cut-out switch was found broken after the accident but he had noticed it in that condition when taking over the train. He had checked that the switch was correctly closed and he had not touched it.

He was insistent that the speed of the train descending the gradient was not more than 5 – 8 m.p.h. although he agreed it was difficult to judge speeds in a tunnel. He was told that the sighting distance of both the tail lamps of the train ahead was about 170 feet and he said that if he had seen them he could have stopped the train a car length (about 50 feet) away from it, although he estimated at another time that he could have stopped in the length of a car.

24. Besley was questioned closely about the dust. He used the following words to describe it :— "It was more like a cloud ; as the lights caught it, it was going round and round as though it was being blown by air pressure—as if my train was pushing it one way and the air from the other train, the other way. It obscured my view of the train in front ; I could see no tail light of any sort. It was a whitish dust as it was going round in the lights—a greyish whitish colour". He added that there were particles of dust flying about in the cloud which was not smoke, fog nor condensation on the windscreen. He had never experienced such a cloud before, except from fog, nor had he heard other motormen tell of having seen one. When asked if he could account for the dust he replied "I have tried to think and the only thing I can think of is that the train in front of me had just tripped past the signal and caused dust which had got into the air and forced it back when it was coming out of the tunnel, and one coming in pushed the air back and formed a block". He heard no whistling or rustling sound, only the normal sound of air passing the train. After coming through the dust, he saw the electric tail light of train 71 first and then the oil light, when close to it. Both lights were burning. He added that he thought he saw the electric light first because of its great intensity.

Besley agreed that he might on the spur of the moment have told passengers just after the accident "They (the Stratford staff) should never have let me down". He explained this to me by saying, "I thought one of the trains being as close as it was to the other, they should have held me at Stratford for a time limit, when they knew how close the trains were behind one another".

He did not know that signal A 491 was also remaining at Red. He said—"I was expecting to find a signal at Danger but definitely not a train in that position. Really, I was looking for anything ahead. Actually I never stopped looking. I was going cautiously in case anything was in front of me whatever it was."

The train brakes had been working satisfactorily. He did not think that the tunnel lights, which were on, affected the sighting of the signals, and he experienced no difficulty in this when going from the light to the darkness in a tunnel.

It was still daylight when Besley's train left Stratford, and he did not notice any smoke or mist hanging over the tunnel. He appreciated that the line into the tunnel was on a steep gradient and said that he always drove cautiously because he remembered a previous accident there.

Besley could not remember when he had last applied the "Stop and Proceed" rule but said that he had done so several times during his service.

Detective Inspector W. Sweeting accompanied Besley to the hospital and remained with him for some time. He recalled that Besley made the remark "Suddenly there was a cloud of smoke and then a crash".

25. Guard Newling, who had worked with Besley for about 9 months, also came on duty at Loughton at 3.40 p.m. He agreed that the train had been checked at most of the signals before Stratford, but did not "trip past" any of them. After stopping at Stratford, a porter told him that signal A 489 had failed, and that the train was to pass it after waiting 2 – 3 minutes. After about 2½ minutes a porter from the front of the train gave the right away signal by raising his arm, and Newling gave the starting bell signal to Besley. The train started slowly and then stopped. Newling was not certain whether it had been tripped at the signal, and he did not notice the air gauge reading. He had kept the guard's compartment door open and it was opposite the station name board on the refreshment room at the second stop.

The train then proceeded into the tunnel cautiously, at a speed Newling estimated as 8 m.p.h. He also agreed it was difficult to judge speeds in tunnels, but he said that the train was definitely travelling more slowly than usual. He did not notice whether the brakes were being applied but he thought the train could have been stopped in a car length ; during this time he was, however, attending to a boy who had been put in his charge. Then there was a heavy impact and he realised there had been a collision. He said it had not been preceded by an emergency application of the brakes. He protected the train and placed the short circuiting bar on the rails and then went forward along the train. The emergency electric lights had not come on so he lit the candle lamps. He could not get beyond the sixth car but realised there was severe damage and a number of casualties, so went back to Stratford to report. All the passengers remained very calm.

Newling thought the train left Stratford under Rule 55(*g*). He later amended this to Rule 77 when shown that Rule. He did not speak to the motorman on the train telephone because he was told another porter had explained the situation to him. Newling has been with the Executive for 3 years. He is not qualified as a motorman.

26. Drivers Goodin, Bryan and Besley all said that the porter at Stratford mentioned neither the need for caution nor that they should "trip past" signal A 489, nor again that the trip cock should be isolated. Guard Motorman S. Cooke of train 48, which was following train 59, said, however, that the porter definitely told him to cut out the trip cock, but added that he would not have done so without instructions from a higher authority.

Evidence of passengers in train 59

27. Mr. R. Mackenzie Smith, of 124, King's Avenue, Woodford Green, a civil engineer and a regular traveller on the Central Line, joined the train at Holborn and was sitting in the centre of the second car. He related that the journey to Stratford was slow with many stops, but he did not pay much attention to them as the train was not tripped at any signals. He was quite familiar with the practice of "tripping", having experienced it on a number of occasions and having always been nervous of the results.

He did not recollect that the train stood in Stratford longer than usual but after starting it drew up at least one and a half car lengths, possibly more, and it stopped again. He stated "as far as I can be certain, I would be willing to swear that we did not trip the signal at the end of the platform because when we stopped I was well clear of the platform and the driver must have been well beyond the signal, and I do not remember any severe pull-up". He took particular note of that stop which he thought was peculiar. Then after an appreciable pause the train started again and went down into the tunnel. Mr. Mackenzie Smith said—"I became nervous again and thought to myself ' we are going down here very fast '—in fact, I thought we were going down at a normal rate ; it was certainly not a slow speed". He could not give an estimate of the speed but said that it "called attention to itself".

Then the collision occurred which he described as an "almighty crash", and he thought he remembered seeing flying debris and dust but the lights went out at once. Immediately afterwards, however, there was certainly smoke and dust. He said there was no panic whatever and added "the people (passengers) were simply marvellous".

At one time he smelt burning paint and became worried but it transpired that it was from the paint on a candle lamp.

28. Mr. H. F. Hodges, also a regular traveller on the line, boarded the fifth car of the train at Liverpool Street. He said it was a slow journey to Stratford, with many stops. He obtained a seat there. The train appeared to leave Stratford at normal speed. He said "it made me look at my watch as I had an engagement that night and I was trying to estimate my time for getting home". He added "I thought that whatever the trouble there was, we had cleared it and we were back more or less on to normal running again". He did not remember the train stopping a second time at Stratford.

29. Mr. J. Roberts, of 275, Chigwell Park, Woodford, was standing at the front end of the leading car which he entered at Mile End. He did the journey regularly. He recalled that the train stopped a second time after leaving Stratford. It was not a sudden stop but he heard the sound of escaping air. It then moved down into the tunnel at, he thought, 8 – 10 m.p.h. He drove a car a great deal and considered himself a good judge of speed. He said the train was certainly travelling more slowly than usual.

After the collision he assisted in releasing the driver who was trapped. Mr. Roberts said "the driver repeated that they had no business to let him out of Stratford"; also "he (the driver) kept repeating that he could not see for dust". He stated that the driver's main concern at that time was for the passengers in the train.

30. Mr. R. H. Judge, of 47, Loughton Way, Buckhurst Hill, was also travelling from Mile End in the same car, and was standing at the front end. He recalled that there was a sudden stop after leaving Stratford and he heard the sound of air escaping. The train then proceeded at a speed which he estimated at 5 – 10 m.p.h. He thought it was definitely slower than usual. He also assisted in tending the driver whom he heard make the statements recorded by Mr. Roberts.

31. Mr. Ivor Laiken, of 53, Charnwood Drive, South Woodford, travelled every day on the line and was sitting near the front of the first car. He said that after stopping at Stratford a second time, rather suddenly, the train began running normally and he gained the impression it was picking up speed. He estimated it was travelling at 8 m.p.h. when the collision occurred. (*Note.*—It appeared that he was not a very good judge of speed, even in the open.)

32. Other passengers have written letters and given various estimates of the speed of train 59. Mr. A. Glasse, F.R.I.C.S., of 28b, Albermarle Street, W.1, who was in the first car, said "I am aware of the difficulty in judging speed in a tunnel as one appears to be going faster than one really is, but in my humble opinion the speed of the train on impact was approximately 6 – 7 m.p.h. It *appeared* that the brakes were applied a split second before we hit". Mr. Brian Trench, of St. Helen's Court, E.C.3, said "we left Stratford at normal speed gathering momentum down the tunnel".

Most of the passengers paid tribute to the courage of Driver Besley and some related that he referred to dust obscuring his view of the train ahead.

