tion, as he approached it ; and that signal was lowered for him to pass. He proceeded forward at a speed of 10 or 12 miles an hour, but had not gone more than 100 yards further when he saw, through the fog, the waggons in question, about 10 yards in front of him. He shut off his steam, and blew his whistle, but was of course unable to do anything towards arresting the progress of his train before a collision occurred. His engine was not damaged, nor were any of his vehicles thrown off the line. One of the goods waggons, the second from the front, left the rails with two of its wheels ; and 3 of the passengers, out of about 20 who were travelling by the train, were slightly injured. It was no doubt fortunate, under the circumstances, that the guard of the goods train did not pin down the breaks of his own waggons.

In looking for the causes of this accident, it is evident, that it was directly occasioned by the mistake of the under-guard, who, unacquainted with the working of the points at the handle of which he was placed, turned the waggons in the wrong direction, and placed them in the way of the passenger train, instead of depositing them in the siding for which they were destined. It was indirectly brought about, also, by the fog, which prevented the head-guard from seeing that the mistake had been made, and the necessity that existed for immediately rectifying it. But it is to be observed, at the same time, that it would not have occurred if there had been a regular pointsman at the " Glory Hole" Cabin, as there ought to have been, if the shunting inspector was liable to be called away, and if these sidings were liable to be used in his absence. The head-guard might, it is true, have worked the points himself, instead of entrusting them to the under-guard, and have sent the latter to give directions to the driver to unhook the engine from the waggons, and to see that the proper waggons were put into the sidings; but I cannot blame this man, who appears to have acted for the best under the circumstances, and who could not have foreseen the mistake that the under-guard was about to make.

With a view to the prevention of accidents in the the neighbourhood of this junction in future, it is desirable that the connections between the main lines and the sidings should be thoroughly well considered, should be re-arranged, and should be materially improved ; and, either that the particular points in question should be transferred from the Southport departure-line to the siding-line near it, or else that they should be worked from the junction-box, and be placed thus under the charge of the signalman. That man cannot, of course, be responsible for their working, or be able to regulate his signals in all cases by the state of the Southport down line, unless they are worked by a lever from his own stage, or, in other words, while they can be worked without his knowledge by the pointsman at the "Glory Hole" Cabin.

I have, &c.

The Secretary of the Railway Department, Board of Trade.

H. W. TYLER, *Capt. R.E.*

LONDON, CHATHAM, AND DOVER RAILWAY.

Railway Department, Board of Trade,
6 March, 1861.

SIR,

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, Chatham and Dover Railway Company, the enclosed copy of the report made by Captain Tyler, R.E., the officer appointed by my Lords to inquire into the circumstances which attended the accident to a passenger train on the 4th January near the Sittingbourne Station.

I have, &c.

The Secretary of the London, Chatham and Dover Railway Company.

JAMES BOOTH.

Railway Department, Board of Trade,
Whitehall, 6th February 1861.

SIR,

IN compliance with the instructions contained in your minute of the 9th 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 on the 4th ultimo, near the Sittingbourne Station of the London, Chatham, and Dover Railway.

The 9.55 a.m. passenger train for Canterbury, left the Victoria Station in London in due course on that day, consisting of an engine and tender, six carriages, and two break-vans, one in the front, and the other in the rear of the passenger carriages. It stopped at the Crystal Palace, Bromley, St. Mary's Cray, Farningham, Strood, and Chatham ; and it left the last-mentioned station at 11.35, twenty-six minutes late, for Sittingbourne. It was approaching a bridge over the railway, about 45½ miles from London, called the Bobbing Bridge, on a falling gradient of 1 in 110, at a speed stated to have been thirty miles an hour, when the guard in the leading van heard what he describes as a loud explosion under him, like a gun going off; and he then felt his van jump, and found the ballast flying under it. The flooring of his van was also damaged by something thrown violently against it from below, and its wheels left the rails.

