MINISTRY OF TRANSPORT & CIVIL AVIATION

RAILWAY ACCIDENTS

REPORT ON THE COLLISION

which occurred on

4th December 1957

near

ST. JOHNS STATION
LEWISHAM

in the

SOUTHERN REGION
BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE

SIX SHILLINGS NET

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1958

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

16*th June* 1958.

SIR,

I have the honour to report for the information of the Minister of Transport and Civil Aviation, in accordance with the Order dated 27th March 1958, the result of the Inquiry into the disastrous collision which occurred at about 6.20 p.m. on Wednesday, 4th December 1957, near St. Johns station, Lewisham, about 3¾ miles from London Bridge, on the four-track Eastern Section main line in the Southern Region, British Railways.

This Inquiry was begun by the late Lieutenant-Colonel G. R. S. Wilson in accordance with the Order dated 5th December 1957. He heard evidence on 12th and 13th December 1957 and on 10th January 1958.

In the prevailing dense fog, in which the trains were running very late, the 4.56 p.m. express passenger train from Cannon Street to Ramsgate, via Folkestone, formed of 11 bogie coaches hauled by a " Pacific " type engine, passed the Red aspect of the Down Through colour light inner home signal of St. Johns signal box, and then after travelling 138 yards it collided at about 30 m.p.h. with the rear of the 5.18 p.m. 10-coach electric passenger train from Charing Cross to Hayes (Mid Kent line) which was standing at the Parks Bridge Junction colour light home signal.

The air brakes of the electric train had been applied to hold it stationary on the rising gradient. As a consequence, the shock of the collision was more severe than it otherwise would have been, and the whole of the body of the eighth coach was destroyed when the underframe and body of the ninth coach were forced over and through it. In the Ramsgate train the rear of the engine tender and the front of the leading coach were crushed together and thrown to the left by the sudden stoppage, most unfortunately striking and dislodging a steel middle column supporting two of the four heavy girders of a bridge which carried the Nunhead–Lewisham double line over the four main tracks.

The two girders subsided at once on to the train below completing the destruction of the leading coach and crushing the second coach and the leading half of the third. About two minutes later, the 5.22 p.m. 8-coach electric train from Holborn Viaduct to Dartford, which was moving slowly on to the bridge towards a signal at Red, was stopped very promptly by the motorman when he saw the girders at an angle; this train was neither derailed nor damaged, but the leading coach was tilted. The electric current was cut off from all the tracks except the Down Nunhead line by the opening of the circuit breakers at the neighbouring substations on heavy short circuit at the instant of the collision; a minute or two later the circuit breakers feeding the Down Nunhead line were opened by the supervisory control. There was no fire.

Owing to the disorganisation of the train services by the fog, both the trains were crowded, and it is estimated that there were nearly 1,500 passengers in the electric train and about 700 in the steam train. It was inevitable in these circumstances that the casualty list was very great, and I much regret to state that 90 persons altogether lost their lives; 88 passengers and the guard of the electric train were killed outright, and one passenger died later of his injuries. Of the 89 fatalities to passengers, there is evidence that 37 occurred in the electric train and 49 in the steam train.

In addition a large number of persons were conveyed to hospitals in the neighbourhood, where 109 were detained, many with very serious injuries, and 67 others sustained minor injuries or shock. The seriously injured included the fireman of the Ramsgate train, and two locomotive drivers who were travelling in this train on duty. The driver in charge of the train, W. J. Trew, was not physically injured, but the shock which he sustained was severe, and Colonel Wilson was not able to interview him nor the fireman until 10th January 1958. I heard further evidence from these men on 21st May when the driver was still suffering from shock.

The first emergency call was received at 6.22 p.m. by the London Ambulance Service from a house by the side of the line, and the Metropolitan Police received a call from another householder a minute or so later. It was made clear that a serious railway accident had occurred, and in consequence the London Ambulance Service put into action the pre-arranged major emergency plan, which included the immediate notification of the London Fire Brigade. There was good road access to the site and the first ambulance to attend was one which was passing at 6.25 p.m. The first ambulance sent out on receipt of the call arrived at 6.29 p.m. in spite of the difficult driving conditions and the first fire appliance arrived at about the same time; as there was no fire to be extinguished, the fire services were able to apply all their resources and skill to the extrication of the injured from the wreckage. The attendance of the Police was also very prompt.

At first it was difficult to assess the magnitude of disaster in the fog, but as the true situation became known, the emergency services were deployed at increasing strength, and many doctors and nurses arrived on the scene; they all applied themselves most efficiently to the work of rescue and first aid under exceptionally difficult conditions; and the last of the injured had been removed to hospital by 10.30 p.m. Much of the responsibility for the excellent work done lay with the regular emergency services including the Police, and with all the railwaymen concerned, but a notable part was played by other organisations including the St. John Ambulance Brigade, the Women's Voluntary Service, and the Salvation Army. Mention should also be

Note: Driver W. J. Trew, who was in charge of the Ramsgate train engine, was tried for Manslaughter on 21st April 1958. The jury disagreed, and at the second trial on 8th May he was acquitted.

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made of the unselfish and generous way in which many lineside residents placed themselves, their houses and their belongings at the disposal of the rescue and first aid parties.

All the four main tracks were blocked by the collision and immediately after it by the fall of the bridge. The North Kent line, which diverges at St. Johns, was not actually blocked, but it was necessary to close it and keep the current off for the sake of the rescue work. As a result the main line services from Charing Cross and Cannon Street to the county of Kent had to be cancelled, and the network of routes from these termini to the inner and outer suburbs was also cut off, with the exception only of the double line via Greenwich which connects at Charlton with the North Kent line. The fallen bridge carried an important freight exchange route, on which there were also some passenger services between Holborn Viaduct and Dartford.

The train services were disorganised by the fog before the accident, with crowds at the London terminals. The blockage of so many vital routes caused much inconvenience and delay and even hardship to thousands of passengers, because it was not possible to give them any service whatsoever towards the end of the evening peak and all alternative means of transport were already taxed to the limit under the prevailing conditions. All that could be done that night was to improvise a few shuttle services " outside " the blockage; some Up main line trains were terminated short, and a few were started back again, with special connecting services as soon as they could be arranged. At 6.10 a.m. on the following morning, Thursday, 5th December, an emergency service was worked via Lewisham avoiding the obstruction, and all the main line services were diverted to Victoria. The freight train working, which included the exchange of considerable traffic between Hither Green Yard and the Northern lines, was also dislocated for several days, and many trains had to be cancelled.

Breakdown gangs and heavy steam cranes from Bricklayers' Arms, Ashford, Stewart's Lane, Nine Elms and Hither Green (gangs only) arrived at the site between 11.30 p.m. that night and 6.0 a.m. on the following (Thursday) morning. The leading six coaches of the Hayes electric train, which were not derailed or badly damaged were drawn forward to Hither Green sidings at about 1.0 a.m., and similarly the last seven coaches of the Ramsgate steam train were taken back to the Up sidings at St. Johns station a little later. The Dartford electric train was also drawn back without incident from the distorted track over the bridge, which had already been shored by heavy timbers to prevent further settlement.

Practically the whole of Thursday was taken up with the work of the cranes in disentangling the damaged coaches at the rear of the Hayes train and in re-railing them. By the early hours of Friday, 6th December, all the coaches of the Hayes train and the engine and tender of the Ramsgate train had been taken forward to Hither Green; the wreckage of the leading coach of this train was cut up where it lay, and the fourth coach and the underframe of the third, with the remains of its body, were drawn back a little later.

The way was then clear for the Civil Engineering Department to proceed with the disposal of the fallen bridge and of the underframe of the second coach of the Ramsgate train on which the weight of one of the girders was resting. Three of the four girders and the steelwork of the bridge floor which weighed about 350 tons were badly distorted, and it was decided to cut them into 6–10 tons sections by oxy-acetylene equipment in order to effect rapid clearance. This was an operation of some delicacy and danger for which further shoring was necessary, and it needed careful organisation.

The railway engineering staff were assisted by some contractors with their equipment and the work went on continuously in 12-hour shifts. The coach underframe had been cut up and removed early on Saturday, 7th December, and the first cut in the top boom of one of the girders was made at 2.0 p.m. on that day. By 11.0 a.m. on Sunday, about 50% of the steelwork had been removed, and it is very creditable that the task was completed by 4.0 p.m. on Monday, 9th December, 5 hours ahead of the planned time. No less credit is due to the other railway staff, who worked with determination and skill for long hours under very distressing conditions on the preceding days.

Tuesday and Wednesday, 10th and 11th December, were spent in clearing up the site and in making good the damage to the permanent way, including re-ballasting, and the main lines were opened again to traffic at 5.0 a.m. on Thursday, 12th December, after an interval of approximately 7½ days; the ordinary passenger services were then resumed, but with such a long interruption there was a heavy accumulation of freight traffic and it was several days before the freight situation became normal. The Nunhead–Lewisham line overhead was re-opened with a temporary bridge at 6.0 a.m. on Monday, 13th January. This bridge will serve until a new permanent bridge can be constructed.

Mist and fog had been continuous in the South East throughout the 4th December, and the fog had become thicker as darkness fell, with some frost. By all accounts the visibility of the colour light signals on the 3½ miles or so of viaduct between Cannon Street and New Cross had been fairly good around the time of the accident, but there was little doubt that the fog was a good deal thicker in the ¾ mile of cutting between New Cross and St. Johns, varying perhaps from time to time and place to place from 20 yards or less to 50 yards or more. There was very little wind.

I. Description of Trains and Effects of Collision

The Electric train

1. The 10-coach multiple unit electric train to Hayes consisted of two four-coach units and one two-coach unit at the rear. Each four-coach unit was of the Southern Region's standard suburban formation with a motor saloon second brake at each end, and a trailer compartment second and a trailer saloon second in between. The two-coach unit was of the standard formation used in the 10-coach trains of the Eastern

Section, with a motor saloon second brake in front, and a driving trailer semi-saloon second behind it; this coach had a guard's compartment as well as a driving compartment at the rear. The total number of seats in the train was 958, and it was carrying nearly 1,500 passengers. The total tare weight was 340 tons and the loaded weight was approximately 430 tons. The total length was 215 yards.

The three units were constructed wholly of steel, one in 1953 and the two others in 1956, and the bodies were welded to the underframes. Central Buckeye couplings were in use between the sets, and the intermediate couplings were of the close three-link type with central buffers. The Westinghouse automatic and electro-pneumatic brakes were in use, and the total brake power available was 267 tons, or 78·5% of the total tare weight of the train, and 62% of the total loaded weight. The train was at rest with the brakes fully applied at the time of the collision.

The Ramsgate train

2. This train was formed of 11 bogie coaches, including a buffet-car marshalled fourth. There were 96 first class and 384 second class seats or 480 seats in all, so that with about 700 passengers, this train also was crowded. The total tare weight of the coaches was 367 tons and the loaded weight was approximately 410 tons. With the exception of the last three coaches and the buffet-car, all the coaches had been built in 1956 and 1957 to the British Railways standard designs with all steel bodies welded to the underframes. The last three coaches were built in 1936 and the buffet-car in 1930, and all four had bodies with steel panels on hard wood framing mounted on steel underframes in the ordinary way. All of the couplings between the coaches were of the central Buckeye type, with the usual accompaniment of Pullman type gangways, and the leading coach was screw coupled to the tender. The vacuum brake operated on all wheels, and seven of the eleven coaches were fitted with direct acting valves. The total brake force was about 297 tons equivalent to 81% of the tare weight and 72½% of the loaded weight.

3. The engine was No. 34066 of the " Battle of Britain " class with 4-6-2 wheel arrangement, and it was stationed at Stewart's Lane Motive Power Depot. It had run 357,391 miles since it was built at Brighton Works in 1947, and it was in very good general condition, having run 3,444 miles only since the last classified repair at Eastleigh Works in October 1957. The weight of the engine in working order with six-wheeled tender was 128½ tons.

Engines of the " Battle of Britain " class of the Southern Region are rather smaller and lighter versions of the well-known " Merchant Navy " class engines, which are among the most powerful in the country. Seventy of the former were built with 8 ft. 6 ins. wide cabs to enable them to work over the Tonbridge–Hastings route with its restricted clearances and forty more were built with 9 ft. 0 ins. wide cabs in common with the " Merchant Navy " class for use on other sections of the Southern Region. No. 34066 was one of the original 70 with an 8 ft. 6 ins. wide cab and the outline and some of the leading dimensions are shown by Fig. 3 of the attached plans. With three cylinders, 16⅜ ins. by 24 ins. and 6 ft. 2 ins. coupled wheels, the tractive effort is 27,720 lbs. at 85% of the boiler pressure of 250 lbs. per sq. inch. The boiler is of ample size and is free-steaming, and the " Battle of Britain " engines are well able to handle 11-coach loads on the stiff gradients of the Eastern Section main lines.

4. These engines are driven from the left hand side where a seat is provided for the driver; there is a pendant regulator handle, and all the driver's controls, including the steam worked reversing gear, the driver's vacuum brake valve and the blower valve, are conveniently grouped. With the wide and flat-sided sheet steel casing of the boiler and smoke box, the forward outlook through the rather narrow spectacle glass is not of the best, and if a signal is on the right hand side of the line, the view of it tends to be obscured from the driver's position rather sooner than it would be with more conventional designs. The cab has a side window through which the driver can put his head to get a better view, but, owing to the restricted structure gauge in some parts of the Southern Region, the usual vertical glass wind-shield is narrow and triangular in shape, and so gives less protection to the driver's face and eyes than the larger rectangular glass shield which has proved so effective elsewhere.

5. The engine was equipped with the steam brake on the coupled wheels, controlled in the usual way by the driver's valve working the vacuum brakes on the tender and on all the wheels of the coaches. The brake force of the engine and tender was 65½ tons equivalent to 54½% of the total weight.

The combined power of the brakes on the engine, tender and coaches, was approximately 362 tons equivalent to 73% of the total tare weight of 495½ tons, and approximately 67% of the total loaded weight of about 540 tons. The total length of the train was 258 yards.

Effects of the collision

6. It will be seen from the site plan, Fig. 2, that the collision occurred on the Down Through line, which is on a right handed curve of 25 chains radius through the acutely angled overline bridge. The point of impact was just at the country side of the bridge nearly opposite to the 5¾ mile post from Charing Cross, and 138 yards beyond the St. Johns inner home signal, No. L.18, which the Ramsgate train had passed at Red. The Hayes electric train was standing with its brakes on, a few yards back from the next signal, the Parks Bridge Junction home No. M.8.

The front of the engine of the Ramsgate train was embedded in the motorman's compartment of the rearmost coach of the electric train, driving trailer No. 77565, and the underframe of this coach was lifted and crumpled for a length of about 5 ft. The passenger accommodation was undamaged at the rear, but the guard's compartment was destroyed. The front compartment and the rear compartment of the motor saloon brake No. 65380 next ahead (the ninth coach) were crushed together, each for about half of its length.

The front of this coach was Buckeye coupled to the motor saloon brake, No. 14408 (the eighth coach), and the violence of the shock broke the steel casting of the front half of the coupler in a clean fracture. It seems that the rear half of the coupler, which was also broken, pushed in the upper part of the headstock in front of it to form a kind of ramp, over which the underframe and body of the ninth coach were driven to destroy the body of the eighth coach leaving the headstocks of the tenth and eighth coaches butted together.

In addition to the damage to the rear passenger compartment of the ninth coach, the motorman's compartment at the leading end was crushed, but the underframe of the eighth coach was left almost bare, and the body was thrown to the right as a crumpled mass of steelwork on to the adjacent Up Through line. The destruction of this coach was responsible for the great majority of the fatalities in the electric train. The leading (motor) bogie of the ninth coach was left behind under the front of the tenth, but its trailing bogie remained in place and was carried by its underframe on to the floor of the coach ahead.

The underframe of the eighth coach was driven for a short way beneath the underframe of the trailer No. 15382 (the seventh coach), but there was very little serious damage to that coach or to any of the leading six coaches.

The front of the electric train was pushed forward by a few feet only, and the greater part of the shock to this train was absorbed by the destruction of the body of the eighth coach. After the accident, the eighth and ninth coaches occupied the space of one, and with the crushing at the ends of the ninth and tenth coaches, the length of the train was reduced by about 85 ft.

7. The engine of the Ramsgate train was not derailed, but the front buffer beam and the main frames at the front end on both sides were bent, and the centre steam chest casting was broken. There was also considerable damage to fittings and platework at the front end. The rear buffer beam was also bent and there was some damage to the intermediate drawgear. There was no collision damage to the boiler, and a driver and fireman who had been travelling with the motorman of the electric train, acted promptly to throw out the fire and smother the remains of it with ballast as a precaution against overheating of the fire box plates. Mr. G. A. Weeden, District Motive Power Superintendent, Stewart's Lane, mounted the footplate approximately four hours after the accident. He found the regulator closed, with the reverser in forward gear at between 40% and 50% cut-off. The driver's vacuum brake valve handle was in the fully applied position, and the blower valve was closed.