Evidence of Passenger in train 71

33. Mr. J. W. Higgs, a clerk in the Staff Section, Railways, of the London Transport Executive, was travelling in the rear car and was standing. He remembered that the train was tripped at a signal before reaching Stratford for it stopped suddenly. He did not recollect a second stop at Stratford and said that if there was one, it was certainly not similar to the previous "tripped" stop. After leaving the station the train proceeded slowly into the tunnel and stopped. He said that after a short time he heard the movement of a train behind, and it seemed to him that it was travelling at a fair speed which was increasing, and it appeared to be running freely. He added "it occurred to me that at the speed I thought it was travelling it would never stop before it hit us ; and of course the next thing was the crash". He was certain that the noise he heard was that of train 59 and not that of a train on either the westbound line or overhead.

Evidence of Station Staff

34. Station Inspector E. G. Brown was on duty at Stratford and was responsible for supervising the work of the entire station. He heard of a signal failure on the eastbound line when he was on that platform (No. 6) and was told by Station Foreman Rowe that porters had been posted to advise drivers and guards to pass the signal after waiting four minutes and to proceed with caution. He saw Inspector Mier of the London Transport Executive on the platform and assumed that he had taken charge of the situation. He was with Rowe at the forward end of platform 6 and saw Mr. Mier enter the driving compartment of a train to Leyton. He noticed that when the train left it was not tripped at signal A 489, and commented on it to Rowe. He satisfied himself that the next train (No. 39), or the train after that (No. 71) was tripped at the signal. He said he gave no instructions to any porter that drivers should isolate the trip cock.

Mr. Brown heard of the accident at about 7.3 p.m. and went towards the tunnel end of the platform; there he met Guard Newling who told him of the collision. He immediately went back and arranged for ambulances, doctors, etc.

Mr. Brown said that he did not know before the accident that there was a copy of the London Transport Executive Rule book at the station. He had never been examined in the Rules.

35. Station Foreman J. Rowe was on duty at Stratford from 6.0 p.m. onwards. At about 6.14 p.m. he realised that signal A 489 was not clearing to Green, and told Porter Wiseman to report the matter to the Control, receiving a reply that all trains should be warned. He told Porter Bolingbroke to advise drivers and Porter Clowser to inform guards to wait four minutes and then proceed at caution, and he advised certain guards himself telling some of them that another train was just ahead. He gave no instructions about isolating trip cocks. He was with Mr. Brown when the train in which Mr. Mier travelled to Leyton left and confirmed that it was not tripped at the signal.

He also did not know the Rules but thought that they required a train to wait two minutes before passing a signal at Red; but he told porters to hold the trains four minutes as an additional precaution.

36. Porter A. Bolingbroke said that he was instructed by Station Foreman Rowe to advise drivers to pass signal A 489 at Red after waiting 3 – 4 minutes and to proceed at caution. He was also instructed by Inspector Mier, a few minutes before he entered the train to Leyton, "to warn all trains before they leave the station", and to tell them to cut out their trip cock and to reset it after passing the signal. Bolingbroke was quite certain that he told drivers to "cut out the trip cock" and that they did so ; one driver questioned the instructions. He did not give any orders to the driver of the train in which Mr. Mier travelled (the train before No. 39), but he saw the driver isolate the cock.

Bolingbroke was unaware of the working of the trip cock and thought that it had to be isolated before the train could pass a signal at Danger.

37. Porter K. C. Clowser said he also was instructed by Foreman Rowe to hold trains for about four minutes and then to advise guards to proceed with caution. As soon as he received the "all right" from the front of the train he informed the guards, who then gave the starting bell signal.

Porter A. E. Wiseman said that he telephoned to the Control about the signal failure and received the instruction "Advise all trains" which he conveyed to Foreman Rowe. Nothing else was said.

Evidence of other staff

38. Divisional Inspector J. C. Mier of London Transport Executive, became aware of signal trouble at Stratford when he arrived there at 6.25 p.m. and heard a porter tell the driver of the train on which he had travelled "This signal is keeping at danger ; proceed with caution when you get the rightaway". Mr. Mier then saw Foreman Rowe who told him that all trains were being held for two minutes, with which he agreed. He then spoke to the Control and afterwards saw Inspector Brown who told him the same as the Foreman. Mr. Mier then went to the front of a train (No. 12) which had been standing at the platform for some time, saw the lineman in the cab and got into it himself.

The train started and then stopped beyond signal A 489 and Mr. Mier thought the train had been tripped. It proceeded slowly and stopped again at signal A 491 at 6.45 p.m. The lineman got down, found the train stop was broken and disconnected it. The train then started at 6.48½ p.m. and proceeded to Leyton. The lineman got into a westbound train to return to Stratford and so did Mr. Mier after he had advised the Control of the cause of the trouble. When he reached Stratford at about 7.0 p.m. he came to know of the collision. He again spoke to the Control who said that the current had been taken off by the driver of train No. 71, and he told the Control to keep it off. After that he went down the tunnel to supervise the detrainment of passengers.

Mr. Mier stated that some days later he came to the conclusion, on thinking the matter over, that train 12 in which he travelled to Leyton had not been tripped at signal A 489, and that the trip cock had been cut out. He could not recollect having mentioned the words "tripping" or "trip cock" to Porter Bolingbroke at Stratford, whom he saw only once.

Mr. Mier said that drivers were acting under Rule 55(*g*) in passing signal A 489 at Danger. He agreed that there is no need for a handsignalman to be appointed under that rule, but the porters were posted on this occasion to inform drivers that the signal would not clear, and they then knew their duty. In such circumstances it is usual for a member of the staff to remind drivers to exercise caution. Rule 77 is normally used for a disconnected signal and requires the appointment of a handsignalman who is required to instruct drivers to proceed with caution. Mr. Mier agreed that the word "handsignalman" was a misnomer for the porters who did not carry flags or lamps.

39. Signal Lineman G. Fray heard of the signal trouble at 6.20 p.m. at Leytonstone and proceeded to Stratford. He went into the relay room and could find no fault. He also examined the train stop at signal A 489 and found it in the correct tripping position. He therefore entered the cab of a train (No. 12) and Mr. Mier got in later. He got down at signal A 491 to try and locate the fault, and he saw immediately that the train stop was broken. He disconnected it and the train proceeded to Leyton. He then returned to Stratford and heard about the accident.

Fray could not recollect whether train 12 stopped after passing signal A 489. He said that when he was working at signal A 491, visibility in the tunnel appeared normal.

40. Divisional Inspector A. J. Gorton heard of the accident at home and proceeded to Stratford, arriving there at about 8.50 p.m. He realised he could do little there and took a car to Leyton where he arrived about 9.30 p.m. He went down the tunnel and met about 40 passengers between trains 39 and 71, who were walking to Leyton. He went through to the back end of train 71 and observed the position of the controls in the wrecked cab of train 59. He saw that the master controller was shut-off, the reverser key placed for forward movement and the brake handle in the full emergency application position.

Evidence on the Detrainment of Passengers

41. Information regarding the detrainment of passengers from the trains stalled at and west of Stratford has been recorded in paragraph 5. The detrainment of passengers of train 59 was started at 7.15 p.m. under the supervision of Divisional Inspector Mier, and all the uninjured passengers in the rear seven cars were cleared by 7.45 p.m.

Detrainment of Trains 39 and 71

42. Substation Control Room Operator W. Oxley was on duty at South Woodford. He said that the circuit breakers for the section Bow to Leyton opened twice on overload at 6.54 p.m.; he replaced them and reported the matter to the Control. At 6.56 p.m. the current again came off and the driver of train 71 spoke to him on the tunnel telephone and said his train had been struck in the rear. Oxley told him to remain on the telephone and advised the Control. The driver said he was going back through the train to assess the damage and came on the phone again at 7.17 p.m. He was very difficult to hear on account of many others talking on the line at the same time but after a few minutes it was gathered that damage had occurred and that the driver of train 59 was badly injured, and he passed that message on to the Control.

43. A timetable of events from the time of the accident onwards as taken from the evidence of Oxley, the staff of trains 39 and 71, the Controllers at the Leicester Square Control Office and others, is attached as Appendix "C".

It will be observed that permission to detrain the passengers was given to the drivers of trains 39 and 71 at 7.40 p.m. and 7.48 p.m. respectively. The detrainment of the passengers of train 39 was started at 7.50 p.m. and completed by 9.10 p.m. ; the equivalent times for train 71 were 8.20 and 9.50 p.m. It should be noted that the detrainment of the passengers from these two trains could not be started until the current had been removed from the eastbound line at Leyton. The foreman of that station had been sent by the Control to Stratford in connection with an incident on a westbound train and consequently there was no one available to open the Leyton section switches. This necessitated the removal of the pressure from the section Leyton to Leytonstone which in turn prevented the reversal of trains at the latter station.