He immediately shouted to the driver and fireman, who were on the engine before him ; but he was unable to attract their attention until he had travelled about 180 yards further. At the end of that distance he succeeded in making the fireman hear, by means of his whistle, as he passed the gateway of a level crossing. The fireman happened at the moment to be turning round to get hold of the handle of the tender-break, and, hearing the guard whistle, and seeing the break-van jumping, he called to the driver to "hold on."

The driver had shut off his steam at the summit of the incline, about three quarters of a mile from the spot at which he received this warning, in order that he might run down with due caution towards the Sheerness Junction ; and he believes that he had slackened speed from 30 to 25 miles an hour, after shutting off his steam, before the condition of the van was pointed out to him by his fireman. He states that he left Chatham at 11.37 by his watch, and that the accident occurred, also by his watch, at 12 o'clock. The distance between Chatham and the site of the accident being 9½ miles, the average speed of the train, after it started from Chatham, would thus appear to have been 25 miles an hour.

On first looking back to see what was the matter, the driver observed that the leading axle of the van was drooping on its right side. He saw that if he pulled up too suddenly he should occasion great risk to the passengers, by causing the carriages to run forward on the disabled van ; and he therefore brought his train cautiously to a stand, at about a third of a mile, or rather more, from the Bobbing Bridge over the railway.

An inspector of the permanent way happened to be standing on the up-line, on a bridge under the railway, at the spot where the train was thus stopped. He heard it approaching him, and noticed that the sound was different from that which the trains usually occasioned. Turning round to look at it, he saw a carriage in the act of falling over on its side ; and he watched it, as it slid along on the right, or inside rail, for what he considered to be about 100 yards, up to the bridge where he was standing.

The carriage that was thus upset, and dragged upon its side, (for, as it appears, about 150 yards,) was a third-class carriage, situated next behind the leading break-van. It contained three passengers ; a warrant officer of the Royal Navy, of the name of Patterson, and two others. Patterson, unfortunately, either fell partly out, or was getting out, of the window of the carriage, as it turned over. He was dreadfully mutilated, by being dragged under it, along the permanent way, and he died a few hours afterwards. The other two passengers escaped without serious injury, though they must have been much shaken.

After the train pulled up, it was found that three vehicles were off the rails :—the van which was next behind the tender, with all its four wheels ; the third-class carriage in rear of the van, which was lying on its side ; and a first-class carriage behind the third-class carriage, with its leading wheels. The axles of the break-van were both in their places, and the trailing wheels were perfect ; but the right leading wheel of that vehicle had lost its tyre. The axle-guards were a good deal bent, but had not given way. The third-class carriage had lost both of its axles ; the leading axle and wheels, or that which was believed to be the leading axle, falling into a ditch on the north of the line, about 20 yards from the bridge on which the inspector was standing ; and the other axle and wheels, on that bridge, as the carriage was coming to a stand.

The only coupling which is stated to have given way, was the screw-coupling between the third-class carriage and the break-van. The side chains which connected those vehicles together were still holding, and were loosened by the driver after the accident.

The first wheel-marks that were noticed on the ballast, as if of a vehicle having been off the rails, were about 30 yards to the west of the Bobbing over-bridge ; and the first portion of the tyre of the break-van was found 45 yards to the east of that mark. The tyre was broken into five pieces, and these were picked up, respectively, at 45, 60, 65, 75, and 90, or 95 yards from the wheel-marks referred to. The third of these pieces was of considerable size, forming upwards of a third of the whole tyre. The others were all of small dimensions.

The third-class carriage does not appear to have left the rails until after the wheels of the break-van had been running for 180 yards over the ballast. It turned on its side about 350 yards from the point at which it left the rails, and it was dragged for about 150 yards in that position before the train was brought to a stand. The line was straight at the point were the tyre of the van gave way, but it curved to the right where the third-class carriage was turned over.