The shock of the sudden stoppage completely derailed the six-wheeled tender and the two bogies of the leading coach, second brake No. 35008. The tender was partially overturned with its rear end lifted and thrust bodily to the left by the pressure of the coaches behind it. The front and rear buffer beams and the main frames of the tender were bent, and the water tank was torn open as the brake compartment at the front end of the coach was crushed into and then driven past it when the screw coupling parted.

The overbridge

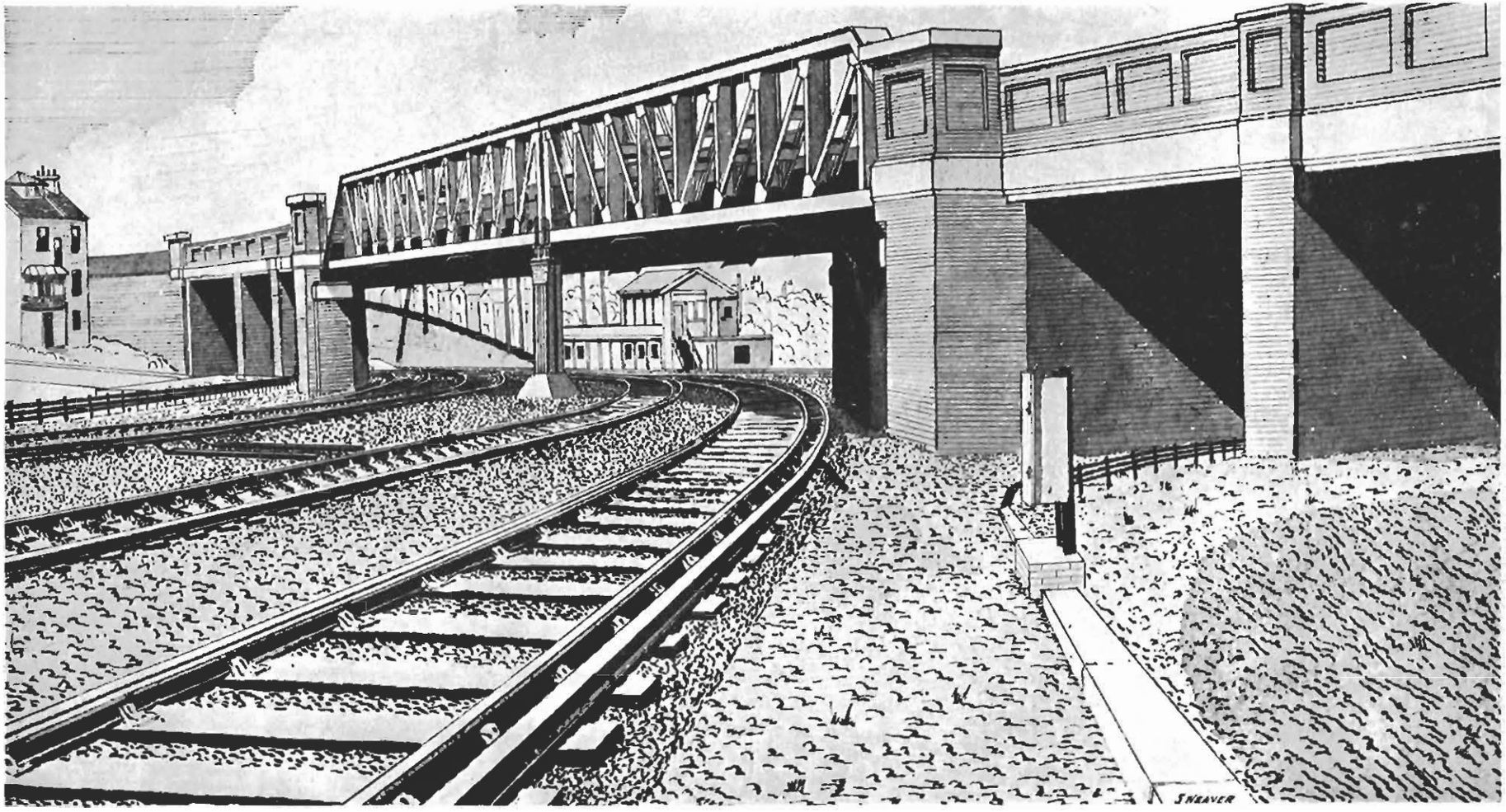
8. Since much of the damage to the coaches of the Ramsgate train was caused by the fall of the bridge girders, a brief description of the bridge itself is desirable.

Bridge No. 111 was built in 1929 to carry the Nunhead–Lewisham double line link over the four curved tracks of the main line at an acute angled skew. Its general construction is illustrated by the accompanying perspective drawing and by the photograph taken after it had collapsed. It was of lattice girder type in two spans, with fabricated cross girders, rail bearers and a steel trough floor. The square spans were about 29 ft. 6 ins., but on account of the acute skew and the curvature, the bridge was not symmetrical, and the main girders varied in length from 87 ft. to 115 ft. The outer ends rested on the abutments, and the inner ends were carried by two fabricated steel stanchions in the 15 ft. space between the Up Local and the Down Through lines. The bridge was designed to the A and B loadings of the tables published by the 1927 Bridge Stress Committee, assuming a maximum rotational speed of the coupled wheels of a steam locomotive of 3 revolutions per second. This provided for the maximum live load stresses ever likely to be applied to the bridge at the moderate maximum speeds at which trains would run over it in view of the proximity of the junctions at Lewisham.

The stanchion supporting the inner ends of the two London side girders consisted of a pair of steel columns close together, each fabricated of rolled steel joists. The stanchion supporting the girders on the country side, which was knocked over, was a single and stouter column, also built up from steel joists, and it carried a dead load of approximately 120 tons—see Fig. 4. Its length parallel to the track and its width were 5 ft. 0 ins. and 2 ft. 0 ins. respectively. With the cast iron cap and fabricated base the height of the column was 15 ft. 0 ins. above the heavy and deep concrete foundation to which it was secured by four 1¼ ins. bolts. The weight of the column and its fabricated concrete-filled base was approximately 14½ tons.

9. There was no doubt that the first blow on the column had been struck by the left hand corner of the tender, and it appeared that the blow had been centred about 7 ft. 5 ins. above rail level.

As a result, the column was pushed out, head foremost, shearing the four 1¼ ins. bolts which attached the cast iron cap, and shearing one and breaking in tenison the other three 1¼ ins. bolts securing the base to the concrete foundation. The column was then projected forward, probably by the underframe of the leading coach, and it was found on its side in the position shown by Fig. 2 and the photograph, with the base some 20 ft. forward from its original position. It was estimated, with the support of calculations, that the horizontal pressure necessary to strike out and throw forward the column in this way might have been between 215 and 280 tons.



BRIDGE No. 111. VIEWED FROM COUNTRY SIDE.

BRIDGE No. 111. AFTER THE ACCIDENT.

Damage caused by the overbridge

10. With their support removed, the inner ends of the girders must have subsided in a second or two on to the leading two coaches, possibly under some restraint from the work done in distorting the bridge floor and one of the main girders on the London side, until finally the end of the girder over the Local lines was resting on the ground, and the weight of the girder over the Through lines was partly carried by the underframe of the second coach.

Considerable damage was done to the leading coach by its forcible contact with the tender as an immediate result of the collision, and the destruction of the body was completed by the crushing and shearing action of the girders as they came down while the coach was still moving forward. The underframe also was badly bent. It was difficult to be certain whether the next coach, open second No. 4377, was still moving as the girders came down on to it, but it appeared that vertical crushing had been mainly responsible for the destruction of its body, which was complete. All the wheels were derailed, and it has already been mentioned that the underframe of this coach was cut up during the removal of the fallen bridge. The leading half of the third coach, open second No. 4378, was also crushed and destroyed, and the leading bogie was derailed, but the rear half of this coach remained clear.

There was some damage to the underframe of the buffet-car No. 7958 marshalled fourth, and the front end panels and the gangway were pushed in, but otherwise the composite body of this coach was undamaged. There was only trifling damage to the last seven coaches, and none of them was derailed.

Speed of collision

11. With the brakes applied on all the wheels, the electric train was an unyielding obstruction, and the total weight of the steam train which struck it was approximately 540 tons. On this basis, it was considered by the Regional Officers that the severe damage, including the destruction of the eighth coach of the electric train, might have been caused by the steam train travelling at 30 m.p.h. or a little more at the instant of the collision.

I agree with this opinion which is confirmed by experience gained in the investigation of other accidents, notwithstanding the suggestions made by several passengers in the steam train, that its speed was considerably less. These passengers have, I think, based their opinions partly on the fact that they felt no great shock when the collision occurred. I should point out, however, that the last ten coaches of the steam train, including the buffet-car, were brought to rest in a distance of approximately 130 ft. This would have given an average retardation from 30 m.p.h. of approximately 0·25 G which is not heavy.

II. Description of Route and Site

General

12. The routes of the Eastern Section of the Southern Region are in the main those of the former South Eastern and Chatham Railway, and the network in the London area is shown by Fig. 1. It will be seen that the two routes from Charing Cross and Cannon Street converge at Borough Market Junction just before they reach the Eastern Section through station at London Bridge, which lies close alongside the Central Section terminal. The general direction thenceforward is towards the south east. For most of the 2½ miles from London Bridge to North Kent East Junction there are six Eastern Section tracks, three Up and three Down, and for the whole of this distance they are carried on a brick arched viaduct alongside the independent Central Section tracks, which curve away to the southward on their own viaducts about two miles from London Bridge.

13. At North Kent East Junction the Eastern Section main route is joined on the south side by the double line goods branch which connects with the Rotherhithe Road carriage sidings at ground level, and then runs on to the Motive Power Depot and goods yard at Bricklayers' Arms; the junctions with the main running lines are facing in the Up direction. North Kent East Junction signal box also controls the junction, facing in the Down direction, with the double North Kent line via Greenwich. A short distance beyond this junction the main route is reduced to four tracks, named in order from North to South, Down Local, Up Local, Down Through, Up Through. This order continues through New Cross station (3 miles from London Bridge), St. Johns (3¾ miles), past the site of the accident, and through Parks Bridge Junction (4¼ miles) and beyond to Orpington (12 miles). From there the line is double to Sevenoaks and Tonbridge, where the Hastings line branches off, and thenceforward to Ashford, Folkestone, Dover and Ramsgate.

14. Fig. 5 is a general plan of the route from New Cross through St. Johns to Parks Bridge Junction; it also shows the relevant signals and track circuits and other information. It will be noted that there is a double line junction at St. Johns, between the Local lines only and the North Kent line via Lewisham, which continues on the straight. At this point the four main tracks begin to curve to the south through the bridge which was brought down, and then become straight for some way ahead. At Parks Bridge there is a double line junction, also facing in the Down direction, between the Through lines only and the Mid Kent line which runs via New Beckenham to Hayes.

Curvature and gradients

15. From Cannon Street through Borough Market Junction to London Bridge, only slow speeds are possible on the very sharp curvature. From London Bridge to North Kent East Junction, the lines on the viaduct are straight or nearly so and level. At North Kent East Junction there is some reverse curvature on No. 3 Down line (" The Spur ") on which the Ramsgate train was running, and thenceforward there is an easy right handed curve which straightens near the London end of New Cross Station. At the country end of this station there is a fairly deep cutting which continues with some retaining walls and a short tunnel,

and several overbridges, for the ¾ mile to St. Johns station. From St. Johns onwards to Parks Bridge Junction the lines are on bank.

It should be noted that, after the length of straight through New Cross station, there is a left-handed curve of 73 chains radius through the cutting to St. Johns, and that the Down Through line, on which the Ramsgate train was running, is straight again through the St. Johns platform. Beyond the platform, all the four tracks pass through the bridge on a right handed curve of 25 chains radius with 4 in. cant, on which there is a speed restriction of 45 m.p.h.

16. There are no gradients of any consequence between London Bridge and New Cross, where the long climb to the summit of the North Downs at Knockholt begins. It will be noted that after a short rise and fall the gradient is rising at 1 in 218 through St. Johns station and that it changes to 1 in 180 at about the site of the accident; thereafter the line rises continuously to Knockholt for 11 miles, much of it at 1 in 120 and 1 in 140.

With the present day steam locomotives, express trains on the Down Through line, if running under clear signals in good visibility, generally attain a speed of 45–50 m.p.h. as they pass through New Cross. With the rising gradient ahead they seldom travel round the 25 chain curve on the far side of St. Johns station at much below the maximum permitted speed of 45 m.p.h.

III. Description of Signalling

General

17. The main route from Charing Cross and Cannon Street via London Bridge was re-signalled in stages between 1927 and 1929 as far as Parks Bridge Junction inclusive concurrently with the electrification of the Eastern Section suburban system, and multi-aspect colour lights with continuous track circuiting were installed on all the running lines. At the same time several of the mechanical signal boxes were abolished, and there remained only two intermediate boxes between London Bridge and Parks Bridge Junction, namely North Kent East Junction and St. Johns.

18. With all the signal aspects under track circuit control there is no manual block working, and the trains are announced from one box to the next by Walker's pattern train describers—see the Appendix and Fig. 7. These train describers are of old-fashioned design, but they have proved very reliable over the years, and all the signalmen on this route are thoroughly accustomed to their working.

Signalling in relation to traffic density

19. Before the line was re-signalled, the frequency of the steam services operated with manual block signalling was already remarkable, but with the electrification and the new signalling it became possible to run many more trains, and the four track main line through St. Johns is now one of the busiest in the world, with a total of 990 trains, or an average of 247 per track, in the 24 hours of a typical weekday. Besides the steam and electric trains there is a considerable movement of freight in the middle of the day and in the night. St. Johns signal box also controls the traffic on the Nunhead–Lewisham loop over the bridge, and if this is included, the number of trains handled by the box in the 24 hours rises to 1,115.

20. During the busiest hour of the evening peak (5.1 p.m. to 6.1 p.m.) on a typical weekday, 44 Down and 37 Up trains are booked to pass St. Johns on the Through and Local lines, 81 in all, or one for every ¾ minute. The 24 trains on the Down Local line and the 20 on the Down Through during this hour represent average headways of 2½ minutes and 3 minutes respectively. For comparison, 1½ minutes is the closest headway worked on the London Transport District and Tube lines.

With this high traffic density and the presence of so many points and crossings, the signals are very closely spaced. There are no less than 19 signals applying to the Down Through line in the 5 miles between Cannon Street and Parks Bridge Junction, giving an average spacing of approximately 490 yards; the majority of the signals are controlled from the signal boxes but there are a few intermediate automatics.

21. In order to maintain the necessary braking distances all the signals have four aspects, Red (R), Yellow (Y), Double Yellow (Y/Y) and Green (G). The sequence of the aspects from signal to signal is conventional, in accordance with Rule 43, which reads:—

"Multiple-Aspect Signals

43. Multiple-aspect signals are colour light signals capable of showing more than two aspects. The aspects and meanings are as follows:—

Aspect	*Meaning*
Red light	Danger.
One yellow light	Caution—Be prepared to stop at the next signal.
Two yellow lights (vertically displayed) ...	Preliminary caution—Prepare to pass next signal at restricted speed and to find it showing one yellow light, or two yellow lights in certain exceptional cases in closely signalled areas. (See Note).
Green light	Clear—Next signal exhibiting a proceed indication.

Note.—Where the distance between a Caution signal exhibiting one yellow light and the stop signal next ahead is insufficient to bring the train to a stand at the stop signal, the Caution signal will be preceded by one or more signals exhibiting two yellow lights—Preliminary caution.

...."

Control of the signals

22. A controlled signal will not clear from Red until its lever in the signal box is reversed; it will then clear to Y, Y/Y or G depending on the aspects of the signals ahead and the occupation of the track circuits. If a signal has been replaced to Red by the occupation of the track circuit or track circuits immediately ahead of it, it will not clear again to Y, Y/Y or G until its lever has been restored to normal and again reversed; the signal levers are locked normal by the track circuits which restore the aspect to Red. Each of the four signal aspects is repeated by a miniature colour light or lights immediately behind the corresponding lever.

The aspects of the automatic signals are similarly dependent on the aspects of the signals and the state of the track circuits ahead, but after having been put to R by track circuit occupation, they will clear automatically to Y, Y/Y or G in response to the signal aspects ahead and as the track circuits are freed.

No fogsignalling

23. Apart from their intrinsic brilliance, colour light signals have the advantage that they can be sited comparatively close to the level of the driver's eye. They are thus much more conspicuous than oil-lit semaphores, particularly at night and in foggy weather, and with very few exceptions the usual fogsignalling arrangements with detonators and hand flags or lamps are not considered necessary where they are installed. See also paragraph 26.

Signals applying to the Ramsgate train

24. Between Cannon Street and New Cross station inclusive, there were 10 controlled and 4 automatic four-aspect signals which applied to the Ramsgate train, the last of which was the automatic signal A.42 at the country end of the New Cross Down Through platform.