Tests

44. After the accident, the brake gear of train 59 was carefully examined in Hainault Depot. It was in correct adjustment on the rear six cars, the brakes of which operated satisfactorily. On the leading two cars, the brake gear was badly damaged but as far as could be observed, the adjustment was also good.

Braking tests

45. At my request certain tests were arranged on the eastbound line from Stratford to Leyton, which I attended on 16th May, 1953. Two trains were used called train A and train B ; each comprised 8 cars. Train B was made up from the same age stock as train 59 and it was loaded with 25 tons of brake blocks to represent the weight of 435 passengers. An electric test speedometer was fitted on this train.

Train A was placed in the position occupied by train 71 when the collision occurred. Train B then proceeded into the tunnel and it was observed that from the driving position, the oil tail light and then both the tail lights of Train A came into view at distances of 214 feet and 167 feet respectively. It was noticed that at the more distant point a tunnel light was directly in line with the oil tail light. These two points were marked Y1 and Y2 respectively. The position of the rear of Train A was marked X and that train was then removed.

A series of braking tests were made with the following results :—

Braking Point	*Corrected braking speed, in m.p.h.*	*Point of Rest*	*Braking distance, in feet*	*Braking time, in secs.*	*Remarks*
Near Y2	18.8	X + 15 feet	180 feet	11.4	Brake was applied 2 secs. after passing Y1.
At Y2	18.9	X + 16 feet	181 feet	10.9	
At Y2	14.3	X — 51½ feet	113½ feet	8.5	

Two other tests were made at slower speeds of 5.7 m.p.h. and 7.1 m.p.h. ; the braking distances were not measured, but in each they were less than 50 feet. In all cases an emergency application of the brakes was made and the "dead man's handle" was released.

A braking distance/speed graph is attached at Appendix B. The solid line represents the values obtained from the tests and the dotted line indicates calculated values. It will be noted that the figures correspond closely.

A further test was made in which Train B was started from a point 100 feet in advance of signal A 489 by a short power application and then allowed to coast into the tunnel, with no brake power applied. At point X it attained a speed of 21.8 m.p.h.

Dust tests

46. As a result of the statement made by Driver Besley when I resumed the Inquiry on 6th August, I asked for further tests to be made which I attended on 12th August. A report on these tests is attached as Appendix D.

It will be noted that no dust was raised by the movement of the trains alone. When it was created artificially it banked up against a stationary train which was in the position of train 71, and the tail lights could be seen dimly at a distance of 165 feet and clearly from 147 feet.

Speed in relation to Damage

47. Mr. A. W. Manser, Chief Mechanical Engineer, Railways, London Transport Executive, informed me that his considered opinion was that, from the extent of the damage to the stock, the speed of train 59 at the time of the impact with train 71 was not less than 15 m.p.h.

48. Driver Besley said that he proceeded from Stratford under the "Stop and Proceed" rule (No. 55(g)) but I have no doubt whatever that he failed to comply with it in that he did not exercise even reasonable caution. That rule is perfectly clear and lays down that a driver must proceed cautiously at such a speed as to enable him to stop short of any obstruction. It includes a warning that trains may be found ahead of the signal to be passed at Danger and that the line may be curved. Capital letters are used to emphasise the need for caution.

49. I have considered carefully all the evidence regarding the speed of the train, which is very conflicting. In this connection it must be said that the judging of speed and distance in a tunnel is difficult, even for an experienced driver. I think, therefore, that the estimate of some witnesses, though given in good faith, was erroneous. I attach considerable weight to the evidence of Mr. Mackenzie Smith, an undoubtedly observant witness: he could not estimate the speed of the train but thought that it was normal for that part of the line. Also to that of Mr. Hodges, who was eager to reach home for an appointment and gained the impression that the trouble which had caused the journey to Stratford to be slow had been passed, and that the normal running speed had been resumed. Taking everything into account, especially the evidence of Mr. Manser, Chief Mechanical Engineer, and having seen the damage myself and examined the wrecked cars carefully afterwards, I am of the opinion that the speed of train 59 at the time of the impact was about 20 m.p.h.

50. The oil tail light of a train standing in the position of train 71 came into the view of a driver of a following train at a distance of 214 feet. Based on an impact speed of 20 m.p.h. and an even acceleration, the speed of train 59 at that point was 16 m.p.h., from which the braking distance was 140 feet. If an emergency application of the brakes had been made instantaneously, the train would have stopped 74 feet from train 71. There is, however, always a short reaction time between the sighting of a danger signal and a brake application, and in this case this may have amounted to three seconds because a tunnel light was in line with the tail light (*see* paragraph 45). By the time, therefore, that the brakes were applied, the train would have travelled a further 74 feet and its speed would have risen to 17.8 m.p.h.; it would then not have stopped in under 163 feet, colliding with train 71 at a speed of 7 m.p.h.

There was, however, no evidence of an emergency application of the brakes before the impact.

51. The reason Besley gave for not applying the brakes in time was that a cloud of thick dust obscured the tail lights of train 71 until he was a few feet from them. He was absolutely certain about the dust and described it in great detail.

52. His statement cannot be disproved but I find great difficulty in accepting it. The two previous trains (Nos. 39 and 71) had travelled down the gradient slowly and train 71 had been stopped with only a slight brake application behind train 39. It is unlikely, therefore, that it would have raised dust. If the emergency brake application by which Goodin stopped train 39 had formed dust, it would probably have been drawn forward by the sucking action of that train when it started again and by the compression of the air by train 59, as was noticed in the tests (*see* Appendix D). Any dust lifted by train 59 itself would most probably have been alongside or behind it. If by any chance the suction of train 39 was insufficient, on account of a train in the westbound tunnel, to draw any dust forward, Besley would surely have noticed it sooner. Again, if there had been some unusual surge of air at the rear end of train 71, as was observed in Test 1, and if it had created a cloud of dust, the tests showed that the tail lights could be seen through it from a considerable distance. The air speed of 40 m.p.h. recorded in Test 1 raised no dust.

The haze experienced by Bryan was in no way like the phenomenon Besley said he observed, and Bryan did not think it affected his view of the tail lights of Train 39 appreciably.

53. I have taken note of the fact that Besley mentioned "dust" to several people immediately after the accident. He was, however, according to his account, standing and peering ahead with his forehead close to the front window as he entered the tunnel; among other serious injuries (it was necessary for his lower leg to be amputated) his head was severely bruised. He must, therefore, have been considerably dazed by the impact and, according to medical opinion, he probably lost consciousness for a short time. When he came to his senses there was undoubtedly much dust in the air as a result of the collision. A possible explanation therefore may be that, as a result of his head injury, Besley genuinely thought that the dust was present *before* the collision and that it prevented him from seeing the train ahead. I have discussed this matter with the Treasury Medical Adviser, the Chief Medical Officer of the London Transport Executive, and with Mr. J. A. McLauchlan, F.R.C.S., the Surgeon Specialist at Queen Mary's Hospital, Stratford, where Besley was taken. They think that Besley's mind must have been very confused after the accident and, from a medical view, they consider that the above explanation is not unreasonable. Mr. McLauchlan also thought that Besley very probably has no recollection whatever of the events for a period of 5 – 10 minutes before the collision. He said that this condition is known as retrograde amnesia and that it frequently results from concussion, or a serious blow on the head such as Besley received.

54. Besley's remarks to passengers who were assisting him to the effect that "they (the Stratford station staff) should never have let me down" is worthy of note, as also is his statement to me that he was "expecting to find a signal at danger but definitely not a train in that position". Notwithstanding the fact that he said later that he was on the look out for a train which may be standing anywhere, I feel quite certain that Besley was *not* expecting to find a train in the position in which No. 71 stood. I believe that if he was expecting to encounter a train at all, he thought it would be standing at signal A 491. In that position its rear end would have been about 400 feet from that signal and the same distance ahead of the tail lights of train 71. In other words, I think that Besley imagined that he had a clear braking distance of some 400 feet although, of course, he could not see ahead so far. That was the distance required for stopping a train from a speed of just under 22 m.p.h. (allowing in this case 2 seconds reaction time), with no margin. It should be noted here that a test train which was allowed to coast down the gradient with no brakes application attained a speed of 21.8 m.p.h. at the point where the rear end of train 71 stood (*see* paragraph 45).

55. It is, therefore, my opinion that Besley allowed train 59 to coast with little, if any, brake power applied, almost up to the point of the impact, by which time the speed had reached about 20 m.p.h. Having regard to the gradient and curvature of the line *such a speed was very much too high. It should not have exceeded* 5 *m.p.h.* At that low speed he could have stopped in less than 50 feet, and I feel sure that the tail lights of train 71 should have been seen from that distance, however thick a cloud of dust there may have been.

