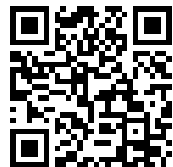


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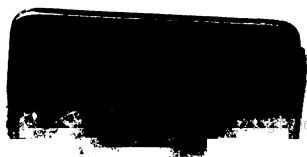
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THE  
HISTORY OF THE RAILWAY  
CONNECTING  
LONDON AND BIRMINGHAM.

*M. L. S. S.*

MY NAME HAVING APPEARED, CONJOINED WITH MR. ROSCOE S. IN ANOTHER WORK ON THE LONDON AND BIRMINGHAM RAILWAY, PUBLISHED BY MESSRS. WRIGHTSON AND WEBB, OF BIRMINGHAM; BUT THE HISTORICAL INFORMATION WHICH IT CONTAINS, BEING FURNISHED BY OTHER PARTIES AS WELL AS MYSELF, I FEEL IT NECESSARY TO STATE, THAT I AM ACCOUNTABLE FOR NOTHING WHICH IT CONTAINS, UNLESS FOUND IN THIS WORK ALSO.

THE  
HISTORY OF THE RAILWAY

CONNECTING

LONDON AND BIRMINGHAM:

CONTAINING ITS PROGRESS FROM THE COMMENCEMENT.

TO WHICH ARE ADDED,

A POPULAR DESCRIPTION OF  
THE LOCOMOTIVE ENGINE:

AND A SKETCH OF

*The Geological Features of the Line.*



BY

LIEUT. PETER LECOUNT, R.N., F.R.A.S., C.E.,

AUTHOR OF THE "EXAMINATION OF PROFESSOR BARLOW'S REPORTS ON IRON RAILS AND CHAIRS,"  
EIC., ETC. ONE OF THE ENGINEERS ON THE LINE, WHO HAS BEEN ENGAGED  
ON THE RAILWAY FROM ITS COMMENCEMENT.

31

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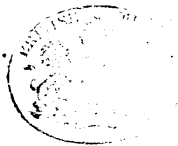
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## LONDON AND BIRMINGHAM RAILWAY.

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THE London and Birmingham Railway is unquestionably the greatest public work ever executed, either in ancient or modern times. If we estimate its importance by the labour alone which has been expended on it, perhaps the Great Chinese Wall might compete with it; but when we consider the immense outlay of capital which it has required—the great and varied talents which have been in a constant state of requisition during the whole of its progress—together with the unprecedented engineering difficulties, which we are happy to say are now overcome—the gigantic work of the Chinese sinks totally into the shade.

It may be amusing to some readers, who are unacquainted with the magnitude of such an undertaking as the London and Birmingham Railway, if we give one or two illustrations of the above assertion. The great Pyramid of Egypt, that stupendous monument which seems likely to exist to the end of all time, will afford a comparison.

After making the necessary allowances for the foundations, galleries, &c., and reducing the whole to one uniform denomination, it will be found, that the labour expended on the great Pyramid was equivalent to lifting fifteen thousand seven hundred and thirty-three million cubic feet of stone one foot high. This labour was performed, according to Diodorus Siculus, by three hundred thousand, and by Herodotus, one hundred thousand men, and it required for its execution twenty years.

If we reduce in the same manner the labour expended in construc-

ting the London and Birmingham Railway to one common denomination, the result is, twenty-five thousand million cubic feet of material (reduced to the same weight as that used in constructing the Pyramid) lifted one foot high, or nine thousand two hundred and sixty-seven million cubic feet more than was lifted one foot high in the construction of the Pyramid; yet this immense undertaking has been performed by about twenty thousand men in less than five years.

From the above calculation has been omitted all the tunnelling, culverts, drains, ballasting, and fencing, and all the heavy work at the various stations, and also the labour expended on engines, carriages, wagons, &c.; these are set off against the labour of drawing the materials of the Pyramid from the quarries to the spot where they were to be used—a much larger allowance than is necessary.

As another means of comparison, let us take the cost of the Railway and turn it into pence, and allowing each penny to be one inch and thirty-four hundredths wide, it will be found that these pence laid together, so that they all touch, would more than form a continuous band round the earth at the equator.

As a third mode of viewing the magnitude of this work, let us take the circumference of the earth in round numbers at one hundred and thirty million feet. Then, as there are about four hundred million cubic feet of earth to be moved in the Railway, we see that this quantity of material alone, without looking to any thing else, would, if spread in a band one foot high and one foot broad, more than three times encompass the earth at the equator.

It will be evident that such a work as this could only have been undertaken in a country abounding with capital, and possessing engineering talent of the highest order. The steps, by which the science of Railways has arrived at its present position, were slow yet progressive. Railways of wood and stone were in use, as well as the flat iron or tramrail, in the middle of the seventeenth century, particularly among the collieries of the north, and were gradually improved from time to time; they still, however, retained a character totally distinct from those structures which will soon form the means of transport through all the principal districts of the kingdom.

At length we lived to see the splendid creations of GEORGE

STEPHENSON, one of those gifted beings who are destined by one unerring stroke to annihilate all those bonds which limit the fame of ordinary men. Watt and Stephenson are of no country; they belong not even to Europe; they are citizens of the world in the truest and best meaning of the word. Centuries hence, when with few, very few, exceptions, even the deeds as well as the names of the heroes, the conquerors, and the politicians of the present day will have become engulfed in one common oblivion, those of Watt and Stephenson will be found rolling imperishably down the stream of time, and fertilising the whole habitable globe with the magnificent creations of their genius.

The first performance to which Mr. Stephenson directed the resources of his mind was the Stockton and Darlington Railway. This was certainly a great attempt; the ice was broken, the old track was fearlessly abandoned; yet it was but the planting of that ladder by which he was to ascend to his present eminence—he scaled that eminence on the Liverpool and Manchester line. It was there the system was shown in all its bearings, and at one blow a full and entire revolution was effected in all our habits and manners, and in our customs and feelings; a revolution which every person will confess is of such extent, that its consequences and its bearings on all the circumstances of civilised life are not capable of being even guessed at, but which even now almost justifies Bishop Wilkins's idea, that in some future time a man would be as likely to call for his wings as he then did for his boots. It is certainly a splendid sight to see one man, by the magic powers of his mind—more than realising the far-famed boast of Archimedes—taking a railway for his fulcrum, and moving the world.

It will readily be supposed, that in such an enterprising country as this, a successful experiment like that of the Liverpool and Manchester Railway, would at once be followed out in all directions, bearing in mind that the expense of such enormous works will, at all times, limit them to main lines of travelling, in order to insure a proper return of capital to the spirited individuals who embark their property in them. Lines from the Liverpool and Manchester Railway to Birmingham, and from Birmingham to London, were among the first which were projected; and, in fact, surveys and other preparations,



for the London and Birmingham line were in progress, prior to the opening of the Liverpool and Manchester Railway, (September, 1830,) and the projectors were waiting only the successful result of that event to mature their plans. Some of these surveys were made as far back as 1825.

In 1830, two lines were proposed; one by Sir John Rennie, taking the Banbury and Oxford line of road, and the other by Mr. Giles, taking its course by the way of Coventry. Companies were formed in each case, and were duly marshalled against each other, with their various staff appointments fully organised, directors, secretaries, engineers, solicitors, bankers, &c., and great were the rejoicings in Westminster Hall.

If the battle had been waged, and if any poet could have been found, capable of bringing into harmonious numbers such uncouth sounds as, cuttings and embankments, blocks and sleepers, and slopes of one thousand eight hundred to one, Homer's ghost might have trembled till all Pluto's dominions gave a simultaneous sympathising shake, like those comical clocks furnished with Hardy's "Noddy," where the one cannot rejoice in a little irregular motion, without the other telling tales by instantly wagging about too. But, fortunately, all parties were too wise, and they deemed it much more prudent, instead of throwing away their money in an uncertain Parliamentary contest, at once to consult, as far as possible, the interest of their several proprietaries, by selecting that line which a majority should consider the best, and thus unite the two companies into one.

George Stephenson had, a little prior to this, been engaged by the parties who had chosen the Coventry line for the Railway, and as he also gave his opinion in favour of that route, it was finally decided that the London and Birmingham Railway should go *via* Coventry, and George Stephenson and his son were appointed engineers to the now united "London and Birmingham Railway Company."

It may be thought that this period of time is passed over too lightly; but it is best. Why should the party feelings, the hopes and the fears, the disagreements, the quarrels, and the heart-burnings of five or six years ago, be perpetuated? It would be in excessive bad taste, to say the least of it, and anything but amusing to the public at large; all

parties did then what all have done since, that is to say, they strained every nerve for the interests of the proprietors, to the best of their ability and judgment, and who could do more? It may be just observed that, through the proprietors principally residing in Lancashire, and, from their proximity to the Liverpool and Manchester line, being to a certain extent practical men, they were better able to take a leading part, and to judge what was most advantageous; and they had heavy votes enough to oblige their judgments to be executed.

There was this object also to be kept in view, in forming such a line as the London and Birmingham Railway—that it is a grand trunk from the metropolis, towards the northern part of England, and that numerous branches would, in all probability, fall into it at no very distant period; that the Irish traffic would all come along it, and most probably the Scotch. It was also to be remembered, that not only the towns near the line would be benefited, but others far distant.

The impulse to travelling which has been given from the facilities afforded by railways, and the cheapness of this mode of conveyance, has been astonishing; and will, of course, continue to improve the more they are brought into use. The increase has varied in all proportions up to the ratio on the Stockton and Darlington line, where the passengers are now eighty times as many as they were before it was in operation.

On September the 11th, 1830, the two Companies united themselves, selecting eight persons from each as a provisional committee. Much had been done previously to this in preparing the public mind, and in endeavouring to obviate opposition, which, however, still continued very strong among those who either could not or would not see the advantages of establishing this means of communication. This has, however, perhaps worked good rather than evil; for it could only be met by the free use of the press, in order to enlighten all those who were willing to receive information on the subject of railways, and this was done to such an extent, that it soon became apparent our danger would be in having too many railways instead of too few.

In the latter end of 1830, a committee of survey was appointed to establish a regular communication with the Engineers, by way of periodical reports, and to correct errors, make improvements, confirm

friends, and conciliate enemies. In October, Messrs. Stephenson and Son reported, that the line, as laid down by Mr. Giles, from Islington to Chipping Barnet, South Mims, Leverstock Green, and Hemel Hempstead, was exceedingly rough, and incurred deep and extensive excavations, and that they would recommend it to leave London near Hyde Park, running almost parallel with the Edgware Road, to Watford, Hemel Hempstead, Great Berkhamstead, and Ivinghoe.

It was also proposed to enter Birmingham on the south side, by a tunnel, so as to gain a central *terminus*. Another plan was to pass up the Tame Valley from Stone Bridge, and join the Grand Junction Railway at Wednesbury, having a branch line to Birmingham; this was done with a view to the advantages of the whole line from London to Liverpool. Both companies were to have stations in Broad street,—the Grand Junction on the north-west side, on a piece of ground of about seven and a half acres; and the London and Birmingham on the south-east side, containing about nine acres, with another station at the Bell Barn Road.

In the summer of 1831, Mr. Creed examined another line, with the mountain barometer, from Northampton, through Bedford, Baldock, and Hutford, to near the West-India Docks; another line through Buckingham, Brackley, and Warwick, was surveyed, and many other attempts at improvement were made, each line having its advantages and disadvantages; the chief things next to the traffic to be kept in view being, to select that line where there is the least difference between the highest and lowest levels, and also that which is least expensive, even if it is not the most direct.

The country between London and Birmingham is a series of basins or low districts, separated from each other by considerable ridges of hills; the object to be gained was, therefore, to cross the valleys at as high a point as possible, and the hills at as low an one. The low districts are—the London basin—the valley of the Colne, extending from Brentford by Watford, to St. Albans—the lowland in the neighbourhood of Leighton Buzzard, on to Stoke Bruern—the valley of the Nen, in which is Northampton—and, the basin of the Avon; which last from its great depth, low level, and abrupt termination on the south, by the high ridge of hills on which Daventry, Kilsby, and Crick are

situated, and on the north side of the Meriden ridge, required particular attention.

The high grounds which bound these districts are—the county boundary between the London basin and the valley of the Colne—the Chalk ridge at Ivinghoe, which rises between the Colne valley and the Leighton Buzzard district—the Blisworth ridge, which forms the southern side of the valley of the Nen—and the Kilsby and Meriden ridges, forming the abrupt sides of the valley of the Avon. The whole will, therefore, stand thus:—

1. The basin at London formed by the Thames.
2. The summit at Oxhey, near the division of the counties of Middlesex and Hertford.
3. The basin of the Colne river.
4. The summit at Tring.
5. The basin of the Ouse, near Stoney Stratford.
6. The summit at Blisworth, opposite Towcester.
7. The basin formed at Weedon by the streams flowing into the river Nen at Northampton.
8. The summit at Kilsby, opposite Daventry.
9. The basin of the river Avon, crossed near Wolston, about five miles south of Coventry.
10. The summit of the Meriden ridge.
11. The basin at Birmingham, formed by the river Rea, which flows into the Tame.

From this sketch of the nature of the ground it is evident what care was required in searching for the best line of road. Mr. Robert Stephenson examined the country in the autumn of 1830, and was ordered to prepare the necessary plans and sections to deposit with Parliament in the November of that year. The time, however, was much too short; and it was only by great haste and force of numbers that the preliminary step of depositing these plans was accomplished.

The standing orders of the Houses of Parliament, although not then so strict or minute as in the present day, required more labour and closer attention than the time would admit of, and the result of all this hurried preparation was by no means satisfactory, and particularly so to the Engineer, who felt that he had not been able to

devote that time and consideration to the project which it demanded. After some further preliminaries, therefore, it was determined to defer the application to Parliament for a bill till the following year, and thus give the Engineer the opportunity of examining and selecting such a line as he could confidently report on as being the best the country would afford. When this was done, the plans and sections were deposited with Parliament in the November of 1831, showing a line almost identical with that which is now executed, where the steepest gradient (except where the line has been extended from Camden Town to Euston Square) is sixteen feet per mile.

During the preparation of these plans it was, of course, necessary that, before they could be made out, the Surveyors and Engineers should go upon the different properties through which the line was to pass, for the purpose of taking the necessary levels, and obtaining the data on which they were to found their drawings. This is a subject which merits the attention of our legislators in no small degree. Parliament orders certain plans and sections of any proposed public work, for which an act is sought to be obtained, to be deposited with their clerk, and with all the respective clerks of the peace for the counties through which such public work is to pass. This is a wise and prudent regulation, as it enables every landed proprietor, or other person interested in property which will be interfered with by the work in question, to go and inspect the nature of this interference, and thus ascertain if any and how much damage will be done to his interests, and to provide against injury, by making a special agreement for the necessary compensation; or he may oppose the bill altogether.

This provision is so far good—but no farther. When Providence ordained that human beings should eat, it was at the same time ordained that the earth, on which they were to live, should afford them food. The legislature has not thought it necessary to follow this wise example: it has ordained that plans and drawings shall be made, but it has not provided the means by which this is to be done; consequently the engineers and surveyors are completely at the mercy of any opponent who holds land, through which the projected line is to pass, as he can at all times prevent them from making the necessary

surveys. Indeed, if he be not an opponent, but happen to have had a bad digestion, or his bilious organs disturbed from any cause whatever, he warns them off his land, and they are left to make their survey how they can, while the measure in question, no matter how advantageous to the public, is put in jeopardy through the want of one or two of Abernethy's blue pills.

A great deal of this opposition was encountered in making the surveys for the London and Birmingham Railway, and although, in every case, as little damage was done as possible, simply because it was the interest of those concerned to conciliate all parties along the line, yet in several instances, the opposition was of a most violent nature: in one case no skill or ingenuity could evade the watchfulness and determination of the lords of the soil, and the survey was at last accomplished at night, by means of dark lanterns.

On another occasion, when Mr. Gooch was taking levels through some of the large tracts of grazing land, a few miles from London, two brothers, occupying the land, came to him in a great rage, and insisted on his leaving their property immediately. He contrived to learn from them that the adjoining field was not theirs, and he therefore remonstrated but very slightly with them, and then walked quietly through a gap in the hedge into the next field, and planted his level on the highest ground he could find—his assistant remaining at the last level station, distant about one hundred and sixty yards, apparently quite unconscious of what had taken place, although one of the brothers was moving very quickly towards him, for the purpose of sending him off. Now, if the assistant had moved his staff before Mr. Gooch had got his sight at it through the telescope of his level, all his previous work would have been lost, and the survey must have been completed in whatever manner it could have been done;—the great object, however, was to prevent this serious inconvenience. The moment Mr. Gooch commenced looking through his telescope at the staff held by the assistant, the grazier nearest him, spreading out the tails of his coat, tried to place himself between the staff and the telescope, in order to intercept all vision, and at the same time commenced shouting violently to his comrade, desiring him to make haste and knock down the staff. Fortunately for Mr. Gooch, although

nature had made this amiable being's ears longer than usual, yet they performed their office very badly, and as he could not see distinctly what Mr. Gooch was about, the hedge being between them, he very simply asked the man at the staff what his (the enquirer's) brother said. "Oh," replied the man, "he is calling to you to stop that horse there which is galloping out of the fold yard." Away went clodpole as fast as he could run, to restrain the unruly energies of Smolensko the Ninth, or whatever other name the unlucky quadruped might rejoice in, and Mr. Gooch, in the meanwhile, very quietly took the necessary sight; he having, with great judgment, planted his level on ground sufficiently high to enable him to see over the head of any grazier in the land; but his clever assistant, as soon as he perceived that all was right, had to take to his heels, and make the shortest cut he could to the high road.

In another instance, a reverend gentleman of the Church of England made such alarming demonstrations of his opposition, that the extraordinary expedient was resorted to of surveying his property during the time he was engaged in the pulpit, preaching to his flock. This was accomplished by having a strong force of surveyors all in readiness to commence their operations, by entering the clergyman's grounds on the one side, at the same moment they saw him fairly off them on the other, and, by a well-organised and systematic arrangement, each man came to a conclusion with his allotted task just as the reverend gentleman came to a conclusion with his sermon; and when he returned to his orthodox "jolly full bottle," the deed was done—the sinners had all decamped,

"And, like the baseless fabric of a vision,  
Left not a wreck behind."

These are a few specimens of what is really a very great hardship, and a hardship which might easily be prevented by Parliament. Whenever a measure of importance to the public comes to such a stage as to render surveys necessary, in order to comply with the standing orders of either branch of the legislature, the parties should be enabled to comply with those orders, or it is manifestly the old plague of the Israelites re-enacted—making bricks without straw.

At last, however, the business was all completed, and the share list

being filled, a bill to enable the Company to make a Railway from London to Birmingham was read a first time on February the 20th, 1832, and a second time on February the 28th, 1832, after a division of one hundred and twenty-five to one hundred and forty-six. It went into committee in the Commons, April the 5th, 1832, and witnesses were examined till the 13th of April; the committee then adjourned, and the examination was resumed on the 21st of May, and on the 5th of June the bill passed the committee, after the examination of nearly a hundred witnesses of various kinds, among whom were merchants from London and Birmingham, manufacturers, carriers by land and water, farmers, gardeners, graziers, &c.

It may safely be said that no private bill was ever more strictly scrutinized than was that of the London and Birmingham Railway; the opposition to it being confined more to the cross-examination of the witnesses in its favour than in producing any direct evidence against it, which, it must be confessed, would have been rather a difficult task. There was not a single fact proved against the great utility of the measure, while its advocates clearly established in its support the following important points, viz.—that the exporting of goods suffered material loss and great inconvenience by the present slow mode of traffic—that goods for the Baltic trade were often detained by the frost for the whole winter, through a very short delay in shipping them—that considerable orders were frequently lost from the impossibility of completing them in time—that merchants keep large stocks of many sorts of articles in London to meet these emergencies, at a consequent outlay and loss—that some particular trades have been almost ruined through the impossibility of getting goods forwarded in time, the coach proprietors having refused to take articles of considerable weight—that nothing is so invaluable in the export trade as expedition and certainty—that in fancy articles it is almost indispensable, orders being frequently sent subject to the condition of their being shipped in a particular vessel—that returns of money were sometimes made in eighteen months instead of nine, through this delay in the shipment of the goods ordered—that farmers would be able to send to London a different kind of produce altogether, and a much better one, particularly lambs, calves, dairy produce, &c., saving also a great expense in



their carriage—besides which, cattle were often driven till their feet were sore, and they could go no further; they were then sold on the road for what they would fetch: in the same manner, sheep were continually being left in every town on the road at a ruinous sacrifice in price—that many estates along the line of railway would be increased in value at least thirty per cent.—the consumer being also benefited as well as the producer.

It was also proved in evidence—that killed meat was repeatedly putrid in summer before it could be sent to the proper market—that the cost of carriage limited the vast supply of manure to a short distance round London; whereas, by a railway, its application would be most materially extended—that all cattle became deteriorated considerably when driven even a moderate distance to market, and produced a proportionably less price; for instance, a sheep driven eighty miles lost eight pounds in weight.

In addition to the speed and comfort of railway travelling, the cost would be reduced; a person living at Malvern would require sixteen hours and a half to get to London, and pay forty-three shillings; while, by the railway, he would be eight hours and a half, at a cost of thirty-two shillings.

In these days of political agitation the rapid transmission of bullion forms a subject of considerable importance, and even one hour saved would be sometimes the means of preventing the stoppage of a bank. Marked evidence was given to this effect.

In like manner, the rapid conveyance of troops was most essential. It was clearly shown, that a less number would be required in any tract of country possessing railway conveyance, as they could be concentrated on any given spot, in aid of the civil power, in the same, or shorter time than could now be done with a larger number of men; and the fact was stated, that a regiment of eight hundred men, and a large quantity of baggage, were only three hours in going from Manchester and being shipped at Liverpool.

On the Leeds and Liverpool Canal, being the one most interfered with by the Liverpool and Manchester Railway, the traffic had actually increased at the time; and it was a curious fact, that, by the Stamp Office returns, there was one more coach licensed at Liver-

pool and Manchester the year after the railway was opened than the year before. Every coach but one had been taken off the road between those towns, but they were still running with the addition of one at the two *termini*, for the purpose of feeding the railway.

It was also shown, that so invariably had it been found that land was benefited by a railway passing through it, that in advertisements for the sale of estates, this circumstance generally formed a part of the advantages detailed—then, again, there were the vast sums expended in labour—the materials bought from the surrounding country—the lowering of the poor rates, not only by the employment given to the local population, but by the large payments to these rates by the railway companies themselves. The extensive cuttings were also taken advantage of for draining by the adjoining occupiers, and altogether new life was infused along the whole extent of country through which the works were progressing.

The above is a short abstract of the leading points which were proved in evidence before the House of Commons; it now remains to be stated what the probable cost of this great work would be, and what return for their risk and outlay the proprietors might reasonably expect.

*The Estimate laid before Parliament was as follows:—*

Excavations and Embankments . . . . .	£179,000
Tunnelling . . . . .	250,286
Masonry . . . . .	350,574
Rails, Chairs, Keys, and Pins . . . . .	212,940
Blocks and Sleepers . . . . .	102,960
Ballasting and laying Rails . . . . .	102,960
Fencing . . . . .	76,032
Land . . . . .	250,000
Water Stations and Pumps . . . . .	3,600
Offices, &c. . . . .	16,000
Locomotive Engines, Wagons and Coaches . . . . .	61,000
Contingencies . . . . .	294,648
	<hr/>
	£2,500,000
	<hr/>

Before drawing to a conclusion with the present work, we shall more particularly allude to the increase which has taken place in this

sum. It will, therefore, be sufficient at present to say, by way of explanation, that in an undertaking of this kind, there are certain works which are of a fixed nature, and which can be fairly taken at the current prices of the day; but there are also others variable both in quantity and price.

For instance, the engineer knows he has, at least, a certain quantity of earth to move, and that, as he crosses over or under a given number of public highways, he must have a determinate number of bridges. All these things are positive data for an estimate, and constitute the principle sums in what are called the contract works; these formed an item of 1,649,155*l.* in the revised estimate of the engineer, and they were actually let for 1,621,821*l.* or 27,334*l.* below the estimate; to this, 76,160*l.* has to be added, for the extension from Camden Town, where the railway originally began, to Euston Square.

From the great increase in prices, which took place almost immediately after the letting of the works, no less than seven contracts were thrown on the Company's hands, and of course these were the most difficult and expensive parts of the works, and in each case, the directors had to purchase all kinds of implements and materials at a vast expense, including five locomotive engines, while, from the times at which these seven contracts took to complete them, there was very little possibility of transferring these implements (technically called the Plant) from one contract to another. This, although a very expensive process, was the only one to be followed, or the line could not be opened under at least a year beyond the time contemplated.

It is a well-known fact, that, from the great rise in prices, there is hardly one of the contractors who has made a sixpence by the three years' labour, and some have absolutely lost money, but have spiritedly performed their engagements whenever it was possible for them to do so. The difficulties of particular works will be adverted to in a future place; in the mean time the reader may be reminded of another class, namely, the variable one.

The contract works, consisting of definite portions of the whole, being let, as the land agents advanced in their labours a series of what are called extra works arose; these consisted of bridges over private roads—of bridges to join lands severed by the railway—of culverts,

drains, watering places, new roads, gates, fencing, approaches to bridges, &c., forming a large portion of the whole, and which could only be ascertained as the agreements were entered into between the owners of the land and the Company's agents.

It is obvious the engineer can have neither a knowledge of the extent of these, nor of their cost, except in a very general way; he only gains full information as he has extracts sent him from time to time from these agreements, showing what has been consented to on the part of the company, and he then gives his orders for the various works to be done. It is evident, therefore, that the total amount of these constantly increasing and variable works, many of them, as in the case of bridges with extensive approaches, costing several thousand pounds, cannot be fully ascertained till the line is nearly completed.