The *Down Through* line signals from New Cross station to Parks Bridge Junction, both inclusive, also the relevant track circuits, are shown by Fig. 5. The signals are described, in their order, by the following table which also gives some important distances:—

TABLE 1

RELEVANT DOWN THROUGH LINE SIGNALS

Signal Box	No. and description of signal	Distance from A.42	Controlled to R by T/Cs
St. Johns	A.42 Automatic	—	48
	L.16 Outer Home...	440 yards	49, 50, 51
	L.17 Intermediate Home — bracketted with L.4 Down Thro' to Down Local Int. Home.	863 yards	50, 51, 52
	L.18 Inner Home...	1,332 yards	53, 54
Parks Bridge Junction	M.8 Home—bracketted with M.5 Down Thro' to Down Local Home.	1,695 yards	54, 55, 56, 57
	M.10 Starting—bracketted with M.12, Down Thro' to Down Mid Kent Starting.	2,171 yards	57, 58, 59, 60

25. It was not disputed that signal No. L.18 was passed at Red by the Ramsgate train, and it was proved by tests of the signalling equipment as described in Section VII that signals L.17 and L.16 were showing Y and Y/Y respectively in the proper sequence. It was also established that signal A.42 was at G, as it should have been. It will be noted that the first warning that the L.18 was at R was given by the Y/Y aspect of L.16 which is 892 yards in rear. This distance even without the sighting distance given in Table 2 was ample for an express train to brake to a stop from the normal speed of 45–50 m.p.h.

Overlaps

26. From the right hand columns of Table 1 and the distances shown on Fig. 5, it will be noted that before signal L.17 can clear to Y to let a train forward to L.18 at R, track circuit No. 52 must be clear, giving a clear distance of 126 yards beyond signal L.18. This distance is termed the overlap, and such comparatively short overlaps are characteristic of this installation where prevailing speeds are moderate and the density of the traffic and the comparatively close headway requires that the signals should be cleared at the earliest possible moment behind a preceding train.

At Borough Market Junction for instance the overlaps at five of the junction signals have to be much shorter in order to avoid traffic delays, and fog signalmen are provided at these signals when visibility is bad, as one of the very few exceptions to the general rule in colour light areas.

In installations where the speeds are high and the trains fewer, the overlaps are generally longer, but it should be borne in mind that overlaps are designed primarily as a safeguard against ordinary misjudgment in braking, especially with unfitted freight trains, and they cannot be made long enough to provide for the type of failure which occurred in this case.

Signal Boxes

27. *St. Johns* signal box works a pair of facing crossovers between the Through and Local lines at the London end of the station as well as the junction between the Local lines and the North Kent line. The scissors crossover junctions at Lewisham with the Mid Kent, the Dartford Loop North Kent and the Nunhead lines are also worked from St. Johns, but these junctions are not shown on Fig. 5 and only those running signals are shown which are relevant to the case.

The box, which is situated close to the junction on the North side of the line is a brick and timber structure containing a manual frame of 54 working and 8 spare levers, and the signalmen standing at the frame have their backs to the traffic. The nearer points and the ground signals are worked mechanically and the outlying points at Lewisham and at the London end of the station are electrically worked. The colour light running signals are controlled through circuit closers on their levers.

In the centre above the frame there is a clearly displayed illuminated diagram, and on each side of the diagram there are panels carrying the train describer receiving and transmitting dials, with the Down dials grouped on the left and the Up dials on the right.

During the peak hours the box is manned by two signalmen, with one man working the Down traffic at the left hand end of the frame and the other man handling the Up traffic on his right. There are also two booking lads, one of whom records the Down trains and the other the Up trains, and they sit at their desks opposite to the Down and Up describer panels respectively. A Down Through train is first described to Parks Bridge Junction when it occupies a track circuit (No. 47) in New Cross station to sound a buzzer in the box, and the next train is not described forward until the first train has cleared track circuit 54, which is the last one controlling signal L.18 to Red.

28. The general character and internal layout of *Parks Bridge Junction* signal box is very similar; the frame contains 45 working and 5 spare levers, and, as at St. Johns, the signalmen work with their backs to the traffic. This box controls four junctions and two pairs of facing crossovers, but only the junction between the Through lines and the Mid Kent line is relevant. The positions of the illuminated diagram and the train describers are similar to those at St. Johns and are shown by Fig. 7. This box also is manned by two signalmen at the peak hours, but owing to the shortage of booking lads, train movements were not being recorded at the time of the accident.

Signal telephones

29. At every signal which is not close to a signal box there is a driver's telephone, by which he can speak to the signalman through an omnibus circuit.

View of the signals

30. The crucial signals in this case were the automatic A.42 at New Cross and Nos. L.16, L.17 and L.18 of St. Johns box. They are of the multi-lens type, and the aspects are arranged vertically, with the Red aspect the lowest but one of the four. Unlike the preceding 13 signals from Cannon Street, which are sited on posts or overhead gantries in the normal position to the left of the line, these four signals, and the Down Through signals Nos. M.5/8 and M.10/12 of Parks Bridge Junction are sited on the right hand side. Fig. 6 gives the relevant dimensions of the first four signals in relation to the Down Through line.

It will be noted from the inset to Fig. 5 that there is plenty of room for the simple signal posts in the wide space between the Down and Up Through line, but none between the Down Through and the Up Local lines, and to have brought the signal aspects to the left of the Down Through would have required fairly elaborate cantilevered gantries. I understand that at the time of installation, when most of the engines were driven from the right hand side, the signals were sited as nearly as possible to the driver's or fireman's eye level in order to give the best view in the prevailing conditions where curvature and overbridges had to be taken into consideration.

31. Colonel Wilson, in company with Mr. T. E. Chrimes, lately the Motive Power Superintendent of the Southern Region, viewed the four signals from the footplate of another engine of the " Battle of Britain " class in daylight and darkness; the weather was clear. They had two runs after dark, firstly with Colonel Wilson on the driver's (left hand) side, and they changed places for the second run.

Their general impression was that the long distance view of all the four signals from the driver's side was good or at least adequate, with the prevailing easy left handed curvature. All the four signals, however, became obscured by the boiler at varying distances as they were approached.

From the fireman's side there was a good distant view of No. A.42, and it remained in view until passed. There was, however, only a comparatively short view of Nos. L.16 and L.17 on the convex side of the curve, also of L.18 on the subsequent straight on account of the intervening bridge, but all these signals remained in view until passed.

32. These somewhat rough and ready tests, which were carried out before Colonel Wilson opened the Inquiry on 12th December, were confirmed later by tests in daylight and clear weather with the same engine, in which careful measurements were taken of distances. The driver was seated in his normal position on the left hand side of the engine and was looking forward through the spectacle as had been the driver on the night of the accident. The fireman was looking through the right hand spectacle. The result of these tests is shown by Table 2.

TABLE 2

SIGHTING OF SIGNALS FROM THE FOOTPLATE OF A " BATTLE OF BRITAIN " ENGINE DRIVEN FROM THE LEFT-HAND SIDE

Signal No.	Distance at which aspect can first be seen in clear weather by:		Distance from signal at which driver loses sight of aspect	Remarks
	Driver—yards	Fireman—yards	yards	
A.42	750	810	113	Signals remain in sight of the fireman until they are passed.
L.16	324	110	80	
L.17	150	105	95	
L.18	500	240	238	

33. From these results it will be noted that, in fog with visibility less than 80 yards, a driver of a " Battle of Britain " class engine would not see any of these four signals at all, because they would be obscured by the boiler before even their " glow " became visible.

I also viewed these signals from the footplates of a " Battle of Britain " and a " Schools " class engine, and I confirm the general impression given above. The shorter and smaller boiler of the " Schools " class engine obscured the view for a much shorter period, but it is doubtful whether, in the very dense fog which prevailed in the cutting, signals L.16, L.17 or L.18 would have been visible from the driver's seat even of these engines.

34. Beyond signal L.18 the line curves to the right at 25 chains radius and the driver, on the convex side of the curve, cannot observe signals M.5/8 at all from his seat; they are, however, excellent signals to see from the fireman's side. There is a good long view on the straight of signals M.10/12 from the driver's side of a " Battle of Britain " class engine, but they become obscured by the boiler at a range of about 250 yards; from the fireman's side the first view is rather longer, and they remain in sight until passed.

IV. SUMMARY OF EVENTS

35. The visibility was generally bad in the London area on the afternoon and evening in question, and as so often happens it was varying from time to time and from place to place. The trains, however, during the evening peak on the Eastern Section were being operated according to the normal timetable, and no special " fog service " had been introduced. Although they were late in leaving the London termini, the Down trains on the Through line were running without excessive delay, taking into consideration the bad weather conditions. Table 3 gives the time of the last five trains through St. Johns before the accident.

TABLE 3

RUNNING OF TRAINS ON THE DOWN THROUGH LINE

Train	Departure time		Passing time St. Johns signal box		
	Actual p.m.	Minutes late	Booked p.m.	Actual p.m.	Minutes late
A. 5.5 p.m. (steam) Cannon Street to Hastings	5.43	38	5.13	6.0	47
B. 5.16 p.m. (electric) Cannon Street to Orpington...	5.45	29	5.28	6.3	35
C. 5.25 p.m. (diesel-electric) Charing Cross to Hastings	5.45	20	5.37½	6.8	30½
D. *5.18 p.m. (electric) Charing Cross to Hayes	5.48	30	5.34	6.11	37
E. *4.56 p.m. (steam) Cannon Street to Ramsgate	6.8	72	5.4	6.20	76

* In collision at approximately 6.20 p.m.

36. It will be noted from this table that Train C which was booked to follow Train D was ahead of it owing to the dislocation caused by the fog. Train E was much later than the others owing to the delay in getting the empty stock to Cannon Street, as described later.

37. *Train A* received 9 successive Green signals before reaching signal A.42 at New Cross which was at Y/Y, and the train was nearly stopped at L.17. Signal L.18 and the Parks Bridge signals were at Y, and the train was finally stopped for 6 or 7 minutes at the Down Through semaphore starting signal at Hither Green to wait for " Line Clear " ahead.

Train B received several checks onwards from New Cross with Train A moving slowly ahead of it, and it also was stopped at Hither Green to wait for " Line Clear " behind Train A.

Train C received Green signals up to North Kent East Junction. It was then checked by Double Yellows and Yellows, and at about 6.9 p.m. it was finally stopped at the Parks Bridge signals M.10/12 at the junction to the Mid Kent line. Train C could have been allowed further forward if the Down line signalman at Parks Bridge Junction had not thought, for reasons which are explained in paragraph 39, that the train was a Mid Kent train to be diverted to the right at the junction; this could not be done at once on account of a preceding Down Mid Kent train via Lewisham and a train from Bromley North which was approaching on the Up Through line.

Train D, the Charing Cross to Hayes electric train which was involved in the collision, left Charing Cross at 5.48 p.m., 30 minutes late, and it stopped as booked at Waterloo, London Bridge and New Cross, and thence it was to be diverted to the Mid Kent line at Parks Bridge Junction. According to the motorman the conditions had not been very bad so far. There had been a succession of Green aspects between London Bridge and New Cross, and the first signal check after leaving London Bridge was at A.42 at Y/Y. Signal L.16 was observed at Y in much thicker fog, and thereafter the signals were clearing from R to Y as Train D approached them. It went by St. Johns box quite slowly at 6.11 p.m., and was finally stopped about 10 yards short of Parks Bridge Junction signals M.5/8 at approximately 6.12 p.m.

38. It will thus be understood that Trains C and D had moved slowly from signal to signal after passing or starting from New Cross, until Train C was stopped (mistakenly) by the Parks Bridge Junction signalman at signals M.10/12. Train D then closed up behind it to signals M.5/8 at Red. The two trains were still stationary at these signals when Train D, which was protected by signal L.18 at Red 138 yards in rear of it, was struck by *Train E*, the steam train to Ramsgate, at approximately 6.20 p.m.

39. The mistake by the Down line signalman at Parks Bridge Junction about the order of Trains C and D arose in the following circumstances. According to the code in force, the " description " for Trains B and C were identical, namely " Main line—Main electric," notwithstanding that C was a diesel-electric train—see Appendix. The signalman had taken note of the description for Train B, but he stated that the description for Train C either was not sent from St. Johns, or that he had missed it, and that the next description which he had seen on his Down Through receiving dial, after the one for Train B, had been " Mid Kent Loop "—" Main electric." This description, which had been sent from St. Johns for Train D directly Train C had cleared track circuit 54, was on the Parks Bridge dial at the same time as the track circuit diagram was indicating that a train (C) was standing at signals M.10/12.

In this way, the signalman became convinced that the Hastings diesel-electric train (C), which he could not see in the fog, was the Mid-Kent electric train (D) to Hayes, and this conviction was not apparently removed by subsequent conversations with the motormen on the signal telephones, the evidence about which was conflicting. The signalman therefore continued to hold Train C at signal M.10/12, waiting for an opportunity to divert it, across the Up Through, to the Down Mid Kent line.

At 6.20 p.m., " Obstruction Danger " was received from St. Johns, and the signalman concerned promptly put the Up home signals to Red, stopping the train from Bromley North on the Up Through line and a train from Orpington on the Up Local.

At 6.23 p.m. the Down line signalman, who was still under the misapprehension, telephoned to the Train Supervision Office at Orpington that " the steam train had run into the diesel," but he heard later from various sources that Train D and not Train C was involved, and he so informed the Train Supervision Office at 7.15 p.m. At the same time he asked if he could let Train C go forward on its journey to Hastings, and it left at 7.33 p.m.

40. *Train E*, the 4.56 p.m. steam express train from Cannon Street to Ramsgate, was formed of 11 corridor coaches which had been prepared for the journey in the Rotherhithe Road carriage sidings (paragraph 13). The train engine with Driver C. W. Stewart in charge came from Stewart's Lane (Battersea) Motive Power Depot. It left there at 3.15 p.m. with a full tender of water and after travelling light via Nunhead, Blackheath and North Kent East Junction, it arrived at Rotherhithe Road at 4.45 p.m., running in the Up direction, tender first, and was backed on to the coaches at once. It had been badly delayed by the dislocation of traffic caused by the fog. Driver Stewart was then relieved by Driver F. Jeffrey of Bricklayers' Arms.

41. Directly the shunter told him that all the coaches were properly coupled, Driver Jeffrey created a vacuum of 21 ins. in the train pipe without any difficulty, and Guard E. Coe tested the brake by making a full application from the extreme rear. Driver Jeffrey then recreated the vacuum to 21 ins. and started the train up the fairly steep gradient of the Bricklayers' Arms branch, stopping at the " outlet " signal, where the pilot engine which was to haul the train to Cannon Street was attached at the rear. The two drivers then tested the brake with each other, and this was done once more at North Kent East Junction where the train was reversed for the journey to Cannon Street with the pilot engine in front and the train engine running tender first at the rear. The journey was slow but uneventful, and at 5.55 p.m. the train stopped in No. 6 platform at Cannon Street, where the pilot engine was uncoupled. According to Driver Stewart, Driver Jeffrey, and Guard Coe, the engine and train brakes were in perfect working order.

42. Driver Jeffrey did not recreate the vacuum from the front after it had been destroyed by the uncoupling of the pilot engine, and at approximately 6.0 p.m. he and his fireman were relieved by Driver W. J. Trew and Fireman C. D. Hoare, the two Ramsgate men who were to take the train forward; they had been waiting for some time at Cannon Street, after coming from Charing Cross where they had arrived at 4.10 p.m., in charge of an Up express from Ramsgate. Driver Jeffrey told Driver Trew that the water

must be getting short because there had been so many delays at signals since the engine had left Stewart's Lane, and on finding that the tender was no more than half full, Driver Trew decided that instead of running through to Tonbridge as booked he would have to stop for water at Sevenoaks (21 miles), and arrangements were made accordingly. It appears that Driver Trew had no difficulty in creating 21 ins. of vacuum. Guard, E. W. Humphries, who had taken over from Coe at Cannon Street, stated that he tested the continuity of the brake by an application from the 7th vehicle.

43. The train started at 6.8 p.m. and with Train D running 9 or 10 minutes ahead between London Bridge and New Cross there were 14 successive Green aspects for it from the Cannon Street starting signal to the automatic signal A.42 at the country end of the New Cross platform, both inclusive—see paragraphs 24 and 25. It does not seem that up to this point Driver Trew had had much difficulty in seeing the signals, and the train passed through New Cross station at about 6.18 p.m., i.e. 10 minutes after the start, compared with the booked timing of 6½ minutes; the average speed from London Bridge (passed at 6.12 p.m.) was approximately 30 m.p.h. and it is probable that the speed at New Cross was approximately 35 m.p.h. with the engine under steam.

44. By this time (6.18 p.m.) Train D was at a stand at signals M.5/8, as described in paragraphs 37 and 38. Signal L.18 was thus held at Red by the occupation of track circuit 53, and its lever in the St. Johns signal box was locked normal. The levers of signals L.16 and L.17 were, however, free to pull, and so clear the signals to Y/Y and Y respectively, and this was done directly Train D cleared track circuit No. 52, so as to bring Train E forward to signal L.18. The speed of Train E, however, was not materially reduced on passing the Y/Y and Y aspects, and Driver Trew did not apply the brake until Fireman Hoare told him that signal L.18 was at Red. The distance of 138 yards to the rear of Train D was too short for the situation to be saved, and the collision occurred as already described.

