

and I trust that this lesson will not be without its effects upon the systems of working adopted on other lines of railway, on many of which very great improvement is required, in preserving intervals of space between the trains, and in adopting modes of working by telegraph which afford a maximum of convenience and simplicity with a minimum chance of misunderstanding and risk.

In order to show the full importance of the subject, I subjoin a table containing the number of collisions from different causes that have occurred between the years 1855 and 1860 inclusive, as compared with the total number of railway accidents on which reports have been made to their Lordships during those years.

I am, &c.

H. W. TYLER,
Captain, Royal Engineers.

The Secretary,
Board of Trade.

CIRCULAR sent to all the working Railway Companies with reference to the Clayton Tunnel Accident.

Railway Department, Board of Trade,
Whitehall, 28th October 1861.

SIR, I AM directed by the Lords of the Committee of Privy Council for Trade to request you to state to the Directors of

Railway Company, that their Lordships' Inspecting Officer, Captain Tyler, R.E., in his report upon the circumstances attending the collision that occurred on the 25th August last in the Clayton Tunnel of the London, Brighton, and South Coast Railway, having discussed at some length the question of collisions on railways, and the means that may be adopted for their prevention; especially with reference to the use that may be made of the electric telegraph, and having made some suggestions of a general character which my Lords think may usefully be brought under the notice of all persons concerned in the management of railways, I am directed by their Lordships to forward to you an extract from that report, and to request that it may be submitted for the careful consideration of the Directors of the

Railway Company.

I am, &c.

The Secretary of the

JAMES BOOTH.

Railway Company.

NOTE.—Extract as marked sent to 189 Railway Companies.

London Brighton and South Coast Railway,
Secretary's Office, London Bridge, S.E.
10th December 1861.

SIR,

THE Board have had under their consideration the communication received from the Lords of the Committee of Privy Council for Trade, dated the 15th October, and transmitting a copy of Captain Tyler's Report on the subject of the accident which occurred in the Clayton Tunnel, on the 25th of August last.

Without entering into the details of that Report, more particularly where it relates to an entirely different state of circumstances on other lines of railway, I am desired to say that, prior to the receipt of such communication, my Directors had had before them their traffic manager's observations on the telegraphic system of signalling between Brighton and Hassock's Gate, pointed out by Captain Tyler in his evidence before the coroner, and described more minutely in his subsequent Report.

My Board feel bound to state frankly that they have not seen reason to alter the views which they have so long entertained on this subject, and they still fear that the telegraphic system of working recommended by the Board of Trade will, by transferring much responsibility from the engine drivers, augment rather than diminish the risk of accident. Indeed, they think it is open to grave doubt whether the circumstances of the serious collision in question do not, when fairly considered, tend to prove that the increasing practice of multiplying signals, and thus lessening the responsibility of the engine driver who is in charge of the motive power, and whose own life is at stake, has not resulted in reducing, rather than in increasing, the safety of railway locomotion.

In deference, however, to the strong recommendation emanating from the Board of Trade, my Directors have ordered that the telegraphic system, as detailed by Captain Tyler, be adopted between Brighton and Hassock's Gate, and they propose to give it a fair trial, and hereafter to consider the results, with a view to its further extension, if those results be favourable, and appear in the interests of the public safety to justify such a course.

I am, &c.

(Signed) FRED. SLIGHT,
Secretary.

The Secretary,
Railway Department,
Board of Trade.

LONDON AND NORTH-WESTERN RAILWAY.

Railway Department, Board of Trade,
Whitehall, 9th August 1861.

SIR,

I AM directed by the Lords of the Committee of Privy Council for Trade to transmit to you to be laid before 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 their Lordships to inquire into the circumstances connected with the accident which occurred on the 11th June from a goods train breaking through a bridge near Wootton.

I am, &c.

The Secretary of the
London and North-Western
Railway Company.

SIR,

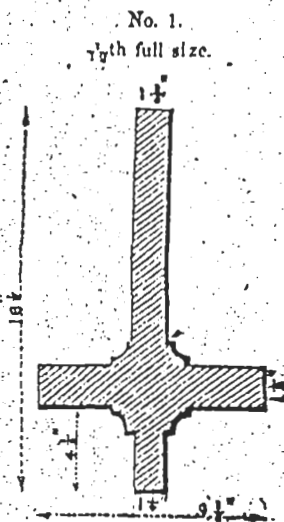
1, Whitehall, 5th August 1861.