If it is assumed that the dust cloud was, as Besley said, so thick as to obscure the tail lights completely, the impact would have been very much less severe if the train had been travelling at a proper speed, and the fatalities might have been avoided.

I believe, however, that the theory put forward in paragraph 53 is correct and that there was, in fact, no dust before the collision. I can, therefore, assume only that because Besley was not expecting a train to be standing in the position of train 71, he was not keeping a careful look-out.

In view of Mr. McLauchlan's opinion that Besley probably cannot recollect any of the events immediately before the accident, it seems likely that he has endeavoured to reconstruct them in his mind and has become convinced that he actually did comply with the Rules. If this is so, it accounts for some of the variations between his evidence and that of others.

56. Besley is 43 years old. He joined the engineering department of the London Passenger Transport Board in 1938 and transferred to the operating department in 1946, becoming a guard in the same year. He qualified as a driver in June 1949, which qualification included a Rule Book examination, and he was promoted to that grade in March 1952. In the meantime, he had worked 93 days as a driver, but he was not re-examined in the Rules on promotion. He attended a three day refresher course in February 1953, one day of which was devoted to the Rule Book and particularly to passing signals at Danger. He had always worked on the Central Line. Besley informed me that he had no worries at home, that he was not tired and felt quite fit. He underwent a general medical examination in May 1949, and his sight was good when it was tested at the same time. His record since joining the operating department was clear and he served in the Army during the war with distinction. He gave his evidence in a straightforward manner.

57. I am satisfied that there was no defect on train 59 and also that the signalling arrangements were in good order. The fact that a loose hook broke the train stop at signal A 491 had no direct bearing on the accident whatsoever. Electrical safeguards are provided to meet such circumstances and in this case they worked correctly and maintained the signal concerned, and the next signal in rear at Danger. Suitable action has, however, already been taken to ensure that hooks cannot damage train stops in this manner.

58. The evidence regarding the "tripping" of train 59 at signal A 489 is also conflicting. It should be noted here that this procedure results in a very sudden stop and the jolting of the train even when the method mentioned by Besley is adopted, and it is not normally likely to be forgotten. Guard Newling did not notice a "tripped" stop and Mr. Mackenzie Smith was quite certain there was not one. Mr. Roberts said that the second stop was not sudden and Mr. Hodges did not remember the train stopping a second time. On the other hand, Mr. Judge and Mr. Laiken both thought that it stopped suddenly, and Besley was certain that the train was tripped.

The evidence regarding the position in which the train stopped after passing the signal has a bearing on this point. Besley said that it stopped in about 2 yards and that he got down from the front door of the cab, to reset the trip cock, on to ballast; the ballast, however, extended only 3 feet beyond the train stop and the signal, and the train could not have been stopped in that distance. Guard Newling stated that when the train stopped he was opposite the station name on the Refreshment Room (*see* inset on plan), and this agrees with Mr. Mackenzie Smith's estimate of the distance the train travelled. In that position the front of the train was 48 feet beyond the signal but the train could have travelled that distance after being "tripped" only if it had attained a speed of $8\frac{1}{2}$ m.p.h., and then the passengers would have been severely jolted. The stopping distance from 4 m.p.h. is 15 feet.

Taking everything into consideration, I have little doubt that train 59 was not "tripped" at signal A 489. This had no direct bearing on the accident, but I refer to it in paragraph 66. The train before train 39 also was not "tripped". In both these cases, therefore, and I am informed that in at least one other case also, the trip cocks must have been isolated.

The drivers of trains 39, 71 and 59, however, denied receiving any instruction from Porter Bolingbroke to isolate the trip cock, but the latter was very certain that he gave it and his statement was confirmed by the driver of train 48, which was behind train 59. The porter clearly did not understand the significance of this instruction which he alleged was given to him by Mr. Mier. I am sure that was not the case, but I do think that he probably misunderstood some remark about "tripping" or "trip cocks" made by Mr. Mier or by one of the station supervisors.

59. I consider that Divisional Inspector Mier, Station Inspector Brown and Station Foreman Rowe might all have taken more effective action, and I think that either Mr. Brown or Mr. Rowe should have spoken to and obtained instructions from the Control, instead of leaving that to a porter. It is difficult to appreciate how Mr. Mier failed to realise at once that train 12, which he joined at Stratford, was not "tripped" at signal A 489, and why he did not take immediate action to ensure that the drivers of the trains following did not isolate the trip cock as the driver of his train must have done.

60. The detrainment of passengers from train 59 and from all the trains stalled at or west of Stratford was, I think, carried out as expeditiously as possible. There was, however, some delay in giving permission for the passengers of trains 39 and 71 to be detrained. This was due mainly to the fact that there was no one in authority at Leyton, the station foreman having been sent by the Control to Stratford in connection with an incident on a westbound train. The number of people talking on the tunnel telephone line at the same time was also a contributory factor.

It is easy to be wise after the event, but I think that some of the delay could have been avoided if Divisional Inspector Cope had been sent from Leytonstone to Leyton instead of to Mile End or, alternatively, if someone had been despatched immediately by road to Leyton. It must, however, be appreciated that when such an accident occurs, involving the detrainment of passengers from so many trains, the Control is heavily pressed ; I am informed that their telephones were ringing continuously for some considerable time after the accident.

I am satisfied that as soon as the permission was given, the detrainment was carried out as expeditiously as possible, having regard to all the difficulties inherent in such an operation, which in this case were augmented by a jammed door in train 71 and the necessity for giving way to relief personnel passing through the trains in the opposite direction.

Remarks and Recommendations

61. According to the documents available this is the first tube train accident, as opposed to accidents on the other underground sections, in which passengers have been killed since the tubes were opened some 60 years ago. This is a truly remarkable record and a high tribute to the staff of all grades and departments of the original Companies, the London Passenger Transport Board and the London Transport Executive.

62. This is, however, the second accident that has occurred at almost exactly the same place and in almost identical circumstances. The previous one concerned an empty train in 1946, before the line was open to passenger traffic, and it resulted in the death of one railway servant. In the present case, twelve passengers were fatally injured. Both accidents were due to the failure of the human element under "Stop and Proceed" conditions. The accident in the open at Northwood, Metropolitan and G.C. joint line, which occurred in 1945 in fog causing the death of three persons, and the less serious collisions at Harrow-on-the-Hill in 1947, between Eastcote and Rayner's Lane in 1948 and between South Ealing and Acton Town in 1949 were all attributed to the same cause.

"Stop and Proceed" working

63. This method of working has been found necessary on the Executive's tube, underground and surface lines, all of which have a very intensive train service and are equipped with automatic signals remote from and uncontrolled by signal boxes. Generally speaking, it is only when "Stop and Proceed" working has to be adopted that safety is completely reliant on the human element. Otherwise, electrical and mechanical devices are provided to counteract its fallibility and to prevent collisions between trains.

"Stop and Proceed" working is not uncommon and has to be adopted to enable a disabled train to be pushed ; it also results from the failure of a track circuit or signal. It is satisfactory to note that the number of such failures has been greatly on the decline in recent years. The comparatively small number of accidents resulting from this method of working is indicative of the caution generally exercised by drivers.

Nevertheless, there have been accidents and, if the well justified faith of the public in the Executive's railway system is to remain, a recurrence of an accident such as this one must be avoided.

64. As a result of the previous accident at Stratford, Lieut. Col. E. Woodhouse recommended in his Report that the staff should be continually reminded of the risks arising from the non-observance of the caution required by Rule 55(*g*). This was met by the annual insertion of a notice in the Railway Traffic Circular and the last reminder appeared in September 1952. These are useful, but it is evident that they are not sufficient in themselves and that some more positive action is necessary.

It would be unreasonable to suggest the abolition of "Stop and Proceed" working for it would completely dislocate the service and would cause hardship to many thousands of Londoners.

An alternative method would appear to be the provision of some form of electrical or mechanical governor to enforce caution on drivers when applying Rule 55(*g*). I have been informed by the Chief Mechanical Engineer that this matter was considered after the first accident at Stratford and that it has again been given serious consideration after this collision. For a number of reasons it was found to be impracticable. The main technical difficulties are twofold and are—firstly, the necessity of setting the governor at a predetermined speed which would have to be the lowest safe speed in any circumstances, say 5 m.p.h. Such a speed would be too low on straight open sections of the line where, under some conditions, 12 – 15 m.p.h. might be safe in daylight and clear weather ; it would result in serious delays and would have a most adverse psychological effect on drivers. And secondly, the difficulty of maintaining the equipment which would be brought into use so seldom but which must be completely reliable when required, would be very great having regard to the fact that there are some 2,300 motor cars each of which run approximately 70,000 miles a year.

