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THE

RAILWAY MAGAZINE,

AND

Annals of Science:

CONTAINING

COPIOUS ACCOUNTS OF ALL RAILWAYS

AT HOME AND ABROAD;

NOTICES OF INVENTIONS, AND SCIENTIFIC DISCOVERIES.

BY JOHN HERAPATH, ESQ.

VOL. III. NEW SERIES.

LONDON:
PUBLISHED BY WYLD AND SON, CHARING-CROSS EAST;
AND SOLD BY ALL OTHER BOOKSELLERS.
1837.

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THE

RAILWAY MAGAZINE;

AND

Annals of Science.

No. XVII. JULY, 1837. New Series.

Tables for Barometric Altimetry. By the Editor.

Since the publication of my observations and theorems in No. 8, I have been repeatedly urged to give the Tables there hinted at, for determining heights by the barometer, to the public, as likely to be of very considerable utility and interest, especially as we have no Tables of the kind in the English language, or adapted to English measures, as far as I know. It certainly was my intention to reserve them for the work on the Mathematical Principles of Natural Philosophy, which I have more than once mentioned, as intended by me at some time to appear, embodying my labours in developing the causes and laws of natural phenomena, but as this time may not be just yet, I have thought it better to yield to the solicitations of my friends, and present my readers with these Tables at once. I do so the more willingly, from the great interest that is taken in the subject of Altimetry, as connected with railways and aerostation.

My opinion of the almost utter uselessness of the barometer as a means for accurate railway levelling, particularly for short distances, remains the same as I have given it in p. 297. Still, however, it may be very usefully employed in determining the elevation of distant points, and may be the means of saving considerable time and expense. If the instruments and observers are good, and the times are well chosen, it is possible too, that its results may be quite as good as nine cases out of ten, of what are commonly called levelling.

The Tables at present in use are those of M. Oltmann, printed regularly in the "Annuaire," and those of M. Biot, published in a small octavo pamphlet, both adapted to French measures. The former does not extend beyond altitudes of between 6,000 and 7,000 metres, and the latter

between 2,000 and 3,000. In the present Tables the range is from 0 to nearly 10,000 yards, or near six miles. MM. Oltmann's and Biot's Tables both require some arithmetical operations, the latter more than the former; but, except finding the quotient of the upper barometer by the lower, our Tables require none; for the allowance for the vapour is too simple to be called an operation. In point of portability and simplicity too, I presume our Tables will be found to have a decided advantage. With regard to the chief point of all—accuracy—it will be sufficient to refer to the examples quoted, and to another fact, which scientific men will know how to estimate, namely, that the present Tables have taken but one element from observation (exclusive of course of the rate of expansion in airs from the temperature of ice melting to water boiling), that is the ratio, of the specific gravities of mercury and dry atmosphere. All other quantities have been expressed from the analysis itself, without any of those half-guess, half-trial lifts, which have been employed in manufacturing the common logarithmic formula. If, therefore, any method is entitled to confidence it must be this, which rests on certain data, and is independent of empirical aids.

I must here beg to notice, that having used the measures for the length of a second's pendulum, and the ratio of the specific gravities of mercury and air given by M. Biot for Paris, the Tables are, of course, adapted to that place, instead of a latitude of 45° and the level of the sea. This will, however, make but a very inconsiderable difference, and may easily be allowed for by Table IV., if thought needful.

Description of the Tables.

Table I. contains the correction for the inequality of temperature of the two barometers in the thousandths of an inch. The arguments are the length of the mercurial column of the upper barometer, and the difference of the temperatures of the mercury in the two barometers. As the upper barometer is probably always colder than the lower, the correction is always additive. But, if the contrary is the case, the correction is subtractive, unless applied to the lower barometer. An error in the correction of the $\frac{1}{1000}$th of an inch would never amount to one yard of altitude in 10,000.

Table II. is the principal table. The argument is the upper barometer divided by the lower, given to three places

of figures; and the numbers in the Table are the altitudes in English yards and hundredths, corresponding thereto. This Table is constructed on the principle that the atmosphere is a perfectly theoretic one, whose lower temperature is 52° Fahr. If such be not the case corrections are to be made for the deviations from the columns of

Table III. This Table is divided into three parts by double lines. In the first part the arguments are the height just found, and the difference between 52° and the Fahr. temperature of the air at the lower station. If the temperature of the air exceed 52° the correction is to be added to the altitude found before, but if less, subtracted.