It seems that the tyre must have sprung open, in consequence of its fracture, at the point where the first wheel-marks appeared, and where the guard also heard the explosion that he describes ; that it was then knocked rapidly to pieces as it came violently in contact with the rails and ballast, the first piece falling at 50, and the last at 100 yards from the place where it sprang open ; that the leading end of the van was pushed towards the right, and its trailing end towards the left, as the carriages from behind ran forward upon it ; that the third-class carriage was thus pushed off the rails, with its leading end to the left, and was turned over, in consequence of a similar pressure from behind, wrenching the screw-coupling by which it was attached to the van into two pieces as it fell ; and that the leading wheels of the first-class carriage behind it were, in the same manner, thrown off the rails.

In this case, extra break-power, promptly applied at the tail of the train, over several vehicles, would have been of essential service,—would have kept the conplings of the carriages stretched, instead of allowing them to run forward upon the disabled van,—would have been the means of preventing the third-class carriage from falling over on its side,—and would, in all probability, have enabled the driver to pull up his train, not only without loss of life, but even without injury to any of the passengers.

As it happened, the guard in the leading van, though he was riding immediately behind the tender, was unable, as will have been seen, to attract the attention of the driver and fireman, and to show them that his van had left the rails, until after he had travelled in peril for 180 yards ; and he would not, probably, have succeeded in doing so for some time longer, if the fireman had not fortunately turned round, whilst he was whistling, to get to his break-handle. A means of communication was here required, such as is now in constant use on many railways, by means of which the front guard could have sounded the driver's whistle, or rung a bell on the engine or tender, and thus have given him warning at once of the fracture of the tyre of his leading wheel. It would then have been the duty of the driver, seeing what had occurred, to have sounded his whistle for the breaks of the hind guard, and, keeping the couplings stretched, to have allowed the train to be gradually pulled up, principally by the action of the hind breaks so applied.

It appears that the driver adopted this course as far as he was able, and thought it expedient to do, under the circumstances, on the present occasion ; but the want of better communication to him from the leading van, and of more break power in connection with the hind van, prevented him from carrying it out to the extent and with the advantage that he might otherwise have done.

The attention of the guard in the hind van was first attracted by his hearing a small stone strike against his window after he had passed through the Bobbing Bridge. He then looked out towards the front, and, seeing that something was wrong, though he could not tell what it was, he applied his break, and kept it on until the train was brought to a stand.

Continuous breaks, applied simultaneously from one vehicle, of different descriptions, are gradually coming into extended use on different lines of railway, with good results ; as well as means of communication, of one sort or another, from the guards to the drivers of trains ; and I would take this opportunity of strongly recommending the directors of the London, Chatham, and Dover Company to adopt these valuable auxiliaries to safety. They will do well to cause their present vehicles to be fitted up with a view to these objects ; and, in increasing the numbers of their rolling stock, to pay special attention to them. They will find advantage from this course, in the increased safety of their line, in the greater inducement that they will afford to the public to travel upon it, and in the decreased expense on account of accidents, for cost of damages to their stock, and for compensation to their passengers, even in the ordinary course of traffic ; and, if they should, unfortunately, after the further extension of their railway, embark in the competition on a large scale which appears to be only too likely, they will find these means of avoiding serious accident, of averting fatal consequences, and of inducing the public to use their line, of still greater value to them.

The tyre, the failure of which was the primary cause of this accident, was supplied to the company with the break-van, by Mr. C. C. Williams, the carriage builder, of London; and it appears to have been obtained by him, together with the wheels and axles, from Messrs. Sandford and Owen, of the Phœnix Works, Rotherham. It was stamped, "Owen's patent," and may be considered superior to ordinary tyres in one respect, namely, in having been rolled out, under that patent, at once into a circular form, instead of having been rolled straight in the first instance, and afterwards welded together at the ends. By this means the great risk of an unsound weld was avoided, and increased security was obtained, so far, against fracture. But it was defective in other respects. It was weakened to a serious extent, like the greater number of tyres now in use, by rivet-holes, averaging an inch in mean diameter, passing through its whole

thickness; it was fastened to the rim of the wheel, (besides being shrunk on to it) by four $\frac{5}{8}$" rivets only; and it was composed of two distinctly different qua lities of iron, that on the exterior having been good, and that on the interior, for about $\frac{5}{8}$ths of an inch, having been of inferior quality.

