NORTH-EASTERN RAILWAY.

Board of Trade (Railway Department),

28, Abingdon Street, Westminster, London, S.W. 1.

16th January, 1918.

SIR,

I have the honour to report for the information of the Board of Trade, in compliance with the Order of the 24th December, 1917, the result of my inquiry into the causes of the accident which occurred on the 19th December to a passenger train at Alne Station on the North-Eastern Railway.

In this case as the 10 a.m. East Coast up passenger express train, ex Edinburgh, was running between Raskelf and Alne, it was partially derailed, and became divided at Alne Station, between the second and third vehicles, and also between the third and fourth vehicles.

The engine and two leading vehicles went forward, and there was an interval of about 848 yards between the portions of the train when they came to rest.

One passenger complained of injury, suffering mainly from shock.

The train consisted of a four-wheels-coupled bogie passenger engine with a trailing axle, with a six-wheeled tender, fitted with the Westinghouse brake on the six wheels of the engine and on the six tender wheels. This brake is automatically applied when the vacuum-brake is worked on the train.

There were 16 vehicles in the train, in the following order from the engine, viz. :—

E.C. Brake Van	No. 19
E.C. Third	,, 12
E.C. Third	,, 30
E.C. Third	,, 358
G.N. Brake, First	,, 260
2 E.C. Firsts	Nos. 89 and 91
4 E.C. Thirds	Nos. 34, 99, 61 and 360
E.C. Brake Van	No. 130
N.E. Van	,, 454
N.E. Compo.	,, 1039
2 N.E. Thirds	Nos. 3599 and 944

All four-wheeled bogie carriages with the exception of G.N. Brake, First, No. 260, which had six-wheeled bogies. All the wheels of the carriages were fitted with the automatic vacuum-brake.

Both Westinghouse and vacuum-brakes are stated to have been in very good order.

The third, fourth and fifth vehicles were badly damaged.

The accident occurred at about 2.53 p.m.

Description.

Approaching Alne Station, the up line runs north to south. It is practically straight and almost level, but with a slight fall to the south. Taking Alne Station Signal-box, which is at the south end of the down platform, as datum point, the following are the distances to various points mentioned in the report :—

To point where part of broken coupling was found	248 yds.	N.
To up home-signal	206 ,,	,,
To trailing points of siding connection to up line	143 ,,	,,
To centre of overbridge north of Station, No. 23	130 ,,	,,
To trailing points of cross-over road in up line	117 ,,	,,
To facing points leading to up independent line	108 ,,	S.
To centre of south overbridge, No. 21	300 ,,	,,

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The first marks on the chairs were just before reaching the 12½ mile post, or 1 mile 620 yards from the signal-box, where 19 chairs were broken and 8 marked, all on the inside of each rail. Just beyond this point 29 chairs were broken and the first wheel flange marks appeared on the sleepers, all on the inside of each chair.

Beyond this point, the only damage to the permanent way was at eight occupation crossings, and in each of these three or four sleepers were broken or damaged and a few chairs broken, all on the inside of the rails, up to a point 173 yards north of the up home-signal or 379 yards north of the signal-box, where very extensive damage to both sleepers and chairs commenced. This continued right through the station, where the platform coping was damaged, up to the point where the leading end of the rear portion of the train came to rest, which was 380 yards south of the signal-box.

The rear of the train was 26 yards beyond the facing points to the up independent line, or 134 yards south of the signal-box.

The permanent way between the 13th and 11¼ mile posts consisted of 95 lb. rails, laid in 1910, approximate weight now 90½ lb., keyed into chairs weighing 49 lbs., on 9ft. × 10in. × 5 in. sleepers, and stone ballast.

It was in very good condition and between these points express trains run at high speed.

Conclusion.

The evidence of the trainmen and others is as follows:—

Driver C. Wilkinson states that he felt nothing unusual in the running of the train until approaching Alne. On passing the up home signal he felt an unusual movement of the engine, as if there had been an application of the brake due to the communication cord having been operated. He looked at his vacuum gauge, and found a reduction of five inches, so he shut off steam. The engine would then be about the south end of the station and the train travelling, he estimates, about 55 to 57 miles an hour. He then looked at the gauge again and saw it had fallen to zero. He knew therefore there must be a complete severance of the train, and, looking back, after passing the overbridge, No. 21, saw that he had only two vehicles attached to the engine and that the second one was oscillating very badly. He let the engine and two vehicles come to rest automatically, as the brake was fully applied. He could see that the second vehicle seemed to be down on the rails. He did not apply steam again to keep ahead of the second portion, as he knew there were 14 vehicles on it, which would have the brakes fully applied. When he stopped, he got down and saw that the trailing pair of wheels of the rear bogie on the second vehicle was missing. He, after seeing the conductor, sent his fireman back to Alne to tell the signalman their position, and that he was clear of the down main line.

