

3d. The signal man of the ballast train did not go as far to the rear for the protection of that train as he was ordered to go by the regulations, though he appears to have believed that he was doing so.

In regard to the first cause, it may be observed that any man may make the mistake of leaving his time table behind him, and that the ballast guard, though he ought undoubtedly to have taken more pains at Birmingham to procure a regular time table, believed that he had found one sufficient for his purpose.

It may also be observed, that though the time table which misled this man appears to be well fitted for the purpose for which it is specially intended, and though he had no business with it at all, yet it would be desirable to act upon the experience afforded by the present accident, and to make it still more perfect, by adding such indications as to the routes of the through trains as would prevent such a mistake from being committed on any future occasion.

To meet the second case, some rule appears to be wanting by which a driver should be forbidden to proceed from one division of the London and North-western Railway to another, without applying in the proper quarter for a time table, and by which a proper supply of time tables should be furnished as a matter of course in each division to foreign drivers coming upon it.

The third cause seems to suggest that a better means should be resorted to for regulating the distance to which the signal men of ballast trains should proceed to the rear, and, indeed, to which all servants of the Company should proceed, under similar circumstances, for the protection of their trains. This ballast signal man knew that he ought to proceed 1000 yards to the rear, and, having gone about 900 yards from the points leading to the siding, and 775 from the point which became after he left the point of danger, he thought he had done his duty. Now it is difficult for a man of this description, or indeed for any man, to ascertain in such a case when he has gone 1000 yards, unless by counting the rails or the telegraph posts. The latter are generally about 60 yards apart, and there would be less excuse for a signal man if he were told to run back for a distance of 17 (or a proper number of) telegraph posts, than if he were only told to run back for a distance of 1,000 yards. I would therefore suggest, for the consideration of the directors, that this regulation might be amended by inserting the words "or 17 (or a proper number of) telegraph posts" after the words "1,000 yards" in their printed regulations.

There is another point in which it is necessary to say, in conclusion, a few words.

The passenger train on this occasion was provided with an extra-ordinary amount of break power, inasmuch as it had two engines attached to it, besides two break vans, and yet a somewhat violent collision occurred, without, apparently, any fault of the drivers, about 800 yards from the point at which they had first seen a red lamp, specially displayed to indicate an obstruction on the line. It would therefore have been a great advantage, even in this case, if there had been a greater supply of break power available in the train, and such an addition of break power would, *à fortiori*, be still more desirable in cases where trains have a still smaller proportion of retarding force available for pulling them up.

Mr. Newall's break, which may be applied to several vehicles with greater rapidity than the ordinary break can be applied to one van, has been used on the East Lancashire Railway for some years with great success, and a similar break has already been tried on portions of the London and North-western Railway. If each of the guards had been able to apply such a break to three vehicles on the present occasion, instead of to his own van only, it cannot be doubted that the passenger train would have been stopped in from 200 to 300 yards less space, and this collision might have been altogether

avoided, in spite of all the causes above enumerated which tended to bring it about.

I therefore beg to recommend strongly to the directors the adoption of a break of this description. I believe that it would save them the expense and annoyance of many a collision, and that it would be the means occasionally of securing their passengers from personal injury and loss of life.

I have, &c.

The Secretary,
Railway Department,
Board of Trade.

H. W. TYLER,
Captain, R.E.

Railway Department, Board of Trade,

SIR,
Whitehall, December 4, 1857.

I AM directed by the Lords of the Committee of Privy Council for Trade to transmit to you, for the information of the directors of the London and North-western Railway Company, the enclosed Copy of the Report made by Captain Tyler, R.E., the Officer appointed by them to inquire into the circumstances connected with the accident that occurred to a mail train on the 5th October on the Trent Valley section of the London and North-western Railway.

My Lords direct me to observe, that it appears probable that if a communication had existed between the guard and the engine driver the engine driver would have been made aware at once of the accident to his train. My Lords also direct me to suggest the desirableness of placing the guards so as to enable them to have a better opportunity than they appear at present to possess of watching the train during its progress.

I am, &c.

DOUGLAS GALTON,
Captain, R.E.

The Secretary to the
London and North-western
Railway Company.

Railway Department, Board of Trade,

SIR,
Whitehall, November 21, 1857.