The thickness of this tyre in the tread was about an inch and a half. It is pretty certain, looking to the loud explosion which was heard by the guard. when it gave way, that it had been shrunk on to the wheel too tightly. It appears to have been fractured, in the first instance, across one of the rivet-holes; but the condition of the fracture does not enable me to give a positive opinion as to how far the metal was sound before it finally gave way. I attribute that fracture,—partly to the state of tension it was in, in consequence of its having been placed on the wheel originally in too contracted a condition; partly to the severe treatment which it received in travelling over a rigid, frozen road; and partly to the weakness of the part which gave way, in consequence of about 18 per cent. of its section, and a larger proportion of the better portion of the metal, having been taken out of it for the admission of the rivet.

The state of tension in which it was, and its sudden release from that state of tension, enabled it the more easily to escape from the wheel, and to fracture the three remaining rivets by which it was secured to the rim. To prevent such a result, the rivets were neither sufficient in quantity, nor were they a good description of fastening. The permanent way was in as good a condition as could be expected, considering the state of the atmosphere, but was not the less rigid in consequence of iron keys having been employed, on Mr. Parson's system, to secure the rails in the chairs.

There are various methods, of which some have been in use for several years, whilst others are of more recent date, for avoiding the weakness thus arising from rivet-holes in the tyres, for securing them to the rims of the wheels in a more advantageous manner, and for preventing them from separating from the wheels in the event of fracture. I had occasion to refer to this subject in a report upon an accident which occurred in the early part of last year, at Tottenham; and I then forwarded diagrams of a system of fastening that had been adopted with these objects upon certain railways. I now beg to enclose drawings of a number of other modes which have been employed; and I would observe, in doing so, that they merit the best attention of the locomotive and carriage superintendents of all railway companies; because the principles upon which they are designed, are calculated, when properly carried out, to provide completely against the danger which is now so much experienced, (and particularly in seasons of low temperature,) of accidents such as that on which I am now engaged in reporting, occasioned by tyres opening out, or flying off, when they are fractured, from the wheels of locomotive engines and tenders, and of railway vehicles.

It will be observed, on an inspection of these diagrams, that, in all the different methods which they represent, the tyre is dovetailed to the rim of the wheel; and in all but one (which is shown at figure 6, plate 1.) there is no weakening of the tyre by rivet, or other holes, bored in it to secure it to the rim. In that case the tyre is tapped through half its thickness only, to admit of a strong screw-bolt being inserted from the interior of the rim. Mr. Beattie adopted this method in the case of engine wheels, under the belief that the weights which the tyres of those wheels had to sustain rendered it necessary to give the rim as wide a bearing upon them as possible, and undesirable to diminish that bearing for the sake of obtaining a fastening at the interior side of those wheels, such as he had applied (fig. 3) to carriage wheels.

In all of these methods, also, except that of Mr. Mansell (figs. 10, 11, 12), and that of Mr. Brotherhood figs. 13, 14, 15), the tyres are so rolled and turned, and the rims are so fitted, that the two are dovetailed together at the exterior side; and the differences between them mainly consist in the various modes which have been adopted for fastening the tyres to the rims under their flanges, on the interior side of the wheels.

Mr. Beattie accomplishes this by grooving the tyre, as at A, fig. 3; by inserting wedge-shaped keys at intervals round the circumference, B, B, B, fig. 1.; and by hammering down the portion C. (fig. 3.) upon the keys thus inserted. Whilst employing this system on the Great Northern Railway very extensively, Mr. Sturrock has found it necessary to place a key on each side of the weld of the tire, as an additional security against its *flying*, in case of fracture on account of a defective weld.