Another method that suggests itself is the provision of speedometers. This question was raised at the Inquest on the victim of the 1946 accident. In commenting on this Colonel Woodhouse explained that at that time no satisfactory type of speedometer had been developed that would stand up to the rough usage and would give accurate readings at low speeds. It should be mentioned that the restricted space in tunnels precludes the use of any form of end drive on a motor axle. He also said that when running under "Stop and Proceed" conditions it is more important for drivers to keep a careful look out ahead than to watch a speedometer dial. Since then, a pneumatically operated speedometer has been developed and all new motor cars are equipped with it. But while this new type is accurate, it is intended to assist drivers to observe speed restrictions on the line and the first marking on the scale above zero is 15 m.p.h. The spacing between these two markings is only ¼ inch and the design does not lend itself to any increase in this distance. This speedometer is therefore valueless for the purpose of assisting a driver to regulate the speed of a train under "Stop and Proceed" working.

The London Transport Executive have therefore sought some other solution to the problem and have examined a number of suggestions. I am glad to report that a measure which is designed to enforce the proper application of Rule 55(*g*) at places where the sighting distance of signals and tail lights is for any reason restricted is now being considered. I have been given the broad outline of the scheme under which a considerable number of additional signals equipped with train stops will be provided, and it appears that it should have the desired results. I recommend, therefore, that the Executive should proceed with the development and application of this scheme as rapidly as circumstances permit.

I am informed that in the meantime a senior railway official of the London Transport Executive has been posted in the Stratford area during the periods of the morning and evening peaks and up to 11 p.m. each night to take immediate personal charge of any unusual situation which may arise.

Rules

65. Drivers proceeding from Stratford past signal A 489 at Danger should have applied the "Stop and Proceed" rule, No. 55(*g*). That rule is applied without distinction, whether the signal has failed to clear on account of a defect in the equipment or is correctly at Red because the line ahead is occupied by a train. It places the responsibility for passing the signal and proceeding entirely on the driver, but it warns him explicitly of the need for caution. No instructions need be given to the train staff.

Rules 77(i) and 81(*n*) also apply to defective signals but they require the appointment of a hand-signalman on whose instructions a driver must act. They also require the handsignalman, if the train is not to be detained, to instruct the driver to proceed from the defective signal to the next signal with caution. They are not so emphatic as Rule 55(*g*) and do not incorporate any of the warnings included in the latter rule, although in some cases they are just as necessary.

66. On the day of the accident two porters had been appointed as handsignalmen at Stratford. One gave instructions to drivers and the other to guards. As a result the driver of train 59 did not speak to the guard on the train telephone as is required by Rule 55(*g*). This may have had no bearing on the accident but, on the other hand, if he had done so the guard might have advised extreme caution while descending into the tunnel.

Again, although the evidence on this point conflicted, both porters apparently advised drivers and guards to proceed with caution after waiting 3 – 4 minutes, while one porter instructed drivers to isolate the trip cock. The latter instruction was highly irregular and it was just as irregular for some drivers to act on it. The circumstances in which the trip cock may be isolated are exceptional and are detailed in the Rule Book. This was certainly not such a case, for the psychological effect of being "tripped" at a signal remaining at Danger is an important feature of "Stop and Proceed" working.

When any form of emergency working is in force it is important that all concerned should know clearly which rules are to be applied and what action is to be taken under them. I am glad, therefore, to report that steps are being taken to make these rules more clear. I suggest also that Rule 55(*g*) might be amplified to include a warning about gradients, which can be deceptive especially in a tunnel.

67. There are a number of stations besides Stratford which are served jointly by trains of the Railway Executive and the London Transport Executive, but which are manned entirely by Railway Executive staff. As mentioned earlier, the staff at Stratford were unaware of the London Transport Rules, and incorrect instructions were given by them. If Railway Executive staff are to continue to control the movement of London Transport Executive trains either in normal working or in an emergency, it is important that they know the Rules to be applied.

68. As has been mentioned, Besley qualified as a driver in June 1949, but he was not appointed to the grade until March 1952. His qualification included an examination in the Rules. He had worked as a driver on a number of occasions during this period, but when he was promoted he was not re-examined. I think that when such an interval elapses after qualification a fresh examination on promotion is desirable, and steps have already been taken to ensure that this will be done in the future.

Rolling Stock

69. All the cars concerned in this accident were built between 1923 and 1930. The greater part of the damage was the result of the headstocks being forced downwards by the impact. Cars built since 1938 have wheels of less diameter and smaller traction motors. This has made possible the use of straight longitudinal members and solebars which provide a considerably greater resistance to collision forces.

70. The failure of the emergency lighting to come on in train 59 was attributed to a 3 pole switch with a lever handle being thrown open by the impact. When this switch was closed some time later the lights in all except the front car, in which the cable was severed, became illuminated. It is on occasions such as this that emergency lighting is so necessary, and it is satisfactory to note that consideration is being given to the provision of some alternative arrangement that should prevent a failure of the lights in this way.

71. The Requirements of the Minister of Transport lay down extensive precautions against fire on underground lines, and these have always been observed by the London Transport Executive and their predecessors. All materials, paints, etc., selected for use are, as far as possible, non-inflammable. The wisdom of this policy was demonstrated in this accident. Only two passengers mentioned fire, although the question was evidently in the minds of many others—one said he smelt burning rubber and the other burning paint. The latter was traced very soon, and to the relief of the passenger, to an emergency candle light, the paint covering of which was scorched by the candle flame. This is a small point and it has already received attention. No burnt rubber could be found.

Detrainment of passengers

72. I am satisfied that the question of the early detrainment of passengers as a result of any untoward incident receives the constant attention of the London Transport Executive. New schemes which will facilitate the control of all the arrangements in an emergency of this kind are under consideration. The need for better telephone discipline on the tunnel wires is apparent and I am sure this aspect of the case will also receive attention.

The method whereby drivers of trains can communicate by telephone with sub-station attendants exists generally throughout the tunnel system of the London Transport Executive railways. In some circumstances this relaying of messages from a driver to the Control is too slow, and the messages can be distorted. In this particular case it would have been much more satisfactory if there had been direct communication between the drivers and the Control, and this method has been advocated by the Inspecting Officers of Railways for many years. I am glad to report, therefore, that a new system by which this direct communication is possible has been installed experimentally on the Northern Line. Certain technical difficulties have, however, been experienced. I hope that these will soon be overcome and that the system will then be extended as soon as possible to all the other lines.

73. The following is a summary of my main Conclusions, Remarks and Recommendations :—

Conclusions

(i) The breakage of a train stop by a hanging hook has no direct bearing on the accident.

(ii) The driver of train 59 failed to exercise the caution which is explicitly required when applying the "Stop and Proceed" rule. The train was travelling at about 20 m.p.h. when it struck the stationary train.

(iii) I find it difficult to accept the driver's assertion that he could not see the tail lights of the train ahead on account of a cloud of dust. His severe head injuries may have accounted for that statement.

(iv) Train 59 was not "tripped" at signal A 489, and the drivers of two other previous trains also isolated the trip cocks.

(v) There was some delay in the detrainment of passengers from trains 39 and 71.

Remarks and Recommendations

(i) A scheme designed to enforce the proper application of Rule 55(*g*) at places where the sighting distance of danger signals is restricted is under consideration, and I recommend that it should be developed as rapidly as possible.

(ii) Very irregular instructions were given to drivers and some drivers irregularly acted on them. Steps are being taken to clarify certain Rules.

(iii) If Railway Executive staff are to continue to control the movement of London Transport Executive trains, they should be instructed in the Rules.

(iv) The question of avoiding delay in the detrainment of passengers in an emergency receives constant attention.

(v) A new system which has been installed experimentally on the Northern line and allows direct communication between drivers and the Control should be extended to all the lines as soon as possible.

I have the honour to be,

Sir,

Your obedient Servant,

D. McMULLEN,
Colonel.

The Secretary,
Ministry of Transport.

EXTRACTS FROM LONDON TRANSPORT EXECUTIVE RULE BOOK

Detention of Trains on Running Lines

Rule 55, *clause* (*g*)

(*g*) When a Driver finds an automatic stop signal at Danger he must bring his train to a stand, and if a telephone is provided at the signal communicate at once with the Signalman and act in accordance with his instructions. Should he receive instructions to pass the signal at Danger he must give one long whistle and PROCEED CAUTIOUSLY as far as the line is clear or to the next stop signal in advance AT SUCH A SPEED AS TO ENABLE HIM TO STOP SHORT OF ANY OBSTRUCTION THERE MAY BE, having regard to the prevailing conditions, such as curvature of line, weather, etc., and to the possibility that the section may be occupied by a train which is displaying only an oil tail light. If the telephone is out of order, or a telephone is not provided at the signal, and the Danger indication is not changed, the Driver must wait one minute or other prescribed period, give one long whistle, and then proceed cautiously as above directed. In the case of a starting signal the Driver must inform the station staff that he is about to pass the signal at Danger and must not do so until he has received the signal to start from the Guard.