Among the variable items are also those denominated additional works. These are the alterations of different kinds, which must constantly arise during the progress of all great undertakings, such as increasing the slopes in particular parts where, on cutting into the ground, it is discovered to assume a different character to that of the borings taken right and left of it, from which borings alone could a judgment be formed in the first instance; in some cases springs of water are cut into, and have to be drained, in others rock is come upon, where no geological indications, or any result from the borings, would at all lead to a suspicion of its proximity; from similar causes bridges have to be enlarged in their foundations, and where the slopes have been increased, in their superstructure also; water has to be procured for the adjoining occupiers of land at considerable expense; and there is a constant and unavoidable increase in the outlay from these and other causes, over which no human foresight can, by any possibility, have the least control.

It could scarcely have been supposed that under the article of extra works, the following curious specimen of the impositions which the company has suffered, would have taken place. In one portion of the line, on the Birmingham division, some land was passed through in such a way, that it was evident the reverend proprietor (considering, doubtless, that his own temporal advantage was essential to the spiritual good of his parishioners) required, in reality, no accommodation in the way of bridges at all. At the first outset, however, he demanded five;

but, in the course of the discussion, came down to four, with an equivalent in the price of the land. It was absolutely necessary to obtain the land, or the contractors would have been stopped in their operations, so that, after a great deal of argument, the company was forced to submit to this enormity, and the agreement was signed, sealed, and delivered, guaranteeing to the proprietor a bridge at **A**, another at **B**, another at **C**, and another at **D**.

Soon after the money had been received, the proprietor wrote to say, he thought he could dispense with a bridge at **A**, and if the company would give him about half its value, he would do without it; of course, as this would save expense, it was agreed to, and bridge **A** done away with, the proprietor receiving about half what it would have cost in building.

When this quantity of hard cash had been a little time warming in his pocket, he discovered he could do without bridge **B**, and offered to commute that with the Company on the same terms as bridge **A**. This being agreed to and paid for, he in succession found out that he could dispense with bridges **C** and **D** on exactly the same terms; and thus every bridge he had so pertinaciously demanded, were one after the other found to be totally unnecessary, as every body knew very well at first; but it is to be supposed that he found it a very agreeable way of getting a few cool hundreds; at any rate, such are the facts—he has been paid for all the four bridges, none of which have been built.

There was no end to the enormous compensations demanded of the Company where, in many cases, no injury was done; the necessary land being estimated by the professional valuers on the most liberal scale, keeping in view the fact that companies of this kind are generally made a dead set at. Under this impression they gave in as a full and ample sum for all that would be required 250,000*l.*, exclusive of fourteen acres for the Euston Extension and Station which cost 74,505*l.* Now what is the fact? 620,000*l.* has now been paid, and there are yet some little out-standing claims remaining to be settled—the Birmingham division averaging about 315*l.*, and the London division 335*l.* per acre.

Peers paid for their votes—opponents paid to gain their consent—

3000*l.* given for a piece of land, and the enormous sum of 10,000*l.* as a compensation for consequential damages, when, instead of damages, the land has been improved ; these and similar transactions soon run away with all reasonable estimates, and yet we firmly believe that in every instance the best plan that could be devised was followed to procure the land as low as possible, taking into consideration that to gain time was in most cases the principle object.

One rather original character sold to the Company some land, and was loud and long in his outcries for compensation, ringing the changes on all sorts of damages which the railway could not fail of bringing on him. Well, his mouth at last was stopped ; he was paid, and in a few months a little additional land is wanted from the same individual, when, surprising as it may appear, for some adjoining parts of this land—so deteriorated by the railway, on which the Company's works had brought such inevitable destruction, and for which reasons so high a sum had been paid—he actually required a much larger price than was given him before, and on the Company expressing the surprise which was natural on hearing such a demand, he very coolly replied, “ Oh, I made a mistake *then* in thinking the railway would injure my property ; it has increased its value, and, of course, you must pay me an increased price for it.”

Another reverend and afflicted proprietor complained bitterly that his privacy was ruined—that his daughters' bedrooms were exposed to the unhallowed gaze of the men working on the railway—that he must remove his family to a watering-place, to enable him to do which he must engage a curate. All this was considered in the compensation demanded, and paid ; yet no curate has been engaged ; no lodgings at a watering-place taken ; the unhappy family have still dwelt in their desecrated abode, and borne with christian-like resignation all the miseries heaped upon them. The gilding of the pill, it seems, has rendered it palatable, and we have no doubt that, if his daughters have a back window as well as a front one, he would be exceedingly glad if a railroad was carried across that at the same price.

Sometimes, however, either by good fortune or artifice, the unconscionable attempts of the landowners were frustrated. We remember a case which, although the amount involved was inconsiderable, may

suffice to show the *animus*. The drainage of a road was demanded from the Company, and the claimant would have undertaken it for a sum of money to be paid him. It appeared, however, that the Company could do it much cheaper by taking the drain across the corner of one of his own fields; this he of course refused to permit. Matters stood thus when he happened to be called to London, and after his return discovered one fine morning, that the Company had made his drain for him their own way, having in fact quietly tunnelled through the corner of his field without committing a trespass.

The remaining part of the Parliamentary evidence which may be adverted to is, the probable result of the traffic to be expected on the line. Some time before the application to Parliament, the Company had secured the able services of Captain C. R. Moorsom, R. N., as one of their secretaries, and it was on a new and original plan of his that the writer of this work calculated the traffic then existing on the main roads and surrounding country, which would be available to the railway when opened. In ascertaining the data for this he travelled no less than two thousand miles.

The way in which these things are usually got up for Parliament is so vague and undetermined, as to merit no other name than a guess, and not a good one either; hence has arisen the common saying with all great undertakings of this kind, "halve the receipts and double the expenditure if you wish to know any thing about it." In the present case, however, the traffic was actually counted on the roads during a fortnight, and the results thrown into a table, to which were added the probable traffic now existing, which at any rate *could* come along the line in less time, and for less money than by any other route; by this means, and by using the Stamp Office returns for all that coaching which was not actually counted on the direct road, a sure foundation was formed for a correct determination of what could be done, and as no increase on the traffic already existing was assumed for the additional facilities which the railway would afford, it is fair to conclude that the estimate is not too large, particularly as only a part of the canal traffic—namely, light goods—was taken into account.

The bill was read a third time in the Commons on the 19th of June, 1833. Its first reading in the Lords was on the 19th of June,

the second reading on the 22nd of June. No division took place on either, and it was sent to the committee of the Lords on the 22nd of June, where a similar mass of testimony was again gone through for seven days, and, notwithstanding the overwhelming weight of evidence in favour of the measure, and the total absence of all reasonable testimony against it, the following, among other members of the hereditary legislature, resolved on burking the bill, after all the expenses which the Company had been put to:—

ABINGDON,	COLVILLE OF CULROSS,	MOUNT EDGECUMBE,
BEAUCHAMP,	DIGBY,	MUNSTER,
BEAUFORT,	HASTINGS,	SOUTHAMPTON,
BROWNLOW,	KENYON,	VANE,
CLARENDON,	MACCLESFIELD,	VERULAM.

The following peers were distinguished as supporters of the bill:—

AYLESFORD,	DENBIGH,	NORTHWICK,
CALEDON,	HOOD,	SLIGO,
DARTMOUTH,	LYTTLETON,	SUFFIELD,
	WHARNCLIFFE.	

Lord Brownlow headed the opponents of the bill, and knowing that if evidence was attempted to be produced against the measure, its weakness would but add to the strength of those who were promoting it; he determined to “knock it over,” as he elegantly phrased it, by brute force alone, in which he succeeded; for on the 10th of July, having mustered all his forces, (according to the approved practice, that *noses* are the grand things,) the moment Mr. Follett, one of the counsel for the bill, had concluded summing up in favour of the measure, and when we expected our opponents to commence opening their case against it, Lord Brownlow made the following motion; in reading which, the peruser is requested to ascertain in which language it is drawn up, whether English as spoken in the nineteenth century, or as we may imagine it in use when the tower of Babel was *left off*.

“That the case for the promoting of the bill having been concluded, it does not appear to the committee that they have made out such a case, as would warrant the forcing of the proposed railway through the



land and property of so great a proportion of dissentient land-owners and proprietors."

This is one more example of the blessings of hereditary legislation. In the elective branch of our constitution, composed of men chosen either from their influential position or their talents, and who are obliged to possess some common knowledge of the current affairs of life,—to these individuals it did *appear* that the measure was, what now is universally allowed—namely, one of vital interest to the community at large, and accordingly they passed it by a large majority; but to the before-mentioned members of the hereditary branch, who are not obliged to know anything, it did *not appear* that such a noble undertaking should be suffered to proceed; *ergo*, if a certain number of hereditary legislators have an unusual obtuseness of intellect, and cannot see a thing when it is put before their eyes, a great public company is to be stopped for twelve months from pursuing a project of such vast importance to the whole country, in almost every relation between man and man, and the twenty-five thousand proprietors, some of whom have been laying eight years out of their money, are to be put to the expense of no less than 72,869*l.* before they are allowed to benefit the country by establishing one of the greatest public works ever achieved by mortal man.

Yes, reader, in every half-yearly report of expenditure sent forth to the twenty-five thousand proprietors, foremost in the items is recorded the appalling fact, that public-spirited men, who are willing to risk five millions of their money, and lay out of a part of it for seven or eight years, in order to complete such a splendid undertaking as the London and Birmingham Railway, must, before they can obtain permission to commence this work, submit to place down upon their records, as the first item of their outlay—

"PAYMENTS FOR OBTAINING THE	}	£.	s.	d.
ACT OF INCORPORATION	}	72,868	: 18	: 10"

The nature of the opposition, and the mode in which that opposition was conducted, will be much better appreciated by the remark which fell from one noble lord, as he came out of the committee room, after the division by which the bill was lost, than by any more lengthened explanation. The following speech tolerably pithy

and significant, was spoken out with a warmth of heart which showed every one it was meant; it needs no comment—"By G—d," said the noble lord alluded to, "it is one of the d—st rascally things I ever saw in my whole political existence."

We had now to commence afresh all our operations, this was done in October, 1832, and plans and sections were deposited again with Parliament by the 31st of November, corresponding as nearly as possible with those of the preceding year, the only alterations consisting in a slight change between Harrow and London, and an alteration in the *terminus* of the railway by stopping at the Hampstead road, close to its intersection with the Regent's Canal, where the Camden Town Station now is, instead of going nearly to King's Cross.

Much was said out of committee during the progress of the bill, on the subject of a more direct line than that which had been chosen. Mr. R. Stephenson and Mr Gooch spent a great deal of time in investigating this question; examining the country and taking levels in all practicable directions in order to ascertain the merits of the route referred to. This was intended to branch off from the present line near Tring, and leaving Aylesbury a little to the south-west, passing near to, and on the easterly side of Bicester, thence on to Buckingham and Banbury, and crossing the river Avon between Leamington Priors and Warwick, was to join the present line again in the neighbourhood of Hampton-in-Arden.

The saving in distance, however, would not have exceeded four or five miles, and in addition to the many difficulties and expensive works on this route, the crossing of the valley of the Avon, near Warwick, was at once a fatal objection, the 16 feet per mile, which is now the maximum rate of inclination, except on the Euston Extension, must have been abandoned if this line had been selected.

The crossing of the river Avon forms one of the basins, or lowest points to be passed over, as we have before explained, and the intersection of the high ground between it and Birmingham, called the Meriden ridge, one of the summits. On the present line the rate of inclination, between the Avon and Meriden ridge, is 16 feet per mile only. Now, on the direct line, the Meriden ridge must have been crossed as well as in the present line, but in a less advantageous place; for the distance

between the high and low points—namely, the river Avon and the ridge in question—would only have been four miles, whereas on the present line it is eight miles. To have gained 16 feet per mile on the direct line, as it was called, would have been impossible without an enormous outlay; whereas it is obtained on the present at a reasonable expense, this in itself was a sufficient objection, inasmuch as the river Avon, near Warwick, is very considerably lower than at Wolston, where we now cross it, and the Meriden ridge would have been intersected at a higher point than at present, besides these high and low points being twice as near as they are where the road now passes through. Hence it is quite evident that a line in this direction, although the shortest by four miles, would be encountered by such sudden and extensive variations of level as to render it a permanently bad locomotive line as compared with the one chosen.

The line by the way of Coventry, Daventry, Stoney Stratford, Leighton Buzzard, Berkhamstead, and Watford, may therefore be pronounced the very best line the country would admit of, and an unobjectionable one for locomotive engines, having no rise greater than 1 in 330, or 16 feet per mile, and this the opponents of the bill were no doubt perfectly aware of, as they never brought forward the direct line, or any other as being better than that which is now executed.

Our bill passed the Commons' committee, March 15, 1833, and the Lords, April 29th, 1833, receiving the Royal Assent, May the 6th, and the means the directors were obliged to resort to, must be left to the imagination of the reader; suffice it to say, that no variation, sufficient to account for the different features of the case, took place in the numerical value of the assenting or dissenting landowners, [See Lord Brownlow's English (?) motion, page 19.] between the time of the first application being thrown determinately out by the Lords' committee, and the time when our bill was passed by them, without hearing any witnesses, making any opposition, or, in fact, doing any thing but going through the necessary forms of the Upper House.

Although we have found during the progress of this great work numerous and severe difficulties, there was nothing to indicate any thing like what we have experienced, and without expending vast

sums in boring, they could never have been anticipated. The district through which the line passes is peculiarly interesting in a geological point of view, and through the railway crossing the different strata, at nearly right angles, it probably intersects a greater number of formations than any other line will do in the same distance.

The strata which are crossed extend from the London clay to the borders of the Coal Measures, and the various deep cuttings and tunnels show most interesting sections of each formation. These have had considerable attractions for the geologists, and have been very numerous visited; they are now, however, becoming rapidly a sealed book; for, as the various works successively approach completion, the sides of the excavations and embankments are either covered with turf, where it can be got, or, where it cannot, with good soil, and sown with grass seed; this method of finishing the slopes being a great support to them, through the tenacity of the roots.

The rivers forming the basins are generally near the division of two formations.

The London clay is penetrated by the Primrose Hill Tunnel, and presents a close, compact, and dry appearance. This tunnel was perfectly free from water, but a more than ordinary thickness of brick lining was necessary, arising from an extraordinary pressure, probably caused by the swelling of the clay on exposure to the atmosphere.

The plastic clay and sands were well shown in the deep cuttings at the first summit from London, in the neighbourhood of Oxhey, before approaching Watford.

At Watford, near the Colne, the chalk first made its appearance underneath the plastic clay. It extends along the line to the Tring, or second summit, where a good section of the lower chalk is given by the deep cutting at that place.

The Watford and Northchurch Tunnels give also good sections, the former of the upper chalk. A coating of gravel, varying in thickness, overlies the whole of the chalk, and, in some instances, forms the actual surface for arable purposes; and, if we may judge from their very flourishing condition, this appears to agree well with turnips. The gravel is most abundant in the neighbourhood of Watford, covering the upper chalk, which in many places it penetrates, or, in other words

the large fissures, or rents in the chalk, are filled with the gravel, and as this latter material was very loose and mobile, it was the occasion of much difficulty and danger in the excavation of the Watford Tunnel; for, at times, when the miners thought they were excavating through solid chalk, they would all in a moment break into loose gravel, which would run into the tunnel with the rapidity of water, unless the most prompt precautions were taken.

As the lower chalk is approached, the gravel and also the flints disappear; and at Tring there is scarcely a trace of either. The strata at the bottom of the cutting almost approaches chalk marl. The great thickness of the chalk is very clearly shown by the long line of intersection it makes with the railway, which crosses it here nearly at right angles.

In descending from the Tring summit towards Leighton Buzzard, the chalk marl, green sand, and weald clay formations are met with; but they are only intersected by the shallow cuttings. The presence of these formations is, however, made sensibly evident by the birdlime properties of the soil, which by no means facilitates the field labours of a Parliamentary campaigner when time is an object of great importance. In such cases it is usual for all surveying parties, when in motion, to attempt to run; but in this district walking was a toilsome matter, and running quite out of the question altogether.

At Leighton Buzzard the line crosses the iron-sand formation, which is found here in cliffs and abrupt hills. One of these is pierced by the Leighton Buzzard Tunnel. The nodules of ironstone found mixed with the iron-sand forms some of the best ballasting in use upon the whole line.

The oolitic series are next crossed, making their first appearance a little to the northward of Leighton Buzzard, and extending to the crossing of the river Avon at Wolston. This distance includes the Blisworth and Kilsby summits, as also the basins of the Ouse and Nen.

The Blisworth summit is made passable for the railway, by a deep and long cutting through the oolitic limestones with beds of shale intervening, and the Kilsby summit is passed by means of a tunnel, two thousand four hundred yards long, chiefly through lias shale containing much water, and partly through a stratum of diluvial sand

full of water. This, as will be seen hereafter, has been a source of much difficulty and expense in the execution of this work.

The organic remains, both at Blisworth and Kilsby, are very numerous, particularly at the former place. In some parts of the excavation for Kilsby Tunnel, there is hardly a cubic inch to be found without shells and other remains presenting themselves to the eye, in all directions, and in all stages of preservation; and, as the earth taken out here has been principally laid into spoil, there will be ample opportunities, for some time yet, for their further examination, which we are certain would well repay either the scientific inquirer or the cabinet collector.

The red marl, or new red sandstone, is first intersected at the river Avon, which, at this place, appears to separate this formation from the lias shale, and the red marl continues to Birmingham. Good geological sections were shown at Coventry, Berkswell, Yardley, and Birmingham, and also by the Beechwood tunnel through the Meriden ridge.

Till within a late period this formation has been generally thought destitute of organic remains, and it is now a doubt with many whether such really exist. There are, however, some facts which tend strongly to confirm a belief in the presence of these remains, and, at all events, we can safely affirm that the formation is not totally destitute of organic *matter*, inasmuch as a live toad was discovered in the deep cutting near Coventry, safely housed in a small smooth cell, in the centre of a mass of red sandstone rock, perfectly solid, with the exception of the small cavity occupied by the toad.

Fragments of silicified wood have also been found in the Hearsall Common cutting, and we believe in the road excavations in the neighbourhood of Coventry; but it is a matter of great doubt whether these belong to the red sandstone or to the superstratum of diluvium which overlies some parts of the red marl. We have never seen them *in situ*, but Dr. Ward, and Mr. Gooch, the assistant engineer of that district, found some of this wood lying loose in the Hearsall Common Excavation, where the red rock extends almost to the surface.

At Wolston, and near Tring, Roman vases and vessels have been met with in the railway cuttings; in fact, as may naturally be supposed, in works of such magnitude, hardly an excavation of average

depth has been got out without some relic of ancient days turning up, or some geological specimen worth preserving, having been found, and in the largest excavations they have been both numerous and interesting in the highest degree.

The following are the different contracts for the principal works along the line, including all the formation of the embankments and cuttings, the erection of bridges, and the laying of the rails. The materials for the road—namely, the rails, chairs, blocks, sleepers, &c., were not provided by the contractors who laid them down, but were furnished by the Company in order to insure their being of a good quality.

<i>Name of Contract.</i>	<i>Original Contractors.</i>	<i>Date.</i>	<i>Second Contractor.</i>
Euston Extension	W. and L. Cubitt .	Dec. 1835	
Primrose Hill .	Jackson & Sheddou .	May 1834	The Company, Nov. 1834.
Harrow .	Nowell and Sons .	May 1834	
Watford .	Copeland & Harding .	May 1834	
King's Langley .	W. and L. Cubitt .	Sep. 1835	
Berkhampstead .	W. and L. Cubitt .	Sep. 1835	
Aldbury .	W. and L. Cubitt .	Sep. 1835	
Tring .	T. Townsend .	Sep. 1834	The Company, Oct. 1837.
Leighton Buzzard	James Nowell .	Sep. 1835	
Stoke Hammond	E. W. Morris .	Sep. 1835	
Bletchley .	John Burge .	Sep. 1835	
Wolverton .	William Soars .	Oct. 1834	The Company, June, 1837.
Wolverton viadct.	James Nowell .	Feb. 1835	
Castlethorpe .	William Soars .	Oct. 1834	Craven & Sons, July 1835.
Blisworth .	William Hughes .	Feb. 1835	The Company, Dec. 1836.
Bugbrook .	John Chapman .	Feb. 1835	
Stowe Hill .	John Chapman .	Feb. 1835	
Weedon .	Edward Boddington	May 1835	W. & J. Simmons, May 1836
Brock Hall .	J. & G. Thornton .	May 1835	
Long Buckby .	J. & G. Thornton .	May 1835	
Kilsby .	Jos. Nowell & Sons	May 1835	The Company, Feb. 1836.
Rugby .	Samuel Hemming .	Nov. 1835	The Company, Oct. 1837.
Long Lawford .	W. & J. Simmons .	Feb. 1835	
Brandon .	Samuel Hemming .	Feb. 1835	The Company, Jan. 1838.
Avon Viaduct .	Samuel Hemming .	Nov. 1835	
Coventry .	Greenshields & Cudd	Nov. 1834	The Company, May 1837.
Berkswell .	Daniel Pritchard .	Nov. 1834	
Yardley .	Joseph Thornton .	Aug. 1834	
Saltley .	James Diggle .	Aug. 1834	
Rea Viaduct .	James Nowell .	Aug. 1834	

It will be seen by the above that out of these thirty contractors no less than ten have broken down, and the works have been completed by

a second party; this has mainly arisen from the great increase in the price of labour and materials, which took place soon after the principal ones were let, rendering it impossible for the contractors to complete their respective works, without incurring considerable pecuniary loss. When this was discovered, of course, a complete want of energy soon became apparent, and the Company were under the necessity, at whatever cost, of getting them into their own, or some other persons' hands as quickly as possible, as it was clear that whatever additional outlay might become necessary on this account, would be much more than counterbalanced by the time which would be gained. In fact, the leading object at all times kept in view, was the opening of the line as speedily as could be done consistent with safety.

There is always one feature which strikingly distinguishes the construction of railways from that of canals, and this is the employment of the surrounding agricultural population. When the reader is informed, that for nearly three years, from fifteen thousand to twenty thousand men were engaged on this work, taken almost invariably from the adjacent towns and villages, and that, in actual labour, nearly four millions have been expended (in earth-work, brick-work, brick making, &c.) among the local population, he will have some idea how this would influence pauperism and the poor rates: whereas, in the making of canals, it is the general custom to employ gangs of hands who travel from one work to another and do nothing else.

These banditti, known in some parts of England by the name of "Navies" or "Navigators," and in others by that of "Bankers," are generally the terror of the surrounding country; they are as completely a class by themselves as the Gipsies. Possessed of all the daring recklessness of the Smuggler, without any of his redeeming qualities, their ferocious behaviour can only be equalled by the brutality of their language. It may be truly said, their hand is against every man, and before they have been long located, every man's hand is against them; and woe befall any woman, with the slightest share of modesty, whose ears they can assail.

From being long known to each other, they in general act in concert, and put at defiance any local constabulary force; consequently crimes of the most atrocious character are common, and robbery,



without an attempt at concealment, has been an every-day occurrence, wherever they have been congregated in large numbers; but they were so thinly scattered over the London and Birmingham Railway, that their depredations partook more generally of a deceptive character, and acts of open violence were rare.

These deceptions were sometimes not a little amusing, as for instance, the following;—A navigator engaged on the Berkswell contract, about ten miles from Birmingham, went one day into a village public house, and made the enquiry, "Have *you* got any gin?" laying great stress on the word *you*; the landlord quickly responded that he had plenty, "Oh," said the navigator, "I am glad of that, I have been to the other public house and broke him of all he had, I wanted two gallons and he had only got one, so I have had to come here for the other one." The gallon was quickly measured out, and put into that which he had before in the bottle. He was then very coolly walking out of the shop; mine host, however, soon reminded him that there was a little process to go through which appeared to have escaped his observation—namely, the paying for the gin. To this the "Navie" shrugged up his shoulders, and said he would pay on Saturday night; Boniface, however, was not to be had quite so easy, and the gallon measure was quickly refilled again out of the "Navie's" bottle, and he departed looking very indignant at not being trusted till his pay-night. It only remains to inform the reader, that what he had originally in the bottle was a gallon of water—not a gallon of gin—and consequently his ingenuity was rewarded by his getting clear off with half a gallon of "mine host's best cream of the valley," in a state quite ready for drinking.

It would be a curious thing, if we could analyse the ideas of those residents in the central parts of England, who have outlived the ordinary limit of human life; those, for instance, whose memories will carry them back for seventy years. We have it from indubitable authority, that within that period, the carrying trade for Yorkshire and Lancashire, from Birmingham and the West of England, was worked by Mr. Worthington with pack horses! as is done in the present day in South America and other countries.

When the canals were opened it was suggested to him by the late

Duke of Bridgewater to establish boats; after some discussion this was done, and the wants of Liverpool, Manchester and Birmingham, were supplied by two boats, weekly, each way, which two boats not being able to procure cargoes at Birmingham, went on to Wolverhampton to complete their load; there are now, in addition to other facilities, 150 boats going through the same route.

In these olden times the Edinburgh coach to London, took fourteen days to go this journey of 400 miles; the London to York took six days to go its journey of 200 miles; the London to Exeter thirteen days for 175 miles; and as late as 1742, the London to Oxford managed to get to High Wycombe in ten hours, when the passengers were carefully put to bed, and were allowed to continue their journey in the morning. From this system we improved till we got to a horse per mile one way, for a fast coach, for the cost of 25*l.* each, and 150*l.* for the coach; the receipts for which must be 5*l.* per double mile to pay the proprietors, and now even these exertions are in their turn despised, and we have doubled, and will probably treble the utmost that ever this expensive system could accomplish. It will take of course some time to clear away long-established customs;—the curfew bell still tolls at Tring, close to the London and Birmingham Railway, we hope the enginemmen will not, through fear of William the Conqueror, put their fires out at the ominous sound.

There is nothing in the construction of a railway any more than in other affairs to show, that politics and honesty are in any way connected. There are some reformers along our line who might well begin by reforming themselves. One of these owned a sand hill near a part of our works, and the material being a very good article for ballast, the contractor asked the Railway Company, as a favour, to treat for its purchase, under the powers of their Act of Parliament. This was done, and the moderate sum of 300*l.* per acre, turned out to be the demand of the proprietor. Of course the Railway Company at once desisted, telling the contractor they would have willingly assisted if they could, but on no considerations would they become a party to this enormous demand, for what would be only a temporary occupation. The contractor thus left upon his own legs, has found means to get the said sand hill for 30*l.* per acre, or just one-tenth.