IN compliance with the instructions contained in your letter of the 8th ultimo, I have the honour to report, for the information of the Lords of the Committee of Privy Council for Trade, the result of my inquiry into the circumstances which attended the accident, that occurred early on the morning of the 5th ultimo, on the Trent Valley section of the London and North-western Railway.

As the up-night mail train was travelling at its usual speed, about 2.17 on the morning in question, three miles to the north of Rugby, the screw coupling by which the tender of the engine was connected with the leading van gave way, and the engine became separated from the train. It is stated to have been dark, and very foggy, at the time, though the moon was shining brightly at Rugby not very long afterwards.

The following is taken from the evidence of those concerned:—

The driver felt a jerk in the first instance, and, unaware of what had occurred, he shut off his steam, and called to the fireman to "Hold on." Before the fireman had time to put on his break, however, they both discovered, upon looking round, that they had lost their train, and the driver therefore applied his steam again. As he did so the train came into collision with his tender with considerable violence; and soon afterwards two other collisions took place in the train, under circumstances which appear at first sight to be rather mysterious, but of which I shall now proceed to give the best explanation that is deducible from the evidence of the officers and servants of the Company.

The train was composed, in the following order, of an engine and tender, a break van, three first-class carriages, a post-office, two post office tenders, a composite carriage, three first-class carriages, a carriage truck, and a break van. The conductor, who accom-

panies the through train, from Glasgow to London, was riding in the composite carriage, eighth from the engine, and there was a guard in each of the vans. The whole train, therefore, consisted of an engine and tender and 13 vehicles, with a guard in front, a conductor in the eighth carriage, and a guard in the rear, and thus pretty good evidence is afforded of what was experienced in different parts of the train.

The jerk which was first felt on the engine, was caused, no doubt, by the breaking of the coupling by which the engine and tender were attached to the remainder of the train; and the driver, according to his evidence, not knowing what had caused the jerk, shut off his steam, and called to the fireman to "Hold on," or, in other words, to put on his break. They both state, however, that before he had time to do so, the driver found, upon looking round, that he had lost his train, and that he then called to the fireman again to "Let go," and endeavoured, by putting on his steam again, to get out of the way of his carriages. But he was too late, for the carriages came into collision with the tender with considerable violence. The engine and tender then ran on out of the way for about three quarters of a mile, and they had nothing to do with what followed.

The Liverpool guard, who was riding in the leading van, states that he first felt a slight motion of the van, as if the driver had shut off his steam, and perceived that the speed of the train was slackening; and that he was immediately afterwards knocked down by a collision which occurred between his van and the tender. He tried to put on his break as soon as he could get up again, but he found that it was out of order, and that the handle turned without effect; and while he was thus engaged, he felt two other collisions, occasioned by vehicles running into his part of the train from the rear. The train soon afterwards came to a stand, and when he jumped out of his van he found that the engine had gone ahead; that his break was out of order, with the rear hind break block dragging on the rails, and that two screw couplings were broken, those between the fourth and fifth and the eighth and ninth vehicles. He did not notice the state of the side chains.

The conductor was riding, as has been already stated, in the eighth vehicle from the engine, a composite carriage from Holyhead.

He felt, first a jerk, as if the buffers ran up together, and then a second, in the opposite direction to the first, as if from the rebound of the buffers; and shortly afterwards the portion of the train in which he was riding ran against a portion in front of it. He says that he perceived two distinct collisions, with a severe rebound from the first, and none from the second. The train afterwards gradually came to a stand, and he observed that the van and two first-class carriages were detached in the front; that the Edinburgh first-class carriages and the post office were also detached, a yard or two in the rear; and that a little behind them was the remainder of the train. He is not sure of the state of the side chains; but he coupled the carriages together again, and they were taken on to Rugby.

The Manchester guard, who was riding in the rear van, and therefore in the same portion of the train as the conductor, felt, first "a bit of a shake, as if the engine had shut off steam," and then, as he was going to his break, a concussion that threw him to the bottom of his van. He got his fog signals, to be ready to run back, and then he thought that they "run against something which appeared as if it was standing dead." The train then stopped, during the time that it took him to get up and give his break three turns.