In such circumstances if the next stop signal in advance is in the Caution or Clear position, the Driver must continue to proceed cautiously to the next stop signal beyond, and provided that that signal is in the Caution or Clear position, ordinary speed may then be resumed. If, however, the second signal is at Danger and is an automatic signal the same procedure as before described must be observed.

(*Note.*—A train ahead, an obstruction on the track, a broken or misplaced rail may be the cause of an automatic stop signal being at Danger.

Where telephonic communication between them is available, the Driver must inform the Guard that he is about to pass an automatic stop signal at Danger in accordance with this Rule, and must state the identification letter and number of the signal. If telephonic communication is not available the Driver must inform the Guard of the identification letter and number of the signal at the first convenient opportunity.

Fixing, Removing or Repairing Signals, or Apparatus for Working Signals and Points

Rule 77, *clause* (*i*)

(*i*) When an automatic stop signal or a semi-automatic stop signal not being controlled from a signal box or ground frame, is inoperative during repair or other work, the Handsignalman must be stationed at such signal . . . . . and he must there exhibit a Danger signal to the Driver of every approaching train until the signal has been repaired. After the train has been brought to a stand the Driver must be advised of the circumstances and act in accordance with the Handsignalman's instructions; if it is unnecessary for the train to be detained the Handsignalman must instruct the Driver to proceed from the defective signal to the next stop signal with caution.

(*Note.*—The handsignalman referred to in this sub-paragraph is required to be appointed under sub-paragraph (b).)

Rule 78, *clause* (*a*)

(*a*) The Handsignalman must be provided with hand signals and detonators. He must act under the instructions of the Signalman, when appointed at a semi-automatic or manually controlled signal, or of the Station Master when appointed in accordance with Rule 81, clause (*n*). The Signalman or the Station Master, respectively, must see that this man is instructed as to his duties and understands what he is to do. If necessary, more than one Handsignalman must be provided.

Defective Signals, Points, Etc.

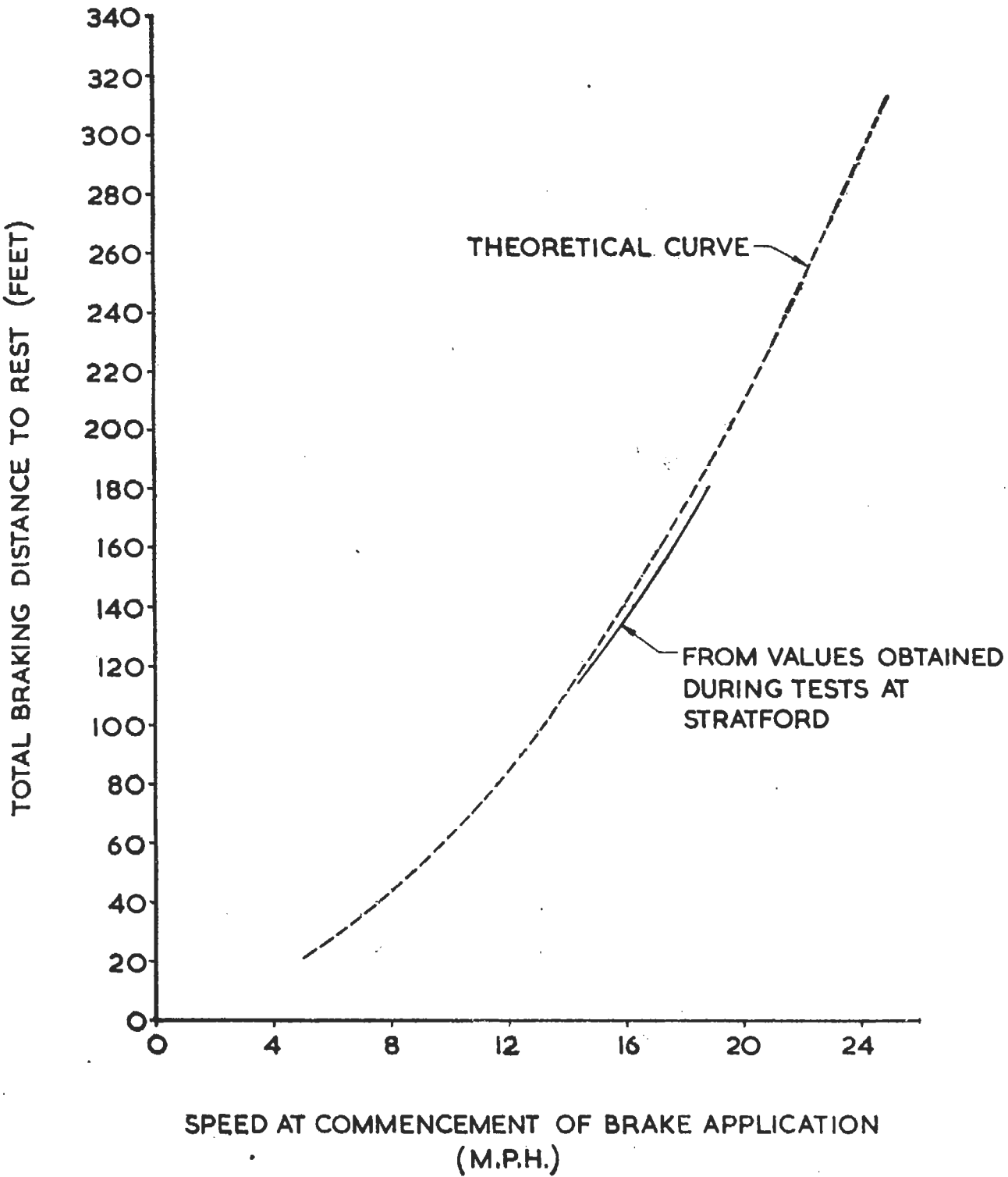
Rule 81, *clause* (*n*)

(*n*) When an automatic stop signal, or semi-automatic stop signal not being controlled from a signal box or ground frame, is defective, ... , a Handsignalman must be appointed at such signal . . . . . and he must act in accordance with the provisions of Rule 77, clause (*i*). The tunnel lighting on the section containing the defective signal must be switched on until the defect has been rectified.

TOTAL BRAKING DISTANCES OF 8-CAR LOADED PRE-1938 TUBE STOCK TRAIN

1 IN 30 DOWN.
DRY RAIL.
TOTAL LOADED TRAIN WT.= 217·1 TONS.
EQUIVALENT PASSENGER LOAD = 435.
THEORETICAL CURVE COMPARED WITH VALUES OBTAINED DURING TESTS AT STRATFORD.

EMERGENCY APPLICATION BY DRIVER'S BRAKE VALVE PLUS DEAD MAN VALVE : E.P. BRAKE CUT IN.



DETRAINMENT OF PASSENGERS FROM TRAINS 39 AND 71.

The following is a time table of events from the time of the accident onwards as taken from the evidence of Oxley, South Woodford sub-station attendant, the staff of trains 39 and 71, the Controllers at the Leicester Square Control Office, and others :—

6.54 p.m. Oxley advised the Control that the circuit breakers for section Bow to Leyton opened twice on overload and were replaced.

6.56 p.m. The traction current on the section came off and immediately afterwards the driver of train 71 advised Oxley on the tunnel telephone that a train had collided with the rear of his train. Oxley passed this message to the Control.

About 6.57 p.m. The driver of train 39 put the telephone on the tunnel wires, heard about the accident and removed the telephone as his train was not involved in the collision.

6.59 p.m. The Traffic Assistant, Oxford Circus, was asked by the Control to go to Stratford.

7.00 p.m. Divisional Inspector Cope was sent by the Control from Leytonstone to Mile End to supervise detrainment and to arrange for westbound trains to be reversed.

7.07 p.m. Message received by the Control from Divisional Inspector Mier at Stratford to the effect that Guard of train 59 had reported a collision with train 71 and that passengers were injured.

7.08 p.m. Request was sent out for ambulances.

7.10 p.m. General call for assistance was issued.

7.12 p.m. Fire Brigade called.

7.17 p.m. (*a*) A message received by the Control from Oxley to the effect that several drivers were talking on the tunnel telephone line who could not be understood (*see* para. 42). The Controller assumed they wanted information about detrainment of passengers.

7.17 p.m. (*b*) The driver of train 71 stated he asked permission on the tunnel telephone to detrain passengers. Several people were talking on line and it was very difficult to make himself understood.

7.20 p.m. A similar message was received by the Control to that at 7.17 p.m. (*a*).