45. The thorough examinations and tests of all the relevant signalling equipment which were made by the staff of the Signal Department under the personal direction of the Assistant Signal Engineer, Mr. A. W. Damon, proved that with signal L.18 at R, signals L.16 and L.17 when cleared must have been showing Y/Y and Y respectively.

46. The continuity of the vacuum brake throughout Train E had been proved three times, once in the siding at Rotherhithe Road by Driver Jeffrey in conjunction with Guard Coe and twice by Driver Jeffrey in conjunction with the driver of the pilot engine which hauled the train to Cannon Street. Guard Humphries had also tested the brake at Cannon Street from the 7th vehicle in which he was to travel. Driver Stewart and Driver Jeffrey reported that the engine and the train brakes were in first class order, and no defects or stoppage of the train pipe were discovered at searching examinations and tests of the steam and vacuum brake equipment of the engine and the coaches after the accident.

V. Evidence

Signalmen

47. The two signalmen on duty at St. Johns for the 2.0 p.m. to 10.0 p.m. turn were L. R. V. Presslee (Down traffic) and T. E. Messer (Up traffic), and they were assisted by two booking lads; both signalmen were thoroughly familiar with the working of the box.

Signalman Presslee stated that he had dealt with a " Down Orpington " (train B) and then with a " diesel train " (train C). He was confident that he sent two identical descriptions " Main Line "—" Main Electric " to Parks Bridge Junction one after the other and this received some confirmation from the entries in the Down side train sheet which appeared to have been made currently. For the second of these descriptions, i.e. for the diesel train, Presslee said that he " sent the clock round twice " in order to draw attention specially to the fact that he was sending a second and identical description.

Presslee then dealt with Train D, the Mid Kent train to Hayes, (paragraph 37) and described it forward. He had already pulled levers 16 and 17 for it and he pulled lever 18 as soon as Train C had cleared track circuit 54, on which signal L.18 cleared to Y. He replaced the levers as the train passed, and in the meantime Train E, the Ramsgate steam train, had been described to him from North Kent East Junction as " Main Line "—" Main Steam Passenger ". Directly Train D had cleared track circuit 52, he pulled levers 16 and 17 to bring Train E forward as far as he was able, i.e. to signal L.18, and he noticed from the indications that signals L.16 and L.17 had cleared properly to Y/Y and Y respectively; he also noted that the indicator of signal L.18 was showing a clear Red. At about the same time he remarked to Signalman Messer " I wonder when he (Parks Bridge) is going to clear the Mid Kent Loop train "; Train E passed the box almost immediately afterwards, and he heard the noise of the collision a few seconds later. He was very startled when the train passed signal L.18 at Red, but he had no time to send " Train Running Away on the Right Line ".

Signalman Presslee said that there was a North Kent electric train passing close to the box on the Down Local line at about the same time as the steam train was passing on the Down Through, and the noise of the North Kent train prevented him from hearing anything of the steam train, so he could not say if its brakes were applied; he just saw the glow of the carriage lights through the fog (at a distance of approximately 15 yards), and he said that the fog was " bad " at that moment. He found it difficult to judge the speed of the train, but he did not think it had been going very fast—more slowly in fact than was usual in clear weather with all the signals " off ". He added that the fog was drifting and that sometimes he could see the head codes of the electric trains and sometimes he could not see the trains at all.

He added that he replaced levers 16 and 17 as the steam train passed the signals, and after the accident he specially noticed that levers 16 and 17 were normal in the frame and that the indicator lights

were showing Red. He sent " Obstruction Danger " to North Kent East Junction at 6.20 p.m., and at the same time Signalman Messer sent this signal to Parks Bridge Junction and to Blackheath.

48. Signalman Messer generally confirmed Signalman Presslee's account and he recollected that levers 16 and 17 but not No. 18 had been pulled just before the accident, and that they were all normal in the frame after it. He did not see the Ramsgate train passing, but afterwards he saw the lights of the stationary rear coaches. He said that the fog had been thick all the afternoon, but that it was fluctuating, and he added that it was quite normal in a bad fog for a Down train to be held for a considerable time at the Parks Bridge signals.

49. The two signalmen on duty at Parks Bridge Junction from 2.0 p.m. to 10.0 p.m. were S. G. Beckett (Down traffic) and T. F. Cunningham (Up traffic), and owing to staff shortage there was no booking lad on that shift. These two men also were thoroughly experienced in the local working.

It has already been explained (paragraph 39) how Signalman Beckett had become convinced that the diesel-electric Hastings train (C) standing at his Down Through signals M.10/12 was a train for the Mid Kent Loop, and he explained that, being under this impression, he had kept it there until he was in a position to turn it off to the Mid Kent line across the Up Through. He was, however, quite frank in admitting that the description of Train C might have been sent from St. Johns and that he might have missed it.

He said that before the accident the driver of a diesel train had telephoned to him, though he could not give the exact time, and he had recognised that the train " was a diesel " because he had heard the noise of the engine over the telephone. The noise had almost drowned the driver's voice, and he had thought that the driver had said that he was standing at signals M.5/8 instead of M.10/12. Beckett said that with the omnibus circuits there was no indication in the box to show from which signal a trainman was speaking. He still had the impression that the train at signals M.10/12 was one for the Mid Kent Loop, and he thought at the moment that the diesel train had " got on my 53 track without the description being put on ", adding that a description was occasionally given late. The next thing he remembered was the " Obstruction Danger " signal from St. Johns on which Signalman Cunningham on his right had immediately put the Up home signals to danger, stopping the two Up trains as already described.

Signalman Beckett could not recollect any telephone call before or after the accident from the motorman of the Mid Kent Hayes train (D), from whose statement it appeared that he may have telephoned to the box from signals M.5/8 at about the same time as the motorman of the diesel train (C); Beckett, however, was not prepared to say definitely that he had not received a call from the motorman of Train D. Generally, Signalman Beckett's recollection of the events was confused, and it was clear that his wrong impression about the order of the two trains had persisted until after the accident. Signalman Cunningham said that after Beckett had answered the box to box telephone from St. Johns he had said " The Ramsgate train has run into the back of a diesel ".

Trainmen—5.5 p.m. steam train, Cannon Street to Hastings (A)

50. This train, which left Cannon Street at 5.43 p.m., and passed St. Johns 17 minutes later was the last steam train on the Down Through line before the accident. The eight coaches were a comparatively light load for the powerful 4-4-0 type engine of the " Schools " class, which is also driven from the left hand side. With the comparatively short boiler, the forward outlook is a good deal better than it is from engines of the " Battle of Britain " class, as already mentioned.

The engine crew were Driver F. J. Frewin and Fireman A. J. Emery of St. Leonards Motive Power Depot. Driver Frewin is thoroughly familiar with the route and Fireman Emery has worked over it regularly during the past six months. As has been stated in paragraph 37, Driver Frewin received a succession of Green aspects after passing London Bridge. He said that he had not much difficulty in seeing these signals, and he was running at 35–40 m.p.h. at New Cross, with the regulator about one quarter open and the reversing gear at about 25% cut off. On his Up journey as a passenger that afternoon he had noticed that the fog had been a good deal thicker between New Cross and St. Johns than elsewhere, and he was expecting some signal checks from New Cross onwards; he was not therefore surprised when he saw signal A.42 at Y/Y at a range which he said might have been more than 30 yards but not as much as 50 yards. He shut off steam and applied the brake at once.

Thereafter Driver Frewin could get no proper view of the signals on the right hand side of the line and he told his fireman to observe them. He said that Fireman Emery had told him that signal L.16 was at Y, and he was moving slowly towards signal L.17 and was very close to it when Emery told him it was at Red. He had almost stopped when it changed to Y, and he just saw the glow of it as he looked across the cab. After that Emery had found signal L.18 and the subsequent colour lights at Y as the engine slowly approached them, and had so informed him.

Speaking of signal L.18, which was passed at danger by the Ramsgate train, Frewin said that in clear weather the driver could see it quite well from the left hand side as he entered St. Johns station, but that " in foggy weather just as the driver thinks he may be able to see it the engine obliterates it ". Generally he thought that the right hand position of signals A.42, L.16, L.17 and L.18 caused no difficulty in clear weather on account of the left hand curvature of the line, but he said that in foggy weather he would either have to cross the footplate or rely on the fireman. He said that he was well satisfied to put his faith in Fireman Emery for the observation of signals when necessary.

51. Fireman Emery said that he had a good fire on leaving Cannon Street. He put on no more coal after passing London Bridge, and thereafter continued to look out for the signals, because he knew that Driver Frewin could not see all of them from his side. He went on to say that the train had reached 35–40 m.p.h. " easily " on the length between London Bridge and New Cross where the visibility had not

been too bad. The fog, however, was worse at St. Johns, Hither Green and Grove Park, and the following is an extract from his evidence about the view which he obtained of signals L.16, L.17 and L.18, about 20 minutes before the accident:—

" Q. At what sort of distances do you think you could see those signals?
A. Not until I was nearly on them.
Q. How near?
A. It is a job to say, 5 yards. The second one (L.16) you mention we had one Yellow and just as we were getting on to the other one (L.17) it came off—we were right on to it. We were not past it—we were on it, I could not see it.
Q. You could not see that signal until the last moment? A great blazing colour light and you could not see it?
A. Yes.
Q. Would you say the same about the signal (L.18) at the end of St. Johns platform?
A. It was the same, I had to keep looking out. At St. Johns I could only just see it as we crept up to it, about a boiler length."

Fireman Emery confirmed that Driver Frewin had asked him to look out for the right hand signals from L.16 onwards and had not crossed the footplate himself.

Trainman—5.25 p.m. diesel-electric train, Charing Cross to Hastings (C)

52. Driver C. W. Bishopp, of St. Leonards Motive Power Depot, was in control and without any obstructions in front of him he had a much better view of signals from his seat than is obtained from the cab of a steam locomotive. He left Charing Cross about 20 minutes late, and he said that the weather was a " bit foggy ", but that the visibility was not too bad between London Bridge and New Cross. He had Green signals as far as North Kent East Junction, and then a Y/Y and a Y before reaching New Cross. Signal A.42 cleared to Y/Y when he first saw it as he ran into the station, i.e. from a distance of about 200 yards.

Signal L.16 was at Y and he saw it clearly at a range of about 50 yards " as he came round the bend ", and he saw signal L.17 " at a coach or two lengths away " (20–40 yards). Signal L.18 came into view at Y at about the same distance, and Bishopp added that he was then about half way along the platform. (This was about 12 minutes before the accident). Signal M.5 had turned from R to Y as he got close to it and he then drew slowly forward to signals M.10/12 at Red.

After waiting about 3 minutes he telephoned to Parks Bridge Junction box to say " I am the 5.25 p.m. Charing Cross to Hastings train standing at signal M.10 ", and he thought that the signalman had replied " All right ". This was the only conversation which he had with the signalman before the accident. He heard of the accident from the motorman of an Up electric train, after the latter had telephoned to the box to say that he had lost the power.

Trainmen—5.18 p.m. electric train, Charing Cross to Hayes (D)

53. Motorman J. B. Skilton, of Caterham Motive Power Depot, was driving this train. Before it left Charing Cross, Driver J. A. Crane and Fireman D. T. Nash, who were travelling home after duty, went into the front brake compartment as the train was so crowded, and Motorman Skilton asked them to accompany him in his driving compartment to help in observing the signals. (At one time Motorman Skilton had been fireman to Driver Crane.)

The train left Charing Cross at 5.48 p.m., and stopped, as booked, at Waterloo, London Bridge and New Cross; it was not booked to stop at St. Johns. Motorman Skilton stated that he had a good run to New Cross considering the conditions, and that the visibility was " fairly reasonable " up to that point. Signal A.42 was at Y/Y and after that he received a succession of Y's until he was stopped by the Red aspect of signals M.5/8 at approximately 6.12 p.m.; he stopped about 10 yards short of the signal, and applied the electro-pneumatic brake to hold the train stationary on the rising gradient.

Skilton's account of the visibility between New Cross and St. Johns was not very definite. He said that he saw signal A.42 from about 20 yards, but when he was told that other drivers had seen the signal from much further off, he said that 20 yards to a driver in fog was not too bad to work with. He thought that he had seen signals L.16 and L.17 from a distance of about 10 yards, and he said that the fog was particularly dense around St. Johns station, and that he had had difficulty in seeing how far he was along the platform. He suggested that the visibility in the neighbourhood of signals L.18 and M.5/8 was 5—8 yards at a maximum, but again he could not say definitely.

Motorman Skilton went on to say that about one minute after he had stopped he telephoned to Parks Bridge Junction box and told the signalman that the train was the 5.18 p.m. from Charing Cross to Hayes and that it was standing at signals M.5/8, and that the signalman had replied " All right when you get the aspect ". (It has already been stated that Signalman Beckett did not recollect this conversation at all). After he had been standing for a few more minutes Skilton felt a jolt from behind which at once suggested to him that his train had been struck by a following train. The jolt, however, was not severe, and it was not until he walked back and saw the wreckage of the eighth coach that he realised how serious the collision had been.

54. Driver Crane confirmed Motorman Skilton's account of the signal aspects received by train (D). He said that the fog was not bad as far as New Cross, but it became a good deal thicker after that, and he estimated that the view of the signals in the cutting between New Cross and St. Johns was down to 4—5 yards.

He confirmed that Skilton had used the telephone at signals M.5/8 soon after he had stopped. After the accident, Driver Crane walked back with Fireman Nash and together they smothered the fire of the engine of the Ramsgate train with ballast. He found Driver Trew on the footplate and he helped him down the bank into a house. He said that Trew was suffering from severe shock and that he " could get nothing out of him ".

55. Fireman Nash spoke of the fog as " patchy ", and not too bad up to New Cross. He saw the two Yellows at signal A.42 as the train stopped, and after that it was a question of " creeping from signal to signal ". The only signal which he remembered having seen after that was L.18 at St. Johns, which was at Y. According to Nash the fog had become very dense there, and the signal " just loomed out of the fog " after he passed the porters room. (The porters room is 130 yards from the signal). The train then continued slowly forward to stop at signals M.5/8 at Red, and Nash also recollected that Motorman Skilton had telephoned almost at once.

Trainmen—4.56 p.m. steam train Cannon Street to Ramsgate (E)

56. The engine crew were Driver W. J. Trew and Fireman C. D. Hoare of the Ramsgate Motive Power Depot and they had worked together for two years. Driver Trew is 62 years of age and has 45 years service with the railway. He has been a driver for 18 years and is in the No. 2 link at Ramsgate which makes regular provision for the main line expresses to London. During 1957 he had worked 38 return trips to London via St. Johns with express passenger trains and the last occasions on which he had done so were on the two days before the accident when he worked the 12.55 p.m. Up express from Ramsgate to Charing Cross and returned with the 4.56 p.m. express from Cannon Street to Ramsgate, as on this occasion.

As has been stated Driver Trew sustained severe shock. He was taken to hospital and after spending a night at Lewisham he was allowed to make his own way home to Ramsgate on 5th December. On 7th December the Ashford District Motive Power Superintendent, Mr. F. L. Howard, interviewed him while he was in bed at his house. Mr. Howard found it difficult to get any coherent statement from him, but in answer to questions Trew said that signal No. A.42 was at Green and that on seeing signal L.16 at Y/Y he had shut the regulator and applied the brake partially. On seeing signal L.17 at Y he had applied the brake fully and it was on before he ran into St. Johns station. He then became aware that he was not going to stop at the St. Johns starting signal at Red. Mr. Howard reported that he could not pursue his questions any further because Driver Trew's nervous tension was acute and he seemed to be on the point of breaking down. Trew had made a very similar statement to the Foreman of the Ramsgate Motive Power Depot on his arrival there on the morning after the accident.

57. Driver Trew was not fit to be interviewed by Colonel Wilson until 10th January. He was then still on the sick list, but he appeared to have recovered his balance to some extent. He told Colonel Wilson at the outset that he had a thorough knowledge of the route, and speaking generally of the right handed signals between New Cross and St. Johns he said that they were all right to see in clear weather but that care was necessary when it was foggy. He also said that he had plenty of experience with the " Battle of Britain " class engines, and he thought that they were good engines to handle and well up to 11-coach loads if they were in good condition. He did, however, consider that the forward outlook compared badly with that from other engines of the class which have been rebuilt without the flat boiler casing.