Such are the statements of the servants of the Company, and they agree very well together as to what seems to have occurred. It would appear that the coupling between the tender and the leading van was the first thing to give way; that after the driver shut off his steam, the speed of the engine slackened so much as to allow the train to run against the

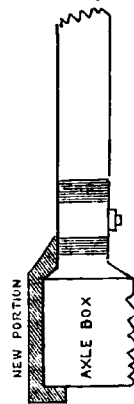
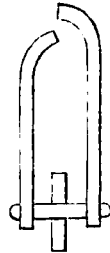
tender with considerable force; that the effect of this collision was to fracture the break apparatus of the leading van, in a manner which I shall presently describe, and, by the subsequent rebound of the buffers, to separate the train into three portions; and that the speed of the first portion having been somewhat lessened, by the action of the broken break apparatus upon the leading wheels of the foremost van, the other two portions successively ran into it, before the whole was finally brought to a stand.

This curious series of events is described as having happened within a very short period of time. It probably occupied, altogether, from the breaking of the coupling to the moment when the carriages came to a stand, about five minutes, as may be estimated by deducting the partial effect of the break blocks upon the leading wheels of the foremost van, and the other retarding causes, from the time in which the carriages would themselves have come to a stand. The carriages ran, at first, up a gradient of 1 in 521, and afterwards, for 70 yards, on the level, and they must have travelled nearly two miles after the first giving way of the tender coupling.

The tender coupling was the only one which I had an opportunity of examining, as the others had been sent away with the different carriages to which they respectively belonged. It was originally $\frac{7}{8}$ " in diameter, and was worn to $\frac{7}{8}$ " \times $\frac{1}{8}$ ", having lost $\frac{1}{8}$ " from its horizontal diameter. The fracture was rusted when I saw it, but it appears to have been perfectly sound, and it ought not to have broken with a less strain than $10\frac{1}{2}$ tons, which is 12 times as much as it would probably have been subjected to when it gave way, including the friction of the train, the resistance of the atmosphere to the leading van at 50 miles an hour, and the additional resistance on a rising gradient of 1 in 521. It had probably, therefore, been unduly strained on some previous occasion, and its appearance, which was somewhat similar to that represented in the margin, was rather confirmatory of this supposition.

The slide bars of the break van were attached, by wrought-iron bolts, to cast-iron projections from the axle-boxes, and had become detached, apparently by the force of the collision, at all the four corners, clean fractures having afterwards been found to have occurred through all the cast-iron projecting pieces. It appears, that of the 214 passenger break vans belonging to the carriage department of the London and North-western Railway at Crewe, 96 are secured in this manner, and 118 are differently constructed, the slide bars being attached to the axle-boxes by wrought-iron bands passing round the latter. It was, no doubt, the momentum of the wheels and axles of the van, when the framing of the carriage was suddenly checked by the collision, that fractured the legs of the rear leading axle-guard, and caused the cast-iron projections from the axle-boxes to give way; but I understand, that though this mode of connexion has been in use for nine years, there has never been a case in which they have been broken before, either in the ordinary working of the line or by collision. The carriage superintendent, however, contemplates a little alteration, by which they will be rendered still more secure. He proposes to extend the slide bars over the top of the axle-box, in the manner shown in the margin.

This break van (No. 228) had been in the shops on the previous week, to be cleaned and painted inside, in order to get rid of an offensive smell of fish, and to have new break blocks. It had been at work with the same break for seven years. All the axle-guards were much shaken by the collision, and, as before



stated, the legs of one of them were broken off. A London and North-western first-class carriage, No. 58, also, had its leading axle-guards broken, as well as its windows, and a Caledonian first-class carriage, No. 25, had its body shifted on its frame; but all the other vehicles were sent forward to London after the accident.

Although, fortunately, unattended by any very serious consequences, this is one of the most remarkable accidents on record. It would hardly be considered within the bounds of possibility, if it had not actually occurred, that a mail train travelling at full speed should suddenly produce three intestine collisions. Such appears to have been the case, however, and all in consequence of the failure of the coupling of the tender, which may possibly have been partially broken as the train was started from the previous station; for it is at the moment of starting that the greatest strain is exerted upon the couplings.

I have given the above account of the accident according to the evidence that I received; but I may add, that it appears to be unlikely that so violent a collision should have occurred between the carriages and the tender, in consequence of the driver's having shut off his steam only, when he found himself separated from his train, and more probable that the tender break was applied at the same time. The driver and fireman both describe the whole thing as "momentary," that is to say, that the collision followed the jerk of separation within a very short period of time.