It cannot be considered that the tyre is so firmly secured to the portions of the rim between the keys, as when a more continuous means of fastening it is employed. In a method which he has proposed for engine wheels, for reasons which I have already given, Mr. Beattie has secured the outer side of the tyre by means of a groove fitting on a notch in the rim of the wheel (O, fig. 6), and has attached it, near the inner edge, by bolts screwed into it from the inner surface of the rim, and inserted at frequent intervals, P, P, figs. 4, 6.

Mr. Gibson inserts *annular keys*, extending all round the circumference, (D, E, figs. 7 and 8,) and hammers the inner edge of the tyre down upon indentations which are formed on these, to clench them, at intervals; or else he hammers down that edge directly upon the rim, as shown at F, fig. 9. The annular keys are an improvement upon the keys at intervals, inasmuch as continuous fastenings are obtained by their employment; and it is said that there is no difficulty in removing a tyre thus attached to the wheel, and in replacing it. As in the former method, the bearing of the rim upon the tyre is reduced to admit of the insertion of the key, however, and the use of the key, whether continuous or not, appears, if it does not detract from security, to be an unnecessary complication, as I shall presently have occasion to show.

Mr. Mansell's tyres (figs. 10, 11, 12) are affixed to wooden discs. They are not shrunk on, as in the case of other methods, but, being themselves bevelled, they are forced on to a bevelled surface by hydraulic pressure. Two grooves (Z, Z,) are formed in the tyre, and two securing-rings, which are fixed, one at each side, into these grooves, are bolted together through the timber discs, by means of screw-bolts and nuts placed at frequent intervals.

Mr. Brotherhood's tyres (figs. 13, 14, 15,) are also fixed to the rims of the wheels by means of two rings (N, N, fig. 13), each of which has a projection on its inner surface fitting into a recess in the tyre. These rings are rivetted together by means of rivets (one of which is shown in dotted lines in fig. 15) placed at the junction of the spokes with the rim. A piece of wood, W, keeps the rings apart, inside the rim.

These two methods, which proceed, as far as the attachment of the tyre is concerned, upon the same principle, are a little complicated, but afford, undoubtedly, great security.

Messrs. Cabry and Owen employ a second dovetail, (H, fig. 18,) between the rim and the tyre, similar to that at the outer edge G; and, after shrinking the tyre on to the wheel, they clench down a portion of the interior of the tyre, K, rolled on it for the purpose, to secure it in its place. This portion is only clenched down at intervals (L, L, L, figs. 16 and 17), to admit of the tyre being afterwards removed and replaced when necessary. It is to be feared that in this system the dovetailed surfaces might not in all cases be fitted with sufficient accuracy to ensure a good result; and that, even if they did so in the first instance, the tyre might alter its shape as it became thin from wear, to an extent that would destroy the efficiency of the fastening.

Mr. Burke's tyre is rolled out into the shape shown

[*To face page* 6.]

PLATE I.

To accompany Captain Tyler's Report to the Board of Trade, dated January 17*th*, 1861.

BEATTIE'S PATENT METHOD OF SECURING TYRES TO CARRIAGE AND WAGGON WHEELS.

(London and South-Western Railway.)

Fig. 1.

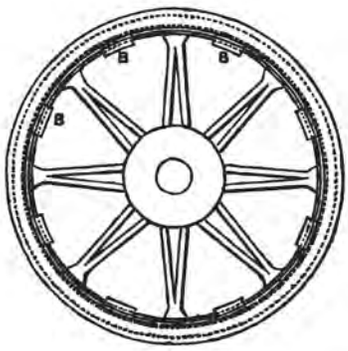
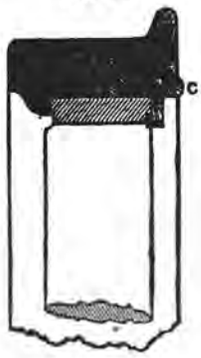


Fig. 2.