On 4th December he had booked on duty at 12.30 p.m., and had left Ramsgate on time with the 12.55 p.m. express train to Charing Cross which is booked to run fast from Ashford and to arrive at Charing Cross at 3.47 p.m. He said that the weather had been cold and foggy all the way; after passing Tonbridge the visibility had improved, but the fog had become bad again from Orpington to London. He had arrived at Charing Cross at 4.10 p.m., 23 minutes late. Trew and Hoare were then relieved, and after having some tea at the staff canteen in the station, they went by train to Cannon Street, arriving there in good time in case the 4.56 p.m. train back to Ramsgate should have been ready to start on time. As it was, they had to wait on No. 6 platform until 5.55 p.m. when the empty stock was drawn in by the pilot engine, with Engine No. 34066 attached at the other end in readiness for the journey, as already described in paragraphs 40 to 42. Trew said that he got very cold whilst waiting on the platform for such a long time.

When Driver Trew took over the engine from Driver Jeffrey a minute or two later, the latter told him that the water must be getting short. As already mentioned Trew decided that he would have to stop at Sevenoaks for water, and he so informed the guard, E. W. Humphries, and also told one of the inspectors; he was confident that he had plenty of water to get through to Sevenoaks. He then created the vacuum which had been destroyed when the pilot engine was uncoupled, and raised it to 21 ins. without difficulty, but he did not destroy the vacuum again in order to test the brake (see also paragraph 67).

58. Trew started the train at 6.8 p.m. and received Green signal aspects up to and including the automatic signal A.42 at New Cross (14 in number). He was looking forward all the time through the front spectacle glass which he said was quite clean and he did not have his head out of the side window. Asked about the visibility between London Bridge and New Cross, he replied that he could not see the signals until he was up to them, and that he could just see the glimmer of them. The following is a verbatim record of his further evidence which he gave to Colonel Wilson on this point:—

" Q. One or two Motormen and Drivers I have questioned said the fog was not so bad between London Bridge and North Kent East Junction and New Cross, and then it got a good deal worse between New Cross and St. Johns. Would you agree to that?

A. I would agree because you could not see practically anything between New Cross and St. Johns.

Q. Did you think it was a bit better between London Bridge and New Cross?
A. Just a little better, but not all that better.

Q. You are on top of the viaducts between London Bridge and New Cross, and being on top of those viaducts do you recollect that it was perhaps a little better?
A. Yes, a little bit better.

Q. How far could you see those signals on top of the arches?
A. Just as I was getting on to them.

Q. You could not see them for any length of time at any rate?
A. No.

Q. Would you say 20 or 30 yards?
A. Yes."

He went on to say that between London Bridge and New Cross he had kept opening and shutting the regulator because he could not see properly, and that his speed through New Cross had been less than the normal 40-45 m.p.h. in clear weather. He had seen signal A.42 at G himself when he was " in the platform " and he thought he had then shut the regulator. (The station foreman on duty at New Cross stated, however, that the regulator seemed to be open as this train passed through the station, and that the engine was emitting a lot of steam). Trew said that he saw the next signal (L.16) at Y/Y, and he added " I just saw it over the boiler, just at the bottom, just the glimmer of the Double Yellow ". He said that he saw the next signal (L.17) at Y, but he was unable to estimate, even very approximately, what was the distance between these signals.

59. After that it was difficult to make much sense of Driver Trew's replies to questions, and to some extent they were contradictory. At first he said that he did not see the lights of St. Johns station, but a little later he said that he had known where he was by the St. Johns lights and when he was towards the country end of the platform he had asked Fireman Hoare what light the signal (L.18) was showing, and Hoare had said " Red light ". Quoting again from the verbatim record of Colonel Wilson's interview with him:—

" Q. Were you not expecting it to be Red?
A. I had given her brake before I got into St. Johns because you can either expect a Red, two Yellows or Green.

Q. Having had two Yellows then one Yellow you would expect a Red?
A. It all depends, they put them on so quick, you get Green, one Yellow or two Yellows, Green.

Q. But if you had two Yellows, then one, you get your train under control?
A. Then you crawl up to the signal.

Q. When he said Red, were you surprised?
A. I was a bit surprised because we never stop there, we never stop there.

Q. You cannot recollect having been stopped at St. Johns?
A. No.

Q. Of course, there was a train ahead, there was a blockage because of the fog. Would you not expect to be stopped anywhere in a fog like that?
A. Yes."

When Trew was asked about his speed through St. Johns, he replied " I would not say I was going 20 or 30 ", but he also said that he was " not crawling ". When he applied the brake he did not feel it take hold, and the engine seemed to go faster.

60. Driver Trew could give no explanation why he did not ask Fireman Hoare to observe signals L.16 and L.17 which, in fog, were so much better to see from the right hand side. He made it clear, however, that this was not because he could not trust Hoare to look for the signals. He said that he would trust him at any time and that he was a good fireman. He got on well with him and they had never been at cross purposes during their two years together.

He said that there had been no steam leaks or other engine defects to distract his attention during the critical period, nor had he been confused in any way by the passage of other trains, for instance by one passing close to him on the Up Local. He also said that he was in good health on that day and had no troubles on his mind. In reply to a question, however, he did say that he was anxious to make as good a run to Sevenoaks as possible, in order that too much time might not be lost by the out of course stop for water.

Colonel Wilson then asked him whether it was possible that, with his mind on the Sevenoaks stop, he had seen signal A.42 at Green and had then lost his location in the fog, having failed to see signals L.16 and L.17—and that he had been taken by surprise when he found himself running into St. Johns station. He replied " I don't think I did ", and when this suggestion was put to him again in a slightly different form, his reply was much the same, " No, I don't think so ".

61. Driver Trew had made a similar statement about the aspects of the signals between New Cross and St. Johns when he gave evidence at the Coroner's Inquest on 31st December, but on 22nd April, at his trial he denied having seen signals L.16 and L.17 in the fog. In view of this contradictory evidence, I considered it necessary to see Driver Trew myself, and on 21st May I questioned him about his action

during this part of the journey He was still shocked and hesitant in his answers. The following is an extract from the verbatim record of my interview:—

" Q. Just tell me of your journey from the time you left Cannon Street station.
A. It was very misty, patchy, we had all Green lights to New Cross.

Q. Could you see the signals all right from your side of the cab?
A. Yes.

Q. Could you see that the signal at New Cross was Green?
A. Yes.

Q. How far away were you when you first saw it? Can you remember?
A. I cannot say exactly.

Q. Were you in the platform?
A. I cannot say.

Q. After that?
A. We came into the valley where the fog was thick.

Q. The signal at the end of the New Cross station platform is known as A.42. Do you know it by that number?
A. No.

Q. That signal was at Green, and what happened after that?
A. I never saw another signal until I saw a white light in St. Johns.

Q. Yes, then what happened?
A. I said to my mate what have we got and he said Red.

Q. That was a Red signal at the end of St. Johns platform?
A. Yes.

Q. There are two other signals between New Cross and St. Johns, you did not see either of them?
A. No.

Q. You know their positions?
A. Yes.

Q. On which side of the line are those two signals?
A. On the Fireman's side.

Q. Did you ask your Fireman to look out for those two signals?
A. No, I was staring out of the glass—I was looking for myself.

Q. I see. Your engine was a " Battle of Britain " class and you must know surely that it is difficult to see signals from the Driver's side when they are on the right hand side of the engine. Did you think of crossing over the footplate and looking out on the other side?
A. I should have looked.

Q. Why did you not ask your Fireman to look for those signals?
A. I was looking out myself.

Q. Having got a Green signal at New Cross what signals did you expect after that?
A. I knew I was all right up to St. Johns.

Q. You have never been stopped at St. Johns before?
A. No.

Q. So you were expecting to get a clear signal there?
A. Yes.

Q. Is that the reason why you were not so particular about those other two signals. Having got a Green signal at New Cross you felt you could leave those other two signals?
A. No, my mind was occupied looking for those two signals.

Q. Have you driven over that line before in fog?
A. Yes.

Q. In " Battle of Britain " engines?
A. Yes.

Q. Could you see those signals then?
A. I could not say, I may have asked my mate to look for them.

Q. Your mate was Fireman Hoare?
A. Yes.

Q. How long has he been your regular mate?
A. Two years.

Q. Satisfactory?
A. Yes.

Q. Do you work together as a team?
A. Yes.

Q. That being so, do you know why he did not look out for those two signals for you?
A. I cannot say.

Q. Does he usually look out for those signals?
A. No.

Q. Am I about right in saying that the Green signal at New Cross re-assured you that you would have the signals up to St. Johns?
A. Yes.
Q. When you gave evidence before you talked about seeing those two signals at Double Yellow and Yellow.
A. Yes.
Q. That was directly after the accident. Was it a fact that you thought they must have been Yellows?
A. No. (Very indistinct.)
Q. Seeing that the fog was so thick between New Cross and St. Johns I think it was quite impossible for you to have seen those signals from the left hand side of the engine.
A. Yes.
Q. Not having seen those signals why did you not slow down the train? You saw the signal at New Cross and you did not see the next two signals.
A. The train was running slow.
Q. You reckoned the speed of the train was such that you could have got it under control had the St. Johns signal been at Caution?
A. Yes.
Q. You were not expecting to get that signal at St. Johns at Red, is that the real answer?
A. Yes."

62. Fireman C. D. Hoare is 32 years of age, with 12 years railway service, and has been a fireman for ten years. He received a fairly severe injury to his hip, but on 6th December he was able to make a short statement in hospital to the Stewart's Lane District Motive Power Superintendent, Mr. G. A. Weeden, of which the following is a record:—

" The weather was very foggy, it being variable.

Passing New Cross, the New Cross Down Through Starting signal was showing a Green aspect.

I then started to fire until my Driver asked me to look out for the next signal. I immediately did so prior to entering St. Johns station and when the St. Johns Down Through Starter came into view, it was a Red light. I told my Driver immediately and he made a brake application. The regulator had been closed previously. There was little reduction in speed prior to the impact.

My Driver did not ask me to see the signals between New Cross and St. Johns Starter, nor did he cross the footplate to view the signals. We were running normally.

I estimate the speed at St. Johns at about 40 m.p.h."

63. Hoare was well on towards recovery, though he was still off duty, when Colonel Wilson questioned him on 10th January, after he had seen Driver Trew. He said that he had got on very well with Driver Trew during the two years for which he had worked with him, and that he had " absolutely full confidence in him ". He claimed a " fairly good " knowledge of the particular route. He considered that engines of the " Battle of Britain " class were not difficult to fire and generally steamed well, and he said that Engine No. 34066 " seemed pretty good ".

Hoare said that after the start back from Cannon Street at 6.8 p.m. the fog had been patchy, with visibility " not good and not bad " as far as New Cross. He thought that the speed had been 30–40 m.p.h. all the way to New Cross, compared with the normal speed of 45–50 m.p.h. in clear weather, but he said that the regulator was open through New Cross with the engine not working hard and " near enough normal running ". He observed the " New Cross starter " (A.42) at G and so informed Driver Trew. He then began firing, and he did not look out again until Trew had asked him to look for the signal at the far end of the St. Johns platform; he said that the fog was " definitely thick " at this point. He also said that Trew had asked him about the signal before the engine reached St. Johns and he could not see the station lights at that time. Hoare added that he always made a point of observing that signal (L.18) just like the one at New Cross (A.42), leaving the two intermediate signals (L.16 and L.18) to the driver " because of the (left handed) curve ".

64. On being asked why, under the particular conditions of fog that evening, he had not made a point of observing signals L.16 and L.17 in order to help Driver Trew, Hoare replied that he had got to do his work. He acknowledged that it was a fireman's duty to order his work with the fire and the injector so as to be ready at awkward places to help the driver with the signals, but he considered that he had fulfilled this duty by observing the signals on the right handed curve on the end of the spur and then signal A.42. After this he felt justified in attending to the fire until he made ready to look for signal L.18 at St. Johns. He said that this was a good place to attend to the fire in preparation for the long climb.

Fireman Hoare was pressed further on this point, with special reference to Fireman Emery's statement (paragraph 51) that he had made it his business to look for signals because he knew that his driver could not see all of them from the left hand side. Hoare, however, did not consider that he would have been justified in leaving his firing in order to look out for signals L.16 and L.17 under the conditions that evening. He said that up to New Cross it had been " a reasonable sort of fog ", and he would have expected Driver Trew to have been able to see signals L.16 and L.17 on the left handed curve. He added, however, that in " really thick " fog it was his practice to leave his firing so as to look for the signals. Furthermore, on seeing signal A.42 at Green he thought it probable that the train would have a clear run

through St. Johns, and that there was a good opportunity to get some coal on the fire in preparation for the rising gradients ahead. Like Driver Trew, he said that he had never before been stopped at St. Johns.

65. Hoare went on to say that although he was not expecting Driver Trew to ask him about signal L.18, he was making ready to observe it. He first saw it when he was alongside the St. Johns platform, but he could not say how far along the platform he was. He thought it might have been half way along, and when it was suggested to him that in that case he must have had the signal in view for quite a long time he replied " No, I don't know, 2, 3 or possibly 4 seconds ".

He was quite sure that, when he told Trew that the signal was Red there was no chance of stopping at it, and he began to feel alarmed. He saw Trew put the brake handle down, though there was not much light in the cab, but there was very little, if any, reduction of speed before the impact. He was fairly sure, if not absolutely certain, that the regulator had already been closed, and he added that it was usual to run through St. Johns with the regulator closed so as to reduce the speed for the curve.

On the question of speed, Fireman Hoare told Colonel Wilson at first that the train had been going through New Cross at 30–40 m.p.h., but on being pressed he said that it might have been running somewhat faster, though he was definite that the speed had been less than usual.

66. I also questioned Fireman Hoare on 21st May with reference to his actions between Cannon Street and St. Johns. He re-affirmed that on leaving Cannon Street he looked out for those signals which usually were first seen on the fireman's side. They included the starter on London Bridge platform, the " gantry " signal at North Kent East Junction, and the New Cross starter (A.42). It was foggy in patches, but he was able to pick out those signals without much difficulty—some were easier to see than others. Approaching New Cross the speed was between 30 and 40 m.p.h. and after seeing the starter at Green he made up his fire so as to be ready to observe the signal at the end of St. Johns platform (L.18) and the other two round the curve (M.5/8 and M.10/12). He again explained that he always observed these signals which were difficult to see from the driver's side, but he did not look out for the signals in the cutting (L.16 and L.17) because normally they were quite easily seen by the driver. On this occasion the New Cross starter was at Green and he did not realise that the fog was so thick in the cutting. If the New Cross starter had been showing a cautionary aspect or if he had known about the fog he would have looked out for the next two signals in order to help his driver.

67. The guard of the Ramsgate train was E. W. Humphries. He is a goods guard by grade, but he has been working with expresses on the main line from time to time during the last 6 or 7 years. He joined the train at Cannon Street at approximately 6.0 p.m. Before taking his position in the brake compartment of the 7th vehicle, he was assured by the foreman on the platform that the " rear was O.K.", meaning that the last corridor door was locked, the gangway shield fixed, and the tail lamp in position and burning properly. Humphries explained that he was travelling in the 7th vehicle, as usual, and not in the rearmost brake compartment, because the last three-coach set of this train is regularly detached at Ashford. He did not go forward to the engine, but the foreman gave him the engine number and the driver's name, and he was told by an inspector that it would be necessary to stop at Sevenoaks for water.

Before the train left he noted that the vacuum gauge was registering just under 20 ins. and in order to test the brake he reduced the vacuum to 5 ins. He appreciated that he was required by the rules to test the brake from the extreme rear, but he did not consider that this was important in the circumstances because the continuity of the brake throughout had been proved by the engine which had brought the train in.

Humphries went on to say that " the visibility was nil " and he could see nothing through his periscope, but he managed to see a few signals at Red through the side window at a distance of about a coach length (the signals had been replaced to Red by the occupation of the track circuits by his own train). He did not see signal A.42 at New Cross probably because of the smoke and steam from the engine, and he was recording the passing time at New Cross (6.18 p.m.) when he was thrown to the floor by the collision.

He thought that the speed of the train was about 30 m.p.h. immediately before the collision, and that it had varied little since the train had passed New Cross. He was positive that the train had been running more slowly than usual, and he said that in clear weather the normal speed through New Cross and St. Johns would have been 40–45 m.p.h. Humphries was quite certain that he had felt no brake application before the collision. He had not been looking at the vacuum gauge at the time.

Passengers

68. Two Bricklayers' Arms drivers who were travelling on duty in one of the coaches at the front of the Ramsgate train and were seriously injured made brief statements in hospital on 6th December. These statements were to the effect that the train was travelling at its normal speed right up to the moment of the impact, and they could not recollect having noticed any brake application. Neither was any brake application noticed by a clerk in the Motive Power Department, Mr. E. W. T. Legge, who was travelling home, after duty, in the 7th coach of the Ramsgate train.

69. Passengers who kindly volunteered to give evidence were Mr. W. H. W. Cane and Mr. L. C. Tucker who were in the Ramsgate train, and Group Captain J. N. C. Law, Royal Air Force, who was in the Hayes electric train. Mr. Cane was in the second coach which was crushed by the bridge, and he and one or two others seated close to him had very fortunate escapes from serious injury. He stated that he was a regular traveller on this route and suggested that the speed from New Cross to St. Johns had been less than 30 m.p.h., and he spoke of 30–35 m.p.h. as the normal speed at this point. His impression was that the brakes were not applied before the collision. Mr. Tucker, who was in the eighth coach, thought that the speed had risen to about 30 m.p.h. soon after passing London Bridge, and that it had varied very little after that. He, too, neither felt nor heard any brake application.