The result would now be the altitude with a uniform gravity in the latitude of Paris, and an undisturbed theoretical atmosphere as to the decrease of its temperature and pressure. If the atmosphere be not in an undisturbed state, we may find, from the second part of Table III., a depression of temperature corresponding to the last corrected altitude, and, by adding it to the temperature at the upper station, a new temperature at the lower. The altitude calculated from a mean of this and the given lower temperature will be the altitude sought, on the principle of a uniform gravity and a dry atmosphere.

By help of the third part of our third Table we obtain the correction for the decrease of gravity, which is always additive. In altitudes under 4,000 yards it never amounts to more than about two yards, and in such cases is barely worth noticing.

Vapour.—The true allowance for vapour is a subject of some difficulty in barometric altimetry. From a mean of several experiments I have been in the habit of allowing eight yards to a thousand. This is, however, a mere average statement. We are much in want of some good series of experiments on this subject. To continue this allowance above 3,000 or 4,000 yards is probably wrong, and for excesses above 6,000 or 7,000 yards it is very doubtful whether any allowance at all ought to be made. However, the present Tables contain a principle that will probably correct any error arising therefrom, and, therefore, the allowance of eight per 1,000 may be safely continued. This correction is always additive.

Table IV. *Latitude.*—Our Tables, as we have stated, are computed for Paris latitude 48° 50′, instead of the usual latitude of 45°. The difference in most cases is so trifling that it is hardly worth regarding, and, therefore, I have given

the correction in Table IV., as if the chief Table had been computed for the latitude of 45° and level of the sea. This quantity is additive for the first 45° of latitude, and subtractive afterwards to 90°. The quantities are computed for every 1,000 yards, and as they are in their respective columns proportional to the altitudes, they may be readily found for hundreds of yards, by simply taking the tenths of those given by the corresponding thousands.

No Table is given for the depression in the barometer due to capillarity, because being constant in any one barometer it ought, in fact, to be marked on it.

Having now described the Tables, I shall here give the practical rule for making the computations from them, and it will be found that the *modus operandi* is incomparably easier than it would appear to be from description.

APPLICATION OF THE TABLES.

RULE.—*The barometers being corrected for capillarity, take out of Table* I. *the correction for the upper barometer, corresponding to the length of its mercurial column found in the side column, and the defect of its temperature beneath that of the lower barometer along the head.*

Add the quantity just found to the height of the upper barometer, and divide the sum by the height of the lower barometer, to four or five places of figures in the quotient, if much accuracy is needed. With this quotient take out the altitude corresponding thereto from Table II.

Take the difference between 52° *and the Fahr. temperature of the air at the lower station, with which, and the altitude just found take from the first part of Table* III. *the first correction. If the temperature at the lower station exceed* 52° *add, if not, substract this correction from the preceding altitude, and it will give the altitude once corrected. Or multiply a thousandth of the altitude first found by twice the excess or defect of the temperature of the lower station above or below* 52° *for the first correction, and apply it as before. This is often shorter than by the Table.*

With the altitude once corrected take from the second part of Table III. *the depression of temperature, and add it to the temperature at the upper station. Half the difference between this sum and the temperature at the lower station, will, with the altitude once corrected, furnish the arguments for a second correction from the first part of Table* III., *to be added if the said sum exceed the lower station's temperature, otherwise subtracted.*

This will give the altitude a second time corrected. Or multiply a thousandth of the altitude once corrected by the difference between the sum of temperatures just found, and the temperature at the lower station for the second correction. Very often this will be much shorter than by the Table.

Multiply a thousandth of the altitude twice corrected by eight, which will give the correction for vapour always additive.

From the third part of Table III., *and the altitude twice corrected, take out the correction for gravity, likewise always additive.*

And from Table IV., *take out the correction for latitude, adding or subtracting it as directed in the Table.*

The application of these three last corrections to the altitude twice corrected, will give the true altitude very nearly in English yards.

I shall now exemplify the use of these Tables with some calculations of observations, extracted chiefly from the work of M. Ramond, "Sur la Formule Barométrique," kindly lent me a few years back, by Mr. Ivory, at a time when I could not procure it in England or France. This will be the fairest way towards my readers of testing the accuracy of the Tables.