The labours of the engineers, it is almost needless to state, commenced long before the ground was broken. In fact, many of them were employed in getting assents to our Bill, from the land-owners who have shown themselves so wise in their generation. Then came the various surveys and levellings required for fixing the line; then the designing and drawing of bridges and other works in detail, in order that approximate estimates of costs might be laid before Parliament. When the period arrived for executing the works, it was necessary to calculate the time which those of the greatest magnitude would be likely to occupy, so that they might be let to the contractors in such an order, that the whole might be simultaneously completed, as far as possible, with reference to the successive openings of portions of the whole line, which was desirable, not only as a measure of pecuniary interest, but to get the road in good repair, and to drill every one into his particular duty. The order of letting the contracts having been decided, assistant and sub-assistant engineers were appointed, as required, upon the general principle of dividing the whole line into four districts, and each district into three lengths, so as to place about ten miles under the immediate superintendence of one sub-assistant engineer; thus each assistant engineer had three sub-assistants, being all subordinate to one engineer-in-chief.

When any particular portion of the works was to be prepared for letting, the sub-assistant engineer, under the direction of his superior, had to revise all the Parliamentary surveys and levels with the utmost care, and draw to a large scale very accurate plans and sections of the land, in order that the quantity of excavations and embankments might be obtained as nearly as possible. It was also necessary to make detailed plans and working drawings, elevations, and sections of every bridge and culvert which carried a road or stream across the railway, or which carried the railway over a road or stream. These, being roughly sketched by the engineer on the spot, were sent to the chief office, to be fairly drawn out with full details, and upon a uniform system laid down by the principal engineer; the object being to put them in such a shape that parties wishing to tender for any of the contracts might clearly understand the nature of the works, and make accurate estimates from the drawings without difficulty. The limits of each con-

tract were defined with reference to the most convenient execution of the works, regard being had to the disposition of the earth work, so that each contractor might make his embankments with the materials yielded by his excavations, as far as it was practicable; care being taken that the aggregate amount of the contract should not exceed the means of the generality of persons in the habit of tendering for such works.

A contract of 100,000*l.* was thought a very responsible undertaking; and the experience of the London and Birmingham Railway has shown that those amounting to or exceeding that sum, have called for extraordinary exertions. Of these there have been seven upon the whole line; four were very soon relinquished by the parties originally contracting for them, and the remaining three executed with great difficulty.

The drawings being completed, and the limits of the contracts fixed, detailed specifications were drawn up, under the engineer-in-chief's superintendence; the whole was then submitted to the inspection of parties willing to tender for the works, who, on an appointed day, delivered in their respective estimates; and the lowest tender was generally, but not invariably, accepted,—regard being always had to the character and means of the parties. The whole of these extensive and important works were let at prices which were under the estimate of the engineer-in-chief.

The original contract drawings were signed by the engineer-in-chief and the contractor, and preserved as documents. Three copies of each, however, had to be made out—one for the use of the committee, one for the engineer-in-chief, and one for the assistant engineer.

When it is borne in mind that the engineering works of the whole railway, in accordance with the above system, were divided into thirty separate divisions, each requiring its own set of drawings, estimates, and specifications, and that all these works, with two unimportant exceptions, were let to various contractors, between May, 1834, and October, 1835, it will be perceived that an extensive and efficient drawing establishment must have been kept at work. Speaking in round numbers, we may say, that for eighteen months, not less than thirty drawings per week, each requiring two days' work from one pair of hands, were turned out from the engineer-in-chief's office.

As the undertaking proceeded, talent of a higher order was brought into requisition—the heaviest and most difficult parts of the work being, in several instances, thrown on the Company's hands by the contractors, after much loss of time, which could only be regained at a vast sacrifice of money. We shall state a few of these cases. Take, for instance, Prinrose Hill tunnel. The construction of this was attended by difficulties of a rather peculiar kind which deserve to be noted, as they may tend to point out the most advantageous mode of executing works corresponding in nature and magnitude.

The tunnel is carried underneath the ridge of high ground which extends from Hampstead to Prinrose Hill, near Chalk Farm, and consists of the blue clay belonging to the London clay formation of geologists. The extreme mobility of this material, when in the slightest degree moistened, is notorious among those who have had to execute engineering works in the neighbourhood of London. In tunnelling, therefore, the greatest care was required, that the excavation as it advanced might be properly supported. For this purpose all the means usually adopted in tunnelling were employed; but the works had not proceeded far, before it became apparent that timbering and supports of ordinary strength were altogether insufficient, the dimensions of the tunnel far exceeding anything of the kind previously executed in the same material.

The tunnel which was attempted of somewhat similar dimensions, several years ago, near Highgate, ended in a complete failure; because the great pressure of the clay was not adequately resisted by the lining of brickwork. Having an example of this kind before them, the engineers were naturally led to prepare themselves with every precaution calculated to avert a similar result. In the progress of the works, therefore, the first step was to excavate in advance of the brickwork about nine feet, and support this portion by the strongest timbering, for the purpose of preventing the falling of the clay. The bricklayers then proceeded to build the lining of brickwork which was carefully laid with the best mortar.

As the works advanced, it was soon discovered that the mortar was squeezed from the joints, and the inner edges of the bricks were found to be in contact; thus by degrees the bricks were grinding to dust,

and the dimensions of the tunnel insensibly, but irresistibly, contracting. The evil was augmented by the form of the bricks, which, according to the custom in and near London, were made with hollow surfaces, and consequently by no means adapted for withstanding pressure, as their edges only could come in contact. The difficulty hence arising was one which seldom occurs in tunnelling, the completion of the brickwork being generally considered to make all perfectly safe.

To obviate the impediment it was immediately suggested that very hard bricks should be used, and Roman cement substituted for mortar. The cement, it was anticipated, would set hard previous to the external pressure becoming so great as to bring the bricks into actual contact with each other; thus the whole surface of the brick would withstand the pressure, and not a small portion of it, as in the case just described, where the bricks were pressed together before the mortar had become sufficiently hard. These expedients, the use of Roman cement, and harder bricks, fully answered the intended purpose; but it was deemed prudent, also, to increase the thickness of the brickwork, in order to remove the slightest risk of accident, or symptom of weakness in the arching. The thickness of the brickwork in some portions of the tunnel is 18 inches, but in the major portion, 27 inches, all of which, with the exception of a few yards, is laid in Roman cement.

The extraordinary pressure which the London clay exerts above others is an interesting object of enquiry; for neither its specific gravity, nor external appearance, would justify us *a priori* in concluding that it was likely to produce excessive pressure upon the brickwork in the manner described, and this too after the completion of the arching. In ordinary tunnelling, where the material is of a gritty nature, which is the case with the generality of clays, or where it partakes of a loose, rocky character, the fragments cannot of necessity move amongst themselves with freedom, and generally may be considered to wedge each other into particular positions, thus lessening the weight with which they press downwards by a quantity equal to that which would represent the friction or resistance to movement.

If this view be correct, it appears reasonable to conclude, that, in the case of a tunnel, the pressure which the surrounding mass exerts

is in some inverse proportion to the friction or resistance to motion amongst the parts themselves of which it is composed. We ought, accordingly, to find the fragments of the London clay moving with extreme freedom against each other; and this is eminently the case, as is continually evinced by the flat slopes which it is found necessary to give to the sides of all excavations made in this peculiar clay. The general inference to which these considerations reach seems to be, that the difficulty of tunnelling, or the strength required in the timbering and brickwork, through different materials, is proportioned to the rate of slope found necessary in excavating through the same materials respectively.

These, and other difficulties, were contended with at such an enormous expense, that this one contract, which was let in the first instance at 120,000*L.*, cost no less than 280,000*L.*, although every attention to economy was used, in all cases, through the whole progress of the work.

Another instance, in which difficulties of no ordinary magnitude were encountered, was at the Kilsby Tunnel, about six miles on the London side of the Rugby station. This tunnel is about 2,400 yards long, and was originally intended to be chiefly built eighteen inches thick; but it was found necessary to increase this, in most cases, to twenty-seven inches; and the whole has been built in either Roman or metallic cement.

The works were commenced about the middle of June, 1835, by J. Nowell and Sons, contractors; but such serious difficulties were met with, at an early stage of the proceedings, that they gave up their contract on the 12th of March, 1836, and nearly the whole had to be performed by the Railway Company. Previous to the commencement of the works, trial shafts were sunk in several parts of the line of the tunnel, in order that the nature of the material through which it would have to pass might be ascertained, and it was found to be generally lias shale, with a few beds of rock, in some places dry, in others containing a considerable quantity of water.

In sinking the second working shaft, it was found that a bed of sand and gravel, containing a great quantity of water, lay over part of the tunnel, and this was such a perfect quicksand, that it was impossible to

sink through it in the ordinary way. By repeated borings, in various directions near this part of the tunnel, the sand was discovered to be very extensive, and to be in shape like a flat-bottomed basin, cropping out on one side of the hill. The trial shafts had accidentally been sunk on each side of this basin, so that it had entirely escaped notice until the sinking of the working shaft.

Mr. Stephenson was led to suppose that the water might be pumped out, and that under the sand thus drained the tunnel might be driven with comparative facility; this proved to be the case, but the expense was of course enormous. Engines for pumping were erected, and shafts sunk a little distance out of the line of the tunnel. These shafts were carried through the sand by means of wooden tubing, and from them, headings were driven into the quicksand to allow the water to flow with freedom to the pumps. The pumping was continued nearly nine months before the sand was sufficiently dry to admit of tunnelling, and during a considerable portion of that time the water pumped out was two thousand gallons per minute.

When the sand became sufficiently dry to allow the working shafts to be sunk in the ordinary manner, headings were driven to each of them from the pumping shafts at the level of the bottom of the tunnel, by which means the water was prevented, not only from rising in the shafts, but in the tunnel, where the work was going on.

The quicksand extends over about 450 yards of the length of the tunnel, and its bottom dips to about six feet below the arch. Great care was required, during all the time of getting through this part, that the sand did not run, it being in some places so fine that great quantities would slip through a very small crevice. It has been effected, however, with only one run of importance.

In May, 1836, one of the large ventilating shafts was commenced, and completed in about twelve months. This shaft is sixty feet in diameter in the clear, and 132 feet deep; the walls are perpendicular, and three feet thick throughout, the bricks being laid in Roman cement. The second ventilating shaft is not so deep by thirty feet. These immense shafts were all built from the top downwards, by excavating for small portions of the wall at a time, from six to twelve feet in length, and ten feet deep.



In November, 1836, a large collection of water burst suddenly into the tunnel, in a part where there were no pumps; of course it rose very rapidly, and, in order to prevent the ground being loosened by it at the far end, where it was excavated, a rather novel mode of building the brickwork was resorted to, as the getting in of the brickwork was the only thing to save it. This method was by forming a large raft, and on this the men and their materials were floated into the tunnel, and with considerable difficulty and danger performed their task.

All the impediments were at last conquered, and the tunnel finished in October, 1838; but, of course, the expenses were increased to a very great extent. The work was let for 99,000*l.*, and it has cost more than 320,000*l.*, or upwards of 133*l.* per yard.

To give some idea of the magnitude of this work:—There are thirty millions of bricks used in it, which, at ten hours for a working day, if a man counted fifty in a minute, it would take one thousand days to get through them all. There is above a million of bricks in the deepest ventilating shaft, and its weight is 4,034 tons.

The weight of the whole tunnel is 118,620 tons; or it would freight four hundred ordinary merchant ships, of about three hundred tons each; and if these bricks were laid end to end, they would reach 4,260 miles.

It is not a little curious to turn back, and watch the first beginnings of a work of such magnitude as this railway, which will cost more than 5,000,000*l.* In November, 1830, there was to be one line of rails only, and the work was to be done for 6,000*l.* per mile. The capital was then one million and a quarter, and no greater velocity contemplated than eight miles an hour. Shares got up to nine and ten premium on the above prospectus, at which many hundreds were sold. Then it was determined to have two lines; and at that announcement the shares fell directly to a discount. In 1831, the proposal was for four lines; and the capital was 3,081,642*l.*, with a proviso that the land, although taken at 300*l.* an acre, was not so high as that required for the Liverpool and Manchester line, through the enormous and unreasonable sums required by some proprietors beyond the real value of the land. We wonder what the speculators of those days would have thought, if they could then have been informed what

the real cost of the present two lines would be. One thing is certain, there would not have been a railway between London and Birmingham for many a year.

Resuming our account of some of the leading difficulties, we may notice the Wolverton embankment, nearly in the centre of which stands the Wolverton Viaduct. On the north side of the viaduct, the material is composed of blue clay, lias limestone, gravel and sand. This part of the embankment stood very well except in one place, where it slipped, not on account of its being composed of bad material, but from the ground itself actually yielding, when the weight of the embankment came on' it. The length of the embankment being one mile and twenty-eight chains, (deducting the viaduct) and the height of a great part of it forty-eight feet, some accidents were to be expected, especially in bad weather; but no one could have imagined what would take place on the south side of the viaduct. Here the material, at the commencement, was composed of sand, gravel, and blue clay. This stood very well; but when we got deeper into the cutting, we worked out some black, soapy clay, very wet; this was tipped on to a turf bottom, and the weather being also very unfavourable, although every care was taken to mix dry stuff with the wet material, yet there occurred one of the worst, if not the worst slip along the whole line. Earth was tipped in for days and days, and not the slightest progress was made; as fast, in fact, as it was tipped in at the top it kept bulging out at the bottom, till it had run out from 160 to 170 feet from the top of the embankment; and at last a temporary wooden bridge was formed, and by wagoning the earth over this, the embankment between the slip and the viaduct was formed, by first digging a trench, five feet deep, and nearly the whole width of the embankment, and forming a mound on each side to prevent it from slipping.

In fine summer weather the bridge was removed, and that part of the embankment, where the slip had been, was filled up; but away it went again, just as it did before, and the yawning gulf appeared to be insatiable. It was months before it was conquered, and this was done at last by barrowing as much earth to the outer part of the slip, as would balance the weight on the top.

There seemed to be no end to the vagaries of this unhappy embank-

ment. There was a portion of alum shale in it, which contained sulphuret of iron; this becoming decomposed, spontaneous combustion ensued, and one fine morning we had the novel sight of a fifty feet embankment on fire, sleepers and all, to the great surprise of a host of beholders. The inhabitants of all the neighbouring villages turned out, of course, in no small amaze on the occasion; and various were the contending opinions as to the why and the wherefore, some said, "The Company were hard up for cash, and were going to melt some of the rails;" others, "that it was a visitation of Providence, like the Tower of Babel." At last one village Solon settled the point—"Dang it," said he, "they can't make this ere railway, arter all; and they've set it o'fire to cheat their creditors."

Another troublesome and expensive part of the line was the Coventry contract. This did not arise through any peculiar difficulty in the nature of the work, but from the supineness and incapacity of the contractor. The work went on without spirit or energy, and the time was rapidly going by which would enable it to be completed with the other parts of the line at that end; the opening of the railway would hence be delayed, and it was difficult to foresee all the consequences. In this dilemma the Company could do nothing but take the work into their own hands; and by great exertions, and a corresponding outlay, it was completed in time.

It was in this contract the toad was found, which has been before alluded to. Mr. Gooch, the assistant engineer on that part of the line, has kindly furnished us with the following account of it:—"During the progress of the excavations through the Park Gardens at Coventry, on the line of the London and Birmingham Railway, at about nine o'clock in the morning of the 16th of June, 1835, the workmen were engaged in removing the material to the depth of eleven feet from the surface, the upper portion of the excavation consisting of—first a stratum of soil, eighteen inches thick, then a mixture of sand and clay, three feet thick, and the remaining depth of six and a half feet consisting of masses of new red sand stone, sound and perfectly formed, somewhat severed by backs and fissures, but still in large solid masses, obliged to be worked away by means of iron bars and wedges, and frequently blasted by gunpowder.

“Two of the workmen, John Horton and Thomas Tilley, having, by means of an iron bar, loosened from the solid mass near the bottom of the said eleven feet a piece of rock, about eighteen inches long, fifteen inches wide, and five inches thick, it was lifted up by Horton, and thrown by him towards the wagons which were in waiting to receive the excavated material, and convey it to the embankment which was forming across the valley of the Sherbourn; the piece of rock, however, did not alight in the wagon, as was intended, but fell by the side of it upon the bottom of the new formed excavation, and was, by the fall, broken nearly through the centre into two parts, which lay upon the ground an inch asunder.

“Thomas Tilley immediately took up one of the fragments, and threw it into the wagon, and was on the point of taking up the other, when his attention was arrested by the sight of a toad in a cavity or cell of the remaining fragment; instead of taking it up he kicked it with his foot, which caused it to fall out upon the ground; he then called to his companions, and told them that he had found a toad in the stone; Horton having joined him they examined the fracture of the other piece of rock and found a corresponding cavity, so that when the pieces were put together the stone was to all appearance perfectly solid, yet there was an oval or egg-shaped hole in the centre. The other workmen, to the number of thirty or forty, soon collected to examine the toad. Its colour when first seen was a light brown; in the space of ten minutes, however, it gradually changed, and the bright brown became a black. The animal seemed to labour under a severe oppression as from heat or weight, or both combined, and gasped frequently. It was rather under the usual size, but it was plump, and apparently in good condition. During the day it remained in the possession of the men who found it, and was seen by many persons, and was often exposed to the sun which was very hot, and to the warmth of the hand; the head appeared slightly injured, supposed to be occasioned by the breaking of the stone. About four o'clock in the afternoon I visited the works; the toad was shown to me, and I fitted one piece of stone upon the other while the toad was in the recess, I found that the rock fitted closely, and I could observe no appearance of an opening or fissure of any kind into the cavity; the stone on every side appeared

perfectly sound and solid. A portion of the cavity was much more round and smooth than the other, being, as I suppose, the lower side upon which the toad had rested. Throughout the whole cavity there was a thin black deposit or lining, but this was more visible on that side which was most rounded, and there were evident marks where the lining was scratched off, as if by the claws of the toad.

“The cavity was three inches long, and one and three quarters inches broad. The two pieces of the stone, with the toad in them, were brought to my office that evening; and I endeavoured, by closing the fracture of the stone with clay, to exclude the heat and air as much as possible, in the hopes of keeping it alive as long as I could, this I succeeded in doing more than three days. During that time, however, it was frequently exposed, as there were many persons who were desirous of seeing it; but it seemed gradually wasting away. The injury in its head, also, became much worse, and doubtless hastened its decay. It lived, however, nearly four days from the time of its discovery.”

We suppose the above is the best authenticated account extant. It was written out and signed by Mr. Gooch (now engineer-in-chief of the Manchester and Leeds Railway), Horton, and Tilley, with a witness to their signatures.

We will next draw the reader's attention to the difficulties experienced at Blisworth. This cutting is one of the largest on the line, and according to the original estimate would have contained 800,000 cubic yards; in consequence, however, of the necessity which was found of adding to the length of the wide part of the cutting, which proved to be requisite during the execution of the work, together with the material arising from numerous slips in the upper part of the cutting, the total quantity removed approximated to one million cubic yards, besides additions which were required to form the adjoining embankments.

The material to be excavated consisted of clay and limestone. The greatest depth is about 55 feet, and the total length a mile and a half. The clay and rock may be described generally as running into strata, not far from parallel with the line of rails, which are arranged to rise from each end of the cutting, towards its centre, at an inclination of 16 feet in a mile.

The quantity of rock excavated was about one-third of the total contents of the cutting ; and a considerable portion of the engineering difficulties of this work arose from the circumstance of the bottom of the rock not reaching so low as the level of the railway—a bed of clay in the deepest part, about 20 feet thick, occurring between the two. To secure this from bulging out, it was necessary to build retaining walls of considerable thickness. The sides of the excavation are laid at two slopes ; for that portion which reaches from the railway to the top of the rock, they are at one quarter to one, and for that portion above the rock the inclination is at two to one,—a ledge or benching, of nine feet in width, being formed where the two slopes meet. The object of the benching is to catch any loose portions of the clay which might be detached from above ; they have also been found very useful as affording foundations for walls of pebble-stone, which it has been found necessary to erect upon them in many places, to retain the numerous slips of the clay above. The excavation has now been about three years in execution. During the first year and a half the progress was extremely slow, owing to the want of proper energy on the part of the contractor, combined with general bad management. It was, in fact, one more instance of the sort adverted to before. The time was frittered away without any thing like a proper quantity of work being done ; and if this was evident at the commencement, where there were no particular difficulties to grapple with, what might be expected towards the end, when it was fully believed that nothing but the most energetic measures could ensure success ? At last, the Company were obliged to get rid of the contractor, by any means, and take the work into their own hands, with the knowledge, that in pulling up for the lost time the expenses would be considerably increased.

From the moment it came into the Company's hands, no trouble or expense has been spared to remedy the evil of the previous slow progress, as much as possible ; and nothing could exceed the animation of the scene which these works presented when in their most active state, with from 700 to 800 workmen all vigorously employed—numerous barrow and wagon runs in continual motion—a steam-engine in constant activity, pumping out the water—locomotive engines at

each end, dragging away long trains of wagons full of earth, or bringing the empty ones back,—and blasts of the rock continually deafening the ear. In fact, the whole cutting seemed alive; and the busy hum of labour, resounding from the one end to the other, gave ample testimony to the zealous exertions of the engineer.

Of course, the expense was considerable. The article of gunpowder alone was, in many cases, twenty-five barrels, of 100 lbs. each, per week: enormous quantities were used before the whole rock was got out. The mode of blasting made use of was by drilling a hole in the stone, about one inch in diameter; the depth being determined by the thickness of the bed. This is done by means of a round iron bar shod with steel, which is lifted up, and then struck down in the hole, water being used with it, causing the stone to cut more readily, till the hole is drilled to the requisite depth.

When the hole is sufficiently deep, it is dried out; a piece of fuse, of the requisite length, is then put in, and the gunpowder is poured all round it, in the requisite quantity, and secured by a covering of pounded brick or stone. Several charges being thus prepared, the ends of the fuses are lighted, and the workmen retreat to a sufficient distance for security. In a few minutes the whole explode, tearing up large masses of the rock, and sending the lighter pieces high into the air. The least noisy of these explosions are generally the most effective, rending up the larger masses of the rock. This is another instance of the truth of the old adage,—

“The more noise, the less work.”

This excavation is crossed by five bridges, some of which are to be of a considerable span, and will present a fine appearance from the Railway: they are to be composed of a mixture of stone got out of the cutting, and brickwork. The different beds of rock in this excavation abound with fossil shells, in a good state of preservation: they consist of nautilus, terebratula, oysters, &c. There were also two or three fossils, of very considerable magnitude, discovered; they were of the Saurian tribe, and were found imbedded in a stratum immediately on the top of the rock, which is a species of half-formed stone, of considerable hardness when dry, but becoming soon softened when exposed to the air and damp.

One of the chief difficulties met with in the course of this work was want of lodgings for a sufficient number of workmen, in the surrounding villages of Hartwell, Ashton, Roade, and Blisworth; and it was found indispensably necessary, soon after the Company took the contract into their own hands, to erect a considerable number of cottages, —one row of which contains sixty houses. The necessity for this will be readily understood, when, as before stated, there were from seven to eight hundred workmen, all employed in the space of about a mile and a half, besides others at a greater distance.

It was originally intended, that the whole of the material which came out of the excavation should be used in the formation of the embankments at each end of it; but, owing to the slowness with which the work advanced while under the contractors' hands, it was found necessary to throw out of it about 150,000 cubic yards into spoil. The land for receiving this, together with that necessary to make up the corresponding deficiency in the embankments, of course, will still farther increase the expense of the work.

The material which was taken from the south, or London end, had to be conveyed an average distance of about a mile and a half, and considerable difficulty was found in the formation of the embankment near the village of Ashton, owing to the unsound state of the valley which formed its base. Immense quantities of material were teemed daily, which, as in the case of the Wolverton embankment, totally disappeared, and the natural surface of the ground actually burst up outside the limits of the Railway, in consequence of the enormous pressure. A culvert near the spot was entirely destroyed from this cause.

The same embankment gave much annoyance from a slip, which took place in it near one of the bridges, and to such an extent, and so high, did the slipping materials reach, as to throw down two cottages, although the utmost exertions were made to save them. At Bugbrook Downs, not far from this contract, there is a slip at four to one.

The embankment at the north, or Birmingham end of the excavation, has more earth in it than the other; but the substratum on which its deepest part rests is of a better description, and no slips of any importance have taken place in that portion of the works; but a culvert



of considerable length was in great danger of being crushed in; the expedient, however, of completely filling it with pebble-stone was resorted to, that material fortunately being at hand; notwithstanding this precaution, it was carried considerably out of its straight direction, so much so that the light can but just be perceived when it is looked through.

It may, perhaps, be thought uninteresting to mention works of so small a magnitude as culverts; but no person who has in any way been connected with their erection, when having to sustain embankments of forty or fifty feet in height, could feel otherwise than nervous during the process of bringing the material over them. An engineer can be wished no worse fortune than to be required to construct culverts under a deep embankment, upon a soft foundation.

From the above view of the nature and extent of this contract, and the means which were resorted to, in order to make up for the serious delay which occurred while the work was under the contractor's hands, every body will be quite prepared to expect that a sum of about 130,000*l.* has been expended beyond the original estimate; and been expended wisely, too, as the loss would have been considerably greater if these exertions had not been made.

Another unpleasant affair for the Company arose from the person who had the Tring contract becoming bankrupt—a matter least expected, perhaps, of any. He was a man of capital and talent, and had established a reputation for years as an able contractor. The works he had on his hands were of the most extensive nature, and ought to have paid him well; when, to the surprise of every one who knew him, he was suddenly declared to be in difficulties through his contracts on the Grand Junction line, and ultimately went into the *Gazette*, leaving the works at Tring, including the heavy cutting through the chalk, to be finished as it best might.