7.34 p.m. Having been unable to get any reply from Leyton Station to continuous rings, the Foreman having been previously sent by the Control to Stratford in connection with an incident on a westbound train, the Controller told Running Inspector H. T. Cackett at Leytonstone to take an empty train to Leyton and to open the section switches, and thus remove the current from the line in the station, for the purpose of detraining passengers.

7.35 p.m. Message from the driver of train 39 asking permission to detrain passengers was received by the Control through the substation attendant. He was instructed to wait, as the current was still on at Leyton.

7.38 p.m. A porter signalman reported his arrival at Leyton to the Control.

7.40 p.m. Oxley was instructed by the Control to remove the current from the eastbound line Leyton to Leytonstone.

7.40 p.m. Oxley removed the current and passed on the Control's permission to the driver of train 39 to detrain passengers.

7.40 p.m. The porter signalman at Leyton was instructed by the Control to start detraining the passengers from train 39.

7.42 p.m. Divisional Inspector Mier reported to the Control from Stratford that all the passengers except those seriously injured had been evacuated from train 59.

7.45 p.m. Oxley was instructed by the Control to remove the current from the westbound line Leytonstone to Leyton as a safety precaution.

7.46 p.m. A message was received by the Control from Oxley that the driver of train 71 was asking to be allowed to detrain passengers—Permission was given.

7.48 p.m. Oxley advised the driver of train 71 to detrain passengers.

7.50 p.m. The detrainment of the passengers of train 39 started.

7.54 p.m. Running Inspector Cackett reported to the Control from Leyton that the section switches were open ; he was instructed to assist in detraining passengers.

7.55 p.m. Oxley was instructed by the Control to restore the current both roads Leyton–Leytonstone to enable reversing of trains at the latter station to proceed.

7.56 p.m. The first passenger from train 39 arrived at Leyton.

About 8.05 p.m. The passengers from the rear end of train 39 were moving forward for detrainment.

8.20 p.m. The detrainment of passengers of train 71 through train 39 started after the driver had been forward to the latter train and made the necessary arrangements.

About 9.10 p.m. All the passengers from train 39 had arrived at Leyton.

About 9.30 p.m. Divisional Inspector Gorton met 40 passengers between trains 39 and 71. (These passengers were probably from the leading car of train 59.)

9.49 p.m. Running Inspector Cackett reported to the Control from Leyton that all the uninjured passengers had been cleared from train 71.

It should be noted that the detrainment of the passengers of trains 39 and 71 could not be started until the current on the eastbound line at Leyton was removed. As there was no one at Leyton to open the section switches, this entailed removing the pressure from the section Leyton–Leytonstone, which in turn prevented the reversal of trains at the latter station.

It should also be noted that a very great many other messages were received by the Control during the period regarding the detrainment of passengers from the trains which were stalled at and west of Stratford and other matters.

APPENDIX D.

RECORD OF TESTS MADE ON THE 12th AUGUST, 1953, ON THE CENTRAL LINE, L.T.E., BETWEEN STRATFORD AND LEYTON IN CONNECTION WITH DUST

At the resumed Inquiry on the 6th August into the collision which occurred on the 8th April, 1953, near Stratford, Driver Besley of the colliding train stated that he was unable to see the tail lamps of the train ahead of him on account of dust. He said that the dust was in the form of a swirling cloud, some two or three yards in depth, situated at a similar distance from the stationary train. He described the cloud as whitish in colour with many particles of dust suspended in it. He said he was unable to see the cloud until he reached it and that he did not see the tail lamps ahead of him until he was practically through the cloud. Driver Besley contended that the speed of his train was not more than 5 – 8 miles an hour and that he made a full emergency application of the brakes as soon as he saw the tail lamps, but as he did so the collision occurred.

2. As a result of these statements arrangements were made with the officers of the London Transport Executive for experiments to be carried out to explore the possibility of reproducing dust such as Besley said he experienced. These tests were carried out between 12.30 a.m. and 4.0 a.m. on the 12th August, 1953. Four trains were used in an endeavour to represent as closely as possible all the conditions obtaining at the time of the accident. Trains No. 1, 2 and 3 were on the eastbound line representing respectively trains No. 39, 71 and 59. (On the day of the accident train No. 59 ran into stationary train No. 71). Train No. 1 was stationed at signal A 491 with train No. 2 immediately behind it. Train No. 3 was positioned just out of Stratford with the front end a car length beyond signal A 489. Train No. 4 was used on the westbound line to represent a train which might have been passing the cross passage between signals R 491 and A 491 at the time of the accident, and which might possibly have affected the air flow.

3. Arrangements were made to start the trains at such times so that their movement approximated as closely as possible the train movements when the accident occurred. It was of course necessary for precautions to be taken to ensure that train No. 3, in the cab of which Mr. Birch, Divisional Superintendent, and I travelled, did not collide with train No. 2.

Test I

4. In this test trains 1 and 4 started somewhat earlier in relation to train No. 3 than was desirable. The speed of train No. 3 at the point where the final full braking application was made was 16 m.p.h., and it stopped at a distance of 180 feet from train No. 2. There was no evidence of any dust whatever.

Test II

5. While trains No. 2 and 3 were in this position a test was made to ascertain how much dust could be created artificially behind train No. 2 by a nozzle on a hose connected to the main reservoir of that train. Air pressure was about 90 lbs. per sq. inch. The nozzle was played over the segments of the tunnel and the ballast for a distance of about 50 feet in rear of train No. 2 for about ten minutes. A considerable cloud of dust was created which I observed from the front end of train No. 3 and also from the ground, but it no more than slightly dimmed the tail lamps of the train. The depth of the dust cloud was 40 – 50 feet but there was no evidence of swirling nor of suspended particles. It should be noted that at this time the other trains in the tunnel were stationary so there were no air currents. The dust had mostly settled in eight minutes.

Test III

6. In this test the most adverse conditions possible were produced by stirring up the dust artificially with the compressed air jet just before the movements were started. The trains were repositioned as explained in paragraph 2 above, and they all started as nearly as possible to the correct relative times. The speed of train No. 3 was 17½ m.p.h. when the emergency application was made and it stopped 147 feet from train No. 2.

It had been found in the tests made in May 1953, that the sighting distance of one (oil) tail lamp of the stationary train from the driving position of the colliding train was 214 feet and of both tail lamps it was 167 feet ; from the centre of the cab of train No. 3, where I stood, the equivalent sighting distances were approximately 225 and 178 feet.

On this test neither tail lamp became visible on account of the dust, until just before the train stopped. It was estimated that the distance from which the lamps first came into my view through the dust was 165 feet and this estimate was based on the position of the lamps, having regard to the curvature of the tunnel. This meant that dust obscured one tail lamp over a distance of some 60 feet and both lamps for about 13 feet. By the time train No. 3 had stopped (147 feet from train No. 2), both the tail lamps could be seen clearly, although their intensity was still slightly dimmed by the dust. Within a matter of a few seconds all the dust had disappeared and the tail lamps showed up brightly.

A London Transport representative at the rear end of train No. 2 said that the air motion in the tunnel caused the artificially created dust to bank up against the rear of that train, but that it was quickly drawn along the train by the sucking action of train No. 1 combined with the compressive action of train No. 3. He also noticed no swirling effect at the rear of the train nor any particles of dust in suspension.

Description of the Tunnel

7. The tube tunnel is 12 feet in diameter with a cross sectional area of 100 sq. feet. The cross section of a train is 74 sq. feet. The tunnel was opened to traffic in 1947. Mr. A. C. Edrich, Assistant Civil Engineer (Permanent Way) informed me that the tunnels are normally cleaned every five years, but he considered this tunnel still comparatively clean and that it would probably not be necessary to use the cleaning process in it until about 1958. The track in the tunnel is ballasted and there is a certain amount of dampness, both of which discourage the raising of dust.

Discussions

8. A number of discussions have been held with London Transport officers all of whom were of the opinion that dust of the intensity seen in tests No. 2 and No. 3 is never produced in practice by the movement of trains. The driver of the test train confirmed this to me. Officers have sought the opinion of other experienced drivers, none of whom can recollect dust of sufficient intensity to obscure signals or train tail lights. All were of the opinion that when dust is raised it is due to the high air speeds along the side of a train and that it never precedes a train. This experience was particularly noticeable during the war when flood gates had sometimes to be operated behind trains.

Air Speeds

9. Using available instruments the speed of the air passing the trains was observed during the tests.

In test No. 1 observations were made by anemometer at the front and rear coaches of train No. 2, and by velometer at the front coach of train No. 3. While train No. 3 was moving at speed, the direction of air movement past train No. 2 appeared to be forward reaching a maximum velocity at the rear of the train of 13 m.p.h. The maximum speed of the air backwards past train No. 3 was indicated at 17 m.p.h. by velometer.

Immediately prior to this, however, two surges of considerable velocity and short duration were observed, one at the front and one at the rear of train No. 2.