Example 1.—According to M. Humboldt, the height of the barometer on Chimborazo was 167·20 lines, while at the south sea it was 337·79; the attached and detached thermometers at the former station were 10°, and—1°·6 centigrade or 50°, and 29°·12 Fahr., and at the latter 25°·3 cent. or 77°·54 Fahr. According to Ramond the quotient of the heights of the two barometers corrected is ·49638. Therefore

By Table 2. ·49638 gives..... ..... 5988·3 yards
And by 3. 77°·54—52°=25°·54 gives + 305·9 first correction

Altitude once corrected.....	6294·2	gives depression.....	57°·26
		Temp. at upper station...	29 ·12
			87 ·08
			77 ·54
	+ 60·1	Difference, excess	9 ·54
Altitude twice corrected	6354·3		
Vapour 6·354 × 8 =	+ 50·8		
Gravity	+ 5·8		
Allowance for Latitude, by Ramond	18·2		
Altitude sought	6429·1		

M. Ramond computes this at 6429·4 yards, a very extraordinary agreement for so great an altitude. Had the second correction been repeated, after making an allowance for it in

the altitude once corrected, the altitude would have come out about three yards more.

Example 2.—Pic du Midi above Tarbes. M. Ramond gives the corrected quotient of the barometers ·73686, and the detached thermometers at the lower and upper stations 20°·3 and 8°·3 of Reaumer, or 77°·675 and 50°·675 of Fahr.

Therefore ·73686 gives		2696·9 yards.	
77°·675—52° = 25°·675 .·. first cor.	+	138·5	
		2835·4 depression	26·08
			50·68
			76·76
			77·68
	—	2·5 difference, defect	0·92
Vapour 2·83 × 8 =	+	22·7	
Gravity.....	+	1·2	
Altitude sought		2856·8	

The trigonometrical altitude is just one yard above this, and M. Ramond's computation 1·2 yard above the trigon. altitude.

Example 3.—Pont du Berger (Puy de Dome) above Clermont Ferrand. M. Ramond has supplied us with the corrected ratio of the barometers at ·93988, and the higher and lower thermometers are—2°·9 and + 0°·3 cent. or 26°·78 and 32°·54 Fahr.

Hence ·93988 gives		558·7 yards.	
32°·54—52° = — 19°·46 which gives—21·7			
		537·0 depression	4·94
			26·78
			31·72
			32·54
	—	·4 defect	0·82
·537 × 8	+	4·3	
Altitude sought		540·9	

The altitude by levelling was found to be 540 yards, or 0·9 beneath ours, and M. Ramond's calculation gives 538·4 yards, or 1·6 beneath the truth.

Example 4.—Let us now take Guy Lussac's great ascent. According to M. Ramond the uncorrected barometers were 765·68, and 328·80 lines, the corrected quotient being ·43262, and the temperatures 30°·8, and — 9°·5 Cent., or 87°·44, and 14°·90 Fahr.

·43262 gives		7083·8 yards.		
87°·44—52° = 35°·44 giving . . .		+ 502·1		
		7585·9	depression	69·78
				14·90
				84·68
				87·44
		— 20·9	defect	2·76
Vapour	7·56 × 8 =	+ 60·5		
Gravity		+ 8·3		
Altitude sought . . .		7633·8		

M. Ramond computes this at 7632·7 yards from the same data. This agreement in such high numbers is truly surprising, and I am inclined to attribute it to the accidental circumstance of the air at that time being in an undisturbed, and very near its mean state.

I have selected the above examples from a vast number of calculations and comparisons in my work before alluded to, not on account of their agreement with Ramond's computations and measured altitudes, but on account of their very great scope. Had I been so disposed I might have exhibited much more favourable testimonies, particularly from some very accurate levellings, but this has not been my object; I wanted to show the uniform truth of the Tables over the greatest possible range.

M. Ramond has shown by a variety of examples that the barometric results of observations at the same place differ exceedingly at different hours of the day. Generally the observations about noon give the greatest altitudes, and M. Ramond thinks those most to be depended on. What may be the true cause of this, at present remains a secret; and there does not appear, from the theorems or tables yet published, the slightest clue as to the amount of confidence to be placed in the observations. It is here, that we think our Tables possess a real advantage. They will not, indeed, show us, any more than others, a measured amount of dependence or error, but they will show a comparative value in the observations. For instance, the less the amount of the second correction the more nearly the atmosphere approaches to its true mean state, and the less the probability of error in the computed altitudes. I am even inclined to believe, that a good series of observations well analysed may lead one to fix very closely the limits, if not the actual amount of error.