Another heavy loss occurred through a change which took place in the form and weight of the rails. Those who wish to enter into the question at large may consult Professor Barlow in favour of long bearings [Fellows, Ludgate-street], and myself in favour of short ones [Simpkin and Marshall, Paternoster-row]. It will be sufficient here to state, that the line of railway was originally intended to be laid

with rails of 50 lbs. per yard, of the shape denominated fish-bellies; but an opinion prevailed, among several of the influential proprietors, that these were too light. After much discussion, it was decided that the weight of all those laid down in future should be 60 lbs. per yard. Professor Barlow's opinion was then taken; and he recommended the parallel at 75 lbs. per yard, and that the length of the bearings should be increased to five feet; or, if liked better, a rail 64 lbs. to the yard, at a bearing of four feet. These have not been found to answer in practice. They would, no doubt, have been sufficiently strong, except under extraordinary circumstances; but, in consequence of having fewer supports, they were found to get out of guage much sooner than those of 50 lbs. to the yard, at bearings three feet long, although the latter had more weights going over them, and the consequent expense of keeping the way in repair would be permanently increased.

Decided experimental proofs having been received of this and other defects, and it having been ascertained that wagons and engines had, in consequence, frequently got off the rails on some parts of the line, an additional sleeper was ordered to be put on all the embankments of thirty feet high and above it, thereby reducing the bearings to two feet six inches; and this not being found a sufficiently extensive alteration, the rails then to be put down were ordered to be laid with bearings of three feet nine inches, in cuttings as well as on embankments. Unfortunately, during the time occupied in the discussion, the price of iron rails rose no less than 4*l.* per ton; so that the additional cost, added to the additional weight, amounted to a very serious sum.

The subject of stations soon began to claim especial attention, as so much depends on having convenient access to the arrival and departure places, combined with appropriate offices to carry on the large business which the Company naturally expects. At the London end of the line, the first Act of Parliament only authorised the Railway to be made from Birmingham to Camden Town, at the spot where the present goods' station is; and as this was much too far for the convenience of the London residents, it became necessary to see which would be the readiest way to bring it closer in; and after full deliberation, the present plan of extending it to Euston Square was adopted, and an Act of Parliament obtained July 3rd, 1835, authorising this

extension. This was another heavy but necessary expense; both land and buildings being, of course, from their proximity to London, at a proportionate price.

The same Act allowed a deviation to be made from the original line near Weedon, by which a very awkward curve was considerably improved. Power was also given to the Company to alter the course of the rivers Ouse and Avon—to purchase fifty additional acres of land for stations—to build a viaduct of six arches, of sixty feet span, at Wolverton—and to construct a drawbridge, to carry the Railway over the Ordnance canal at Weedon. This Act also repealed the provision in the former one, which enacted that the distance between the outside edges of the rails should not be more than five feet one inch; and also the clause which provided that the directors of the Company were to be, in certain proportions, residents at London and Birmingham, or within twenty miles. It also provided that general meetings might be called by fifty instead of one hundred proprietors, holding in the whole two thousand shares; and allowed a toll or rate of one shilling per passenger for the extension line from Camden Town to Euston Grove, —the goods not going further than Camden Town.

By the first Act the Company were empowered to borrow on mortgage 835,000*l.*; the second Act increased that sum to 1,000,000*l.*, with leave to enlarge the capital to that amount, if thought advisable; and by a third Act, passed June 30th, 1837, they were authorised to raise another 1,000,000*l.*, on bonds, with power, if they thought fit, to create new shares for these two additional millions.

The third Act also repealed the clauses of the former ones which provided that the half yearly general meetings, and the special general meetings, should be held in either London or Birmingham, and directs that they may both be held wherever the directors think proper. It also alters the number of the directors, there may now be any number between twelve and twenty-four; and it limits the passage of trains across Curzon-street, in Birmingham, to twelve times per day. This latter clause is rather amusing; because, by unhooking the carriages, they may be crossing it all day long, as it requires at least two carriages, of some sort or other, to constitute a train.

It was a matter of some moment to determine on the plan and na-

ure of the stations at the *termini* of the line ; the intermediate ones simply required a booking office—waiting room, with the necessary conveniences—a room for the police inspector—and one for the porters: these, thrown into a neat building, form all that is required. They are placed, of course, so as to suit, as far as possible, the surrounding population ; and the quality of the water, and its situation, determines a pumping engine to be necessary or not. The number of these stations will, in time, very probably be increased ; in fact, the greater facilities the public find in these and all other respects, the more will the money pour into the pockets of the Company.

At the *termini*, it was decided that the plan should be on a scale commensurate with the magnificence of the whole undertaking, and the question of expense was not to be entertained. When it is considered that on the convenience and appropriateness of the buildings at the *termini* so much of the regularity and good-working of the Railway must depend, too great pains could not be taken on such an essential subject. Every thing depends so much on rapidly working, for a short space of time, that no means should be neglected which can at all conduce to that end.

At the London end the entrance is through a magnificent gateway, having offices for parcels, &c., on each side. A very handsome medal of this entrance has been struck by Mr. Hardwicke, the architect, under whom it was erected. Inside is a building containing, on the ground floor, the necessary booking-offices and waiting-rooms, also a room for the superintendent of police ; on the upper floor is the board room for the directors, a waiting-room, secretary's room, offices for clerks in the audit and finance department, and the office of the superintendent of the coaching department.

On the farther side of this building are the arrival and departure stages, covered in with a light handsome iron roof. The stages are built up to nearly the height of the carriage floors, so that the passengers are not obliged to climb up, but have merely to walk in. There are four lines of rails between the stages ; and the Company have ensured the means of considerably enlarging the whole, by making it a double station, should the traffic render it desirable to do so, which is more than probable.

At the end of the departure stage is a small building, for keeping lamps, grease, and tools of all kinds, required for the station. On the opposite side, next the arrival stage is another small building, containing a waiting room for persons coming to meet their friends, a room for lost luggage, and various other useful offices. A little distance from the arrival stage is the carriage-house, containing, on two floors, ample room for either making or repairing a large establishment of carriages; and also storing those not immediately required for use, A short way from this an endless rope is laid down on iron sheaves, to which the trains are attached by a selvagee, fixed on the foremost carriage; the other end of the rope communicates with a steam-engine of sixty-horse power, by which the train can be drawn up to Camden Town, in ordinary circumstances, at twenty-five miles an hour. This inclined plane, although not a desirable thing, was unavoidable, on account of the difference of level between the two stations. The steam-engine is entirely under ground; but its chimney and that of the reserve engine, form conspicuous objects, from the beauty of their figure and form.

It is not because locomotives cannot draw a train of carriages up this incline that a fixed engine and endless rope are used, for they can and have done so; but because the Company are restricted, by their Act of Parliament, from running locomotive engines nearer London than Camden Town. The trains, on their way to London, run down this incline by the effect of gravity, under the guidance of a careful man, denominated a Bankrider, who has the charge of the train during its passage. We may here mention a useful fact relative to inclined planes. It has generally been supposed that, on a slope of one in two hundred and fifty, well made carriages would barely stand still, and this inclination has been termed the angle of repose; but at an incline of one in three hundred and thirty, on the London and Birmingham Railway near Beechwood Tunnel, a wagon ran away, and could not be caught till it got to the Coventry Station, into which it came at eight miles an hour.

The Station at Camden Town is appropriated for all the traffic in goods, the offices for which are seen to the right. The nearest building to the Railway is the locomotive engine house, in which the engines,

tenders, coke and water, are kept, and where, as at Birmingham, engines receive small repairs; but any repairs of consequence are to be done in large premises, erected for that purpose, at Wolverton, near the middle of the line. Coke ovens are also built at this station, the chimney of which is seen to the right.

The Birmingham Station is somewhat differently arranged, the ground not being so advantageous. The station for the goods is on the one side of Curzon-street, and the passenger station on the other; and on this plan the ground was excavated, and the goods' offices and stables built, the earth being wanted to fill up the other parts of the station. The board room for the directors, the secretary's offices, and the offices of the finance and correspondence departments, the engineer's office, and the parcels' office, are all contained in one building, handsomely fitted, and having four noble Ionic columns in the front, and four three-quarter columns at the back. The entrance to the station is to the left of this building as you approach it from the town, and the exit on the right; the booking-offices, waiting-rooms, a temporary parcels' office, are contained in the long building having a colonade in its front. The arrival and departure stages are about the same height as those in London; but the roof over them is much larger, there being six lines of rails under it instead of four. The London roof is eighty feet wide; by some strange mistake, Mr. Roscoe has stated this to be only "about fifty feet," in his publication.

This roof being one of the finest (if not the finest) in the world, some few particulars of its various parts may be interesting. It covers a space of 217 feet long and 113 wide. It is formed of wrought iron in two spans of 56 feet 6 inches each, and the length is divided into 33 bays or spaces between each principal rafter, making 34 double, or 68 single, sets of principal rafters, a double one being considered to go across both spans, or the whole width of 113 feet, and the single one going across the 56 feet 6 inches only.

These principal rafters are supported by three tiers of open ornamented arched girders made of cast-iron, each tier running the whole length of the roof, or 217 feet, the girders are supported by three rows of cast-iron columns, one at each side of the roof, and one in the middle; these likewise run the whole length of the roof, and the

row, next the booking-offices, are firmly attached to that building by wall plates, inside and out, with connecting bolts.

The feet of the principal rafters are tied in by tension rods running across, and rising in the middle a little above the horizontal line; these are connected with the upper angle of the principle rafter by a king bolt, and each half of the principal, right and left of the king bolt, has two queen bolts and diagonal braces, the lower ends of which slope in towards the king bolt, and are connected at the bottom to the tension rods. There are 804 longitudinal stretchers fixed between the principals at the top, to tie them firmly together, and 201 longitudinal stretchers at the bottom in a line with the tension rods.

Twenty-two wrought iron coupling plates are introduced along the tops of the girders to secure them together, going over the tops of the columns, and being firmly fixed to them. The principals are covered—first, with one inch deal boarding, laid diagonally, so as to form a perfect brace and tie to the whole roof—and, on the boarding, the whole is slated in the usual way. The gutters are of cast-iron in  $9\frac{1}{2}$  feet lengths, and the rain water is delivered by them into the cast-iron columns, which convey it down to the drains below.

The weight of the cast-iron in columns, girders, bases, gutters, &c. is about 80 tons.

The weight of the wrought iron in principal rafters, tie rods, tension rods, &c. is also 80 tons.

The weight of the planking is 75 tons.

The weight of the slates is 90 tons.

Making an allowance for nails, screws, pins, bolts, and other matters of that kind, the total weight of the roof may be taken at 326 tons: over the departure step sashes have been introduced with a view to obviate any shade being thrown on the interior of the building to which the roof is attached. The general appearance and the airy lightness of the whole of this handsome covering to the station, have been remarked by every one, particularly when looked at from either end.

It consists of the following parts:—

Cast Iron columns . . . . .	52	
— girders . . . . .	39	
— gutters . . . . .	66	
— bases to columns . . . . .	52	
— water pipes . . . . .	33	
	<hr/>	242
Wrought Iron principal rafters . . . . .	136	
— tension rods . . . . .	136	
— king bolts . . . . .	68	
— longitudinal tie rods . . . . .	201	
— braces . . . . .	408	
— queen bolts . . . . .	272	
— longitudinal stretchers . . . . .	804	
— coupling plates . . . . .	22	
— plates to connect ditto . . . . .	40	
— wall plates . . . . .	34	
— eye bolts to connect tension rods . . . . .	34	
— connecting plates, securing the braces, king and queen bolts, to the principal	680	
— octagon plates at top and bottom of king bolts . . . . .	136	
— plates for braces . . . . .	816	
	<hr/>	3,787
— pins . . . . .	578	
— bolts and nuts . . . . .	2,200	
— rivets . . . . .	2,380	
— split keys . . . . .	1,156	
— gibs and keys . . . . .	442	
— screws . . . . .	65,780	
	<hr/>	72,536
Planks . . . . .		1,721
Plates . . . . .		36,000
Nails . . . . .		72,000
Iron Straps . . . . .		292
		<hr/>
Total number of parts . . . . .		186,578

At the end of the departure stage is a small building, containing the lamp and grease room, police office, porters' waiting-room, and store room for lost luggage. Farther on is the locomotive engine house, which is exceedingly well adapted for its purpose ; although it is rather in the way of the lines of rails, and occasions thereby an awkward curve, which has several times thrown the carriages off the road.



The locomotive engine house is a building with sixteen sides, capable of holding sixteen engines and tenders, or thirty-two engines alone: these stand with their ends towards the sixteen sides of the building, one against each, on sixteen ways, all meeting on a turn-plate in the centre, by which the engines are got out along the respective lines of rails, which run from the engine-house to the station. Under each engine is a pit, about three feet deep, which enables the engine-men to get underneath the engine to examine, clean, or repair it. There are eight water-cocks near the pits, so that a pipe and hose can be got to every engine, without crossing any other. The water laid on by the Birmingham Water Company has so great a pressure on it, that it will, through a contrivance by Mr. Henry Rofe, their engineer, make its way into the engine boilers when the steam is up, and has even forced through the pores of cast-iron, three inches thick; notwithstanding which, fish both live and thrive with more than this additional weight upon them, the pressure at the engine-house being 180 feet, and fish in excellent condition have been found in air vessels where the height of the water was at least 250 feet. It will, perhaps, give a better idea of the pressure when it is stated, that a boy, not long since, endeavouring, in mere play, to get out a wooden plug, driven into one of the water-ways in the town, at last succeeded, when it flew out like a shot, beating in his skull, and killing him on the spot.

In the front of the engine-house are store-rooms, offices, and work-shops, over which is a tank, holding one hundred and seventy tons of water, it is provided with a steam-engine to work pumps from a well below, in case the supply from the Water Works Company should fail. The engine-house is built on land about twenty feet lower than the present surface, under which are store-rooms for coke, and a communication to a large coke vault under ground, which opens out to the canal.

There is a great deal more difficulty than would at first be imagined in laying out a railway station; and, perhaps, in every one now in existence, if it had to be entirely built over again, some change would be desirable: there are so many things to be amalgamated, and such various accommodation to be provided, that the business becomes exceedingly complicated. A convenient access for the engines and

trains, without bad curves—a good situation with regard to the town—an easy access, to and from the engine-house, and to the carriage sheds and repairing shops—a proximity to water—a convenient situation for the store department: these are a few among the many desiderata, which render it a very difficult thing to make them all fall into the necessary arrangement; but we may say of our stations, that as much has been made of the ground as could, by any possibility, be done under the circumstances of the case—these circumstances having repeatedly changed.

During the progress of the works temporary buildings were erected at Camden Town, for the purpose of constructing second-class carriages, horse boxes, wagons, carriage trucks, &c.; the whole of which were made there at, of course, a considerable saving: workshops were also built at Birmingham, where, amongst other things, all the wedges for the rails, on the Birmingham division of the works, were made at about half the price they could have been got by contract. It was originally intended to have three classes of carriages—the first class as at present. The second class were to be closed on the outside, but with all three bodies open to each other on the inside, and without lining or cushions—these were both put out to be manufactured by contract. The third class were similar to those now used, except that they had no roof; but it was found desirable to omit the middle class, put a roof to the third class and call it the second class—thus retaining only two kinds, except the night trains; in these the original second class closed coaches are used, and the open ones by day. All these arrangements, however, are as yet only in a state of transition.

If we now take a review of the progress of the works, we shall see the respective steps by which this gigantic undertaking has been brought along the stream of time. The early part of 1835 may be soon enough to commence our view. It was at this time the rails question had begun to be agitated; and at a general meeting of the proprietors, held at Birmingham, in the month of February, it was decided that, until the results of the experiments in malleable iron bars, of different forms, which the directors had undertaken at the suggestion, and under the direction, of Professor Barlow, should be ascertained, all the rails to be ordered should be of the parallel form, the

upper and under tables alike in size, and the weight as nearly 60 lbs. to the yard as might be compatible with the most advantageous manufacture of the iron; that the weight of the chairs should be correspondingly increased, and the rails firmly secured to them by a filling-in piece; that the use of patent felt and wooden keys, on a plan similar to that recently adopted by the North Union and Liverpool and Manchester Companies, and also of the "lewis," for securing the chair to the sleepers, be recommended to the immediate attention of the engineer of the Company—consideration being given to the advantage which may be gained in strength, by placing the chairs nearer to each other than three feet, from centre to centre; that the blocks should contain not less than five cubic feet each, and granite to be used, if the expense be found not materially to exceed the cost of limestone, or grit of the best quality—in which case measures were to be promptly taken for ensuring a sufficient supply of granite, to be exclusively used for all blocks on the railway in future; these were excellent provisions in the main. It would have been well if they had never been departed from.

Fifty-eight miles of the railway were at this time let to the contractors; they had possession of the land, and were going on satisfactorily, except at Wolverton, where the work was partially retarded by the Grand Junction Canal Company, who refused to allow the contractor to erect a temporary bridge over their canal, and a decision had to be obtained in the Rolls Court.

The Euston extension had been surveyed; and as no opposition was expected to an Act of Parliament for it, (the terms on which land could be got, likewise showing it to be the most advantageous line of approach into London,) it was decided on to apply for the Act forthwith, which also embraced the alterations at Wolverton, Weedon, and Brockhall, by which two tunnels and a bad curve were avoided.

At that time a great prejudice existed against tunnels, arising entirely from ignorance; and the directors, in order to set the minds of the public at rest, had a special visit to the Primrose Hill Tunnel made by Drs. Paris and Watson, Surgeons Lawrence and Lucas, and Mr. Phillips, the Lecturer on Chemistry at St. Thomas's Hospital; the object of the visit was to ascertain the probable effect of such a tunnel on the health and feelings. The length is 3,750 feet, height twenty-

two, width twenty-two; ventilated by five small shafts, six to eight feet only in diameter, and from thirty-five to fifty-five feet in height.

The experiment was made under unfavourable circumstances; the western extremity of the tunnel being only partially open, which, of course, made the ventilation less perfect than when the whole would be complete. The steam of the locomotive engine also was suffered to escape for twenty minutes, while the carriages were nearly stationary at the end of the tunnel. Even during their stay near the unfinished end of the tunnel, although the cloud caused by the steam was visible near the roof, the air, for many feet above their heads, remained perfectly clear, and apparently unaffected by steam, or effluvia of any kind, neither was there any damp or cold perceptible.

The atmosphere of the tunnel was found to be dry and of an agreeable temperature, and free from smell. The lamps of the carriages were lighted; and in their transit inwards, and back again to the mouth of the tunnel, the sensation experienced was precisely that of travelling in a coach by night, between the walls of a narrow street. The noise did not prevent easy conversation, nor appear to be much greater in the tunnel than in the open air.

Judging from this experiment, and knowing the ease and certainty with which thorough ventilation may be effected, these gentlemen were decidedly of opinion that the dangers incurred in passing through well-constructed tunnels were no greater than those incurred in ordinary travelling upon an open railway, or upon a turnpike road; and that the apprehensions which have been expressed, that such tunnels are likely to prove detrimental to the health, or inconvenient to the feelings of those who may go through them, are perfectly futile and groundless: and to these opinions, thus strongly expressed, they all signed their names.

The money expended on the railway at this time was 399,554*l.*, every thing included; among which must not be forgotten the 72,869*l.*, paid for obtaining the Act of Incorporation.

The next meeting was in August, 1835. The money then expended was 639,051*l.*; and eighty-six miles of the railway were let to contractors, below the estimates of the engineer-in-chief, and two-thirds of the whole land purchased. This was the season of brightness

and hope; no reverses had come on, and all was sunshine and harmony, except the unfortunate discussions on the rails question.

In February, 1836, the money expended was 1,054,642*l.* The whole line was now let to contractors, under the estimates; yet it was foreseen that the original capital would be exceeded; for, besides the contracts let, there were the extra works, which, it was found would exceed ten per cent. on the contract; also the additional expense of permanent way materials—the rise in the price of iron—the larger quantity of land which was found to be required, together with its very enormous price—these circumstances occasioned the directors to publicly state that the total outlay would be considerably beyond the original estimate.

The contractor for the Euston extension line was put under a penalty to complete the works by January, 1837; and there was no reason to doubt his ability to fulfil this engagement. It was expected that, in the spring of 1837, the first twenty-one miles of railway, out of London, would be opened; and that, in the summer of that year, ten miles more up to Tring, together with the part from Birmingham to Coventry, would be finished; and that the whole line would be completed in the summer of 1838. The quicksand had been discovered, and it was seen that Kilsby and Blisworth would be the latest portion of the works; but the great mishaps were yet in the womb of futurity.

In August, 1836, the expenditure had reached to 1,492,101*l.*; and the expectation was still confidently held out, that the whole line would be opened in the summer of 1838, and the first twenty-one miles in the spring of 1837. The Primrose Hill Tunnel, 1,105 yards long, was completed, except 114 yards; the Kensal Green Tunnel was finished, and traversed by the Company's engines; 1,423 out of the 1,793 yards of the Watford tunnel were done; and the difficulties which were presented by the quicksand in the Kilsby Tunnel were at this time so far surmounted, as to leave no doubt that they would not delay the opening of the line beyond the period mentioned. Every exertion was used with all the other portions of the line, so as to give the proprietors the benefit of a revenue at the earliest possible period. Although it was well known that, for the attainment of that object, an additional expense would be incurred, the advantage to be derived

was expected to be more than commensurate with the additional outlay which would be required.

The directors at this time had entered into a contract, under the guarantee of two responsible sureties, with Mr. Edward Bury, of Liverpool, an able and experienced builder of locomotive engines, for the conveyance of passengers and goods on the Railway, by locomotive power, to whatever extent might be required, at a fixed rate of remuneration,—the Company providing engines of Mr. Bury's specification; and Mr. Bury, on his part, keeping them in repair: the contract to be in force for three years, from the opening of the whole Railway. The Company thus assured to themselves the advantage of locomotive power, at a moderate and uniform rate, and under a system of management which it is the interest of the contractor to render mutually beneficial to the Company and himself. Such locomotives, and a portion of the carriages which would be first wanted, were at this time contracted for.

On referring to the bills for railways connected with the London and Birmingham, a great source of gratification was no doubt felt by the proprietors, as there would, in consequence, be an increased traffic: this might be fairly anticipated, from the direct communication opened with the northern and eastern parts of the kingdom, by means of the Midland Counties, North Midland, and Birmingham and Derby Railways, besides the line connecting Birmingham and Gloucester.

A line was also surveyed to join Leamington and Warwick with the London and Birmingham Railway, at Coventry. This proposition afterwards fell through; but it can only be for a time, as those places will, doubtless, not contentedly sit down while all around them are receiving the benefit of railway transit.

Great as the scale of expenditure now appeared, the proprietors, there is no doubt, felt confident that, if the works proceeded with an energy proportioned to that expenditure, they should hail its increase as an additional evidence of the approach of the great undertaking to completion. 443,800*l.* had now been taken up by loan, and there appeared not the least difficulty in getting as much money as would be wanted.

In February, 1837, the expenditure was 2,285,321*l.* Contracts were now entered into for the stations at London and Birmingham.

At the London end of the line, near Camden Town, the Company have about thirty-three acres of land, which is the depôt for the buildings, engines, wagons, goods, and various accessories of the carrying department of the Railway; at Euston Grove there are seven acres in the passenger station—the two are connected by the extension line, on which are four lines of rails. At the Birmingham end the stations contain about ten acres. The London station, except the entrance, was contracted to be done in June, 1837, and the Birmingham, by November, 1837; the intermediate stations were also put in progress.

The expectation of opening the first twenty-one miles in the spring of 1837, was now doomed to be disappointed. Owing to the late unexampled season, this idea had to be abandoned till the summer: the continued bad weather for the last four months, had defeated the calculations of the engineer, in a degree which no former experience could anticipate. In some descriptions of soil, this delay could not have taken place to such an extent as in the London clay, which was exemplified by the progress of the works on the other parts of the line, where the material was more favourable; but in the London district, the incessant falls of rain had rendered it quite impracticable to proceed uninterruptedly—the excavations and embankments on the Primrose Hill contract were persevered in, till the extra expense was such, that the directors, as well as the engineer, saw the full propriety of suspending further operations.

The works on the extension line only required six weeks of fair weather to finish them; the works of the Primrose Hill contract, which were in the Company's hands, were nearly completed, except the Brent embankment; the Primrose Hill Tunnel was finished, and traversed by the Company's engines: and great part of the permanent way laid on the first twenty-one miles. The embankment on the north of the Brent might be called finished; while that on the south side required only 60,000 cubic yards of material to complete, which, in an ordinary state of the weather, would require only three months.

From that point to Watford all was progressing as well as could be wished. The Watford Tunnel was finished, and but little remained in the excavation. The state of the three succeeding contracts was also very satisfactory. The North Church Tunnel was finished; and,

with the same exertions on the part of the contractors which had hitherto been evinced, there appeared no reasonable doubt but that the works might be all completed, and the line opened to Tring, by the autumn. The quantity of water, however, yielded by the Tring cutting, in addition to that which had fallen in rain, together with the argillaceous character in the chalk in that cutting, rendered it absolutely necessary to stop all proceedings on that embankment; it had, in fact, been proceeded with, till it was at last quite impassible.

The heavy Wolverton Embankment had now been divided between two contractors, and the works there were proceeding satisfactorily. The Blisworth works were in the possession of the Company, by an agreement with the contractor; and all the skill of the engineers, and the pecuniary resources of the Company, were to be at once brought to bear, in endeavouring to make up for the lost time; the rate of progress, of course, depending on the quantity of water and rock, the precise nature of the latter not having yet been ascertained.

Two lengths of the quicksand in the Kilsby Tunnel were bricked in; that work, therefore, began to assume the character of ordinary tunnelling; and, unless a very unexpected quantity of water should be found, where, at present, no signs of it existed, there was still every hope that the whole line would be opened in the summer of 1838, and that part between Birmingham and Rugby by the end of 1837.

A Bill which was at this time proposed, for carrying a line from Tamworth to Rugby, by the Birmingham and Derby Railway Company, and which was to be continued on to Stafford by another company, was opposed by the directors of the London and Birmingham Company, as a competing line.