A little calculation will show how far that can have been the case. Supposing the train to have been travelling about 60 feet a second, or a little more than 40 miles an hour, the retarding influences on the engine will have been to those on the carriages in the proportion of about three to two, and the retardation in feet per second, about '16 on the former, and '24

on the latter. The difference of speed, also, between the two, at the time of collision, after the driver shut off his steam, would have been,

Seconds.	Ft. per second.	or	Miles per hour.
In 20	1·6	or	1·1
40	3·2	or	2·2
60	4·8	or	3·3
90	7·2	or	4·9
120	9·6	or	6·6
180	14·4	or	9·8

And it will thus be seen that two minutes must have elapsed, between the shutting off of the steam and the collision, to have produced a collision of $6\frac{1}{2}$ miles an hour, or three minutes for a collision of about 10 miles an hour, as well as that the driver would have run upwards of a mile in the former case, and nearly a mile and a third in the latter, between these two events.

It therefore appears more probable that the driver ran on for a considerable distance after he lost his train, and was pulling up, with the idea, perhaps, that he had got far enough out of its way, before it caught up the engine, and came into collision with it.

This, however, if he had told the truth about it, would have been an error of judgment rather than a fault on the part of the driver, and no blame appears otherwise to attach to the Company or any of their officers or servants; and the only means of guarding against such an accident for the future, is by a careful selection of thoroughly sound couplings for purposes of this nature.

I have, &c.

H. W. TYLER,
Captain, R.E.

The Secretary,
Railway Department,
Board of Trade.

LONDON AND SOUTH-WESTERN RAILWAY.

Railway Department, Board of Trade,

SIR, *Whitehall, November 25, 1857.*

I AM directed by the Lords of the Committee of Privy Council for Trade to transmit to you the enclosed Copy of the Report made by Lieut.-Colonel Wynne, R.E., the Officer appointed to inquire into the circumstances connected with the explosion of the boiler of a locomotive engine on the 10th ultimo at the Basingstoke Station of the London and South-western Railway.

My Lords trust that the Directors will take effectual means to prevent the possibility of the safety valves of the locomotive engines being tampered with by the drivers.

I am, &c.

DOUGLAS GALTON,

Captain, R.E.

The Secretary to the
London and South-western
Railway Company.

Railway Department, Board of Trade,

SIR, *Whitehall, November 18, 1857.*

I HAVE the honour to acquaint you, for the information of the Lords of the Committee of Privy Council for Trade, that I have inquired into the circumstances connected with the explosion of the boiler of a locomotive engine at the Basingstoke Station of the London and South-western Railway on the 10th October.

This accident occurred at 1 10 a.m.; and as both driver and fireman were killed by the explosion, there is no direct evidence to be obtained as to the state of the valves, and the general condition under which the engine was working; the collateral evidence of the guard and the few porters who were up at the time is of an uncertain character, and does not throw much light on the subject as to whether the explosion occurred under ordinary or extraordinary pressure of steam; this, however, in the present instance, is of

less importance than is generally the case, as an examination of the ruptured part showed that the material was defective to such an extent as must very much have reduced the factor of safety from that which it was intended to have been.

The engine was a new one, having only commenced working in June. It was constructed on Mr. Beattie's patent for burning coal and consuming the smoke. The fire box for this purpose was made nine feet long, and divided into two parts in its length by a vertical water space two or three inches in width. The first compartment, which is next to the tubes, he calls a combustion chamber, and the back one is the true fire-box in which the fuel is placed. The fire-box is made as usual of copper; but the combustion chamber is constructed with a double cylindrical casing of boiler plate, having a water space of $2\frac{1}{2}$ inches between them. The part of the boiler which yielded was in the combustion chamber, along the seam of the rivets of the cross water division, and about half way up the cylinder, from this point to the tube plate the inner cylinder was bulged inwards, thus:

On examining the plate that had yielded, it was found to be formed of two distinct laminæ, which had not been united in the manufacture of the plate; it was therefore a weak point, which from the effects of corrosion must have sooner or later yielded before the other parts of the boiler were worn out; and therefore, as I before remarked, the question of whether or not the valves were tampered with is not on the present inquiry a matter of such serious importance. I will now give a summary of the evidence I was able to obtain.

The engine was a six-wheeled four-coupled heavy goods engine, and was stated to be capable of drawing 50 waggons, equivalent to a load of 450 tons. The valves were regulated for a pressure of 120 lbs. on the square inch. On the day preceding the accident, the engine left Southampton at 9 p.m., having a train of 35 waggons