70. Group Captain Law, who is a regular traveller on the Mid Kent line, was in the sixth compartment of the second coach of the Hayes electric train, i.e. approximately 33 yards from the front of the train. As it was unusual for the train to be held for any length of time in the position where it was standing, i.e. at signals M.5/8, he left his seat, lowered the window and on looking out he saw the two " deep ruby red " lights of the signals showing very distinctly through the fog, which he described as not really dense. As the front of the train was about 10 yards from the signals he was looking at them from a range of about 43 yards, and he thought that the extreme visibility of these particular signals might have been about 50 yards. He also saw the lights of the houses behind the line at a range of about 30 yards. It should be noted that the line here is on bank where the fog may have been less dense. Group Captain Law had got back to his seat when the collision occurred. From his description, the shock of the impact was felt fairly severely at the front of the train, and he thought that it was pushed forward for a few yards.

VI. Summary of Evidence on Visibility

71. The evidence about the visibility of the relevant signals is summarised in Table 4.

72. The fog was so dense directly after the accident that the first people to begin rescue work at the point of impact did not realise that the bridge had collapsed, and police who walked from St. Johns station estimated the visibility at about 10 yards.

73. A clear and concise letter, describing the character of the fog in South East London in the early evening of 4th December was received in this Ministry from a member of the public, Mr. C. E. Fieldgate. He was driving a car from Dartford across London to Edgware, and he passed close to Lewisham at about the time of the accident. He stated that the weather was clear on Rochester Way, until he reached the valley of the River Cray (7–8 miles east of Lewisham), where he noticed that a bank of fog seemed to be following him. He managed to keep ahead of this bank of fog for a time, but it overtook him when he stopped for petrol just short of Blackheath (2½ miles east of Lewisham), and he stated that the practical driving visibility was then 3 yards or less.

Driving with difficulty across the heath in the fog, he passed some traffic light signals without seeing them, but on descending from the heath he saw and stopped at the traffic lights at Lewisham Road, about ½ mile due north of St. Johns station. By this time the accident had occurred, and he got caught in the stream of ambulances and fire appliances going to the scene. After crossing Lewisham Road, Mr. Fieldgate noted that the fog had gone on the Deptford (north) side, and thereafter his route via New Cross, Southwark Bridge, the City and Highgate Hill was practically clear of fog. The fog became thick again on the other side of Highgate Hill and persisted until he reached his destination at Edgware.

In summarising his letter, Mr. Fieldgate drew attention to the very local character of the fog which " fell into the valley at Lewisham."

VII. Tests of the Signalling Equipment

74. Signal Inspector F. W. Mann, whose headquarters are at Hither Green, received a call at 6.30 p.m. at his home which is close to St. Johns station. He arrived at the signal box at about 6.50 p.m., and on learning what had happened he went out and verified that signal L.18 was at Red. He paced back from the signal and found that its light was obscured by the fog at a range of about 60 yards. This was at approximately 7.0 p.m., 40 minutes after the accident. He then went back to the signal box and verified that levers 17 and 18 were electrically locked by the occupation of track circuits 52 and 53.

In the meantime, Lineman E. M. Peerenboom, who was in his cabin close by, had been called into the box by the signalman's buzzer, and on being told that the Ramsgate train had run past signals he checked that levers 16, 17 and 18 were normal in the frame, all with Red indications. He then went outside and checked that signal L.18 was at Red, and he went back a little later and found that signals L16 and L.17 were also at Red. He stated that on his routine inspection two days before the accident he had changed the Red aspect bulb of signal L.16 because the main filament had burnt out (the secondary filament was still intact), but he had no occasion to change any of the bulbs of signals L.17 or L.18.

75. The signalling equipment was thoroughly tested on the following morning by Inspector Mann under the supervision of Mr. A. W. Damon, the Assistant Signal Engineer. The first test which was made was to verify (*a*) that the signals were responding correctly to their levers, (*b*) that the correct aspect was displayed at each signal in relation to the aspects of the signals ahead, and (*c*) that the indication behind each lever corresponded with the aspects shown at the signal. At automatic signal A.42 only test (*b*) was possible. These tests were carried through between signal A.42 and signals M.10/12 at Parks Bridge Junction inclusive by pulling the appropriate levers in succession with a man at the signal under test to check the aspect and telephone to the box. Mr. Damon and Inspector Mann stated that these tests were satisfactory in every way.

76. In addition, insulation tests were made with a 500-volt megger of all the signal aspect circuits. The four aspect line wires for each individual signal were tested as a group for insulation to earth, and then each individual line was tested to earth and to each of the other line wires in turn. The lowest " group " test record of insulation to earth was 150,000 ohms at signal L.18, and the lowest recorded insulation resistance for any individual line wire was 500,000 ohms, also at signal L.18 (Red aspect).

Mr. Damon stated that he was entirely satisfied with these insulation tests, and that there was not the remotest possibility of a false indication having been shown as the result of electrical leakage.

TABLE 4

SUMMARY OF EVIDENCE ON VISIBILITY

Train	Witness	Visibility between London Bridge and New Cross up to Signal A.42		Visibility between New Cross and St. Johns Signals L.16, L.17, L.18 and M.5/8	
		Approx. Time p.m.	Remarks	Approx. Time p.m.	Remarks
5.5 p.m. steam train to Hastings (A).	Driver Frewin ...	5.50–5.55	Not much difficulty in seeing the signals.	5.55–6.0	No statement on visibility. Did not observe the signals from his side.
	Fireman Emery ...	5.50–5.55	Visibility not too bad.	5.55–6.0	L.16 and L.17 seen at last moment, perhaps 5 yards. L.18—about a boiler length.
5.25 p.m. diesel-electric train to Hastings (C).	Driver Bishopp ...	5.55–6.3	A bit foggy. Visibility not too bad.	6.0–6.8	L.16—about 50 yards. L.17 and L.18—a coach length or two.
5.18 p.m. electric train to Hayes (D).	Motorman Skilton...	6.0–6.5	Visibility fairly reasonable.	6.5–6.10	Not very definite. L.16 and L.17 10 yards. L.18 and M.5/8 5–8 yards. Fog particularly dense around St. Johns station.
	Driver Crane ...	6.0–6.5	Not bad as far as New Cross.	6.5–6.10	A good deal thicker after New Cross. View of signals in cutting down to 4–5 yards.
	Fireman Nash ...	6.0–6.5	Patchy. Not too bad up to New Cross.	6.5–6.10	Very dense at St. Johns.
	Group Captain Law	6.12	—	6.12	Saw twin red lights of M.5/8 at 43 yards. Extreme visibility of these signals estimated at 50 yards.
4.56 p.m. steam train to Ramsgate (E).	Driver Trew ...	6.10–6.18	A little better than between New Cross and St. Johns. Saw signals just as he was getting on to them. Perhaps 20–30 yards.	6.18–6.20	Could scarcely see anything.
	Fireman Hoare ...	6.10–6.18	A reasonable sort of fog. Not really thick.	6.18–6.20	Definitely thick. Signal L.18 in view for 2, 3 or possibly 4 seconds.
—	Signalman Presslee of St. Johns signal box.	—	—	6.20	Could see lights of Ramsgate train at about 15 yards. Visibility varying before the accident.
—	Signal Inspector F. W. Mann.	—	—	7.0	Signal L.18 just obscured at 60 yards (paced).

VIII. The Brakes of the Ramsgate Train

Stopping distances

77. As has been mentioned in paragraph 2, the brake cylinders of seven of the eleven coaches of the Ramsgate train were fitted with direct admission valves, which serve to accelerate the response of the train brakes to the driver's application. Static tests with a " Battle of Britain " class engine attached to a train composed of similar vehicles to those of the Ramsgate train showed that with an emergency application the vacuum at the extreme rear of the train was reduced by 10 ins. in 10 seconds, and was practically destroyed in 20 seconds. With the partial application, the vacuum at the rear was reduced by 5 ins. in 10 seconds, and in 20 seconds the 10 ins. reduction at the engine had been propagated throughout the train.

78. The stopping distances which might have been possible with the Ramsgate train were estimated by the Chief Mechanical and Electrical Engineer of the Southern Region, with due allowance for the rising gradient of 1 in 218 at signal L.18 and beyond it. These distances are given in Table 5.

Table 5

Estimated stopping distances of the Ramsgate train on a 1 in 218 rising gradient

Speed (m.p.h.)	Stopping Distance (yards) from point of emergency application
20	55
25	87
30	130
35	175
40	235
45	310
50	395

This table makes no allowance for the distance lost on account of a driver's reaction time in appreciating an emergency and applying the brakes.

In furnishing these figures, the Chief Mechanical and Electrical Engineer observed " I would point out that it has been necessary to interpolate between two well established stopping distance curves for emergency applications, inasmuch as the train was composed partly of B.R. and partly of S.R. stock. The effect of gradient has also had to be taken into account, and the figures given are, necessarily, of an approximate nature, particularly as the initial speeds specified are relatively low, this feature making the initiation of the brake application and the rate of propagation very critical."

Tests and Examinations

79. In view of Driver Trew's initial statement that he applied the brakes before reaching signal L.18, much evidence was taken and exhaustive tests were made to establish their integrity. It has already been stated (paragraph 46) that Driver C. W. Stewart, who had brought engine No. 34066 light from Stewart's Lane to the carriage sidings at Rotherhithe Road, reported that the steam and vacuum brakes on the engine and tender were in good working order. Driver F. Jeffrey, who relieved him at Rotherhithe Road, and the guard of the empty train, E. Coe, both stated that they made a satisfactory test of the train brakes together before it left the siding, and Coe said that he had initiated the test from the brake compartment at the extreme rear. After the train had been pulled out of the siding, the pilot engine, which was to haul it to Cannon Street after reversal at North Kent East Junction, was attached at the rear, and before the train left the Junction two further tests of the continuity of the brakes were made between Driver Jeffrey's engine and the pilot engine the other end.

In these circumstances, it was not considered necessary to question the driver of the pilot engine, especially as Guard Coe said that the brakes had worked properly at the many signal stops on the way to Cannon Street, and finally when the train stopped in the platform just clear of the buffer stops.

The vacuum was destroyed throughout the train when the pilot engine was uncoupled at the buffer stops, and the vacuum was created again by Driver Trew about five minutes later. Guard Humphries stated that on taking over the train he made a test from the seventh vehicle, in which he was to travel (paragraphs 42 and 67), by reducing the vacuum from about 20 ins. to 5 ins., but Driver Trew made no mention of this test. It is possible that he did not notice the fall of vacuum on the gauge, and as soon as Humphries closed his van valve again the small ejector would have restored the vacuum without any action on Trew's part. With all the signals clear, Driver Trew had no occasion to use the brake until he had passed New Cross.

80. Although Driver Stewart had been entirely satisfied with the brakes of engine No. 34066, the engine vacuum connections were dismantled and were examined by Mr. E. Dibb, the Head Office (Mechanical) Inspector of the Motive Power Department.

Mr. Dibb explained that the chief object of his examination was to make sure that there was no obstruction in the pipes between the vacuum ejector on the footplate and the rear hose connection of the tender. All the steel and flexible pipes and their connections were taken down and tested mechanically with a light and by poking through with a rod. All were found to be clear.

Mr. Dibb also found that the right hand vacuum cylinder was free in its trunnions and the piston free in the cylinder, but the piston and cylinder on the left hand side were jammed owing to a fracture of

the cast iron vacuum cylinder by the buckling of the tender frame in the collision. The cylinder and piston of the engine steam brake were in order.

81. The complete vacuum ejector with its associated steam brake valve was transferred, without receiving any attention, to a similar engine, No. 34068. It was found to be working correctly, and Colonel Wilson made a personal test when he travelled on this engine to view the signals (paragraph 31).

After the accident Mr. Weeden found that the vacuum brake handle was in the fully applied position and that the vacuum controlled steam brake valve was closed, but by that time, there was no steam in the boiler (and no vacuum), and under these conditions, the steam brake handle could have fallen to the closed position by its own weight.

82. Equal care was taken to test the vacuum brakes of the coaches. About 2½ hours after the accident the brakes of the last nine coaches were found to be still hard on, and on the following day some of the brakes had to be released by hand before the coaches could be moved. This was no proof that a brake application had been made by Driver Trew because the first three vacuum hose connections had been ruptured in the collision; it proved, however, that sufficient vacuum for a strong brake application had been maintained throughout the train. It was also noted that the piston of the leading vacuum cylinder of the 1st coach had moved upwards by 3½ ins. and that the piston of the trailing cylinder had gone fully home as a result of damage to the rigging.

It was not possible to test the working of the brakes of the 1st and 2nd coaches, but those of the last nine coaches were tested in the sidings of St. Johns station under the supervision of Mr. N. Hill. the Chief Carriage and Wagon Inspector of the Southern Region. The last seven coaches were tested together in their proper order, but the 3rd and 4th coaches had to be tested separately as a pair on account of the damage which they had received.

A vacuum of 20 ins. was created, and it was found that all the brakes were properly released. The vacuum was then destroyed, and all the pistons moved upward to press the brake blocks hard on to the wheels. All the piston strokes were between the authorised limits of 3½ ins. and 7¼ ins ; the brakes of the first six of the nine coaches had been adjusted two days before the accident, and the piston strokes varied little from 3½ ins., and in the last three-coach set the strokes of all the pistons were about 5 ins.

This test proved that the train pipe was clear along the last nine coaches of the train. The train pipe of the first and second coaches was cut into short sections, and no obstruction was found by the Senior Carriage and Wagon Inspector of the London Area, Mr. F. Scott. It was found that the grilles in all of the vacuum hoses were in order and in place. These grilles are designed to prevent cotton waste or cleaning cloths from being drawn accidentally into the train pipe.

IX. Conclusions

83. The detention of the Hastings diesel-electric train for several minutes at the Parks Bridge Junction signals M. 10/12 resulted in the Mid Kent electric train to Hayes being stopped at M. 5/8, the next signal in rear, and the occupation of track circuit 53 by this train held signal L. 18 at Red, 138 yards behind it. The signalling equipment, which was thoroughly tested, was found to be in order throughout, and consequently signals L. 16 and L. 17 must have been showing the correct Double Yellow and Yellow warning aspects at distances of 892 yards and 469 yards respectively from signal L. 18 at Red. These were the first adverse signals which the Ramsgate train had received after leaving Cannon Street with the Hayes train appreciably far ahead.

84. The diesel-electric train would not have been held for so long at signals M. 10/12, and might not even have been stopped there, had not Signalman Beckett thought that it was the Mid Kent train which was by then indicated on the train describer.

The statement of Signalman Presslee of St. Johns box that he described the diesel-electric train forward to Parks Bridge Junction at the right moment was confirmed by the St. Johns train record sheet in which the entries appeared to have been made currently by the booking lad. It is most probable, therefore, that Signalman Beckett, who had not the assistance of a booking lad, missed the description of the diesel-electric train, as he admitted possible, and, having no record, he supposed the trains were running in their correct order with the Hayes (Mid Kent) train leading.

This led to the unusual stopping of the Hayes train at signals M. 5/8 because the diesel-electric train was being held unnecessarily at the signal ahead. I should make it quite clear, however, that although Signalman Beckett made this mistake he was in no way whatsoever responsible for the collision. With L. 18 at Red and with L. 16 and L. 17 showing correct aspects in rear of it, the Hayes train was fully protected by signals.

85. Driver W. J. Trew of the Ramsgate train admitted from the first that he passed the St. Johns starting signal L. 18 at Red, but subsequent statements explaining his grave error were contradictory. When interviewed by Colonel Wilson on 10th January he stated that he saw signals L. 16 and L. 17 showing Double Yellow and Yellow respectively and that he had applied the brake before reaching St. Johns, but when he gave evidence before me on 21st May he said that he did not see signals L. 16 and L. 17, and having got a Green at A. 42 he was not expecting a Red at L. 18 where he had never been stopped before.

86. A great deal of evidence was given about the density of the fog and the view of the colour light signals, and this is summarised in Table 4 and paragraphs 72 and 73. Although visibility generally was bad in the London area during the afternoon and evening, the drivers of the evening Down trains on the Eastern Section main line had not much difficulty in observing the signals as far as New Cross. The line, which is

on viaduct for most of the way up to there, then runs into a fairly deep cutting at the country end of the station just past signal A. 42. This cutting extends with some retaining walls and a short tunnel and several overbridges as far as signal L. 18 at the country end of St. Johns station. All the witnesses agreed that the fog was much denser in the vicinity, and I conclude that at the time of the accident visibility was reduced to between 10 and 30 yards. It will be seen from Table 2 that in these conditions the view of signals L. 16, L. 17 and L. 18 from the left hand driver's seat of a " Battle of Britain " class engine would have been obscured by the boiler before their glow became visible to the driver. The evidence of Driver Frewin of the Cannon Street—Hastings steam train shows that he could not see the aspects of these signals even from the footplate of a smaller " Schools " class engine, and he relied on his fireman to observe them.