T. S. Johnson, the fireman, states that, on nearing Alne Station, he noticed a little check to the engine, and just afterwards saw that the vacuum gauge was at zero. He immediately attended to the sanders. When they came to a stand, he arranged with the conductor, W. Fraser, that he should go back towards the Alne Signal-box and take notice of the down line. He found a vacuum pipe on this line which he removed: otherwise the down line was clear all the way. He then arranged with the station-master that the engine and leading coach should go forward to Tollerton, the station in advance, and arrange for single-line working between Tollerton and Alne. He then returned to the engine, and they went forward to Tollerton.

W. Fraser, the conductor, states that he was riding in the van, No. 19, next the engine, and that the train ran as usual until approaching Alne, when he felt the van jerking. He was not aware that the train had parted until they came to a stand. He then arranged with the fireman that the latter should go back to Alne, while he, after getting the passengers out of the second vehicle into his van, walked forward to Tollerton to inform them there where the leading portion of the train was standing. It took him about 20 minutes to walk to Tollerton, and while he was there the driver brought the engine and brake-van into the station, and then they opened single-line working between that place and Alne. The second vehicle was full of passengers, but he received no complaint of any injuries.

William Waugh, who was guard of the rear portion of the train, was riding in brake-van No. 130, the fifth coach from the rear of the train. The train ran as usual until nearing the Alne up home-signal, when the vacuum brake was applied, apparently in the ordinary way. He looked out of his van to ascertain the cause, and afterwards saw a vehicle oscillating very much near the entrance to the up independent line south of the station. He looked at his vacuum gauge and saw it was at zero. He then applied his hand-brake hard on and waited until the train came to a stand. He then got out and saw that the derailed carriage was E.C., third, No. 30. Having got the passengers out of this carriage, he walked back on the down line to the signal-box to inform the signalman, who told him that he had blocked both lines.

J. H. Sims, the signalman on duty at Alne at the time, states that the first indication that anything was wrong with the train was the fact that some of the levers were shaking at 2.53 p.m. He first caught sight of the train when it was passing underneath the bridge, No. 23, north of the station, and some of the carriages seemed to be oscillating considerably. As the train passed the up waiting-room, he noticed that it had divided between the second and third vehicles and that fire was flying from the rear part of the second vehicle, which appeared to be down on the rails. When the train got near the facing points leading to the up independent line, the third carriage appeared to come off the rails and to go towards the up independent line, while the remaining portion of the train seemed to push this vehicle a short distance and then go by it. The guard immediately came to his box and asked if he had protected both up and down lines.

A. Finkill, a chargeman signal-fitter, stated that he was standing on the down platform at Alne about 20 yards from the south end, waiting for the up express to pass; and, when the train was near the up home signal, he saw a large flame of light. He then noticed the train had divided. After the train had divided he observed that the interval between the portions seemed to vary; and, when the two portions passed him, there was an interval of about 40 ft. between them. He estimated the speed at which the train passed him as about 30 miles an hour. The brakes were applied, but the wheels were revolving. He states there were three vehicles attached to the engine when it passed him. He then saw a vehicle swerve to the left of the main line as it was passing over the connection with the up independent line. He went to the assistance of the passengers in the carriage which was derailed, and thereafter examined the facing points leading from the up main to the independent line and found them properly set for the up main line.

J. Todd, carriage-examiner, Darlington, where the train had last stopped, states that the train arrived at Darlington at 2.11, and he examined it in the usual way on both sides—i.e., he used his hammer on the left-hand side of the train on every wheel and walked along the train on the platform side. He found everything in good working order. He had his lamp, and looked under the train, besides examining the wheels and draw-gear.

The two platelayers, who walked the length of line concerned in the accident in the morning, found everything in good order, and the driver of the train that passed over the up line into the up independent line six minutes ahead of the express, states that his engine and train ran quite smoothly, and nothing unusual occurred in the running.

The condition of the train when it came to a stand was as follows, viz.:—The engine and leading van were on the rails, but the second vehicle, E.C., third, No. 12, was without the rear pair of wheels of the rear bogie, the other three pairs of wheels being on the rails. The rear bogie was badly damaged and was down on the rails owing to the wheels being gone.

There was an interval of 848 yards between the second vehicle and the leading vehicle of the other part of the train, which was E.C., third, No. 358, originally the fourth vehicle of the train. This had its leading bogie derailed, all four wheels. The remainder of the train behind the fourth vehicle was on the rails, and all the couplings were intact. The third vehicle of the train, E.C., third, No. 30, was tilted over and standing between the up main and up independent lines, its rear end being 82 yards beyond the facing points leading from the up main to the up independent line. The leading bogie was foul of the up line, and had broken the footboards and axle-boxes of the carriages that were carried past it after it came to rest. These were the whole of the train behind it with the exception of the three rear vehicles, which were undamaged.

The couplings between the second and third vehicles had become uncoupled, but not damaged; but the coupling between the third and fourth vehicles was broken.

These East Coast joint service carriages are fitted with centre buffers, and with Laycock-Buckeye automatic couplers, and the coupler at the rear end of the third carriage, No. 30, was broken just behind the knuckle.