Correct, as I have reason to believe these Tables are, I

have a plan for others on a somewhat different principle, which I have no doubt will be still more accurate, but the labour of the computations prevents at present my carrying the plan into execution.

The second part of Table III., is very useful in determining the mean depression of temperature to any given altitude, and vice versa. To save trouble I have added a column of centigrade depressions. Several interesting problems might easily be solved by this part of the Table, which it would be out of place here to discuss.

It need hardly be observed, that the very same process we have followed will serve to find the depths of wells and pits, as well as the altitudes of hills.

I have now only to request, as these Tables may hereafter be printed in a separate and commodious form by myself, or will constitute part of the work once or twice mentioned in this paper, that they will not be reprinted in any other way without my consent.—[EDITOR.]

Mr. Stephenson's Estimate of Road Bridges on his Brighton Line.

[The following details of cost of bridges, given in evidence, will probably prove interesting to many of our readers.—ED.]

			Miles.	£.
1.	Turnpike Road:	London to Worthing	10¼	736
2.	"	Ditto	11¼	661
3.	"	London to Dorking	14	1,036
4.	"	Near the Punch bowl.....	14½	711
5.	"	Capel to Rusper	22½	575
6.	"	London to Worthing.....	25¼	2,010
7.	"	Horsham to Windsor.....	27	1,275
8.	"	London to Worthing	30¼	772
		Average cost, 972*l.* each.....		£7,776

PUBLIC AND PRIVATE ROAD BRIDGES.

1.	Road	from Wimbledon to Merton	¼	647
2.	"	Lower Worple-lane	½	671
3.	"	from Kingston to Merton	1	478
4.	"	near Cannon-hill	1½	596
5.	"	at Lower Morden	2¼	498
6.	"	from Kingston to Cheam	3¾	828
7.	"	from Ewell to Kingston.....	5	626
8.	"	Ewell to Hook	5¾	1,105

			Miles.	£.
9.	Road	near Epsom Court	6¼	458
10.	"	on Epsom Common	7½	696
11.	"	to Ashtead Woodfield	9¼	535
12.	"	on Leatherland Common	10½	716
13.	"	" " to Leatherhead	11	575
14.	"	from Westhumble to Mickleham	13¼	560
15.	"	to Denbigh-house	13½	527
16.	"	Lane to Ranmere Common	13¾	417
17.	"	to Reigate	14¾	483
18.	"	near Scammel's Farm	16	437
19.	"	to Brockham	17	570
20.	"	Ditto	17¼	513
21.	"	near Duke's Lodge	17½	462
22.	"	from Newdigate to Rusper	19¼	437
23.	"	at Newdigate	19¾	813
24.	"	from Newdigate to Rusper	20¼	500
25.	"	to Temple Farm	21½	496
26.	"	at Warnham	25½	827
27.	"	to Warnham-court	26	833
28.	"	Randle's-lane	26½	701
29.	"	at Tower-hill	29½	833
30.	"	to Prior's Farm	30	675
31.	"	to Cripplegate	30½	567
32.	"	Ditto	30¾	427
33.	"	to Cobb's-hill	31½	582
34.	"	Ditto	31¾	447
35.	"	from West Grinstead to Cowfold	33½	566
36.	"	to Henfield	35½	500
37.	"	at West End	37¼	522
38.	"	from Bineham Bridge	37½	675
39.	"	at Beeding	41	683
40.	"	from Beeding to Henfield	41¼	1,006
41.	"	from Adur Lodge	43¾	675
42.	"	from Old Shoreham to Brighton	44	463
43.	"	to New Shoreham (Level Lodge)	44¼	234
44.	"	from Buckingham to New Shoreham	44½	585
45.	"	at Kingston	45¾	645
46.	"	at Kingston Common	46	500
47.	"	at Southwick	46¼	645
48.	"	from Coppard's Gap to Portslade	47	596
49.	"	from Hove to Portslade	48¾	545
50.	"	to Hove Farm	49¼	591
				£29,967
				£7,776
		TOTAL		£37,743

The following Document was delivered in from Mr. Driver:—

March 10, 1837.

Average Estimate of the annual value of the land per acre in the following Districts required for the purpose of the railroad, exclusive of the compensation for all loss and inconvenience occasioned from severance of the estates, or for any special damages for building, or for injury to places as residences; and also exclusive of any lessees' or occupiers' claims for profit, or for tillage and crops upon the land.