I am, therefore, convinced that Driver Trew did not see signals L.16, L.17 or L.18, and accordingly he did not make a brake application until after his fireman had called out that L.18 was at Red.

I consider that his severe shock accounts for his contradictory evidence. His earlier statements about his actions between New Cross and St. Johns were, I believe, based on what he thought he saw and on what he thought he should have done, and his later statements were made after he realised ultimately that he could not possibly have seen signals L.16 and L.17 through the fog.

87. Estimates of speed generally vary widely according to individual judgment, more particularly in fog when landmarks are blotted out, and it is usually better to rely on an assessment made from a study of the wreckage and other factors. The complete destruction of one coach of the electric train and the severe damage to the steam train show that the force of impact was severe, but it was intensified by the relatively unyielding obstruction of the stationary electric train standing with all brakes fully applied. Taking these factors into consideration, it seems likely that the speed of the Ramsgate train at the moment of impact was 30 m.p.h. or a little higher.

88. Although Guard Humphries of the Ramsgate train and other witnesses said that they did not notice any retardation of the train before the collision, I accept the fireman's evidence that the driver applied the brakes but the speed of the train was scarcely reduced. There is no question, however, of a brake failure because the tests made by the trainmen who took the empty stock to Cannon Street and the thorough examination of the equipment after the accident satisfied me that the brakes had been in good order. Driver Trew was not expecting to be stopped at signal L.18 and I have no doubt he was taken by surprise when his fireman called out that the signal was Red. He is not of the type to re-act rapidly to an emergency, and in these circumstances it is probable he did not apply the brakes until after the engine had passed the signal. The rear of the electric train was only 138 yards ahead, and this distance would have been covered in less than ten seconds. Consequently the reduction in vacuum should scarcely have reached the rear of the train before the collision and the brakes would only just have begun to take effect. I conclude, therefore, that Driver Trew's attempt to stop the train reduced its speed a little but it was made too late to be effective.

89. It is difficult to understand that a driver with Trew's experience and knowledge of the route made no attempt either to observe signals L.16 and L.17 himself or to ask his fireman to look out for them. He knew that these signals were on the right hand side of the line and that the view of them from the driver's seat was obstructed at close range by the engine boiler. In the prevailing conditions of very poor visibility, clearly he should have crossed to the right side of the cab or told his fireman to look out. Instead, he remained seated staring ahead through a narrow spectacle glass while the engine ran on through the dense fog into the cutting between New Cross and St. Johns. I can only conclude that he did not appreciate how severely the visibility was reduced. Also I have little doubt that having seen a Green aspect at A.42, he assumed unjustifiably that he would not be stopped at L.18 because he had never before been stopped there. Consequently he did not reduce speed when he missed signals L.16 and L.17, and as already mentioned his attempt to stop the train was made too late. Therefore I hold Driver W. J. Trew solely responsible for this accident.

Trew is 62 years old with 45 years' railway experience, and he has been a driver for the last 18 years. He has a thorough knowledge of the Eastern Section main line and he has been driving " Battle of Britain " class engines for the last 13 years. He is described by his supervisors at Ramsgate Motive Power Depot as a loyal, conscientious worker, not so quick witted as some, but reliable and sober. He was in good health on the day of the accident, and I can find nothing to account for his lamentable failure on this occasion, except for his unwarranted assumption that signals which he did not see stood at Clear instead of at Caution.

90. Although signals L.16 and L.17 were on his side of the line, I do not consider that Fireman C. D. Hoare should be criticised for failing to observe or remark on them because in clear weather these signals can usually be seen by the driver without difficulty. Hoare had a good knowledge of the route through New Cross and I am satisfied that, in accordance with his usual custom, he was helping his driver by looking for those signals which normally are seen first from the right hand side of the footplate. Having seen the New Cross starter, A.42, at Green and unaware the fog in the cutting was so dense, he took the opportunity of making up the fire before ascending the long gradient to Knockholt. I accept his statement that had he known the fog was so dense he would have looked out for signals L.16 and L.17, as did the fireman of an earlier steam train.

X. Remarks and Recommendations

91. This accident should have been prevented by Automatic Train Control of the Warning type. With this equipment an audible warning is given in the engine cab on the approach to a semaphore distant signal at caution, or to a multi-aspect colour light at Double Yellow, Yellow or Red. In addition, should the driver fail to respond to the warning, there is an automatic application of the brake sufficiently powerful to stop a train from high speed with the engine regulator fully open. Had Warning Control been installed on the Eastern Section main line through New Cross a siren would have been sounded in the engine cab on the approach to signals L.16, L.17 and L.18, and I am convinced that Driver Trew would not have ignored these warnings and that he would have got his train under control before he reached L.18 at Red.

Alternatively, had Trew been in charge of an electric or diesel-electric train with no obstruction in front of the driver's cab he could scarely have failed to see the powerful colour lights, although they were on the right of the line.

92. After several years of extensive trials the British Railways system of Automatic Warning Control was finally approved in November 1956, and the British Transport Commission have planned to install this safeguard on all the main routes in this country. It is not practicable nor are there sufficient technical resources available to undertake all this work at once, but the Chairman of the British Transport Commission has given his assurance that the Commission will do all in their power to accelerate the programme.

In the Southern Region, Automatic Warning Control will be installed first on the West of England main lines from Waterloo to Exeter and Bournemouth where most of the signals are semaphores, and large quantities of ground and engine apparatus have already been ordered for use on these and other main lines throughout the country. The equipping will follow of the Southern Region main lines radiating from London to the Kent and South Coasts including the Eastern Section main line through New Cross.

93. It must never be supposed that Automatic Warning Control will relieve drivers of their responsibility for the observance of signals, which is and always will be their fundamental duty, but it will help them, particularly in conditions of poor visibility. Multi-aspect colour light signals with their powerful and penetrating beams of light are also of great value in such circumstances, and these are being installed in increasing numbers throughout the country. The multi-aspect signalling on the Eastern Section main line, which was brought into use between 1927 and 1929, has contributed in no small measure to the safe and efficient operation of one of the most densely occupied railway lines in the world, on which, until now, no train accident involving passenger fatalities had occurred during the last 30 years.

94. Other occasions when steam locomotive drivers have failed to respond to colour lights have led to serious accidents, notably at Harrow and Wealdstone in 1952, when a driver passed a colour light distant signal at speed in thick morning mist, and in 1944 at Ilford, where a driver ran past three colour lights (one at Yellow and two at Red) at night in dense fog. Consequently, when the plans for the development of Warning Control were made, it was decided to extend the use to colour lights as well as to semaphores, but with priority to those lines which are mainly equipped with the latter type of signal.

95. Many suggestions have been received for the improvement of railway safety, including proposals for a train stop or similar apparatus which imposes an irrevocable brake application on a train passing a signal at danger. Before considering the merits of this proposal, one should recall that with the system of signalling on British Railways, a driver is adequately warned of his approach to a stop signal at danger by a distant signal which is sufficiently far for the fastest and heaviest train to be stopped in time. Consequently the overlap ahead of the stop signal, which must be clear of obstruction, allows only for misjudgment by a driver in controlling his train after receiving a caution, and not for his absolute failure to apply the brakes.

A system of train stop control is in use on tube railways such as the London Transport Railways where conditions are exceptional. The trains are of standard type and they travel at relatively low speeds and regular intervals. The overlaps beyond stop signals are of sufficient length for a train to be stopped, but they are relatively short. On a main line, however, where trains vary so much in weight and in speed, the introduction of such a system by itself would result in increasing very greatly the lengths of the overlaps beyond stop signals, which would reduce to an unacceptable extent the capacity of many of the very densely operated sections of the line. Furthermore, it would be extremely costly and it would also necessitate the complete re-signalling of the lines.

Statistics show that the provision of train stops at stop signals, in addition to Warning Control at distant signals, would add little to the safety of travel, and that during the 46 years from 1912 to 1957, 31 per cent. of the fatalities in train accidents might have been saved by Warning Control alone, while with both forms of control this figure would have risen only to 38 per cent. The cost of equipping the main lines with Warning Control will be high, but the cost of installing both systems would in no way be commensurate with the advantages obtained.

I consider therefore that on the main lines in this country the British Railways latest system of Warning Control, with its audible signal in the cab, its visual reminder and its automatic brake operation if the driver fails to respond, is, at present, the best practicable aid to drivers in controlling their trains safely under all weather conditions.

96. Although the Down Through signals between New Cross and St. Johns are on the right hand side of the line, they are well sited, taking into consideration the difficult conditions of curvature, cuttings and overbridges, and it is doubtful whether much improvement would result from moving them to the left hand side of the line. The view from short range would be improved, but from long range it might be reduced. Furthermore, this problem will not long persist because the Southern Region modernisation plan provides for the replacement of all steam trains on this section by electric or diesel-electric trains controlled from driving cabs with no obstructions in front of them; the New Cross and St. Johns signals will then be clearly visible both at long and short range.

Owing to the intensity of traffic and the existence of so many junctions, the signals on this part of the Eastern Section main line have to be closely spaced, and the overlaps have been reduced to a minimum, but the distances between a Double Yellow and a Red signal, even without the sighting distance, allow ample space in which to stop a steam or diesel-electric train from the maximum permissible speed. Electric trains with their more powerful brakes require even shorter distances.

There is, therefore, no need to make any alteration to the siting and spacing of the signals on this line.

97. As already mentioned, work on the installation of Automatic Warning Control has begun on the Southern Region West of England main line, and it will be extended later to other main lines in the Central and Eastern Sections of the Region. I do not suggest any alteration in the priority of this work because this safeguard is more needed on lines with semaphore signals which are operated by steam engines than in colour light areas where electric or diesel-electric trains mainly are running. In view, however, of the very dense traffic on the Eastern Section main line, its equipment with Automatic Train Control will rank high in the next stage of the programme.

98. Although the view ahead from the driver's seat of a " Battle of Britain " class engine is adequate, the close range view of signals on the right hand side is much restricted by the long boiler. This applies to most modern engines, but it is particularly noticeable on the original " Battle of Britain " engines, with their 8 ft. 6 ins. wide cabs, which were built to run on the Hastings line, with its restricted loading gauge. In consequence the spectacle glass is small and the glass windscreen is narrow. These have been improved on the later engines with 9 ft. wide cabs, and some of the original engines have also been rebuilt with the wider cabs. Diesel-electric multiple units are now running on the Hastings line, and consequently the 8 ft. 6 ins. restriction need no longer be applied to the " Battle of Britain " engines. They will, however, be running on the West of England main lines for some years, and I recommend, therefore, that they be fitted with wider windscreens until they are rebuilt with wider cabs.

99. Many improvements have been made since the Walker's train describer was first introduced 30 years ago. For example, the modern magazine instrument, which stores the descriptions transmitted to it, shows on a display panel those trains which are at or approaching the signals controlled from the signal box. Thus a description remains in view until the train has actually passed into the section ahead, and a signalman should have no difficulty in identifying any train which may have stopped in his section.

Similarly, omnibus telephone circuits have been superseded by selective ringing or individual circuits with visual location indicators on a control panel in the signal box, thus enabling a signalman to know at once from which signal a speaker is telephoning.

These modern equipments add to operating efficiency, which cannot be dissociated from safety, and they are now used extensively in colour light signalling installations. In view of the intense traffic on the Eastern Section main line and its probable increase after modernisation, the replacement of the Walker's train describers and omnibus telephones is being reviewed in connection with this programme.

100. It has been suggested that a powerful tail light on the back of the electric train might have prevented this accident, but the train was in fact protected by a powerful electric signal light 138 yards in rear, and even then the available distance was not sufficient in which to stop the Ramsgate train by the time the driver realised his mistake. It should be pointed out that trains in this country are run on the space interval system, whereby only one train at a time is allowed in a block section and the train ahead is invariably protected by caution and danger signals which should give ample warning to any approaching train. There are, admittedly, cases when good tail lights might have prevented accidents, and the British Transport Commission is carrying out experiments to improve the present lights.

101. Other suggestions for improving railway safety make reference to radar and radio. The possibility of using radar has been considered from time to time in consultation with scientists who have specialised in this subject, but the general conclusion is that radar is not applicable at present to railway conditions despite its proved success at sea and in the air. One of the difficulties is that radar works in straight lines and consequently it is not possible to tell on curves whether an obstruction seen on the radar screen is on the same or an adjoining line. Such confusion would be dangerous and hence radar cannot yet be considered as a substitute for, or an addition to, signalling.

The use of radio in railway operation has also received a great deal of consideration, but in its present state of development, it has not been found suitable for controlling the movement of trains in this or other countries with similar railway systems, owing mainly to the very large number of train movements and signal boxes involved, and the consequent difficulty in ensuring that messages are received and properly understood by the right persons.

Radio is already in general use in other spheres of railway working, such as in marshalling yards, where messages can be transmitted rapidly from shunting staff to engine crews and where misunderstanding will not endanger the safety of the travelling public.

The possibilties arising from the development of electronics are not being neglected by the British Transport Commission, and investigations into its application are proceeding.

102. It was a stroke of great misfortune that the collision took place underneath a heavy rail overbridge and that one of the supporting columns was knocked away, thus precipitating the girders of the bridge on to the train below. The design of the bridge and its supports was sufficiently strong to carry all normal loads with an adequate margin of safety, and I know of no other case in which a bridge has collapsed in this way, but in view of the serious consequences of this accident the problem will be considered in future bridge design. I understand that, where practicable, safeguards will be included to reduce the risk of collapse if the supports of an overbridge are struck accidentally.

103. On this occasion the casualties would undoubtedly have been even heavier but for the commendably prompt action of Motorman D. S. Corke in stopping the Dartford train as it was running on to the overbridge. His action saved the leading coach and possibly the next one from toppling on to the wreckage

below. Not only was Motorman Corke keeping a sharp look-out for signals, as was his duty, but he acted immediately on seeing the tilting girders of the damaged bridge.

104. The serious dislocation of traffic caused by the widespread fog, followed by a disastrous collision, aroused alarm among some members of the travelling public, and a number complained that a " fog service " had not been introduced on the Eastern Section of the Southern Region. Before considering this particular problem, I should make it clear that a " fog service " is instituted to reduce the pressure on track capacity and so make it easier to keep traffic moving. It is not a safety precaution and it has nothing to do with " fog signalling ".

It is well known that fog disrupts all forms of transport, but it normally interferes less with railways than with air, sea or road transport because trains travel on fixed lines and their movements are rigidly controlled by fixed signals. Speeds are reduced because observance of signals is more difficult on account of reduced visibility, and special precautions are necessary to reduce the risk of accident. Comprehensive rules covering all aspects of fog working are given in the British Railways Rule Book. They include the stationing of fogsignalmen with detonators, flags and handlamps at appropriate semaphore signals in order to give drivers warning of adverse aspects, and the introduction, when necessary, of double block working whereby two block sections ahead instead of one must be clear before a train is allowed to go forward. As stated in paragraph 23, it is only in exceptional circumstances that fogsignalmen are employed where there are colour light signals, which can be seen so much better than semaphore signals.

These precautions are taken to help drivers in their highly responsible task of controlling trains in conditions of bad visibility, and the extent to which movement continues on the railway compared with other forms of transport is striking evidence of the skill and endurance of the staff and the efficiency of the system.

105. The reduced speeds of trains in fog lead to delays and late running which tend to become cumulative on such highly complicated railway systems as those operating in the suburban and outer suburban areas of the Southern Region. It will be noted from paragraph 20 that during the busiest hour of the evening peak, 81 trains pass through St. Johns—one train every three quarters of a minute. To ease the situation, fog services are introduced where possible and fewer trains are worked, but experience has shown that on the Eastern Section where trains are normally overcrowded during the peak hours, any material reduction of the business services is undesirable because of the resultant serious congestion of passengers at the London termini.

Accordingly it will be appreciated that during fog, delay and overcrowding of trains is inevitable in the peak hours, and in the Eastern Section last winter these conditions were aggravated by the operating difficulties in working a temporary signal box at Cannon Street.

106. In conclusion, I wish to pay tribute to the late Lieutenant Colonel G. R. S. Wilson's skilful and exhaustive summary of the evidence and to his masterly presentation of the facts, on which this report is largely based. I also acknowledge with appreciation the help which I have received from the officers of the Southern Region.

I have the honour to be,

Sir,

Your obedient Servant,

C. A. LANGLEY,

Brigadier.

The Secretary,

Ministry of Transport and Civil Aviation.

APPENDIX

Walker's Pattern Train Describers

With these instruments one description only is displayed at a time. Both transmitting and receiving instruments consist of circular glass covered dials around which a pointer can rotate. On the circumference of the dial a number of white discs are fixed, usually twelve, each at the clock hour positions. On each disc a route or train description may be engraved in words, as also can " cancel ".