As the contract approached completion, it was found that the contemplated works for the efficiency of the railway, in the carrying department, as well as for the road itself, would require the sum of one million more than was expected, and that the total outlay would probably reach four millions and a half. This additional cost was stated to arise—

1. From additions, alterations, and extras to the original plan of the works.
2. From the extension line to Euston Grove.



3. From the additional quantity of land (eight hundred acres) and the much higher price the company had been compelled to pay for it, —a price in some degree extorted by the necessity of obtaining possession at an earlier period than, by the provision of the Act of Incorporation, the company could legally enforce.

4. From the increased price which it had been found necessary to give for all the materials forming the permanent way—such as rails, blocks, sleepers, chairs, &c., as well as for the additional weight of the rails and chairs, which experience had shown it to be prudent to use; and from the greater expense of conveying them to their destination than was anticipated.

5. From the unforeseen difficulties in the Primrose Hill, the Blisworth, and the Kilsby contracts.

6. From the ample provision made in the carrying department, and particularly with reference to the traffic to be expected from other railways, for which Acts have been obtained since the original calculations were made.

The estimated cost of the railway, at this time, was as follows:—

EXPENSES OF OBTAINING THE ACT OF PARLIAMENT	£ 72,869
Land and compensation	506,500
Contract works for forming the road	2,146,068
Permanent way materials, and incidental expenses	693,822
Station buildings	154,521
Locomotive engines	100,215
Carriages, wagons, &c.	153,500
Euston extension	255,722
Interest on loans	114,262
Law proceedings, including two new Acts	12,000
Conveyancing	53,800
Engineering and surveying	127,100
Direction	13,300
Office charges	27,515
Printing and advertising	4,800
Sundries including travelling expenses	10,600

£4,446,594

The increase in the permanent way materials may be accounted for thus:—

The increased weight in the rails, and rise in the price of iron . . . . .	258,000
The additional price of blocks and sleepers, and incidental charges thereon . . . . .	21,485
Increase in the number of stations on the line, and consequent addition of rails, &c. . . . .	47,000
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	£326,845

The addition in the cost of the works forming the road is as follows:—

From an increased width in the Railway, increased slopes, and increased dimensions of bridges, the revised exceeded the Parliamentary estimate by . . . . . £110,240

The whole contracts were let below the revised estimate. The excess of expenditure chiefly arises in the following contracts:—

Primrose Hill.—Including the tunnel, total length six miles, additional outlay from the extremely disadvantageous circumstances under which the Company was compelled to take up the contract . . . . .	21,636
Ditto.—In new roads, bridges, and sewers, required by diverting existing roads, through Camden Town depôt, and in other places . . . . .	27,552
Ditto.—In additional strength in the two tunnels from the peculiar nature of the London clay . . . . .	34,151
Blisworth.—Additional outlay required to make good the loss of six months' time, and for the completion of the costly parts which have fallen to the Company to execute . . . . .	60,000
Kilsby.—The occurrence of an extensive bed of quicksand, lying over nearly one-fourth of the length of the tunnel, and requiring to be drained by powerful steam-engines, which must be kept at work till the completion of the contract; the other parts of the tunnel abounding in water, and rendering it necessary to increase the number of shafts to an extent which could not have been foreseen . . . . .	140,000
Extras on the remaining contracts . . . . .	48,659
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	£442,238

The loans taken up to this period were (at 4 per cent.) . . . . .	560,061
Ditto ditto ditto (at 4½ per cent.) . . . . .	49,300
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	£609,361

On the 20th of July the first part of the Railway was opened to the public, up to a place called Boxmoor, twenty-four miles from London; and although, in consequence of the works still going on connected with the entire completion and finishing off this portion of the Railway, only three trains per day could be run from each end, the traffic proved very considerable, and also to be increasing. A great advantage arose from thus gradually opening the line, by which means an opportunity was afforded of organising the arrangements required in the various departments, progressively improving on a small scale, and benefiting from experience previous to more extended operations.

In August, 1837, the money expended was 3,102,272*l.*, and the loans received 1,045,717*l.* It was fully expected at this time that the Railway would be opened from London to Denbigh Hall, and from Birmingham to Rugby, being 77 miles, by the first of January, 1838; but this expectation was, of course, understood as contingent on the works not being retarded by causes which it was not in the power of an engineer to control.

The Railway was opened to Tring in the month of October, as had been anticipated; but a winter of unusual severity and duration, by retarding the remaining works, made the farther opening in January, 1838, impracticable; so intense, in fact, was the cold, that the ground was frozen two feet in depth, and although, by means of large fires and using hot mortar, brickwork was in some cases carried on, every one at all conversant with such works, will readily know how much time must necessarily be lost under weather which for weeks kept the thermometer at nearly zero.

The state of the different contracts in the middle of February, 1838, will be best shown by Mr. Stephenson's Report, which was as follows:—

“In reporting on the present state of the works on the line, and our prospects as to future openings, it will not be necessary to treat in detail of that portion between London and Tring which is already open to the public, nor to mention specially the quantities of fencing, brickwork, &c., which remain to be done on each contract, as stated in the estimates already delivered,—such works being, comparatively, unim-

portant, and not likely to interfere, in any way, with the opening of the line. It may, however, be stated, with reference to that portion between London and Tring, that the permanent road is in tolerably good order, except on the Brent Embankment near London, and on the Colne Embankment near Watford. Both these works have continued to subside, with scarcely any intermission, more or less rapidly since their formation; the former, from the slippery nature of the material which composes it; the latter, from the unsoundness of its substratum in the valley of the Colne. The gradual subsidence of embankments admits of no other remedy than maintaining the level of the railway by the constant supply of new sound material, adapted for ballasting, which, in the present case, may fortunately be obtained from a convenient spot, and at a moderate expense; for there is in the Company's possession, at the south end of the Watford Tunnel, a large store of excellent gravel and chalk, sufficient to meet all the demands of the line and stations between Watford and London for some years.

“The only other points between London and Tring which call for remark, are the Boxmoor Embankment and some portions of the Aldbury contract, where we found it very difficult, at first, to keep the rails in working order; but they are now in much better condition, and will continue to improve rapidly during the ensuing spring and summer. By this period we may expect that all the embankments will become so consolidated, as to admit of the engines working over them without any necessity of reducing the speed below the proposed average speeds to be adopted with the passenger trains.

“The Tring contract, which comprehended the most extensive excavation on the line, is now nearly completed. The whole of the excavations and embankments are ready for the further opening to Denbigh Hall, except that about four thousand yards of permanent road remain to be laid—not in one length, but made up of several smaller portions. The greatest quantity to be laid continuously is about one mile, at the south end of the great excavation; for executing which quantity, as well as all the other unfinished parts of the permanent road in three weeks, every arrangement was made at the latter end of December. It has, however, been impracticable to proceed as

intended, owing to the intense and protracted frost, which set in a few days after the beginning of the year, continuing up to the present date, without a single available interval of one day. The contractors have been urged, and every expedient resorted to, for the purpose of proceeding with the permanent road, so as to expedite the approaching opening, but without success. There still remains work which, as nearly as can be calculated, must require three weeks to perform, after a thorough thaw has taken place. The embankments throughout this contract consist almost entirely of chalk, which being already well consolidated, and little liable to subsidence, the immediate use of the permanent road may be reckoned upon as soon as completed.

“The Leighton Buzzard contract is in a very similar position to the last, though in a more forward state. The excavations and embankments are completed, and the permanent road laid with the exception of about a mile, made up of separate portions. The ballasting is all on the ground, and nothing remains to be done but laying the rails and blocks, which are also on the spot. The Linslade Tunnel is completed, one line of permanent road laid through it, and the fronts so far advanced, that executing the remainder of the stone and brick-work will form no impediment whatever to the opening.

“In the Stoke Hammond contract the excavations and embankments are completed, except a small portion left on the slopes of the cuttings, which cannot interfere with the permanent road. Of this there remains little more than a mile to lay in different places.

“The Bletchley contract is completed, except 350 yards of permanent road. This contract terminates at Denbigh Hall, where a station is now being formed for the temporary terminus of the London division of the line. The shed for the engines and coaches is erected—the necessary turnplates fixed—the sidings stopped by the frost, but in a state to be finished in a fortnight—the huts for the engine-men are ready to be inhabited—the stables for Chaplin and Co. are in a forward state—a small office erected on the bridge over the Turnpike-road, and an approach to the level of the railway from the Turnpike-road, are nearly completed.

“From the above statements relative to the work remaining to be done between Tring and Denbigh Hall, it is evident that the time of

opening through this district depends on, and must be regulated by, the completion of that portion of the permanent road remaining unfinished at the south end of the Tring excavation.

“The whole of the works on the Wolverton contract have, for some time past, been advancing in the most satisfactory manner. The quantity remaining, in the Denbigh Hall excavation, does not now exceed 50,000 yards; part of which is to be conveyed into the Wolverton Embankment, and the remainder thrown into spoil. The present rate of progress will justify the calculation that the cuttings and embankments, including the Wolverton Embankment, will be closed in eight weeks from this time. The permanent road is also in an advanced state. The unfinished portion is less than two miles, the greater part of which will be laid before the excavations are finished. We may, therefore, calculate upon the permanent road being extended from Denbigh Hall to Wolverton in eight or nine weeks.

“The Wolverton Viaduct contract is completed, with the exception of the permanent road, which cannot be commenced until the embankment is brought up to both ends.

“In the Castlethorpe contract the excavations and embankments may be regarded as completed—the latter are entirely so. On the slopes of the excavations a quantity of rock is left purposely, the chief part being intended for ballasting the permanent road, of which there is yet to be completed a length of two miles and a half. This does not much exceed the quantity stated as remaining on the last contract; and, as the excavations become more advanced, the period for completion may be reckoned the same.

“The progress made throughout the works of the Blisworth contract has upon the whole, exceeded the estimated average. Hitherto this was to have been expected, from the favourable position of the material excavated, and the large quantity thrown into spoil; but the character of the excavation is now more difficult; and as it gets deeper, the space for employing men gradually becomes more confined. The material is increasing in hardness; and within the last few weeks, there has also been a greater quantity of water. These impediments naturally render any estimate of the quantity which may be yielded by the south end of the excavation for the embankment southwards, in some

degree uncertain. An arrangement has therefore been made, and is at present acted upon, for throwing an additional quantity into spoil from the centre of the excavation, and supplying the deficiency in the embankment by a corresponding quantity of side-cutting at the southern extremity of the contract. The object thus aimed at is the completion of the south portion of the contract in May, nearly at the same time with the Wolverton and Castlethorpe contracts; at which period an extended opening may be made from Denbigh Hall to the village of Roade, situate on the turnpike road leading from Stoney Stratford to Northampton, and only five miles from the latter town. This position appears highly advantageous for the next temporary *terminus*, which must remain the *terminus* for the London division, until the opening of the whole Railway.

“In the Blisworth Cutting there now remain about 100,000 cubic yards of material, which will be disposed of nearly in the following manner :—

30,000	cubic yards	to Ashton Embankment.
35,000	—	to Blisworth ditto.
35,000	—	to spoil.

The first quantity is that which relates to the opening of the line, as far as Roade; and, reckoning the south end of the cutting to yield at the rate of 10,000 yards per month, this may be effected in three months, allowing the necessary time for joining the permanent road.

“The completion of the Blisworth Embankment will probably not much exceed the end of May, from which date the undersetting will commence. By the time this has advanced to the site of the spoil, it is expected the excavation will be cleared to the level of the permanent rails. The undersetting being a work of a novel character, and placed in a situation where contingencies will in all probability occur, there is some difficulty in calculating the time it will require. After giving the subject the most attentive consideration, I do not deem it advisable to state this at less than three months from the time of the excavation being entirely cleared or bottomed—bringing to the end of September the completion of the contract, as regards readiness for the opening of the line.

“The future methods of procedure and expenses in the Blisworth

Cutting have been calculated upon the evidence and appearances now before us; but it is not improbable that, in the undersetting, our plans may require modification, as indicated by circumstances at the time. Such cases will necessarily increase the cost beyond what was last estimated; but the quantity of materials now remaining in the cutting being small, and a considerable portion of the space for undersetting being exposed already, the additional expense cannot, it is thought, be very considerable. Three miles of permanent way remain to be laid.

“In the Bugbrook contract the excavations and embankments throughout are closed; but it will be necessary to deposit an additional quantity of material upon one of the embankments, in which there has occurred a very extensive slip. About two miles and a half of permanent way remain to be laid.

“The Stowe Hill contract is in a satisfactory state, as regards the prospect of completion. The tunnel has been finished some time. A small quantity of excavation is yet to be brought from the south end of the tunnel to the embankment at the north end of the contract. There are about 600 yards of permanent road to be laid.

“In the Weedon contract the excavations and embankments are completed. There are about 1,100 yards of permanent road to be laid, and the greater portion of ballasting is on the ground.

“The Brockhall and Long Buckby contracts are under the same contractors, and have been worked conjointly; they may, therefore, be regarded as one with reference to completion. The works are in a more backward state than they ought to be. There is an excavation at each extremity: one near Weedon, containing 70,000 cubic yards; the other, at the south end of Kilsby tunnel, containing 80,000 cubic yards. From these two excavations one intermediate embankment is to be formed, requiring 97,000 cubic yards; the redundancy of the excavations is to be deposited in spoil. With moderate exertions these works may be closed in four months. There remain about four miles and a half of permanent road to be laid.

“Kilsby Tunnel is at present in a very satisfactory state, and the monthly progress as regular as can be expected, considering the nature of the operations. No new difficulty has recently occurred, except



the capricious appearance and disappearance of water in some of the shafts, both in and beyond the quicksand. Between these shafts the junction of the respective portions of the tunnel has consequently become rather uncertain,—the actual rate of progress in tunnelling, through the intermediate space, falling short of what was estimated. To remove this source of contingency as much as practicable, it has been found necessary to sink additional shafts, for the purpose of dividing those unfinished portions which would require the longest time to execute, or in which our average rate of progress was most likely to be interrupted by water, or a change in the nature of the strata. On the 20th of January last a careful admeasurement was made, to determine accurately the distance unfinished between each pair of shafts, and the time of completion for each calculated upon an average which there are no reasonable grounds for doubting. The results are stated in the following table:—

<i>Quantity remaining between Shafts.</i>	<i>Progress per Month</i>		<i>Time of completion</i>	
	YARDS.	YARDS.	MONTHS.	
Between 1 a and 1 b . . . 33	33	6	5½	Say end of June.
— 1 b and 1 c . . . 44	44			
to be done from intermediateshaft				
x . . . . . 14	14			
— 1 c and 1 d . . . 40	40	6	6	Say middle of June.
to be done from intermediateshaft				
y . . . . . 10	10			
— 1 d and 2 . . . 54	54	6	5	Say middle of June <sup>2</sup>
to be done from intermediateshaft				
l . . . . . 16	16			
— 2 and v shaft b . . . 53	53	6	6½	Say end of July.
— v shaft b and 2 b . . . 69	69	9	6	Say mid. of July.
— 2 b and 3 . . . . . 17	17	12	5½	Say mid. of July.
— 3 and 3 a . . . . . 25	25	12	1½	Say mid. of March.
— 3 a and v shaft A . . . 28	28	12	2	Say end of March.
— v shaft A and 5 . . . 15	15	12	2½	Say mid. of April.
— 5 and 5 a . . . . . 37	37	12	1½	Say end of Feb.
— 5 a and 5 b . . . . . 37	37	9	3	Say end of April.
— 5 b and 6 . . . . . 42	42	9	4	Say end of May.
— 6 and 6 a . . . . . 30	30	6	4½	Say mid. of May.
			5	Say end of June.

“The averages of progress adopted in the table may appear to be scarcely borne out by reference to the reports of progress in some particular shafts; but such instances are accounted for, either by the occurrence of a fallen length (which was the case in one of the quicksand shafts), or by the proximity of the face of the tunnel to the shaft, which lessens the room for working, and invariably reduces the rate of progress below that which ought to be taken as a guide.

“The circumstances requiring the adoption of the expedients explained above (in order to avoid disappointment by the further protraction of the time fixed for final completion), have necessarily caused the expense of prosecuting this work to be materially augmented beyond what was estimated last year; and in addition to this, it has been found absolutely indispensable to increase the prices of mining, timbering, and brickwork formerly paid to the sub-contractors, and which expense was proved to be altogether inadequate. In the quicksand especially, although effectually drained, the utmost caution in mining has been required, and an expenditure of timber unavoidably occurred, which would appear excessive and lavish to any one whose experience has been confined to ordinary tunnelling. The present plans of proceeding have been arrived at by close observation and mature reflection, and cannot with safety or propriety be altered for the purpose of economising. Several circumstances have occurred demonstrating that none of our precautions or expenses have exceeded what the magnitude of the difficulties attending this work imperatively demanded.

“The Rugby contract, having been given up into the hands of the Company, is now proceeding under the direction of the engineers. A considerable proportion of the excavations, embankments, and permanent road is already executed, and there now remain two excavations to complete; one of them at the north end of Kilsby Tunnel, containing 143,000 yards—the other near Rugby, containing 102,000 yards. The quantity to be conveyed from each to the Hillmorton Embankment is almost 60,000 yards, which will occupy four months, making the period for completing this contract extend to July; and to this we must add one month for the permanent road, making it the beginning, or say the middle, of August.

“The works of the station at this point are at present in rather a backward state, owing to the severe and continuous frost, which has almost entirely put a stop to the brickwork and permanent road. The booking-office walls are built, the timbering of the roof put on, the engine and tank-house in a forward state, as also the huts for the engine-men. The turn-plates will be fixed in a few days. The completion of the permanent road will occupy a fortnight after it is practicable to commence laying it.

“From this station to Birmingham one line of permanent road is laid throughout, and the other, with the exception of a short distance (about one hundred and fifty yards) in the Church Lawford cutting. Though laid, however, the road is not in a fit state throughout to be travelled upon by engines and trains; for, on some of the principal embankments, it requires to be raised and adjusted. But this is a work which, with a proper number of men, can easily be completed before those other points, already specially alluded to, as regulating the approaching opening.

“In the Birmingham station the large turn-plate in the locomotive engine house is completed, and the necessary rails fitting it for the reception of engines will be laid in a few days. The lines of rails in the passenger sheds are laid, and the requisite sidings will be completed in a fortnight.

“From the foregoing remarks on the respective contracts throughout the line, it will be perceived, that the works now remaining to be executed are not only confined to a few points, but also limited in magnitude. Blisworth alone appears to involve difficulties which may possibly interfere with our calculations and prospects. From Denbigh Hall to Blisworth the works are now rapidly approaching to a close. The great feature of that portion of the line—the embankment over Wolverton valley—will be joined to the viaduct in about a month; and the line virtually finished and prepared for passengers as far as Roade, in the course of May next. The unfinished portion of the line will then be confined to the distance of twenty-three miles between Blisworth and Rugby; but the greatest portion of this length is at present nearly complete, and the only works of any magnitude remaining are—

"1. The Blisworth Excavation, now containing not more than 100,000 cubic yards of materials to be removed.

"2. The Long Buckby contract, with two excavations, both of which may easily be executed in less than four months.

"3. The Kilsby Tunnel, with 400 yards of tunnelling to be done, divided into portions so limited in extent, that the calculated periods for the junctions being formed between the shafts (as detailed in the table given under the proper head), may be looked forward to with almost entire confidence;—and

"4. The Rugby contract, now in a very forward state, the unfinished works being confined to two excavations, favourably situated and circumstanced for suitable measures being adopted to secure their expeditious completion.

"Of these four points there are two—the Long Buckby and Rugby contracts—which involve no difficulty whatever, the works being quite of an ordinary character; of the remaining two, Kilsby and Blisworth, it is only the latter which need be regarded with particular anxiety, and this work it does not appear impracticable to complete in time should the approaching season prove favourable. Unless there should be impediments to the undersetting of the rock with masonry exceeding what is at present anticipated, we may reckon on an opening through it in six months from the first of March next, which would make its completion almost, if not actually, simultaneous with that of Kilsby Tunnel."

On the first of January, 1838, the expenditure was 3,981,829*l.*; and the loans, and cash advanced by proprietors in advance of their calls, amounted to 1,828,797*l.*

From the continually increasing difficulties which from time to time presented themselves, an enlarged outlay of money was rendered unavoidable; and it became evident that the existing capital of four millions and a half would not be sufficient; but it was expected that it would suffice to open the whole line for passenger traffic, from end to end—hence any addition to the capital which might eventually be required would principally arise out of further preparations, on an increased scale, for the goods department.

The state of the weather was such that it was found impossible to

open the line, up to Denbigh Hall, and from Birmingham to Rugby, till the 9th of April; from that day passengers have been conveyed regularly between London and Birmingham, travelling seventy-seven miles on the railway, and thirty-five, between Rugby and Denbigh Hall, in coaches, furnished under a contract by Messrs. Horne and Chaplin, at 7*l.* 14*s.* 6*d.* per double journey, of 37 miles, including all expenses. There were unfortunately not enough of them, which occasioned many persons to be refused their passage, and occasioned both loss and inconvenience. As far as the railway was concerned, any number of passengers could be taken; but when the middle ground was to be got over, the coaches of course, had a limit, beyond which no person could be booked, yet at the above price, coach masters ought to have jumped at the chance of furnishing conveyances to any extent.

For several days before the coronation every place was taken, and 10*l.* offered and refused for a seat; at last the people went in hundreds to Rugby, on the chance of getting to Denbigh Hall how they could, —when wagons, carts, donkey chaises, or anything else were put in requisition, at enormous prices, up to a shilling a mile, to get them along; and some speculators, who got stages down there by the railway during this glut, charged 4*l.* inside and 2*l.* 10*s.* out, for the distance from Rugby to Denbigh Hall.

The line of railway between London and Tring was too far distant from the Holyhead road to hold out sufficient inducement to coach proprietors to abandon their accustomed track, for the chance of a comparatively small saving of time; the certainty, also, that a few weeks would make a complete alteration in the passenger traffic, on all the roads parallel to the railway, effectually checked the establishment of new lines of communication for coaches from Tring to the north; hence it happened, that, from the time when the season for excursions had passed, and the curiosity of the public had been partially gratified the railway travelling was limited to the purposes and accomodation of the immediate district. This afforded an opportunity of practically ascertaining the effect of the ordinary passenger traffic on that portion of the railway; and it was found to exceed the amount, which had been calculated on, considerably; thus affording encouragement to all parties concerned, as to the future prospects of the undertaking.

Between the 20th of July, 1837, and the 14th of February, 1838, there had been no less than 162,216 passengers conveyed along the Railway, without an accident to any individual; except one elderly lady who lost a front tooth,—but, upon strict enquiry, it was clearly ascertained to have been loose before.

It was considered of more importance that passengers should be able to rely on a certain and safe conveyance to and from the stations where the trains stop, than that they should, in the first instance, travel at the highest possible speed: the chief aim of the directors, in the regulation of the trains, was to ensure a uniform precision of movement on the Railway. In this endeavour they were ably seconded by their contractor for locomotive power, Mr. Bury; and a degree of punctuality in the arrivals and departures has, for some time past, been attained at all the stations; which, considering the unavoidable imperfections of a road so recently formed, and the many difficulties to be surmounted in every new undertaking, could scarcely have been anticipated, and, it may be added, which has not been accomplished upon any other Railway. The only thing, in fact, which prevented this regularity from being universal, was the delay consequent on the coaching between Rugby and Denbigh Hall, and the circumstance that some of the trains have to wait the arrival of the passengers by the Grand Junction Railway.

The preparations for the carriage of goods have occupied much attention; and the directors, aware of the advantages of combining experience with system, in the management of a business so extensive and complicated as the future goods traffic will most probably be, have engaged the valuable services of Mr. Baxendale, of the well-known firm of Pickford and Co., to conduct this department, under a contract which is to take effect from the opening of the Railway for this branch of business.

An agreement has been entered into, by which this Company rent the Aylesbury and Tring Railway, at 2,500*l.* per annum, being five per cent. on the estimated cost, for five years certain; and looking to the importance of the traffic from the fertile vale of Aylesbury, and the communication which this branch will open with Oxford and other places, this agreement must be considered a very advantageous one.

The inhabitants of Banbury have also, at a general meeting, resolved to make a new road to the Railway, by the shortest route, at Weedon, where a first class station will be made; and the same may be expected at all other towns which do not possess the requisite commodious means of getting to the Railway. In fact, from Northampton to Blisworth a line of railway has been projected; and the promoters applied to the directors to place the making of it in the hands of the Company's engineer,—to which an assent has been given, and the works are forthwith to be commenced.

In August, 1838, the expenditure was 4,592,698*l.*, and the loans amounted to 2,119,000*l.*; the land amounted to the sum of 622,507*l.* From January the 1st, to April the 8th, when the line was only open from London to Tring, the number of passengers conveyed amounted to 36,024, being a daily average of 244 for the whole thirty-two miles, and the receipts amounted to 7,272*l.*, while the expenses were no less than 8,049*l.*; but from the 9th of April to the 30th of June, the number of passengers was 122,814, being an average for the seventy-seven miles of 715; the receipts, deducting the expenses of the intermediate coaching, were 41,324*l.*, and the expenses 16,098*l.* only.

It was proposed, for the accommodation of passengers by the Railway, that an hotel and dormitories should be established on an extensive and unappropriated piece of ground belonging to the Company, in front of the Euston Station, leaving sufficient space for a handsome entrance, the hotel to be erected on the east side, and the dormitories on the west, according to a plan prepared by the Company's architect.

The directors of the Railway Company for the time being, are trustees of the land at a nominal rent, and have formed a company with the requisite capital, to be raised in shares of 25*l.* each; the trustees are to have the entire control of all the buildings, and are to agree with one or more respectable tenants for the occupation, at rents calculated to afford ample remuneration to the shareholders for their outlay. The building on the east is to be arranged for all the purposes of an hotel, with a spacious coffee-room for the accommodation of the inmates of it, and of the persons in the dormitories who may be desirous of availing themselves of the hotel coffee-room.