IN compliance with the instructions contained in your minute of the 12th June last, I have now 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 11th of that month, in consequence of the failure of a bridge on the London and North-Western Railway between Leamington and Kenilworth.

The 6 a.m. mineral train from Kenilworth to Leamington passed over the line in due course on the morning in question, and started empty on its return journey from Leamington at about 7 o'clock, with a 6-wheel-coupled goods engine (such as was usually employed) attached to it, which weighed about 30 tons, independently of the tender. It was travelling at a speed of seven or eight miles an hour, when a bridge at Wootton, half way to Kenilworth, suddenly failed under the weight of this engine.

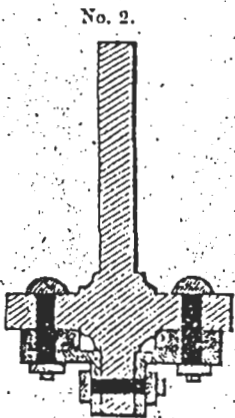
The bridge was constructed in the year 1844, to carry the railway over the junction of two roads,



namely, that from Stoneleigh to Guy's Cliff, and that from Leek Wootton to Hill Wootton; and it covered a span of 50 feet. The main girders, consisting of two timber trusses, were connected together below by five cast-iron transverse girders (of the section No. 1. in the margin); and these latter were suspended at their ends on wrought-iron bolts attached to the trusses. The rails were carried on longitudinal sleepers, resting on planking, which covered both the cast-iron cross-girders and the longitudinal baulks of timber under the planking which were supported by them.

In the year 1853, the trusses of the main girders were strengthened, some of the timbers were renewed, new rails were placed upon the bridge, and one of the cast-iron cross-girders was patched, to cover a defect which appeared, below the flange, and near the middle of it, at the point where the strains upon it in tension were greatest.

It was spliced, as shown in section No. 2. in the margin, with two angle irons, each $3\frac{1}{2}'' \times 3\frac{1}{2}'' \times \frac{1}{2}''$, by 3 feet long, and two packing strips, $1'' \times 2\frac{1}{2}''$ by the same length, and was pierced by bolt holes (shown in black in the section), on each side of the flange, and below it; those through the web having been six in number.



Bolt-hole $\frac{3}{4}''$ in diameter.

The debris of the bridge and the train were left undisturbed, at the request of Mr. W. Savago Poole, the coroner for Kenilworth, until I visited the scene of the accident the day after it occurred. The main girders were then standing

nearly in their places. The cast-iron cross-girders had all broken transversely, at various distances from their centres, and were hanging by their ends from the main trusses, the wrought-iron bolts by which they were connected with the upper portion, and attached to the lower portion of the trusses, having in no case given way. The engine, which had been travelling tender first, stood upright upon its wheels in the road nearly in the middle between the trusses, and against the abutment nearer to Kenilworth; while the tender, which had evidently passed off the bridge before the engine fell, was dragged back upon it, and rested on it in an upright position, with its wheels against the face of the abutment.

The six waggons next behind the engine fell in upon it, and lay in a confused mass, with a seventh upon them, filling up the chasm formed between the trusses.

The driver and fireman had unfortunately been crushed to death by the tender, as it fell back upon the engine; but the guard, who was riding in a break-van at the tail of the train, and a porter who was with him, do not appear to have been injured; as the remaining waggons of the train, and the van, were brought to a stand against those which fell into the road, without very great violence, when no room was left on the road for more.

Of the five cast-iron girders which had thus failed, and whose failure was obviously the cause of the accident, three exhibited flaws in the sections of fracture. The first, commencing from the Leamington abutment, had a blow-hole in it $\frac{1}{2}'' \times \frac{1}{2}''$, close to the lower end, which had not been visible from the exterior. The third had two similar defects in it, one near the bottom, $\frac{3}{4}''$ deep by $\frac{1}{4}''$ wide, and the other in the fillet $1\frac{1}{2}'' \times \frac{3}{4}''$. The second showed decided symptoms of a previous crack, which had extended, not only below one of the bolt-holes (indicated in the above section No. 2.) in the middle web, but also for some little distance above this bolt-hole; and it had evidently been by far the weakest of the girders for some time before the accident. The sides of this crack could not have been seen from the exterior because they were covered by the splicing angle-irons. The bottom of it might have been observed to open during the passage of a train over it; but it was not unlikely to escape observation, which it appears to have done. There can be no reasonable doubt that this second girder was the first to give way under the weight of the goods engine. It must have been previously in a critical condition; and after having been cracked in the manner that I have described it was not extraordinary that complete fracture should at length take place.