Fig. 3.



BEATTIE'S TYRE-FASTENING FOR ENGINE-WHEELS.

Fig. 4.

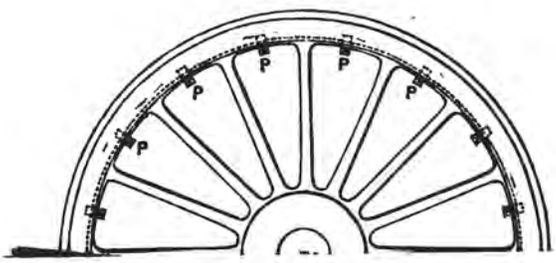


Fig. 5.

Fig. 6.

PLATE II.

To accompany Captain Tyler's Report to the Board of Trade, dated January 17th, 1861.

CABRY AND OWEN'S PATENT TYRE-FASTENING.

(Midland Great Western [of Ireland] Railway.)

Fig. 16.

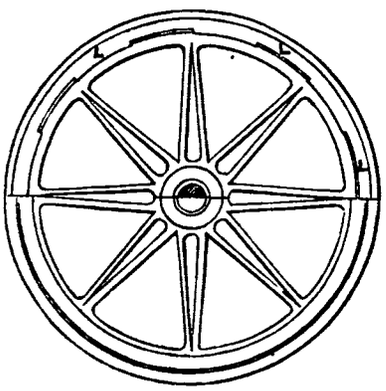


Fig. 17.

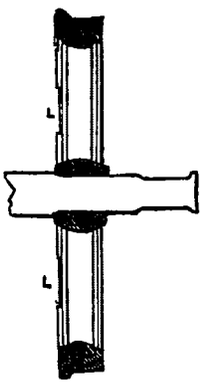
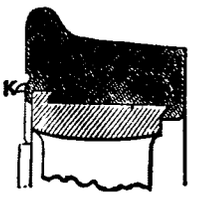


Fig. 18.



BURKE'S PATENT TYRE-FASTENING.

(Brighton Railway.)

Fig. 19.

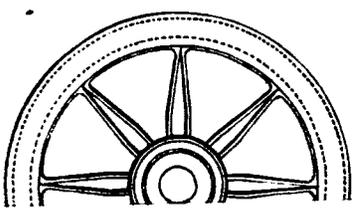


Fig. 20.

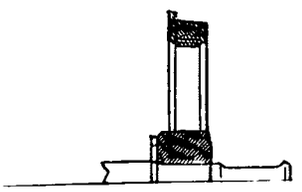
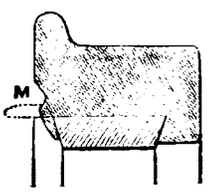


Fig. 21.



in fig. 22, and is welded, turned to a true surface, heated, slipped on to the wheel, and allowed to contract, in the usual manner. It is then turned over; the portion x is heated to a red heat; and that portion is hammered down against the rim all round its circumference.

All of these methods of fastening tyres are superior to that which is now commonly adopted, and any one of them may be considered, when the materials are well selected, and when careful workmanship is employed, to afford a high degree of security.

That which is shown in figs. 19, 20, 21, and 22, is, perhaps, the most simple, and the most likely to come into general use. The disadvantage that it would present to some eyes, in the impossibility of taking it off the wheel, for tightening or repair, after it is once fixed on, and replacing it again in its original condition, is by no means so serious as it might appear to be at first sight. Either security must be more or less sacrificed when this condition is maintained, or else some more complicated arrangement connected with the rim, such as those of Mr. Mansell and Mr. Brotherhood, must be employed; but, in truth, the cases in which repairs, requiring the removal of the tyre, become necessary, when good wide tyres are carefully attached to well-constructed wheels, are so rare that they may fairly be left out of consideration; and a tyre which has worn slack, and is re-shrunk on the wheel, will almost always become slack again within a short period. Such an operation is hardly worth performing; and when a good tyre is securely fixed, in the first instance, by means of an efficient continuous *clipping* attachment, it will then be worn out to the thinnest state in which it is fit for use, without any apprehension of danger, in consequence, either of its fracture, or of its slipping off the wheel.