The building on the west is to be arranged for dormitories, and

divided into as many rooms, of convenient dimensions, as the allotted space will admit of,—a proportion of the number to have small sitting or dressing-rooms attached to them, so that passengers on their arrival may be accommodated with a sleeping-room, and if required, a sitting-room; each of the apartments to be charged at a price varying according to the floor and scale of accommodation. A coffee-room is to be also established in the same building, for breakfast and refreshments; but the house is not to be licensed for wine or spirits; the dormitories are to be altogether a separate establishment from the hotel. Convenient baths will be erected in each building; and it is further intended that a space of ground, situated near these establishments, should be appropriated to a mews, for the convenience of persons requiring post-horses, and for the standing of horses and carriages at livery.

The charges of every description, including attendance in the hotel, dormitories and mews, are to be regulated according to a scale which every person will have an opportunity of inspecting. The shares were all offered, in the first instance, to the Railway proprietary, to accept or not as they thought proper; and the buildings were commenced forthwith. It is a pity the same thing is not done at the Birmingham end; although passengers can there be accommodated with breakfast and luncheon, at a fixed charge, including servants. The main object of the undertaking being to promote the success of the Railway, by providing for the comforts of the families and individuals who travel on it, there is evidently as much reason for it at the one end as at the other.

On the whole of the passenger and parcel traffic, to the 30th of June, 1838, the receipts were 83,234*l.*, and the disbursements, including 16,755*l.*, paid for intermediate coaching, amounting to 53,380*l.*, leaving a balance in the Company's favour of 29,854*l.*; which was certainly more than there was any reason to expect, through the drawbacks arising from various causes. In fact, the principal end and aim in opening the two ends of the line was not profit, but advantage, to the concern, in getting every one drilled to his duty prior to the final opening for the whole length; as it turned out, however, it was both useful and profitable.

At the general meeting in February, 1838, the directors adverted



to the probability that additional capital would be required, for business on a far more extended scale in the goods department than was originally contemplated; and the enquiries which they made, in the next six months, sufficiently demonstrated the necessity of a large and immediate outlay, not only as respects the proposed arrangements for this description of traffic, but for some additional accommodation in the passenger department. The central station for engines and goods at Wolverton, the goods stations at Birmingham and London, and along the line, required to be at once commenced. The additional stock of engines already contracted for, and an increased number of wagons and trucks, were also urgently required; and it was seen that further sums would be wanted, to complete the works of the road, and to wind up the accounts of the contractors.

The directors always felt it to be a part of their duty not to restrict the proper outlay of capital, when satisfied it would secure the convenience of the public, the stability of the works, and the efficient management of the traffic; and they felt persuaded that a perseverance in this course, to the completion of the undertaking, would be found most economical in the end, and best calculated to ensure the permanency of that successful result which is now happily placed beyond the reach of doubt.

At the general meeting in August, 1838, the difficulties at Wolverton, Blisworth, Kilsby, &c., having been successfully overcome, and a single line of rails having been laid, on which a train, with several of the proprietors, had passed over, from end to end, the engineer-in-chief reported that the entire opening of the line might be expected in September; but that he was prevented from fixing the day, as a portion of the work remaining to be done depended, in some degree, on the state of the weather.

The above train went the whole distance, exclusive of stoppages to examine the works, in five hours; but the directors have always looked at safety so much more than speed, that they limited the trains to six hours on the opening, till the winter months are got over, and the embankments become more consolidated.

A great deal of the increase in the cost of the work arises from the extension given to the plans of the stations, on which so much of the

good working of the Railway will consist. They may be made on almost any scale, and in the original estimates were taken very low—namely, at 19,600*l.*; whereas our estimate is that they will cost 460,000*l.* When the original calculations were made there existed hardly any guide whatever for any one to make an estimate, and but little former experience to lead the way, there being no other line in operation from which could be derived the means of coming to an accurate conclusion, in a concern of such magnitude,—so that, on this account there is less blame to be attached to any party than would at first be supposed.

The Company have never found the least difficulty in borrowing money on their credit, and they were doing so in August, 1838, till they could apply to Parliament for power to raise more capital, which will be granted as a matter of course, when it is seen that 5,000,000*l.* has been bonâ fide expended in carrying out the works, and that they are now so far advanced towards a final completion, that the line has been in constant operation with passengers for some months.

The engines at present employed upon the line are as follow :—

No. 1 made by Mr. Bury, Liverpool	No. 20 by Mr. Hawthorn, Newcastle.
2	21
3	22 by the Haigh Foundry Company, at Wigan.
4	23
5	24
6	25 by Rothwell and Co., Bolton.
7	26
8	27
9	28
10 made by Hicks and Co., Bolton.	29
11	30
12	31 made by Mather Dixon and Co. Liverpool.
13	32
14	33
15	34
16 by Mr. Hawthorn, Newcastle.	35
17	36
18	
19	

A very superior engine was also made by Robert Stephenson,

for carrying the trains up the inclined plane from the Euston Square station to Camden Town, till the fixed engines were completed; and the performance of the whole has been most satisfactory, as may be judged from the following instances.

The average of fourteen trips, of twenty-three miles, up 1 in 440, with the engine No. 16, was twenty-two miles an hour, with a gross weight, including the tender, of seventy-five tons,—viz., fourteen carriages and one hundred and forty-eight passengers: the consumption of coke was 148 lbs.

The average of fourteen trips, of three-quarters of a mile, up 1 in 90, from Euston Square to Camden Town, with the large engine built by Robert Stephenson and Co., was fifteen miles an hour, with seventy tons,—viz., fourteen carriages and one hundred and forty-eight passengers. The engine No. 7 built by Mr. Bury, went ten miles in ten minutes with only one cylinder working, four of which miles were up an incline of 1 in 660. Comets are said to be only young planets navigated by steam, and occasionally going to the sun for a few more sacks of coke; and we shall, by-and-by, rival the American Locomotionist, who is going to put a handful of chips in his pocket, borrow a tea-kettle, and set off for the moon.

It is to be noted, that although the London and Birmingham engines are made by different persons, they are constructed exactly alike, in all their parts, and of an exact size every where, being entirely made from working drawings given out by Mr. Bury of Liverpool, who contracts to work the line. This will, eventually, conduce to great economy, as every individual part of an old and disabled engine, which is worth preserving, can be used in the formation of a new one.

Whether the mode of contracting for locomotive power, or that of the Company's working their own engines, will be the best, is not yet known—the method of contracting not having been sufficiently tried. Mr. Bury has only commenced since the line has been opened the whole length. In fact, we are yet so much in our infancy with respect to all railway operations, that we may say we have every thing to learn, and to learn by the most expensive of all processes—experience.

It was matter of great doubt, at an early period of the railway system, how it would act when the snow laid so deep upon the ground as

to interrupt the ordinary communications on the common roads: they have, however, completely triumphed over all difficulties of this sort. This was strikingly proved on the Newcastle and Carlisle Railway, where the possibility of so working was fairly put to the test on the 26th of December, 1836; and the utility of railways demonstrated in the fullest manner. In the deep cutting through the Cowran hills, the snow had drifted to the depth of four or five feet; and when the Hercules engine came down, on the morning of the above day, great numbers of the country-people assembled to see how it would act in such an emergency, and to render any assistance which might be required. On arriving at the spot, however, the engine made no bones of the matter, but dashed right into the drift, clearing its way through, apparently without the slightest difficulty; the snow, at the same time, flying over the top of the engine chimney like foam from the broken waves of a violent sea; and notwithstanding this and similar obstructions, the train came down from Greenhead, twenty miles, in one hour and a quarter. The trains, in fact, continued to keep their times, while all communication by common roads were more or less seriously obstructed, if not entirely cut off.

Before a railway can be opened even partially, cursory observers would hardly credit the number of small items which have to be provided, the procuring of which costs in the aggregate no insignificant sum of money; and in a concern of such magnitude as the London and Birmingham Railway the expense was commensurately great, as it was no use to incur an additional outlay, when the line was completed, by fitting out the two ends previously to their opening in a temporary way; the plan pursued was, therefore, one which would harmonize with the whole arrangements when the line was entirely finished.

The preparations for lighting the Euston Square, Camden Town, and Birmingham stations, took up considerable time and labour. These stations are all supplied with gas, by contract, on very fair terms, from the Gas Companies whose works are adjacent to them; large mains being laid throughout the whole of them, from one end to the other, in situations which admit of smaller mains being brought into all the various buildings; from these branch off pipes of different

sizes, so as to convey the gas into all the various rooms and offices, passenger sheds, engine houses, coke vaults, carriage sheds, &c., as well as generally about the ground, in sufficient numbers to give an efficient light, and at the same time with a due regard to economy. It was also found necessary to light up the whole of the extension line between Camden Town and Euston Square, and at the Birmingham end provision is made for the lights to be continued to the end of that noble structure the Lawley-street Viaduct: proper gas meters are fixed in places which insure the quantity burned being correctly ascertained. The locomotive and goods departments having each separate meters to show their respective consumption.

In the department of the resident engineers, there had to be provided ballast engines, ballast wagons, hand trucks, and implements of all kinds, every railway requiring to be constantly rose with ballast on the embankments for a long time after its construction. Land was purchased in situations where the requisite materials could be excavated; and, at stated hours, so as not to interfere with the regular traffic along the line, the ballast is brought in the wagons to convenient spots near where it is required, and then distributed in the hand trucks, which, from their small size, can always be readily lifted off the rails, to allow the passage of the trains.

All the requisite tools for laying and repairing rails, joins, crossings, eccentrics, turnplates, &c., had also to be provided—such as chisels, hammers, crowbars, levers for lifting the rails and blocks, beaters, rammers, drills, gauges, sights, spirit levels, &c.—to a large extent; the plate-layers being distributed in gangs, one overlooker being stationed to each district: these districts are from four to eight miles in length, according to the state of the road, each having a complete set of tools. Under the overlooker is a foreman, time-keeper, and from three to six men per mile, who are continually employed in repairing those various parts of the line which are found to be most out of order. The resident engineers receive all their tools, and implements of every kind, from the store-keeper, by written requisitions which they make on him.

The various inclinations on the line are marked at every change, the top of the mark showing whether the train is about to go down

er up the inclination, by being cut with a slope. This is reversed for the opposite line of rails on which the trains travel in the contrary direction; each quarter of a mile is measured and marked; this is in accordance with the Company's Act of Parliament. We are not aware, however, whether Parliament defined the sort of mile-posts which are set up.

In order to prevent accidents as much as possible, although men are properly stationed to all the eccentrics which turn the switches, a signal has been contrived which must, in all cases, show when they are wrong; consequently, if the engine-man keeps a proper look-out, he can never get off the line from that cause. This signal is as follows: when the sliding-rail is put in a wrong position, it turns an upright rod round, and this carries on its head a red and white lamp by night, and a red and white canvass signal by day; in either case the red is shown to the coming engine when the switches are wrong, and the white when they are right. The gates at all the paved crossings along the line show similar signals by night and day, which are in all cases worked by the opening and shutting of the gate.

The points and crossings work very well on this line; but there are so many different sorts in use on the various railways, each having their firm advocates, that every one must be convinced there is yet more to be done—certainty and simplicity seem to be the leading requisites here; and we have no doubt that before long, these essential things will be moved by the engine itself, which would effect a considerable saving; a new kind is however now being introduced which is an improvement on the old switch rail and seems to answer well.

Except at the principal and out-stations, no siding-places have yet been made; nor can this be done till the nature of the traffic, viewed as a whole, is seen. So much depends on the quantity of the goods requiring to be carried, and the degree of speed at which it is desirable to travel, that the longer the construction of the siding-places are deferred the better. So much is saved in the cost of locomotive power, by travelling with the goods at a decreased velocity, from that which the public has a right to expect in the case of the passenger trains, that a well-organised system, enabling these two to pass each other by means of siding-places, situated according to a thoroughly matured

plan, in unison with the nature of the traffic, would form a most essential feature in this and every other railway.

In the locomotive department, preparations of all kinds have been made to insure the safe and economical working of the Railway. Each engine carries a box of tools; the various out-stations where there are locomotive engine-houses, have them fitted up with forges, vices, and work-benches, enabling the engines to receive trifling repairs. In the locomotive engine-houses at Birmingham and London, more extensive works are carried on; but the whole of the repairs of consequence which may be necessary, will be done at Wolverton, near the centre of the line, where preparations have been made on a scale fully equal to what will be required.

Each station is furnished with an alarm, to give notice of the approach of all trains, and to summon the whole of the men to their appointed places. These alarms are so constructed, that a weight is wound up after they have performed their office; this prepares them to perform it again. On the policeman, stationed at them, seeing the forthcoming train has reached the proper spot, he pulls a trigger, and the weight begins to descend, ringing a loud gong-shaped bell by means of internal machinery: this leaves the policeman at liberty to watch and attend to the safety of the train. Bells are also hung, so as in a few seconds to collect together the whole of the men belonging to the station, for any required purpose.

Large wagons will be prepared, on which engines or carriages can be carried: these will be furnished with all sorts of implements requisite to enable them to bring in damaged engines or coaches, such as tackles, shears, ropes, winches, levers, screw-jacks, slings, chains, &c., together with all the requisite tools. These wagons will be kept ready to be dispatched at a moment's notice, so as to enable damaged engines or carriages to be immediately removed from off the line, and taken to a proper place for being put into a state of repair. This will be much aided by the system which has been adopted, of having every thing to one exact scale, so that what will fit one engine will fit all the others—a system which has also been carried out in the manufacture of the carriages to a great extent.

In the coaching department, a great number of implements have

been required, in order to insure the ready working of the line, such as short ladders, for getting on and off the arrival and departure stages; long ladders, for loading the luggage on the roofs of the carriages, and other purposes; steps, for loading luggage at the departure stage; shoots, for letting the luggage run off the carriages at the arrival stage; circular stands, to receive the luggage when taken off the carriages, so as to enable the passengers to select their own; trucks, for wheeling about luggage, parcels, &c.; notice boards, to direct passengers to the various booking-offices, waiting-rooms, refreshment rooms, &c.; luggage gauges, for the carriages to pass under, when loaded, in order to see that the load is not too high to pass under the bridges; lamp boxes, grease boxes; stands for coupling bars; sentry boxes for the policemen, the watchmen, and the gate-keepers: together with a great variety of other things, too numerous to mention, were all requisite before the line could be correctly worked.

Where the turn-plates are opposite the arrival or departure stages, large bays are obliged to be cut out, to enable the carriages to be turned, otherwise the buffers would not admit of their going round: sliding platforms had to be made for these, so as to draw back on rollers, to admit of the turnplates being used, and yet, when rolled forward again, to leave no break in the continuity of the stage. Proper places for the embarkation and disembarkation of horses and carriages, with the requisite means of connecting the boxes and trucks, which were to convey them, with the road on which they came down to the station, together with the proper fastenings and means of securing them, had all to be brought into working order, before any precision or regularity could be arrived at.

The best modes of lighting the carriages, and instituting the necessary signal lights, had also to be put into operation. The lights necessary for these purposes are, for the carriages, a simple mode of giving to the inside of the carriage, a soft and mellow light, sufficient to enable the passengers to read with ease, and yet not to dazzle the eyes. This has been effected by a lamp invented in London; and we think still better by one which we ourselves have invented (it would be odd if we did not think so). In size, mode of fixing, and appearance outside the carriages, both lamps are nearly similar. They are



fitted in a hole cut through the roof; the part remaining above the roof is protected by a box; that part which comes through the roof, has the appearance, to a person sitting inside, of a glass saucer; in the London one the glass is plain, which occasions a dazzling to the eyes of those who are at all weak in that organ; in the Birmingham ones this is obviated by the saucer being made of ground glass. By an improved construction of the fountain principle, the latter lamp is rendered as nearly shadowless as makes no matter—the body of the lamp being entirely above the flame, and the connection between the two consisting of a tube, not more than  $\frac{3}{16}$ ths of an inch in thickness, which should always be turned towards the door of the carriage. These lights are used by day as well as night, to illuminate the carriages while they are going through the tunnels.

It is requisite that the trains show as a head light a white light, and as a tail light a red one. We have proposed, as a substitute for these, an arm revolving between two uprights on the centre carriage or thereabouts of the train; the arm to revolve on a pivot through its centre, and to carry a lamp at each end; this arm being connected by a simple drum and strap with the axle of the coach, may, of course, be made to revolve at any required velocity; the number of revolutions which it makes in any given number of seconds being known at all the stations. It is an indicator directly it becomes distinctly visible, not only of the approach of the train, but of its rate of speed; when the train stops it is, of course, stationary, and if the train backs astern it moves in a reverse direction; thus informing any person either before or behind a train of all its motions, and the rate at which it is travelling. Powerful lenses should be used both for the fore and back lights, either of which can show a red light at pleasure;—both these and the roof-lamps are patented.

Fitting out the store department, and furnishing it with a sufficient stock of articles for the supply of all the various branches of consumption along the line, was a work of no little labour, and of the greatest importance. To ascertain what was required, in what quantities, at what times—to ascertain the current prices, so as to be able to check the contractors—to issue out and close the necessary contracts—and to find stowage for the whole, where it would not only be

preserved from damage, but be at all times easily accessible, required no small share of consideration; even the stationary branch alone contains several hundred books, forms, and papers of various kinds, branching out into all the various departments, and as yet no regular storehouse has been built either at London or in Birmingham; temporary accommodation being all which it has been possible to procure for some time yet, every nerve having been strained to effect the entire opening of the Railway, and all other objects rendered subservient to this.

The fittings of various kinds to the buildings at the principal stations amounted to a considerable item. When these buildings were delivered over by the contractor, of course they consisted of nothing but the bare walls; and they had then to be put into such a state of equipment, as to furnish, as would fit them for their various uses. The locomotive engine-houses had to be supplied with forges, workbenches, vices, tools of every kind, with a reserve of each in store; a large stock of coke had to be provided—coke cranes had to be erected—materials for cleaning the engines to be procured—together with a thousand minutiae gathered together, which are only known to practical men, but all of which require time, attention, and money, to set in order before work could be attempted.

The superintendent of police is responsible for the general good conduct and order of all the men under his charge, and he is required to reside where he is appointed, and to make himself well acquainted, by frequent personal intercourse, with the character and conduct of every man under his orders, and to take care that all orders and regulations issued from time to time are promptly and strictly obeyed, and that clear and concise instructions are given to each man, so as to insure the correct performance of all their duties, he being held responsible that they are properly understood. He furnishes a daily report of occurrences, detailing every instance of neglect, and every complaint which has been made to him, from whatever quarter; and he may at once, if the nature of the offence requires it, suspend the offender, or take any other precaution which may appear to be necessary. He has also the charge of examining all the weekly pay-sheets, previous to their audit, the men being paid under his especial superintendence; and he also takes care that each man's signature is attached to his amount.

There is one inspector of police at each station, who has to reside wherever he may be appointed, and to attend at all hours when required. He is directly responsible to the superintendent of police, from whom he receives all his instructions, and to whom he makes a daily report of every thing which occurs; and in the case of any neglect of duty, or misconduct on the part of any of the men under his orders, and in every case of a complaint against a man, he, without delay, communicates the particulars to the superintendent, sending the offender to head quarters, if the case requires it, as soon as possible; he sees that all orders, as they are given out from time to time, are promptly and strictly attended to throughout his district, the limits of which are of course defined.

He has the control of all the policemen at his station and in his district, and is held responsible for their attention, good conduct, and efficiency. He has also under his charge all the switches, to which the most vigilant attention is required. It is his business to render every assistance in his power to the clerks and guards, and supply as quickly as possible any wants which they may communicate. He also regulates the weekly payments—paying the money, and obtaining every man's signature to the amount—and transmitting a weekly completed pay-sheet to the superintendent, comprising the pay of all the men in his district.

The men receive their money weekly, on an appointed day, being paid from lists which are all regularly audited; and any debts which they contract, if not immediately paid on orders to that effect being given, the amount is deducted from their salary. They are not to leave the Company's service without giving one month's previous notice of their intention; and in case they quit without such a notice being given, all their pay then due is forfeited. If any articles in their charge are damaged, or improperly used, a deduction from any pay then due is made, sufficient to make good the damage or to supply a new article. Each man is liable to immediate dismissal for disobedience of orders, negligence, or other misconduct; and every man dismissed from the Company's service, or who may resign his situation, must, before he quits their employ, deliver up every article of dress, and of the appointments which have been supplied to him.

No instance of intoxication is ever overlooked, and any man dismissed from the Company's employ on this account is also liable to be fined before a magistrate. Any case of rudeness or incivility to the passengers is promptly punished. All the men are also considered liable for damages done through negligence, and they are at all times ordered to appear in their proper uniform, in a state of neatness and cleanliness. One shilling per week of their pay is deducted to form a sick fund. The pay of men sick, or absent without leave, is always suspended for the special orders of the committee on the case.

There are two guards to each train, the under guard obeying the directions of the upper, who carries the time-piece slung by a belt across his shoulder, and he is required to reside wherever the arrangements of the trains render it necessary. The guard receives his instructions from the head station-clerk, and he reports when the train is ready to start. The train is entirely under his control, and the passengers and their property under his protection, and he is responsible for the safety and regularity of the whole, taking care, previously to starting, that the carriages are properly coupled,—that the requisite number of brakes are in the situations assigned for them, and that they are in proper working condition,—that an adequate number of tarpaulins are provided, and the luggage properly covered up.

He has also to see that the signal lamps are attached, and the roof-lights in proper condition, and that the carriages are in a fit state of cleanliness and efficiency,—reporting every deficiency to the chief inspector, to ensure an immediate remedy. He is not to allow any of the passengers to stand upon the coaches while the train is in motion, nor in any other manner endanger themselves by imprudent exposure; and in case of accident or obstruction to the train, he must consider the speedily forwarding of the passengers of the first importance, or whenever this proves to be impracticable, he must adopt the quickest mode of communication to the next station and to head quarters.

He keeps an exact record of each journey, with the fullest particulars of every occurrence on the road, the times of arriving at, and starting from, each station, and the causes of any detention which may arise; and, in case any persons show a pass, he must obtain and report their names on his arrival. On reaching London, at the Camden

Town station, he is instantly to communicate the number of coaches to the head bankrider, who takes charge of the train down the inclined plane,—he is to inform him of the number of efficient brakes, and surrender the whole into his charge, to be conducted to the Euston station—himself acting under the bankrider's directions.

The bankrider has the entire control and management of the inclined plane from Camden Town to Euston Square, and of every thing which passes up or down; he attaches the rope to every train of carriages which is drawn up the plane, and suffers nothing to descend but that which is conducted by him,—every man upon the plane implicitly following his directions. He carefully inspects into the condition of every train, and ought never to attempt to move it till he is perfectly satisfied of the safety of every part. He sees that the rope and sheaves are kept in proper condition, and the sheave axles well greased; he uses all the vigilance in his power to prevent any rubbish being placed on the inclined plane, or any obstruction of any kind, and reports any omission to convey the requisite signals, at the top or bottom of the plane, by the persons employed to do so; he gives constant attention, not only to the brakes, but to the wheels, grease-boxes, and other parts of the machinery of the carriages coming under his notice, and reports any negligence or imperfections he may have observed, and he is constantly supplied with signal flags, or well-trimmed lamps, to give the necessary signals.

The police are placed along the line, at distances varying from one to three miles, according as local circumstances render it necessary. Each man has his beat and duties defined in all cases; and is provided with two signal flags, one of which is red and the other white; the white flag is held out when the line is clear, and no obstruction exists to the passing of the train; and, on the contrary, the red flag indicates that there is danger, and the train must not pass this signal till it is ascertained that the cause of danger is removed. When the pole is dropped horizontally on the shoulder, it indicates that the policeman wishes to communicate with the train.

Each policeman is likewise furnished with a revolving signal lamp to be used after dark; which shows, at the will of the holder, a white light when the line is clear from all obstruction, a green light

when it is necessary to use caution and the speed of the train must be diminished, and a red light to intimate the necessity of stopping.

The constables placed on a beat, when they first come to their stations every morning, immediately walk the whole length of their beat, to see that the line is in all parts perfectly clear; the constable on the first beat from London comes on the south end of his beat and walks north, and the constable on the second beat comes on the north end and walks south, and the two meeting, where their beats join, communicate to each other the state of the line. The same rule is observed all along the line, the constables acting by pairs, and they are required to meet where they relieve each other for meals. The gate-keepers, switchmen, and others, at particular posts, are not included in this arrangement, in consequence of their being fixtures. In case of any obstruction, which it is not in the power of the constable himself to remove, he may summon the nearest assistance, and refer the party for remuneration to the inspector of the district, to whom he is to report all the circumstances as promptly as possible.

The foremen porters at London and Birmingham, and the collectors of tickets at the out-stations, have the control over the other porters, and are responsible that the carriages are in proper condition, the luggage properly stowed, and every thing ready for the train going at the appointed time,—informing the inspector when the train is prepared to start, that he may give the signal at the proper time. They also have the charge of all stores belonging to the coaching department.

The whole of the men on the permanent establishment are identified by numbers, are clothed in a green uniform, and receive annually the following articles of dress and appointments:—

**Inspectors.**—One body coat, two pair of trowsers, two pair of boots, and one hat, with a great coat every two years.

**Porters.**—Two jackets, two pair of cord trowsers, two pair of laced boots, one cap.

**Guards.**—Two frock coats, two pair of trowsers, two pair of boots, and one hat, with a great coat and cape every two years.

**Police.**—One body coat, two pair of trowsers, two pair of boots, one hat, and one stock, with a great coat and cape every two years.

The process of auditing the books and cash documents connected

with the passenger and parcels is as follows, (and a similar mode is adopted of auditing the accounts of all the other departments, all vouchers remaining in the audit office) :—Every book in any way relating to cash is kept in duplicate, one set being in use for the week, while the set used the previous week is sent up for examination at the audit office; and at the end of the week the audited set are sent out to the various stations to be used, while they send up to the audit office those last used and so on, alternating the sets every week.