Separate pairs of transmitting and receiving instruments are installed for describing (*a*) the route to be taken by a train and (*b*) the type of train.

The transmitting instruments are operated by clockwork type mechanism, the pointer rotating in a clockwise direction, step by step from one description to the next. Around the circumference of the instrument case, on the outside, small levers are disposed one at each description. These can be pulled forward, left in the forward position, and later restored to normal. The pointer can be held at any description by pulling forward the lever at that description. Restoration of the lever frees the pointer so that it is driven around the dial until another lever is pulled forward at which description the pointer will again come to rest.

Transmitting instruments are connected electrically to corresponding receiving instruments at the next signal box. Each pointer movement from one disc to the next in the transmitter sends an electrical impulse to the receiver, causing its pointer to follow " in step ". Each " step " of the pointer produces an audible " click ".

Thus at St. Johns, to describe, for example, an electric train running on the Down Through line and destined for Orpington, the Down Through *route* transmitter would first be used, and its pointer would be set in motion by pushing back to normal the lever at which the pointer is held, i.e. at the last indication sent. The pointer would then revolve round its dial, by steps clockwise until the lever at " Main Line " is pulled and left forward, on which the pointer would come to rest at " Main Line ". The Down Through *route* receiver at Parks Bridge Junction would have followed in step and its pointer also would have come to rest at " Main Line ".

Immediately after that, the Down Through *train* transmitter at St. Johns would be run round in the same way to " Main electric ", and the Down Through *train* receiver at Parks Bridge Junction would follow suit. Thus the complete description received on the two dials at Parks Bridge Junction would be " Main Line "—" Main Electric ".

At the time of the accident there was no special description for a diesel electric train and consequently the " Main electric " disc was used for this purpose. A separate disc for " Main diesel " has now been made available by combining two freight train descriptions under one heading.

The springs of the transmitters are wound once each 24 hours.

(86575) Wt. 2172—V 140 K28 7/58 D.L.

SOUTHERN REGION

COLLISION AT ST. JOHNS, LEWISHAM

4th. DECEMBER, 1957

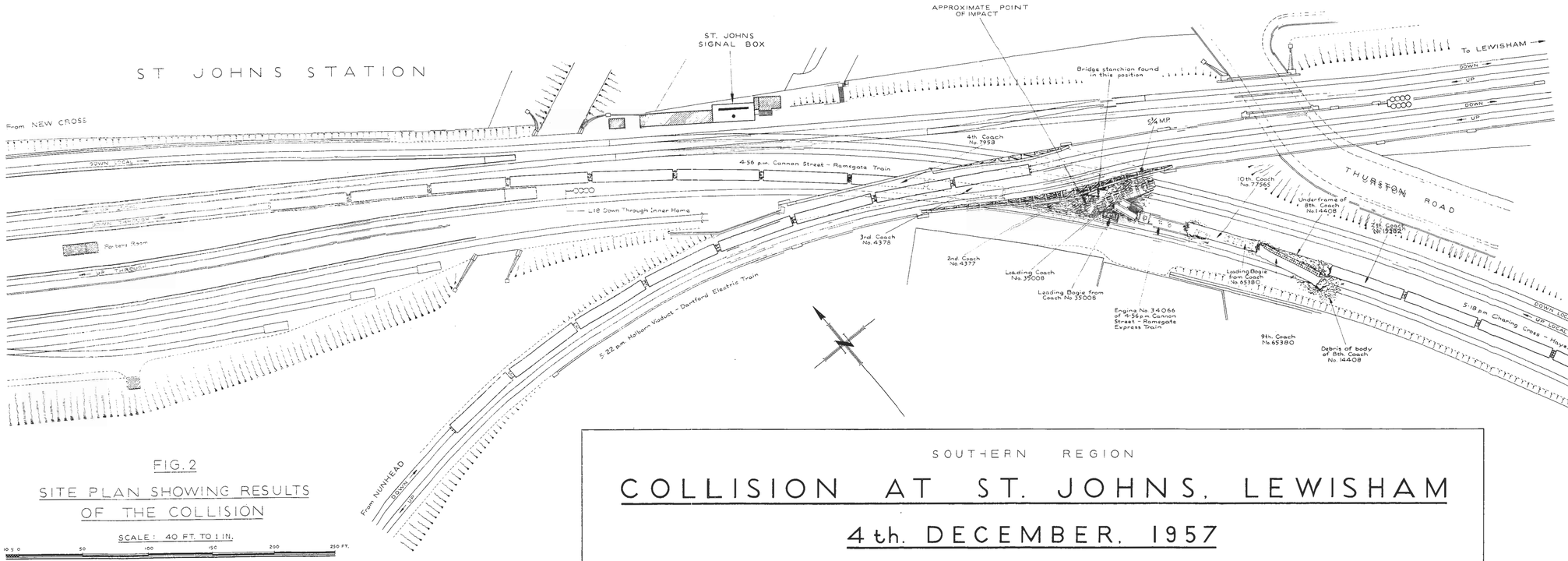


FIG. 2

SITE PLAN SHOWING RESULTS OF THE COLLISION

SCALE: 40 FT. TO 1 IN.

FT. 10 5 0 50 100 150 200 250 FT.

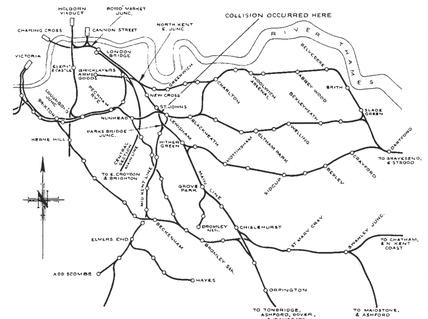
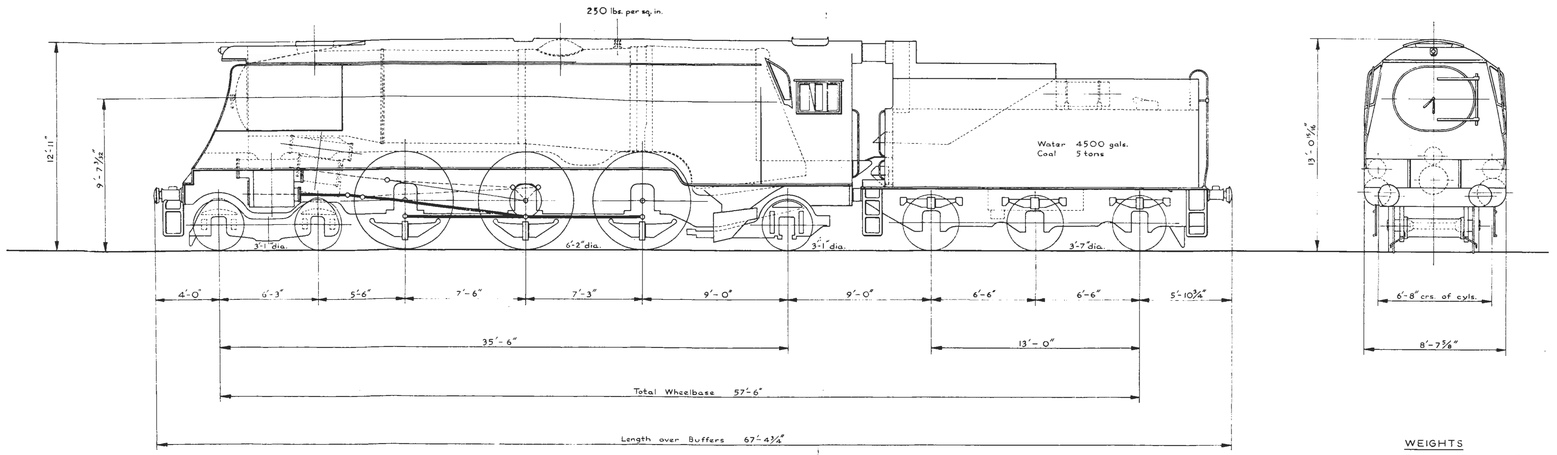


FIG. 1

SKETCH MAP SHOWING THE PRINCIPAL EASTERN SECTION LINES IN THE LONDON AREA

6812 (H.P.P.)

FIG. 3 ENGINE No. 34066 —— BATTLE OF BRITAIN CLASS



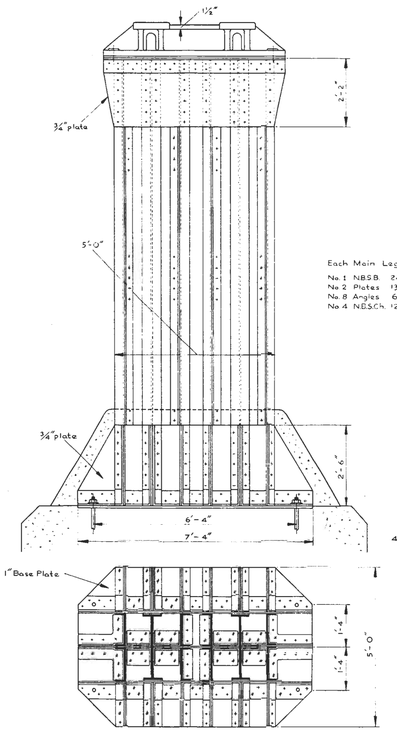
Weights in working order	T. C.	T. C.	T. C.	T. C.	T. C.	T. C.	T. C.	T. C.
	15 - 10	18 - 15	18 - 15	18 - 15	14 - 5	13 - 13	14 - 4	14 - 15

WEIGHTS

	Engine	Tender	Total
	T. C.	T. C.	T. C.
Empty	77 - 0	17 - 5	94 - 5
Working order	86 - 0	42 - 12	128 - 12

Built at Brighton 1947

SCALE: ¼ INCH TO 1 FOOT



Each Main Leg of Stanchion
No. 1 NBSB 24" x 7½" x 90 lbs.
No. 2 Plates 13⅜" x ½"
No. 8 Angles 6" x 3½" x ⅝"
No. 4 NBS.Ch. 12" x 3½" x 25·25 lbs.

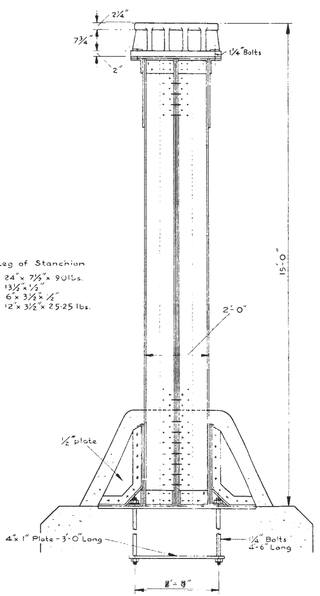


FIG. 4
BRIDGE No. 111
INTERMEDIATE STANCHION
COUNTRY SIDE

SCALE: ½ INCH TO 1 FOOT

WIDEWAY AND SIXFOOT DIMENSIONS		
LOCATION	WIDEWAY BETWEEN DOWN & UP THROUGH	SIXFOOT BETWEEN DOWN & UP THROUGH
SIGNAL A 42	——	5'-11"
" L 16	10'-10¼"	6'-5½"
" L 17	11'-5½"	6'-4½"
" L 18	12'-5½"	7'-8¼"

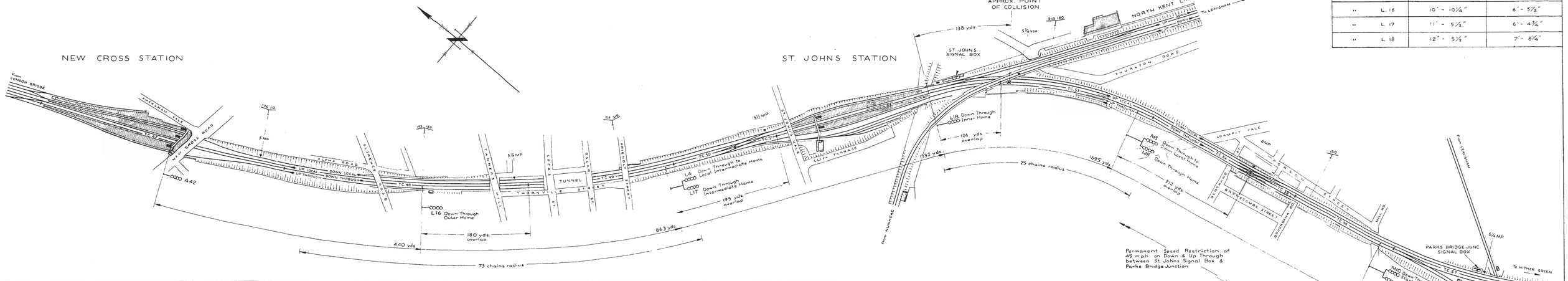


FIG. 5

GENERAL PLAN — FROM NEW CROSS TO PARKS BRIDGE JUNCTION. ALSO SHOWING RELEVANT SIGNALS AND TRACK CIRCUITS

SCALE: 1/2500

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

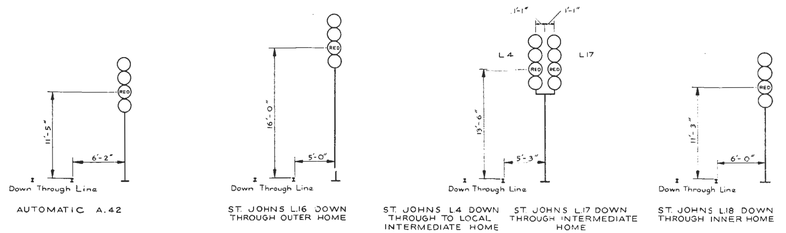


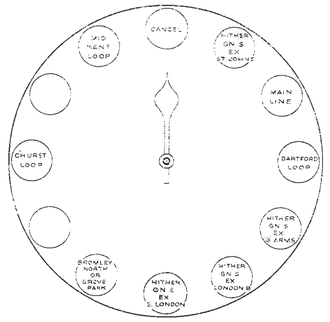
FIG. 6

VERTICAL AND LATERAL POSITIONS OF SIGNAL ASPECTS

6612-2172-V140

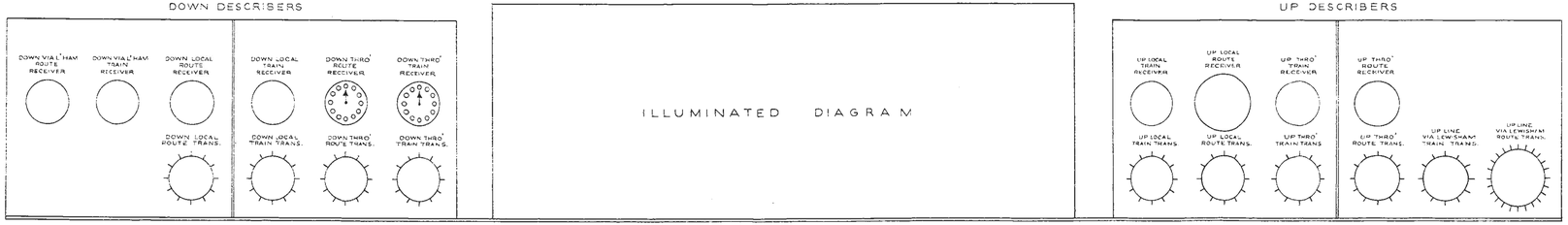
FIG. 7

PARKS BRIDGE JUNCTION SIGNAL BOX SHOWING TRAIN DESCRIBERS, DIAGRAM, AND LEVER FRAME

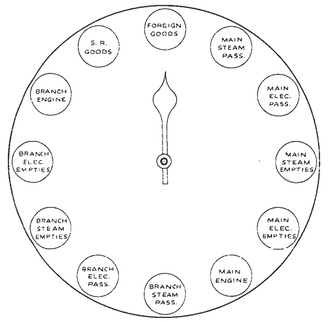


9½" DIA.

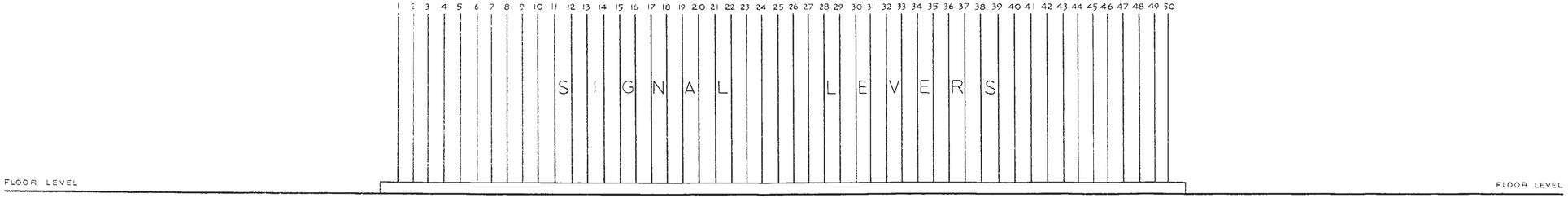
DOWN THROUGH ROUTE DESCRIBER PROFILE



DOWN THROUGH TRAIN DESCRIBER PROFILE



9½" DIA.



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