These cross-girders were placed at distances of 8'4" apart, from centre to centre; and, when the second girder gave way, the additional strain thrown suddenly upon the first and third caused them, apparently, to give way also. The fourth and fifth, then, in consequence of the forward motion of the engine, being subjected successively to the greater portion of its weight, must have failed in like manner, until the engine fell, not far from the end of the bridge, into the position in which it was found in the road below.

The breaking weight of these cast-iron transverse girders, when sound, may be estimated to have been about 40 tons in the centre, or 80 tons equally distributed over their length; and the greatest strain produced upon them by the passing of the engine in question, in addition to the stationary load, to have been equal to a weight in the centre of each of about 11 tons, so that the factor of safety when the girders were sound would have been between 3 and 4, instead of 6, as is desirable in the case of all cast-iron girders employed in railway bridges.

But the second girder above referred to, was weakened most materially, when it was patched in 1853, by the holes (at the ends of the splices) that were made in its flange, and through the lower portion of its middle web; and it was afterwards still further reduced in strength by the crack, connected with the bolt-hole next to the west end of the splice, which was the immediate cause of its failure.

These girders were of a defective form, inasmuch as the flange should have been at the bottom of them, instead of at $4\frac{1}{2}''$ from it; but they were constructed at a time when these matters were not so well understood as at present. They were of ample strength for the engines then in use, but they did not afford a sufficient margin of strength for the much heavier engines of the present day. The application of the splice upon the second of them in 1853, was an improper proceeding, as it was likely to lead to its ultimate failure, by weakening it at the bolt-holes near each end of the splice, and by the extra stiffness produced in the part spliced, which would tend to bring increased strains upon the portions near to those at each end of it which were thus weakened.

Instead of splicing that defective girder at that time, it would have been better to have taken out all the five girders, and to have substituted in their places new transverse girders of a better description and more suitable material.

That they should have been allowed to remain, and that this girder should have been so patched, and retained until failure occurred, is too much in accord-

ance with ordinary railway practice, which does not take sufficient account of the increased weight, and, I may add, increasing weight, of the engines of the present day. Those engines are permitted daily to run in too many instances over bridges which were never intended to carry much more than half their weight; and sufficient attention is not as a general rule paid, upon lines which have been opened for a number of years, to the necessity of strengthening the bridges in

proportion to this increased weight of the engines employed, so as to ensure the margin of strength that it is desirable to interpose between a reasonable degree of safety and actual failure.

*The Secretary,
Board of Trade,
Whitehall.*

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

LONDON AND NORTH-WESTERN RAILWAY.

*Railway Department, Board of Trade,
Whitehall, 10th December 1861.*

SIR, I AM directed by the Lords of the Committee of Privy Council for Trade to transmit to you, to be laid before the Directors of the London and North-western Railway Company, the enclosed copy of the report made by Colonel Yolland, R.E., the officer appointed by my Lords to inquire into the circumstances connected with the collision that occurred on the 24th October at the Bay Horse station of the London and North-western Railway.

I am, &c.

JAMES BOOTH.

*The Secretary of the
London and North-western
Railway Company.*

*Railway Department, Board of Trade,
Whitehall, 4th December 1861.*

SIR, I HAVE the honour to report, for the information of the Lords of the Committee of Privy Council for Trade, in obedience to your minute of the 18th ultimo, the result of my inquiry into the circumstances which attended the collision that occurred on the 24th October at Bay Horse station, on the Lancaster and Carlisle section of the London and North-western Railway, between a disabled goods train and the down auxiliary mail, when nine passengers and the engine-driver of the mail train were injured.