A storekeeper has the supervision of all stores, materials, utensils, coke, stationary, books, tools, and all other articles required for the use of the coaching, engineering, and all the other several departments throughout the line, of the whole of which he has the custody and distribution; his accounts exclusively comprise quantities, without having any reference to money. Whenever an article is required for the use of any department, a requisition note or indent is addressed to the storekeeper by the principal of the department, which is the storekeeper's voucher for the demand. If in store the article is immediately supplied, and a receipt note, descriptive of the article, and stating its delivery, is taken by the storekeeper, which is his voucher for its delivery.

At the passengers' booking offices, at the *termini*, the cashier has the sole charge and control of the office, and of the persons employed therein, and he has the sole custody of all money received for passengers, parcels, horses, carriages, or any other thing, the cash being transmitted to him by all the other booking clerks after each train. The money taken at the out-stations being also sent in to him, and the whole is by him placed in the bank,—all the receipts, including excess fares, and every other branch of revenue, passing through his hands only. He is also responsible for the accuracy of the accounts, and for the punctual dispatch of the business of the office; he prepares the daily statement of the passengers and fares, also the weekly account current; he also makes the necessary calculation of the Government duty on the passengers, paying it monthly at the Stamp Office.

The ticket books are originally sent from the audit office for each station, carefully numbered and registered, and when transmitted to the audit office at the close of each week, they are rigidly examined,

and every ticket which has not been accounted for in the summary, or shown to have been destroyed, is placed against the principal booking clerk of the station where the omission has taken place; this is for the traffic from the *termini* which is all done by tickets, but the traffic from one out-station to another, is carried on by means of cards, a number of which, proportioned to the traffic, or to the average issue, are sent weekly to each station, numbered and stamped with a private mark, as well as with the names of the stations through which they are intended to pass.

The principal booking clerk of each station, has placed to his account the number of cards transmitted to him, and receives a deduction for all he issues, taken from the summaries at the end of the week; the cards not issued or remaining on hand, are then returned to the audit office, and if they do not accord with the number in the card issue book, the principal booking clerk is held responsible for the difference.

A schedule of errors is prepared weekly, referring to each station, in which all errors and negligence, of whatever description, during the previous week, are recorded, and explanations are in each case required of every irregularity, all cash errors being amended in the succeeding week's account current. An excess and deficiency of the cash-book, is kept at each out-station, and this is transmitted with the weekly accounts to the audit office; this either establishes or impeaches the accuracy of the principal booking clerk's cash account.

The irregularities in the ticket collections, if any, are also noted; and, in general, every transaction is rigidly and thoroughly examined. The objects attained by these searching enquiries in the audit office being as follows;—every card and ticket issued is accounted for, or the principal booking clerk has to pay for its value; no ticket or card is ever issued for less than its value, or the clerk at the out-station pays for the difference, and every cash transaction is correctly calculated and traced from its origin, till the money is paid into the banker's hands. The examining clerk is assisted by lads, who are principally occupied in classifying, numbering, sorting, and stamping the cards and tickets under his superintendence.

The business at the out-stations requires great attention and accuracy. On the clerk commencing his business in the morning, he first



makes out his passengers way-bill or docket, this is always taken forward by the guard of the train; it is made out in duplicate, one for up the line and the other for down, each being printed on different coloured paper. These dockets state all the particulars relative to the train, with the number of passengers, their fare, and every other necessary information.

A summary of each departure train is made out as soon as it has left the station, showing the number of passengers, parcels or goods and their fares, and a statement of the excess fares, and the reason of them; a classification of the daily totals is also made and sent in to the audit office, on which is also stated the money received for goods, parcels, horses, carriages, cattle, and booking, all of which is sent to the principal booking clerk, who sends it away by the last train to London and Birmingham, so that no money ever remains a night at any station except the *termini*.

The tickets are printed on coloured paper, they require four colours, yellow and blue for instance, for the up trains, the first class being yellow, and the second class blue; the different classes down being distinguished by white and pink; these tickets are all collected by the guard at the last station before arriving at London or Birmingham, and the whole for the day are transmitted to the audit office by the first train the next morning: this is the method with passengers going the whole length of the line, and for those who get down at the out-stations, they are admitted one at a time at a wicket where their tickets are taken, and it is ascertained whether they have paid their fare to the right place; the tickets are not collected by the guards, till all the passengers have got into the carriages, who are going from that station to the *terminus*, by which means he gets theirs also. The tickets taken at the wicket are also sent to the audit office on the following morning, with a statement of their number and amount, a statement of those issued, and a return of the number of cards collected and issued; these cards are used between one out-station and another instead of tickets, but the same steps are taken with them as are made use of with the tickets.

In all papers of any kind, throughout every department, nothing that can be printed or stamped is written; this very much conduces to precision and accuracy.

In the same manner, way-bills are made out for the parcels, each package having a ticket pasted on it of coloured paper. These are of a different colour when the package is to go the whole length of the line, to that which they have if they are to be left at any of the out-stations, as a guide to the guard. At the *termini*, there are separate offices for goods and parcels distinct from the passenger office.

In the above slight sketch which we have given of the manner in which the railway is worked, it will be sufficiently seen that the system which has been established aims at affording safety, and as much accommodation, as present circumstances will allow, to the passengers, and a perfect check on the money transactions of the company. The latter is a most difficult point, and will require some time to perfect in all its various details, which is by no means to be wondered at in a concern of such magnitude; the wonder is, that the business has been conducted so satisfactorily as it has, and it now only requires simplification.

The entire line was opened to the public on the 17th of September, 1838; and the problem will now soon be solved, to which so many anxious hopes have been directed—namely, what will be the dividend? The standing joke on railway estimates has long been—"double the expenses and halve the profits." We rather think, on the London and Birmingham line, one half of the prophecy will receive a tolerable defeat.

No one has watched the expenditure on this line more narrowly than we ourselves have done; yet although we were till lately far a-head of every one else in our prediction of its cost, it was not till two years after we began to estimate the outlay, that we came sufficiently near the ultimate sum; and this only by making use of an entirely new method of working out the estimates. We drew these up every six months, and the following are the *minimum* amounts which we successively calculated would be necessary to complete the work:—

February, 1835	. . . . .	£3,742,000
August, —	. . . . .	3,770,823
February, 1836	. . . . .	3,886,227
August, —	. . . . .	4,232,486
February, 1837	. . . . .	4,929,197

August, 1837 . . . . .	£5,228,620
February, 1838 . . . . .	5,278,302
August, — . . . . .	5,288,155

It is now nearly two years since we affirmed that the cost of the work would not, without difficulty, be kept on the *right* side of five millions; and since that time we have had to endure, divers rubs, manifold quizzings, sundry jokes, and various jeers—of all sorts and sizes, from a kitten's ear to a horse's collar—we have, in fact, been rubbed up, and then rubbed down again, both wet and dry, all in good humour, of course, poetical effusions included; and now, having beaten our adversaries at all points, we are entitled to a gentle joke in return.

Nothing could equal the vagaries which were played with these unhappy estimates of ours—"This can't be allowed,"—"This must be reduced one half,"—"This must be knocked out altogether,"—"This is full four times too much,"—and away went the pen across the figures, like the boys playing at ducks-and-drakes on their slates, till, heaven help us for our sins, they were in several instances reduced to about a million and a quarter; if we had been at all addicted to nervousness, we should have certainly fallen into jiggeries on more than one occasion: we were sure to be wrong which ever way we went, like the unfortunate French actors, whom the Bishop of Arras, in 1695, prohibited by an edict from marrying, and afterwards anathemised for living *avec les concubines*; or like Mr. Murphy, who is always either weather-wise, or other-wise. Now, however, the expenditure being on the *wrong* side of the five millions, we will just quietly recommend our worthy friends, on a similar occasion, to remember the honest advice of the parson, "We are all very smart at finding out the handspikes in other people's eyes, but we don't say much about the capstan bars in our own."

The enormous price paid for the land we have before given some idea of, and this system of robbery is not confined to one part of the country or another, but seems general. The following remarks, from the *Railway Times*, will amply bear out this opinion. "The extortionate claims of land-holders for compensation, in respect of property required by railway companies, have again and again been animadverted upon by us, as any attempt more glaring than usual chanced to

come to light. The subject is one to which the press ought frequently to recur,—as being the only means of shaming these wholesale plunderers into a more honest course.

“The extent to which the system has been carried is scarcely credible. We have had the curiosity to cast up the total amount of claim and award, in a dozen cases lately decided on by juries, and find, that while the sum of the former falls little short of 100,000*l.*, the latter scarcely reaches 20,000*l.*, or about one-fifth of the modest demands made on the companies! In individual instances the disproportion is still more striking, in the sum received being, to the sum sued for, as one to seven, eight, or nine! Whence arises this vast discrepancy? Juries, if they have any leaning at all, invariably lean to the side of a private individual, rather than to that of a public corporation; and show a disposition (a very excusable feeling, by-the-way,) to give the most ample compensation, that honesty and justice will allow, for injuries done to private property, even when those injuries are in a great measure imaginary. To what, then, if not to barefaced attempts at extortion, are the extravagant sums, claimed by the owners of property required for railway purposes, to be ascribed?”

“It has long been a most convenient and peace-preserving practice, to discriminate between the public and private characters of certain eminent individuals,—to denounce a man, for example, as the most corrupt and venal of politicians, and, in the same breath, laud him as the most estimable and exemplary of mortals in private life. Probably, the gentlemen land-holders imagine, that some such distinction will be observed in their case, and that they will be looked upon as altogether incapable of over-reaching their neighbours, although they omit no opportunity of picking the pockets of railway companies, as far as the law will permit. For our own part, we acknowledge no nice distinctions of this kind, and scruple not to call that man an extortioner, who seeks to use his own power, and to call in the omnipotence of the law, to drive a bargain which he *knows* to be unjust, whether the party with whom he deals be a private individual, or a public body. It is fitting that all cases of the kind be placed on record, that posterity may know who the men were who did their best to crush the railway system in its birth, by a series of attacks hitherto unprecedented, upon

the purses of its promoters. In that *black* list will be found the names of not a few who would feel highly indignant were their *piety* or their *patriotism* called in question, but who, nevertheless, have not scrupled to make claims, and to bring forward others to substantiate them on oath, knowing all the time, that these claims were most grossly and flagrantly unjust. Nor are the cases which have come before the public a tithe of those which are fairly within the description of extortionate; every advantage, even the meanest and most despicable that low cunning could suggest, has been taken of the difficulties in which companies have been placed, to swell, by private agreement, the rapacious demands of these land sharks, and, in too many instances, they have been successful."

Hear also what the Irish railway commissioners say on the same subject:—"It is notorious that the consent of men of great influence has frequently been obtained, as a matter of policy, by agreements to pay amounts totally out of proportion to the value of the land or premises required, and when the assents of individuals will preclude the necessity of recurring again to Parliament, as in some cases of proposed deviation, the matter to be considered is sometimes a calculation, not of the real value of the required property, but of the amount which the undertakers of the measure can afford to pay in preference to applying for an amended bill. Occasionally, even the alternative has proved so onerous, that it has been judged better to abandon altogether a useful improvement."—"To make the assent of proprietors necessary for obtaining the power to establish one of these great undertakings, is in reality to abandon the high principle that private rights (liberally paid for) must give way to great public interests. The purpose which this formality is most usually made to have at the present time, is to enhance, by pretended dissent, the amount of compensation; many a dissent being purchased off by what can only be denominated a bribe."

"The bill is presented to Parliament, and if it be strenuously opposed, particularly by a rival company, then commences the rich harvest of counsel, solicitors, engineers, and persons summoned and retained in London for the purpose of giving evidence; discussions are entered into respecting every professional matter connected with

railways, the principles of curves, and gradients; of friction and gravity, are investigated; questions on which, in many cases, the counsel, the witnesses, and the court, are all equally ignorant. Then a formal effort may be made, and perhaps with success, to reject a measure after an expenditure of tens of thousands of pounds, not on account of some very essential grounds of objection, but frequently for some such trivial cause as that notice to the proprietor of a small piece of waste land was left at No. 23 instead of No. 24 in a given street. Thus a project, though possibly of great value (for that does not alter the case), may be defeated for two or three sessions of Parliament, having the whole to recommence each time." "After the Company has once battled its way, at an enormous expense, through Parliament, it has still to contend, under many disadvantages, with the landed proprietors and others, to whom compensation is to be made; after which it has its own way, and is in a condition to make reprisals upon the public for all these unnecessary delays and vexations."

These hardships and robberies are so truly and graphically described, that we could almost imagine the eloquent writers had been behind the scenes in company with ourselves, and that they had in view the 72,868*l.* 13*s.* 10*d.*, the memorable

"Payment for obtaining the Act of Incorporation,"

and the 630,000*l.* for land, and "compensation," coming from the London and Birmingham Railway Company, as part of the price at which they were allowed to commence one of the greatest public works every yet undertaken in the world; but, alas! we know other burnt children too. Things are managed better than this on the other side of the Atlantic; there, juries have awarded payments *to* railway companies *from* landholders, when the road has been carried through their property.

Notwithstanding the many untoward circumstances which have beset the path of this gigantic enterprise, it has gone on with steady perseverance, till the object has been achieved in spite of every difficulty. At the last meeting of the proprietors, in August, 1838, it was admitted that it must cost at least five millions, whereas the Company had no power to raise more than four and a half millions, till

they could again apply to Parliament. The effect of this announcement was, that without any appeal to the public for loans, the half million was subscribed for by the directors, proprietors, &c., in about two days, and tenders for a million more have been offered and refused, simply on the credit of the undertaking, and without any other guarantee.

Large as the outlay must eventually be, that on common roads will, in some cases, present a tolerable approximation, for they are iron roads to a more considerable extent than is generally supposed.

A stage coach horse wears out 4 lbs. per lunar month from off his shoes, and a wagon horse 4,8 lbs.; the former travels about 270 miles in that time, at ten miles per hour, and the latter twenty-six miles per day, and four days per week, or 416 miles, at two miles and three quarters per hour; taking each and all upon an average, and it is known that the proportion of loss was just ten times as great twenty years ago. The tires of a wagon which went 6,048 miles in five months lost 309 lbs., and a set of stage coach tires are worn out in travelling from 1500 to 2500 miles, losing 210 lbs. now, and formerly double that quantity; this, and all other repairs, including the hire of the coach, were formerly contracted for at sixpence per double mile, but they are done now for twopence-halfpenny—a set of four coach tires weigh one with the other about 240 lbs. new, and 30 lbs. when worn out; they were formerly only five-eighths of an inch in thickness, but are now seven-eighths: the contractors always replace them quick enough in order to run no risk.

The number of four-horse coaches which would have been required to carry all the traffic, for short and long distances, on the direct roads between London and Birmingham, reduced to a distance of 110 miles, would be about eighty per day one way. The number in 1832 was exactly seventy-five. In the same way the equivalent number of vans would be five, of wagons ten, and of market carts twenty-six. None of these are at all connected with farming; if we, therefore, double the two latter quantities for the farm carriage, we shall have, as a general equivalent, for the long and short distances,

80 four-horse coaches,	20 five-horse wagons,
5 two-horse vans,	52 one-horse carts.

making each one journey of 110 miles per day; and from the data we have given above, which is taken partly from evidence laid before the House of Commons, and partly from the statements of the actual contractors, it may be found that, in the last fifty years, there has been deposited on the direct roads between Birmingham and London the enormous quantity of 47,616 tons of iron, while the whole of the rails, chairs, and spikes on the London and Birmingham Railway only weigh about 35,000 tons, including those in the stations.

We have no means of ascertaining whether these latter articles will last fifty years, although a late writer on the subject informs the world that a rail one inch thick in the head, and wearing away one-eighty-fourth of an inch per annum, will *consequently* last eighty-four years! We suspect the said head would have rather an unique appearance towards the latter end of December in the eighty-third year, and perhaps a little sooner.

The Grand Junction Railway Company's station, in Curzon Street, is now finished, and the trains which arrive by the London and Birmingham Railway, in the latter town, run into the Grand Junction station, where those passengers who are going forward to Liverpool, Manchester, &c., are put down in readiness for the next train, which is arranged to start after allowing a reasonable time for refreshments. In like manner, the Grand Junction trains from Liverpool and Manchester run into the London and Birmingham station, where the passengers for London are forwarded with a similar attention to speed and convenience. Both these stations were built by those enterprising contractors Messrs. Grissell and Peto, of London.

While on the subjects of convenience and comfort, we may just observe, that although more remains to be done in these respects, we ought in fact to say, much more; yet we have arrived, at all events, so far towards perfection at present, in railway travelling, that Ladies can be readily accommodated, under even *extraordinary* circumstances, as it appears was done on the Paisley railway, where on a late occasion, soon after a train had started, the passengers were much alarmed by the guard calling out to the engine man to stop the carriages immediately, for "some person is in ——;" the order was so quickly attended to, that the last word was lost amidst the unmusical sound of the brakes;



but the alarm continued, as the guard kept running to every carriage asking for a surgeon; dreading that some serious accident had occurred, many persons alighted to enquire what was wrong; they were however very agreeably disappointed, to find that it was merely an additional passenger, who had no ticket, raising up its voice in the most approved manner, on its first introduction to the world. This could by no means be called a *mis*-carriage, because first of all, both mother and infant were found to be doing *as well as could be expected*, and secondly because the intruder was a young gentleman. There is no doubt but that the printed regulations of the Company would clearly define what his fare ought to be, but to correctly ascertain his parish, would most probably be a matter of somewhat greater difficulty.

Such comforts as the above, were but little thought of when the outcries were first risen against railways, several years ago; the tirades which were then issued against the system, were quite ludicrous enough certainly, and were happily taken off in the following sketch, which appeared in an American New York paper, about the time of their first introduction in that country—we have heard much worse arguments seriously put forth in England against their adoption;—A canal proprietor is supposed to speak.—

“I see what will be the effect of it,—all the whole world will be set a gadding,—twenty miles an hour, sir,—why you will not be able to keep a single 'prentice boy at his work,—every Saturday evening he must take a trip to Ohio, to spend the Sunday with his sweetheart,—grave plodding citizens will be flying about like comets,—all local attachments must be at an end, and not only that, but it must encourage flightiness of intellect; and all kinds of people, will, in spite of themselves, be turned into immeasurable liars,—their very conceptions will be exaggerated by their munificent notions of distance—‘Only a hundred miles off, my dear madam! I'll step for your fan, and have it here in one minute.’—‘Pray, sir, will you dine with me to-day at my neat little box at Alleghany?’ ‘Why, indeed, I don't know. Let us see, I shall be in time for the railroad. Very well, I'll come; but you must let me off in time to be back for the theatre.’ And then, sir, there will be barrels of pork, and chaldrons of coals, and cargoes of flour, ay, and even lead and whiskey, and such like

sober things that have always been used to decent travelling—running away like a set of mad skyrockets. It will upset the whole gravity of the nation. And then, sir, think of flying for debt!—a set of bum bailiffs, if even mounted on bomb shells, will stand no chance whatever of capturing an absconded debtor, only give him a fair start. The whole thing is a pestilential, topsy-turvy, harum scarum, whirligig. Give me the old, solemn, straight-forward regular, Dutch Canal, three miles an hour for expresses, and two for quick business-like journies, with a yoke of oxen for a heavy load. None of your hop, skip, and jump whimsies for me. I go for beasts of burden—it is more primitive and scriptural, and suits a moral and religious people like us far beyond all this teakettle nonsense.”

It is all very well to laugh at these things now, when the fight is over and the battle won, but when we remember the obstacles thrown, and thrown successfully, in the way of these great improvements,—the falsehoods, the ribaldry, the corruption and bribery, together with the other foul manoeuvres which were set to work, only seven years ago, in the case of the London and Birmingham Railway, and by which, after all the evidence which could by any possibility, be required, the bill, for enabling this great work to be constructed, was thrown out by a committee of our hereditary legislators; we confess our faces ought rather to wear the contour of Heraclitus than that of Democritus, especially as we have also to recollect, that on the fate of this bill, in all probability, depended, for some time to come, that of such works in general,—especially long lines.

The Liverpool and Manchester Railway had, in all conscience, hard fighting enough, before they were allowed to answer the question for posterity—are railways useful and advantageous or not? When they had, to the admiration of the world, triumphantly resolved this question in the affirmative, the oponents of the “abominable innovation,” as it was called, directly shifted their ground, and grave and learned counsellors in the law, were readily at hand, who, notwithstanding they were receiving fees, on the same day, for arguing in favour of as well as against railways, both in general and particular, and, in at least one instance, fee’d first, by the oponents of a great company, to declare such works were utterly uncalled-for, and after-

wards fee'd by the same company, to show cause, of course, that there was nothing like railways and leather—were ready to declare, and did declare, and there were hereditary legislators who listened, and agreed with them, that the proposition of a railway from London to Birmingham was absurd, was monstrous, that it savoured of nothing but an indirect species of insanity—that because a railway had been constructed under the most particular and peculiar local circumstances, between such towns as Liverpool and Manchester, where the existing state of traffic was such as could be found between no other two towns in England—that, therefore, a railway between London and Birmingham, places between which nothing but the most ordinary, every-day, “Dutch canal express-boat at three miles an hour” communication could, by any possibility, be required, was, in fact, equivalent to—as our friend from the other side of the Atlantic wittily observed—running the risk of converting, in spite of themselves, the whole people of the country into “immeasurable liars.” Alas, that such things should exist! but it is so; “the wisdom *lies* in the wig.”

Where the Irish railway commissioners picked up the straggling embellishments, adorning their second report, we know not, but they do contain a number of home truths;—for instance, when they refer to opposition being got up against railway companies, for the entire and sole purpose of being bought off, their admirable description can only have been based on a knowledge of facts.

For instance, after all the decided hostility paraded against the bill for the London and Birmingham Railway, and the witnesses examined as to the utter uselessness and inefficiency of such an undertaking, at least as a matter of profit to the shareholders, and after all the iniquitous loss and damage which such a mad-brained project was to inflict on the line of country through which it was to pass; and this was, by one well-fee'd speaker, (the wisdom again *lie-ing* in the wig,) compared to hardly anything short of an earthquake; and, although the opposition to the measure was of course made on public grounds, with only a *very little* private interest in the matter—a mere modicum—what was the upshot of all this public-spirited feeling, this patriotism, this unheard-of loving-kindness for the “country,” under the heroic influence of which they had fought so many hard hours, by Tewks-

bury clock," and with just exactly as much truth as Falstaff did.

This is one result:—a distinct proposition was made, from these very same public-spirited people, to the directors of the London and Birmingham Railway Company, offering that, if they (the company) would pay their opponents the small sum of 10,000*l.*, the opposition should be withdrawn! The directors indignantly scouted such a disgraceful transaction, and, in consequence of their honesty, they lost their bill.

We will give one more little occurrence which distinguished the period about which we are now writing, and but one,—not that we want more, nor that we want many more; we have a certain brown-covered memorandum-book, tolerably well known to our friends, which contains a *few* trifling additions, which may be had when they are "wanted," like YORK was. A person who spoke of himself as an accredited agent from influential parties, rode in a certain stage-coach with us, not a very long time after the London and Birmingham Railway Bill was lost, and the conversation happened to turn on that subject, our companion interested us not a little, as he evidently knew intimately some of the tactics of the Company, which were of that description generally considered confidential. What particularly struck us was, his assertion, repeated several times, that the bill was lost entirely through not taking his advice; that he both could and did show the directors how it might have been gained to a certainty; that his opinion was not a mere conjecture, but amounted to a positive matter of fact, of which he had laid before the directors the absolute proof; but they had refused to act according to the advice which he had thus given them, and which would have conduced so much to their interests, and that of the proprietors at large, and that they had consequently nobody to thank but themselves.

Our conversation with this person extended to a considerable length, but the above extract from the notes we made at the time, is sufficient for our present purpose, which is to state, that an agent answering the description of our above fellow passenger, did offer to the directors to secure them six or seven votes, in the very place were they were ultimately found to be wanted, and that for this essential piece of service, he only required to have previously placed in his hands, the small

sum of a few thousand pounds. We need hardly add the proposition was rejected with well merited scorn; and thus through common honesty, the bill was, very probably, a second time lost. We know the name of the person who made the above offer to the directors; but we do not know the name of our stage coach companion, consequently we are unable to state whether they are one and the same; we have given facts, and that is all our business in the matter.

Now the railway is made, we have a right to amuse ourselves with some of the speculations which appeared in print some seven years ago; when in the midst of public meetings held by the nobility and gentry, unanimously voting that railways were wholly unnecessary; and particularly between London and Birmingham, and after a due comparison with animal magnetism, metallic tractors, St. John Long, Bedlam, &c. we find the cost of that work stated at 7,793,727*l.*, there are no shillings, pence, or farthings. In this sum, after purchasing the land, making the railway, including ballasting, and paying for the blocks and rails, there is a small item of only 3,069,887*l.*, for "Machinery and all other costs;" for 70 miles out of the 112 which compose the line; and this is stated to be calculated "on the most legitimate deductions, from the best existing data," and as "altogether independent of some other contingencies."

The returns are then stated at 131,670*l.* per annum less than the yearly expenses; "thus upon the most favourable view that it is possible to take of the railway between London and Birmingham, that is, granting the Company *all* the trade, they must *in spite of any effort they can make*, much more in spite of any words that they can utter, borrow 130,000*l.* the first year, in order to pay the interest on their capital; they must borrow 136,000*l.* the second year, and at the end of fifteen years, they would have the pleasant prospect of a debt of fifteen millions; give them time and it would creep up and up, till it exceeded the national debt."

Our author then astonished at his own liberality, in merely saddling the Company with a debt of some 800 millions, declares that the view he has taken of the case is "much too favourable to be possible" and "we must now," he says "examine what would be the expectation of rational men;" before he begins his rational reform, however, he just

quietly let us know, that "if the nine figures of arithmetic be faithful to their forms, a tunnel from Birmingham to Mexico has a chance of being completed in the same year as this Railway;" after which we have it in black and white printers' ink, that the Railway travelling is to be "absolutely slower than the coaches," and that "a velocity of fifteen miles an hour is in itself a great source of danger." At the inclement season of the year it will follow, of course, that we shall frequently receive the intelligence, communicated by the witty editor of a London newspaper—"the mails can't get in, to the delight of Miss Martineau."