The real disadvantage of this mode of fastening, appears to me to lie, either in the liability to an imperfection of fit between the rim and the tyre, or of a want of parallelism in the dovetail surfaces in the first instance; or else in an alteration of the shape of the tyre, by spreading or otherwise, from wear and tear, which must always become greater as the tyre becomes thinner, and which would, therefore, render the fastening less and less secure, at a time when it was more and more necessary that it should be efficient.

To prevent the possibility of such defects, I think that a modified mode of fastening might be adopted, such as I have shown in figs. 23 and 24, which would be well adapted for all wheels, which would give increased security at all times, and which would remain efficient up to the last, becoming, indeed, more secure as the tyre got thinner, and hollow from wear.

In the application of this arrangement, the tyre would have to be grooved at o, fig. 23, when t was turned to its proper size, as in the cases of the tyres shown in figs. 6 and 12; and the rim of the wheel would have a notch on each side of it. The tyre should not be in too heated a state when the wheel is slipped into it, as the rim would not in that case penetrate into the recess at o; but it has been found by experience that a sufficient heat may be imparted to the tyre in shrinking it on, without any difficulty in slipping it into a recess of suitable dimensions being encountered. Fig. 23 exhibits the condition that would exist between the wheel and tyre, when the wheel is first inserted; and fig. 24, the finished tyre, after the inner edge at Q is hammered down upon the rim.

Although there is greater fear, in general, with regard to a slack tyre, or a loose tyre, or a broken tyre, the most dangerous tyre of all, is that which has been shrunk too tightly on to the wheel, and whose state of tension renders it ready to fly upon any violent blow being administered to it, by a bad joint, or an uneven crossing, in the ordinary course of traffic. This is the sort of tyre that yields the clearest ring to the hammer of the carriage examiner, and that inspires him frequently with the greatest degree of confidence; but this is the tyre that ought in reality most to be dreaded; and this is the description of tyre that occasioned the present accident.

But even when a tyre has been placed upon the wheel in a condition of too much strain, there ceases to be danger, when it is secured to the wheel in some manner, such as I have now indicated, in which it is prevented from separating from the rim, or, as it is termed, from *flying*, when fracture takes place.

I do not wish to induce the directors of the London, Chatham, and Dover Railway to adopt any plan in particular; but I desire to impress upon them the great importance of carefully considering this subject, and of taking measures for securing their tyres to their wheels in future, by the means that may appear to them to be most conducive to the safety of the public. I have taken pains to lay before their Lordships, for transmission to them, the different methods that have been proposed, and the best conclusions at which I have been able to arrive in regard to them; and I trust that they will find the present report of some assistance to them in their deliberations.

I have, &c.
H. W. Tyler,
Capt.. R.E.

The Secretary,
Railway Department,
Board of Trade.

LONDON, CHATHAM, AND DOVER RAILWAY.

Railway Department, Board of Trade,
Whitehall, 19th February 1861.

Sir,

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, Chatham, and Dover Railway Company, the enclosed copy of Capt. Tyler's report on the accident which occurred to a passenger train near the Teynham Station, on the London, Chatham, and Dover Railway, on the 5th Jan.

I am, &c.
(Signed) J. Booth.

The Secretary of the London, Chatham, and Dover Railway Company.

Railway Department, Board of Trade,
Whitehall, 7th Feb. 1861.

Sir,

In compliance with the instructions contained in your Minute of the 9th 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 on the 5th ultimo, near the Teynham Station of the London, Chatham, and Dover Railway.

The 7.45 p.m. passenger train started from the Victoria Station in London punctually on the day in question for Chatham and Faversham, and left Sittingbourne, which is rather more than 45 miles from London, also at its proper time—9.58. It consisted