Bay Horse station is situated about six miles south of Lancaster. It is protected by semaphore signals at the platform and by distant signals north and south of the station; the distant signal towards the south being 375 yards from the level crossing at the north end of the platform where the collision took place. The line is nearly level.

At night when the lamps are lit, the down station and down distant signals can be first seen in approaching the station from the south, from the same spot 1580 yards from the level crossing; but, owing to a curve in the railway, they are not in the same line, the station signal being seen to the left of the other. The distant signal continues in sight of a driver until the train is close under an over-bridge 425 yards from the level crossing, while the station signal remains in sight for 770 yards, and is then lost sight of for 330 yards, after which it can be seen until it is passed.

On the 24th October the 10.30 p.m. down goods train, consisting of 30 loaded and 10 empty waggons from Liverpool to the North, left Liverpool at 10.35, and it proceeded on very well until it had passed the Whiston incline, up which it was assisted by a pilot engine at the rear of the train; and when it reached St. Helens, 12 miles from Liverpool, the pointsman showed a red light to the driver as he passed, and then the driver ascertained that he had lost a portion of his train. Three waggons had become unhooked, and it is surmised that this was done when the pilot engine joined the rear of the train at the bottom of the incline. The driver took his train on to Collins Green, 1½ miles beyond St. Helens, and placed them in a siding, and then he returned to the sidings at the top of the Whiston incline, and brought on the three waggons, which the breaksman had in the meantime put into the sidings, and reformed up his train at Collins Green and proceeded on to Wigan; he lost 1.10 by the breaking of his train into two parts. At

Wigan he was obliged to shunt for the down limited mail, by which he lost 25 or 30 minutes, and reached Preston at 2.30 a.m., or 1½ hours late.

He was occupied 15 m. at Preston in leaving one waggon, and in taking in coke and water, and left at 2h. 45m. or half-an-hour late. Before the train left Preston, the driver was told by the head breaksman that they could get to Carnforth, 6½ miles north of Lancaster, in time to shunt for the 3h. 29m. a.m. down auxiliary mail, —Carnforth being the appointed place.

The driver says he was supplied with bad coal at Preston, but that he got on very well till he passed Brock station, 7¼ miles north of Preston, and then about one half of the brick arch in the firebox of the engine fell in, and in consequence of the quality of the coal and the falling in of the arch he could not get any steam, and the speed fell off, so that he only managed to reach Bay Horse station at 3h. 50m. or thereabouts.

He says he travelled at from 20 to 25 miles an hour, until he reached Brock in about 20 minutes from the time of leaving Preston; that his engine is worked at 120lbs. pressure, and he had that amount of steam when he left Preston, but not more than 60lbs. when he got to Bay Horse station.

He says the down distant signal exhibited a white light as he approached Bay Horse station, and that he saw it as soon as he came out of the cutting where it first comes in sight; and he also saw the station signal from the same spot, also showing a white light; that he did not take particular notice whether the distant signal was a good or a bad light; that it was a windy night, but not raining as he came along, and he pulled up his train so that the van at the tail of the train stood to the north of the level crossing and station signal.

As soon as he stopped, he told the 2d breaksman, who was riding on the engine for the purpose of sanding the rails as they came up the incline out of Preston station, to get down and tell the pointsman to put on the signals, as he was going to shunt there for the 3h. 29m. down auxiliary mail, as soon as he could, and there is evidence to prove that the signals were at once put on.

He says he made one attempt to push his train back on to the up line to get out of the way, and failed, and was about to make another, when he heard the mail train coming, apparently fast, and saw it come under the bridge close to the distant signal; but he could not say whether the steam was on or off; and he heard the sound of the whistle for the breaks, as soon as the engine got under the bridge, but not before; and the collision occurred, he thinks, 6 or 7 minutes after he arrived.

The 3.28 a.m. down auxiliary mail is due to pass Bay Horse station at about 3.55 a.m., and it was apparently running as near as possible to its proper time, as the collision occurred about 3.54 or 3.55; and the driver of this train says, that as he came out of the cutting he could not see any light at the distant signal; that there might be a little delay in looking for the station signal, as it is more to the left. He admits that he knows that it is usual to keep a light burning at the Bay Horse station, but he had never seen a red light there; that he saw the station signal at "danger," when he was about half way across the bank (somewhere about 800 yards from the level