"Commercial travellers," he informs us, (doubtless from "the most legitimate deductions,") "would, as a matter of course, never by any chance go by the railroad, and the occasional traveller, who went the same route for pleasure, would go by the coach road also."—"Not one of the nobility, or gentry, or those who travel in their own carriages, would, by any chance, go by the railway."—"Even if a man had no carriage of his own, what inducement could he have to take so ungainly a conveyance?"—Hence, "one-fourth of the passengers would never go by the railway;" nor "one-third of the goods;" and scarcely a "nameable fraction of the intermediate trade."

Then comes his rationality proposition, which is also to be "extravagantly liberal." This consists in showing, (of course, if the nine figures of arithmetic be faithful to their forms,) that instead of the income being only 130,000*l.* per annum less than the working expenses, it must be 258,220*l.* less, or that the railway will be "losing a quarter of a million a year," and this is in all probability still too favorable, for none but "the solitary stranger who had nobody to tell him better, would go swinging at the tail of an engine."

He appears to have at one time intended to be both "serious" and "learned," on the "mischief that this railway, if executed, would produce to the country," but "as the execution appears to us an utter impossibility, we deem that unnecessary;" we should have considered this as tantamount to an admission, that he had been laughing at his readers, and making a fool of himself, all through the preceding parts of his publication, but he winds up by recommending the "facts and arguments" contained in his pages, "to the solemn and patient exa-

mination of those who, like ourselves, wish well to the interests of Old England." We think this comes up to, if it does not beat, brother Jonathan's Dutch canal.

We must now draw to a conclusion, and shall only notice another singular mistake which Mr. Roscoe has been led into, viz., that the expense of the stone blocks for "the whole line," may be divided into three parts, one of which is for freight to the Thames. The blocks on the Birmingham half of the line, ought not to have been accused of this iniquity, they are totally guiltless of having been freighted into the Thames, and the directors at that end of the Railway, would have strangely misused the Company's money, if they had purchased their blocks in places where they would have had to travel by that route, while the quarries of Derbyshire were close at their hand.

## LONDON AND BIRMINGHAM LOCOMOTIVE ENGINES.

LOCOMOTIVE ENGINES are matters of such interest at the present day that almost every person must be anxious to understand some little about them; we have, therefore, written the following matter as an Appendix to our History of the London and Birmingham Railway.

We have no space to enter into any enlarged statement respecting the engines used on this line, although much might be said on that subject which is not to be found in print up to the present time; but we shall give a short and popular account of their general features and construction, so as to enable every one to comprehend the use of their various parts; at any rate, as they appear externally. If any of our readers wish to follow our description, they will find the departure stage at Birmingham the best place for examining the engines; for which purpose, however, they must not leave the stage without permission. They do not accompany the carriages to the terminus at the London end of the railway, the trains descending from the Camden Town to the Euston square station, by the effect of gravity. The Wolverton station will also afford a similar opportunity.

The external appearance of the body of the engine may be divided into three parts, which may be called the fire box, the smoke box, and the boiler; which last connects the former two. In the domed part is the fire box, which almost entirely occupies the whole space from a few inches above the door, which opens out on the platform on which the engine-man stands, down nearly to the bottom, where there is a small space occupied by the grate. The fire box is encompassed both on the top and round the sides by water, except at the part where the door is fixed, this water communicates with that in the boiler. A plug of lead  $\frac{3}{4}$  and tin  $\frac{1}{4}$ , fusible at a dangerous heat, is placed on the top of the fire box; this melts if the water is let so low as to leave the head of the fire box dry, and the steam then rushes into the furnace. The part of the engine between the smoke box and the dome is entirely taken up with the boiler; of which all the upper part of the dome also forms a portion; it is filled with water up to about half way between the top of the fire box and the axis of the regulator. The handle of the regulator is seen about a foot above the door of the fire box. It is by this handle that the passage of the steam to the cylinders is opened and shut. The boiler is cased with wood, to prevent, as much as possible, the radiation of heat, and conse-



quent loss of fuel in maintaining the steam at its requisite pressure, which is about 50 lbs. on the square inch.

That part of the boiler which is above the top of the fire box is an entirely open space, but the lower half of the boiler has, between the upper and back part of the fire box and the nearest plate of the chimney end, about 86 tubes 2 inches in diameter running through it, one end of them opening into the fire box, and the other end into that compartment of the engine called the smoke box; this is the circular headed box painted black, from the middle of which the shaft of the chimney takes its rise. These tubes form one of the most essential requisites to the success of the modern locomotive engines, they are surrounded entirely by the water in the boiler, and the flame and heated air from the fire box being forced to go through them, there being no other passage to the chimney, they expose so great a surface to the action of the heat, that steam is generated in a very rapid manner; although, in the first instance, it takes nearly two hours after the fire is lighted before the steam is properly up, there being very little draft to inflame such a fuel as coke, while the engine is standing still.

In the upper part of the boiler, which, above the water, forms the steam chamber, is the horizontal pipe which conveys the steam to the cylinders, by means of a vertical pipe attached to the horizontal one, immediately under the centre of the dome, and open at the upper end. This pipe rises nearly to the top of the highest part in the centre of the dome, in order to prevent the bubbling or jolting of the engine throwing the water into the steam pipe. It is up at the top of this vertical pipe that the steam is admitted by means of the regulator, which consists in some engines of two circular discs, with apertures in them, one being fixed and the other turning round, by means of the handle outside the engine, the effect of which is that the apertures are brought either opposite to each other, admitting the whole force of the steam, or placed one by the side of the other, in which position no steam can pass; or they may vary the passage to any degree required, between these two limits. In other engines a cock, instead of discs, is used for the same purpose, and in those on the London and Birmingham line the effect is produced by a screw valve, on the smoke box side of the vertical pipe; in either case the handle of the regulator is that which completely controls the admission of steam, according to the quantity which the handle is turned round.

The smoke box contains the cylinders, one end of these may be seen in the front of the engines, nearly behind the wooden framing, with the oil cups and cocks for admitting oil into them; it also holds the slide valves, by which the steam is allowed to enter the cylinders, the steam supply pipe, and the steam exit pipe; also a small pipe for conveying condensed water out of the cylinders. There is a passage in the smoke box completely round

the cylinders, by which means, when the engine is at work, the heated air and ashes can encompass them in every part to keep them hot; when the engine stands still, this takes place but in a very small degree, through there being then but little draft, and a partial condensation of the steam is the consequence; this enters the small pipe above mentioned, and runs off at a cock in the front of the engine, below the framing; the iron handle of which is to be seen just above the framing. This cock is kept open as long as possible, its handle then pointing directly forward from the engine; and just before the train starts the engine man shuts it, the handle then is across the engine. A large door, surrounded with a brass frame in the front of the engine, can be opened when required, in order to allow the workmen to take to pieces or repair the parts inside the smoke box; and a smaller door in the larger one, being only latched, can be opened at any time, for the purpose of examining the interior.

The steam is admitted in and out of the cylinders by what are called slide valves, which are fitted to each; these valves are worked by a pair of rods attached to eccentrics fixed on the axle, and when the engine is required to go backwards, another pair of eccentrics, also on the axle, are set in motion; by these means the slide valves are drawn backwards and forwards; the action of these rods may be seen at the back part of the smoke box. When the valves are placed in their first position, the steam is admitted at one end of the cylinder and on one side of the piston, while at the same time the way is opened for it to get out from the other end. When the valve moves to the opposite position it reverses this—namely, it shuts the two former passages, and opens two others, letting the steam in and out of the cylinder at the opposite ends respectively to what it did before, its entrance being, of course, on the contrary side of the piston. There are in reality but three passages to each cylinder, two for the entrance of the steam, and one which, by the motion of the slide valve, answers the double purpose of allowing it to escape from either end of the cylinder.

Under the boiler will also be seen the piston rod working in and out of the cylinder; being attached to the piston at one end, and joined to the crank axle by the connecting rod at the other; it is this which gives motion to the engine. The small brass dome towards the chimney end of the boiler contains a safety valve, locked up from the engine man. On the top of the dome, over the fire box, is another which he regulates at pleasure. The long arm of the lever of this is  $17\frac{1}{2}$  inches, the short  $4\frac{1}{2}$ , and the valve has a diameter of  $2\frac{3}{8}$  inches at the bottom, the shape being conical. The spring balance attached to the end of the lever of the safety valve, may by means of the screw at the top, be regulated to let off the steam at any point up to 60 lbs. per square inch; and it is generally worked at 50 lbs. Between the safety valve and the balance, on the top of the dome, is the steam whistle, for warning the workmen on the

road and others that the engine is approaching. This upper and small part of the dome, covers what is called the man hole, from its size just admitting a man to get in to clean and repair the interior of the boiler or the works within it.

On the left hand side of the dome is the water guage, composed of a glass tube communicating with the water and steam in the boiler; it has three cocks, two between the glass tube and the dome, and one at the bottom of the glass tube. When this lower one is shut and the other two opened, the water enters the tube through the lower of these two cocks, and the steam through the upper. The water then stands in the glass tube at the same height as it does in the boiler, and can be constantly examined by the engine man; the use of the third cock, at the bottom of the tube, is to empty it by when required. Near the water guage are three other brass cocks, in a slanting direction, one above the other; these, which are called the guage cocks, all communicate with the boiler, and afford an additional means of examining the quantity of water in it, by opening them and noting whether water or steam comes out. The water should on no account ever be allowed to get below the head of the fire box, not only because less steam would be generated, but also that the head of the fire box would be injured by the heat.

On each side of the dome, close down to the platform, is a brass handle, turning an iron rod, which opens and shuts what is called the pet cock, this is connected with the force pump by which the boiler is filled; these pumps are worked by the straight part of the piston rod, not far from the cylinder, their plungers being the outside moving part on each side at that end of the engine; they are, of course, always at work when the engines are going, but water is only admitted to them when the boiler requires it; this is regulated by a cock to each supply pipe from the tender, the iron lever handles of which may be seen on the top and front of the tender, one on each side. The copper tubes seen under the engine and tender, form the communication by which the water is conveyed to the pumps; and the two tubes, when the tender is attached to the engines, are connected by a third, which is flexible. The use of the pet cock is to inform the engine man whether the force pumps are in order; if this is the case when they are working, and he opens the pet cock, water instantly rushes out; if it does not, he immediately tries the other side, and if both pumps are disabled he must examine and repair them directly, or put out the fire. Near the handle of the pet cock, on the right hand side of the dome, is an iron handle close to the platform and parallel with it, this turns a brass cock under the platform, by which the water is let out of the boiler, and by which the engines are blown off; that is to say, the water forced out when the steam is up, which is done every five or six days or otherwise, according to the quality of the water, to clean the boiler.

On the right hand side of the dome, just above the pet cock, is an iron lever

handle, which, by means of a long rod attached to it, throws the eccentrics off the connection which they have with the slide valves; the cylinders are then no longer supplied with steam, and the engine if left to herself would gradually lose her velocity, and come to a stand still; this effect is produced by putting the handle in the middle of the sliding arc against which it moves, when it is put to the top of the arc, the eccentrics are thereby so disposed that the engine goes backwards; and when it is put to the bottom, the engine on the contrary, will go forward; a notch in the iron arc retains it in either of these two latter positions. These handles are made to act directly opposite to this by some manufacturers, the position of them being purely a matter of choice. When the eccentrics are put out of connection with the slides, or out of gear as it is technically termed, the engine may then be worked by the two long upright handles, above that which has just been described, which will move the slides at the will of the engine man; so that if the eccentrics or their rods are completely broken, the engine can still go on; and it is by these handles, technically called the head gear, that the engine is moved very small distances, as they can be regulated better for that purpose than the eccentrics can be; they also admit the steam with an impulse, by being pulled quick, whereas the motion of the eccentrics is slower; some makers, however, dispense with these.

Underneath the fire box is the ash pit, this forms the lowest portion of the dome, it is open to the whole front of the engine, and closed at the bottom, sides, and back, except where the door is seen. The fire bars in the bottom of the fire box, run quite across the box, and are in separate divisions, with about six or seven bars in each; these can be taken in and out, and when the fire is required to be suddenly extinguished, the engine man, by turning the iron turn handle close to the top of the door of the ash pit, can trip them out so that the fire and the bars fall into the road.

The various parts of the machinery are generally oiled by means of brass cups, having a small tube running from nearly the top of the interior of the cup through the bottom, down close to the part to be oiled; in this tube is a cotton wick, the lower end of which communicates with the part to be oiled, and the upper end hangs over the top of the tube into the oil in the cup, and thus forms a syphon for conveying the oil in small and equal quantities to the part which requires it; other makers do this by cocks and pipes, leading to the various points from a common receptacle. In the front of the engine, extending close down to the rails, is a guard iron, which is fixed there for the purpose of clearing the rails of any thing laid on them, either through carelessness or wilfulness; this is a most useful contrivance, and has prevented serious accidents on more than one occasion; for instance, on the 1st of October, 1838, one of the engines on her arrival with the train at Birmingham, was found to have this iron on one side wrenched round, in a manner which

could only have happened by its coming in contact with some very hard substance, in all probability purposely laid on the rails.

The tender which carries the supplies of coke and water needs no particular description, it has a brake attached to it, for checking the speed, the long handle of this may be seen on the right hand side. The supply of coke carried in the tender is about 21 cwt., and of water about 700 gallons. The engine consumes at about the following rate—water, 1400 gallons per 70 miles—coke, if good, about 14 cwt. for the same distance; but the quantity of coke depends on its quality and the weight of the load, and the quantity of water depends also on the weight of the load.

A SKETCH OF  
THE GEOLOGICAL FEATURES OF THE LINE.



THE science of geology would be often materially assisted, if the railway companies were to correctly ascertain, and publish, the nature of all the various material through which their excavations are made. This can only be done while the works are proceeding, as the slopes ought to be turfed as speedily as possible, in order to assist in preventing slips. We have collected the following account of the strata on the London and Birmingham line, from information arising out of the various surveys, borings, &c.; and, although it is not so full nor so perfect as we could wish, we offer it, as an example, with the hope of inciting persons connected with other lines to present to the public more enlarged and complete accounts of their respective works.

We shall commence at the London end, from which, the first 13 miles runs through the London clay, a very bad material for any kind of engineering operations. There is much diversity of opinion about the slope at which it will stand, for on the Southampton railway embankments made of it are formed with one base to one perpendicular; several of these, however, have slipped.

0	}	London clay.	
to			
13			
14½ mile trial shaft,	Yellowish Clay . . . .	3 feet.	
	Darkish Clay . . . .	18	
	Yellowish sandy Loam . .	5	
	Black Clay . . . . .	7	

15 $\frac{1}{8}$ mile trial shaft, Rubble . . . . .	4 feet.
Clay . . . . .	8
Blue Clay . . . . .	8 $\frac{1}{2}$
Chalk and Marl . . . . .	7
16 $\frac{1}{2}$ mile.	Chalk quarry.

The chalk formations, the upper part containing flints and the lower without, extends from the above quarry to 34 $\frac{1}{8}$  miles from London. Watford Tunnel is in the upper formation, with a thick irregular covering of gravel; this part of the chalk has occasional fissures, as much as 100 feet deep, filled with clean gravel, which, when worked into, rushed down with such violence, as to plough the walls of the tunnel as if bullets had been shot against it.

34 $\frac{1}{8}$  miles. Chalk Marl and Green sand.

39 miles. Iron Sand formation, consisting of ferruginous sand and sand-stone.

41 $\frac{1}{8}$  miles. Oxford Clay formation.

44 $\frac{1}{8}$  miles, trial shaft. Blue clay mixed with chalk fragments, 28 feet; query, if not diluvial?

45 $\frac{1}{4}$  miles, trial shaft, Blue Clay, 18 feet.

From 41 $\frac{1}{8}$  to 53 $\frac{1}{2}$  miles is principally the Oxford or Clunch clay, consisting chiefly of beds of grey, blue, and black shale, nearly destitute of water.

48 $\frac{1}{4}$  miles, trial shaft, Brownish-yellow clay, with fragments of chalk, 13 feet. Grey, blue, and blackish clay 17 feet.

The material was proved here, by a well at Denbigh Hall, to 70 feet below the above, and was without water.

52 miles, trial shaft, Mixed Brown earth . . . . . 16 feet  
Dark Brown clay . . . . . 29

52 $\frac{1}{8}$  to 53 $\frac{1}{8}$  from 7 to 10 feet of yellow and blue clay.

53 $\frac{1}{4}$  miles. The upper part of the great Oolite formation is considered to commence here, and to extend to 61 $\frac{7}{8}$  miles.

59 miles. This excavation contains,—

Soil and loose stones . . . . .	3 feet.
Yellow lime stone . . . . .	11

Ditto ditto . . . . .	6½ feet.
Blue shale, getting very hard . . . . .	10½
Ditto no water, . . . . .	17

59½ miles. This excavation contains,—

Gravel and soil . . . . .	4 feet.
Yellow limestone . . . . .	5½
Blue shale . . . . .	13½
Blue rock . . . . .	1½
No water.	

We now come to the large cutting, and the general features of this consist in beds of clay, from the surface downwards; laying in a basin formed by the rock, which dips from the surface, at each end of the cutting, towards the centre, where it reaches the bottom of the excavation; under the rock is blue shale, and the details of the whole cutting are as follows,—

59½ to 60½ miles.

Sand and Loam . . . . .	5 feet.
Clay . . . . .	2
Yellow limestone . . . . .	14
Blue do., very hard, mixed with thin beds of shale . . . . .	13
Blue shale . . . . .	5
Very little water 1 foot lower . . . . .	8

60½ to 60¾ miles.

Soil and clay . . . . .	2 feet.
Stoney yellow clay . . . . .	9
Blue clay . . . . .	14
Yellow limestone . . . . .	16
Soft do. and some water . . . . .	1½
Hard do. . . . .	¾
Blue shale . . . . .	¾
Blue limestone, very hard . . . . .	2
Blue shale and sand vein . . . . .	2
Stronger shale . . . . .	1½
Very hard blue limestone rock . . . . .	4½
Strong blue shale . . . . .	4½



61 miles.

Sand and loose stones . . . . .	3 feet.
Yellow limestone . . . . .	13
Soft do. . . . .	$\frac{1}{2}$
Yellow limestone . . . . .	2
Strong brown clay . . . . .	4
Yellow limestone with a 3-inch parting, a little water . . . . .	4
Blue shale . . . . .	$14\frac{1}{2}$
Very hard blue limestone, with a soft 3-inch parting . . . . .	$6\frac{1}{2}$
Very dark blue shale . . . . .	$2\frac{1}{2}$
Brown sandy loam; water below.	4
Rather soft greenish stone with hard beds . . . . .	$3\frac{1}{2}$
Green rock . . . . .	$1\frac{1}{2}$
Blue shale . . . . .	$\frac{1}{2}$

61 $\frac{1}{4}$  miles.

Loose shivery limestone . . . . .	$2\frac{3}{4}$ feet.
Yellow marl . . . . .	$1\frac{1}{2}$
Shivery limestone . . . . .	$1\frac{1}{2}$
Limestone . . . . .	8
Yellow marl . . . . .	7

This ends the Blisworth large excavation.

61 $\frac{7}{8}$  to 61 $\frac{9}{8}$  miles. Ferruginous sandy marl.61 $\frac{9}{8}$  to 64 $\frac{3}{8}$  miles. Fullers' earth bed of the inferior Oolite.64 $\frac{3}{8}$  to 66 $\frac{1}{8}$  miles. Marl-stone and shale, forming the fullers' earth bed of the inferior Oolite, with an irregular bed of limestone.66 $\frac{1}{2}$  to 69 $\frac{1}{2}$  miles. A bed of calcareous sand-stone, in a thick shale strata, from 15 to 20 feet above the level of the canal. Stowe Hill Tunnel was altogether through shale, and perfectly dry.69 $\frac{1}{2}$  to 71 $\frac{1}{2}$  miles, Inferior Oolite and Marly Sandstone, with thick beds of Gravel and Sand.71 $\frac{1}{2}$  to 86 miles, Generally the upper Shales of the Lias formation.

71½ miles, A line of Springs about this part, considered to issue from the top of the Lias beds.

73<sup>7</sup>/<sub>8</sub> miles, Sand Hill in Lord Spencer's property.

76½ to 77¼ miles, Kilsby Tunnel. The top of this hill is considered to be formed of the lower beds of the Inferior Oolite, consisting of alternate beds of Rock and Marle, and passing into the Lias formation. The strata at the London end consists of,

Soil . . . .	2½ feet
Yellow Clay . .	5½ —
Brown Clay . .	2½ —
Blue Shale . .	17 —
Blue Marl . .	19 —

The Birmingham end consists of Soil 5½ feet, of Yellowish Clay 9, of Blue Shale 6½, of Brown Iron Stone 1¼, of Blue Marl, with three beds of Blue Stone 22¼.

Near the London end of the Tunnel a bed of Quicksand was found to lie in the shape of a basin, the bottom of which extended, in some cases, nearly to the springing of the arch) over a length of about 400 yards.

79½ miles, Sand Hill.

86½ miles, Lias, Limestone and shale, being from the top Blue Clay, apparently diluvial, 4 feet 9 inches; Brown Clay, with beds of Ochreous matter, 6 feet three inches; Blue Shale, in beds of 9 to 12 inches, 6 feet 6 inches; Yellow and Blue Lias Limestone, 5 feet 8 inches; Blue Shale to the bottom of cutting, about 25 feet.

87½ to 88½ miles, Lower Marl, and Shale, of the Lias formation.

88½ miles to Birmingham, the line passes through the New Red Sand Stone and Marl formations.

88½ mile stone, Soil, 2 feet; Blue Clay and Gravel, resting on Red Sand Stone, 10 feet.

- 90  $\frac{1}{2}$  miles. Very dry Sand and Gravel.
- 90  $\frac{1}{2}$  miles. Sand resting on Red Marl
- 92 miles. Clay and Sand, 8 feet; Red Clay, 11 feet;  
Strong ditto, 9 feet; Very strong and Marly,  
2 feet.
- 93  $\frac{1}{2}$  miles. Soft Yellow Sand-stone.
- 98  $\frac{1}{2}$  miles. Beechwood Tunnel.—Red Sand-stone.
- 99  $\frac{1}{2}$  miles. Sand, 2 feet; Red Clay, 10 feet; Rocky Red  
Marl, 38 feet.
- 101  $\frac{1}{2}$  miles. Sharp Gravel, forming an extensive tract in  
this valley.
- 102  $\frac{1}{2}$  miles. Blue and red Marl, dry and hard, to 70 feet.
- 103  $\frac{1}{2}$  miles. Blue Marl.
- 106 miles. Gravel and Sand.
- 107  $\frac{1}{2}$  to 109  $\frac{1}{2}$  miles. The cuttings are Red Marl, overlaid by  
Gravel.
- 110  $\frac{1}{2}$  miles. Yellowish Sand, 11 feet; Red Clay, 9 feet;  
Rocky Red Marl, with irregular beds of Blue  
Marl, 17 feet.
- 110  $\frac{1}{2}$  miles. Red Clay, 12 feet; Rocky Red Marl with  
irregular beds of Blue Marl, 28 feet.—This  
formation extends to the Birmingham terminus.



**LIST OF THE DIRECTORS OF  
THE LONDON AND BIRMINGHAM RAILWAY,**

FROM THE PASSING OF THE ACT OF INCORPORATION, TO THE  
COMPLETE OPENING OF THE LINE.

Those marked \* were in office when the Act was obtained. Those marked † were  
in office when the line was completely opened.

—◆—  
*Chairmen :*

\* Isaac Solly, Esq. † G. C. Glynn, Esq.

*Deputy Chairman :*

† J. F. Ledsam, Esq.

*Directors :*

<p>* † G. P. Barclay, Esq. * G. Bacchus, Esq., † J. B. Boothby, Esq. * † E. Calvert, Esq. * W. T. Copeland, Esq. † J. Cooke, Esq. * J. Corrie, Esq. † E. Cropper, Esq. H. Earle, Esq. J. Foster, Esq. * W. Francis, Esq. * † G. C. Glynn, Esq. * J. Gibson, Esq. † R. Garnet, Esq. * † P. St. L. Grenfell, Esq. * W. Hawkes, Esq. † D. Hodgson, Esq. † H. Holdsworth, Esq. * A. Kenrick, Esq. * J. S. Lefevre, Esq. * † J. F. Ledsam, Esq. * D. Ledsam, Esq. † T. Lowe, Esq.  * † Richard Creed, Esq.</p>	<p>* G. Larpent, Esq. * Sir W. Lubbock, Bart. * † W. Phipson, Esq. * J. Pearson, Esq. * † J. L. Prevost, Esq. * T. Price, Esq. * Edmund Peel, Esq. † T. Rathbone, Esq. * H. Rowles, Esq. * T. Smith, Esq. * C. Shaw, Esq. H. Smith, Esq. * J. Solly, Esq. * W. H. Sparrow, Esq. * † John Sturge, Esq. Joseph Sturge, Esq. * J. Turner, Esq. * † T. Tooke, Esq. * H. Warre, Esq. * † J. Walker, Esq. † E. Wilson, Esq. * A. Wilson, Esq. † T. Young, Esq.  * † Cap. C. R. Moorsom, R. N.</p>
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*Secretaries :*

## ENGINEERS.

*Engineer-in-chief:*

Robert Stephenson, Esq.

G. W. Buck.

Charles Fox,  
John Birkenshaw,  
Timothy Jenkins,  
F. Young,  
Cap. Cleather, R. S. C.

John Crossley.

S. S. Bennett,  
E. Jackson,  
J. Gandell,  
M. Farrell,

F. Forster, and  
afterwards,

H. Lee,  
E. Dixon,

G. H. Phipps.

C. Lean,

J. L. Gooch, and  
afterwards,

J. Brunton,  
S. Meek,

F. Foster.

John Reid,  
B. L. Dickenson,  
M. Montealegre,  
R. B. Dockray,  
Lieut. P. Lecount, R. N.

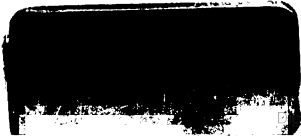












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NOTTINGHAM 1993