Both surges appear to have exceeded 30 m.p.h. for 5 – 10 seconds and to have reached a maximum speed in excess of 40 m.p.h. That at the front of the train was in the forward direction, while that at the rear was in the backward direction. The former may have been promoted by train No. 1 drawing away at the commencement of the test. The latter would, however, seem more likely to be the effect of train No. 4 passing on the westbound line and acting via the cross passage. The movement of train No. 4 rendered speculative any deduction as to the cause of these surges.

During test No. 3 the speed of the air backward past train No. 3 was observed at 20 m.p.h. by velometer. No readings were taken on the stationary train, but it was noted that the movement of the air at the back of that train was in the forward direction.

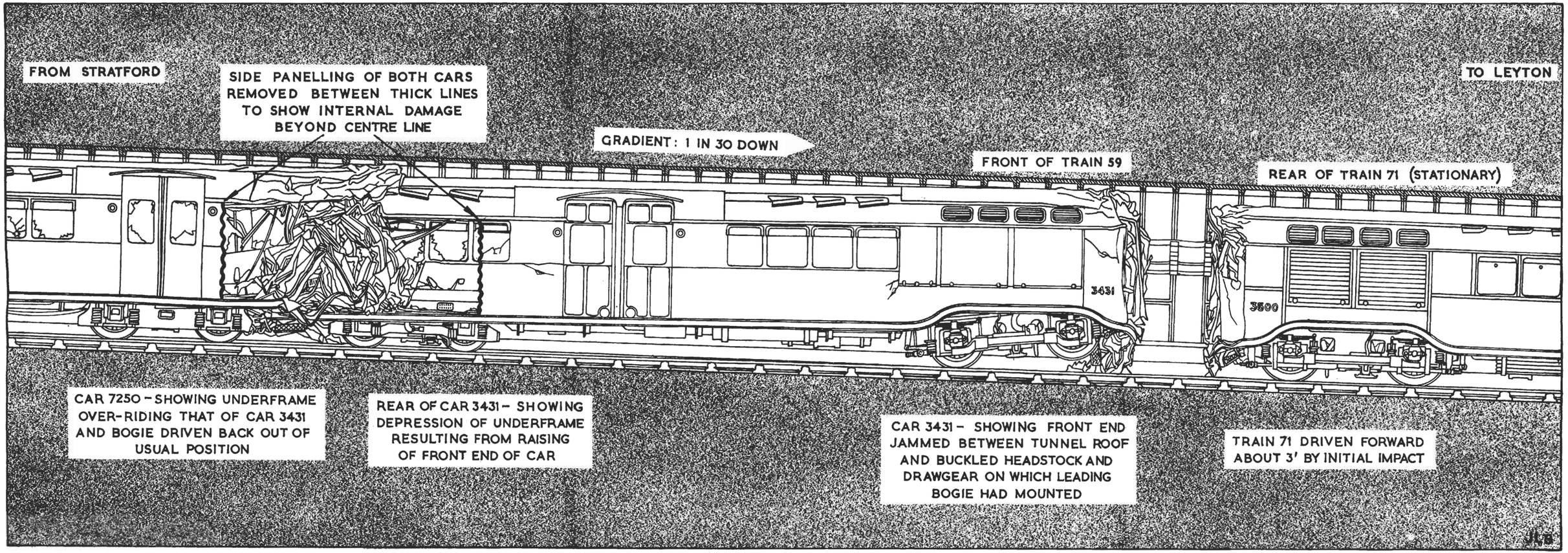
Quality of the Dust

10. Most of the dust accumulates on ledges and in recesses. It is dark in colour and fairly heavy, and is formed mainly from brake blocks (cast iron and non-ferrous), cloth and hair, all in very fine particles.

(*Signed*) D. McMULLEN.

14th August, 1953.

12192 *Wt.*3259/2822 *K*12 10/53 *E.D.P.Ltd.* 648



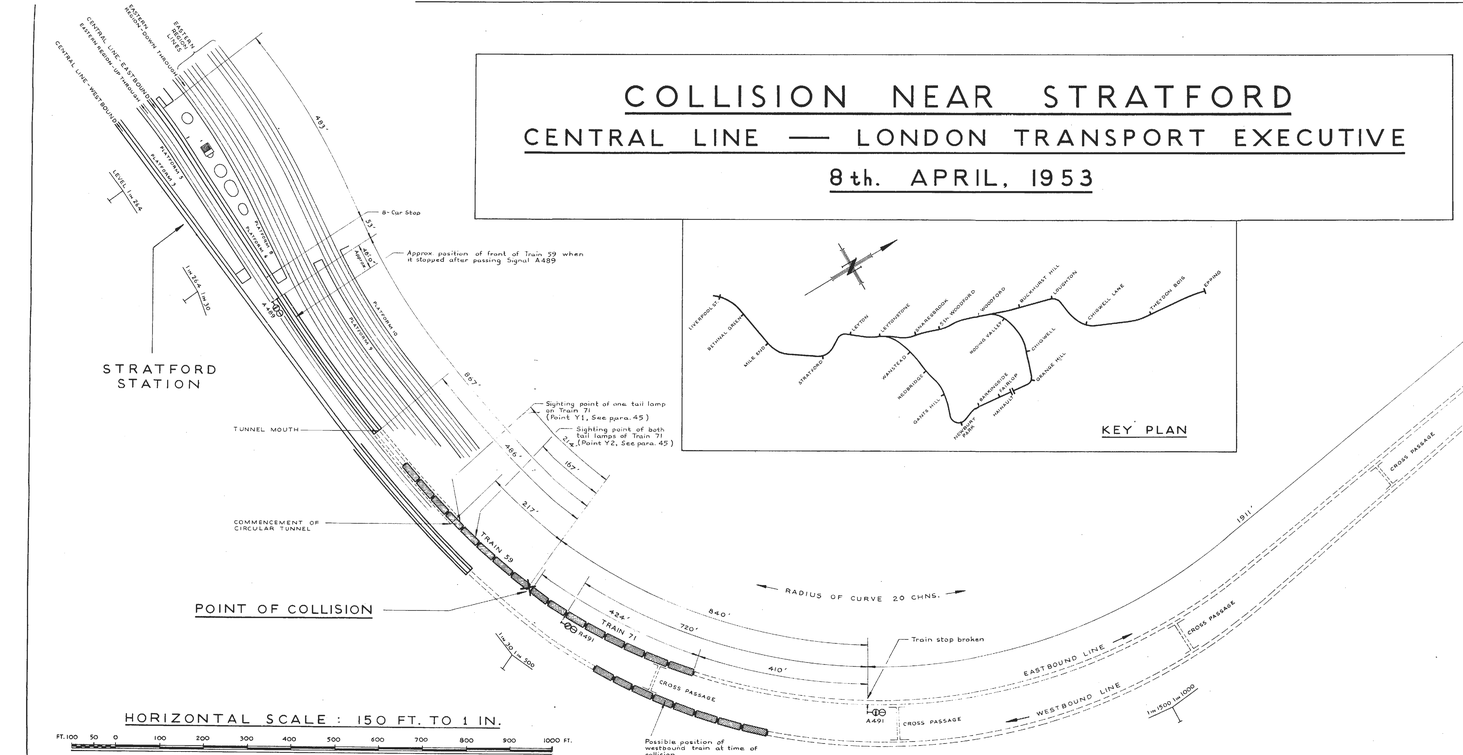
RECONSTRUCTION OF THE COLLISION AT STRATFORD. CENTRAL LINE - APRIL 8TH 1953

5332-3259-2882-L500-10/53 (H.E.P.)

COLLISION NEAR STRATFORD

CENTRAL LINE — LONDON TRANSPORT EXECUTIVE

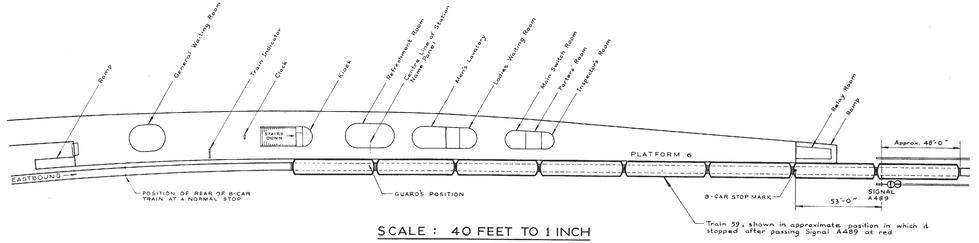
8th. APRIL, 1953



HORIZONTAL SCALE : 150 FT. TO 1 IN.

FT. 100 50 0 100 200 300 400 500 600 700 800 900 1000 FT.

ENLARGEMENT SHOWING PLATFORM No. 6



SCALE : 40 FEET TO 1 INCH