From the description given above of the damage to the permanent way, a wheel must have been derailed on the inside of each rail at a point 1 mile 620 yards north of the signal-box; but this does not appear to have had any effect on the running of the train until the engine was near the up home signal, when the communication cord was probably pulled, applying the brakes partially. Immediately afterwards the train parted (as the driver noticed, the vacuum gauge had gone to zero) between the third and fourth vehicles. The broken part of the coupling of the third coach was picked up 42 yards north of the home signal. Very extensive damage to the permanent way commenced at a point 173 yards north of this signal and, I think, must have been caused by the third vehicle becoming derailed owing to one or both wheels on the broken axle, which had become detached from the bogie, fouling the wheels of the third vehicle. The broken axle and wheels must have been carried along underneath the third and succeeding coaches, as, when the train came to rest, the right-hand wheel and half axle were found standing upright under the centre of G.N., No. 260, the fifth vehicle, and the left-hand wheel and half axle near the rear of the fourteenth vehicle between the up main and up independent lines.

The division between the second and third vehicles probably took place a little later than that between the third and fourth, and was caused by the second coach, E.C., No. 12, losing its last pair of wheels, the rear of the carriage sinking down towards the rails, and so the coupler became unfastened automatically, and it was not damaged in any way.

The axle was broken transversely, exactly in the middle, viz., 2 ft. 1½ in. from each wheel boss, and the fractured surfaces were badly defaced, as they had been running, and grinding together, for some little distance.

I think, from the position of the damage to the permanent way—i.e., only in the four-foot on the inside of the rails and chairs—and from the appearance of the broken axle after the accident, there can be no doubt but that the fracture of the axle of East Coast carriage, No. 12, was the cause, and not the result, of the derailment of the train. This carriage was built at the North-Eastern Railway Company's works at York in June, 1898, and re-axled in April, 1913. It was thoroughly overhauled and repaired at York in July, 1917, when the wheels and axles were examined in the ordinary way. The tyres of the wheels on the broken axle were turned up, and the vehicle was returned to traffic in a satisfactory condition. The weight empty was 29 tons 6 cwt., and as the weight of one pair of wheels and axle is 1 ton 2 cwt. 3 lb., the weight borne by each of the four axles was 6 ton 3 cwt. 3 lb. when the carriage was empty, and, allowing for the crowded carriage and luggage, probably a little over 7 tons at the time of the accident.

The dimensions of the axle are as follows:—

Diameter. Journal.	Diameter, Wheel Seat.	Diameter, Centre.
4 in.	5½ in.	4¾ in.

It formed one of a cast of 50 axles made by the Monk Bridge Iron and Steel Company, Leeds. One axle out of the 50 was tested, the following method being adopted:—The rough axle was placed upon supports 3 ft. 6 in. apart, and the tup, weighing 1 ton, was dropped 24 ft. between these supports on to the axle, and the deflection was then taken. This *first* blow showed a deflection of 3 in. The axle was then reversed, and the deflected part was standing upright when the tup was again dropped from the same height, which *second* blow brought the axle straight. The axle was kept in this position, and the tup was again raised the same height and dropped, when another measurement was taken, and this *third* blow showed a deflection of 3·$\frac{1}{16}$ in. The axle was then turned over again and a *fourth* blow was given, when the axle was again brought straight. The axle remained in this position, and a *fifth* blow at the same height deflected it 3 in.

The test for tensile strength of a piece of the tested axle cut from the wheel seat gave the following results:—Ultimate stress per square inch, 37·5 tons, with an elongation of 30 per cent. before breaking.

The analysis gave the percentage of phosphorus ·018, of sulphur ·022 and carbon ·260.

The tests taken of the broken axle after the accident gave the following results, viz. :—

	Tensile Test.			Bend test, 9″ × 1¼″ sq., round, 2½″ dia. bar.	Analysis.				
	Yield point, tons per sq. in.	Ult. stress, tons per sq. in.	Elong. per cent. on 3″.		P Phosphorus	S Sulphur	C Carbon	Si Silicon	Mn Manganese
1 . . .	22·0	34·2	34·0	180° Not broken	·021	·031	·250	·049	·720
2 . . .	21·7	35·0	34·0	Do.	·021	·031	·250	·049	·720
3 . . .	22·0	34·8	34·0	Do.	—	—	—	—	—
Tests prior to delivery .	—	37·5	30·0	—	·018	·022	·260	—	—
N.E.R. specification . .	—	35/40	25/20	—	Max. ·035	·035	—	—	—

Samples No. 1 and 2 were taken from either side of the axle adjacent to the fracture, and No. 3 from the wheel seat. The analyses were made from drillings close to the fractured faces.

The tests and analyses do not throw any light on the cause of the fracture, as the material is of a good quality.

On thoroughly examining the fractured surfaces after being cleaned up, it was difficult to say with any degree of certainty whether a flaw existed or not, as they were so badly defaced. There is, however, slight evidence of pitting at one point, ¾ in. inside the axle ; and it is possible a flaw existed in this position, and this, I think, must be regarded as the most probable cause of the failure of the axle and of the subsequent derailment.

I have, etc.,

E. Druitt,

Lt.-Col.

The Assistant Secretary,

Railway Department,

Board of Trade.