	Average Annual Value per Acre. £.	s.	d.
From the Junction at the Southampton Railway to Leatherhead	1	10	0
From Leatherhead to the Punchbowl, near Dorking	2	10	0
From the Punchbowl to Horsham	0	17	0
From Horsham to the Brooks	0	18	6
From the Brooks to Shoreham	1	18	0
From Shoreham to the Terminus at Brighton, but exclusive of the site for such Terminus	3	13	0

Mr. Brunel's Railway Gage. By A FRIEND TO RAILWAYS.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

Sir, — I have lately seen some remarks in a cotemporary magazine respecting the Seventh Report of the London and Birmingham Railway, in which the reasons of the excessive expenditure in the operations of that road are canvassed. Some of the observations, I believe to be quite correct, and well argued, but there is one subject upon which I beg to call in question, not only the soundness of the arguments used, but also the *truth* of the assertions which it contains.

I take the liberty of requesting you to insert in your respectable publication, if you deem them worthy of such an honour, my views on this subject, as I am quite sure the party attacked will not take the trouble to refute the statements there made, but which may probably do injury to a subject of the greatest importance, to railways in general— not I should hope in the minds of scientific men, who can form a just estimate of the merits of the case, but in the estimation of the public at large, who are now become zealous supporters of railways in all parts of the kingdom.

I quote the following statement verbatim, as containing the objectionable matter of which I complain :—

"Contract works for forming the Road.

"The excess under this head is 442,238*l.*, and the manner in which it has arisen is thus explained in detail by the engineer, Mr. R. Stephenson.

"'The first cause of excess is stated to be '*an increased width in the railway.*' How much this increase is the Report does not state; but we believe it to be not less than four feet upon twenty-six. We believe, also, that we are right in presuming that this increased width has not been adopted from any conviction of its necessity on the part of the judicious and intelligent engineer of the Company, or even on the part of the Directors, but from a prudential regard for the theory lately propounded by the engineer of the Great Western Railway, that the only proper width for railways is 7 feet (instead of from 4 feet 8 inches to 5 feet), and the only proper diameter for railway carriage wheels also 7 feet (instead of from 4 feet 6 inches to 5 feet 6 inches), and from respect for the good opinion entertained of this theory in certain circles which are reported to exercise a great sway in all railway matters. Mr. Brunel *may* be in the right—all other railway engineers in the wrong; and therefore it is good policy to be provided against the contingency! Other railway engineers, to be sure, have experience on their side, which Mr. Brunel confessedly has not; they have also the established principles of mechanical science with them in their adherence to past usage. But what of all that? Has not the new system been voted by a numerous public meeting of railway adventurers, held in a certain great town in the north, to be the only true system? And what tribunal so capable of deciding upon a grave scientific question like this, as a miscellaneous public assemblage of merchants, manufacturers, tradesmen, shopkeepers, and the like? The truth to speak —the Birmingham Railway shareholders are made to run a much greater risk for this whim of Mr. Brunel's, and for the confiding credulity of his friends and admirers, than there is any good reason to justify." Thus much for the Magazine.

The first excess we are willing to allow was owing to "an increased width of the railway," or, as we presume the engineer intends to imply, of the embankments, cuttings, &c., along which the railway is laid down. But I altogether deny the correctness of the conclusions drawn from this fact, viz. that the increased width was adopted "from a

prudential regard for the theory lately propounded by the engineer of the Great Western Railway," respecting the proper width for railways, for I believe the subject was not agitated, and certainly not decided upon, till long after the main features of the London and Birmingham Railway were too far advanced for alteration; besides it is evident the engineer never contemplated any alteration *in the width of the rails* by the fact that the tunnels and bridges are the same as at first intended, the former being only 22 feet wide, a space I should think too narrow for 7 feet rails. Besides, we are well aware, that after the commencement of the London and Birmingham Railway, it was anticipated that the Great Western Railway would form a junction with it and adopt the same terminus, and consequently the same dimension of road in every respect. This plan, however, thanks to the avarice of the London and Birmingham Railway Company, was abandoned. Again, it would appear to me (who am nevertheless a decided advocate of the wide rails) as the height of folly to attempt any future alteration in a road of so much importance, not only from its connexion with the Grand Junction, and Liverpool and Manchester Railways, but also from the tremendous cost and loss of property in condemning the engines and carriages of the old line, and the stoppage for some months of the enormous traffic that must take place on the road.

In the said magazine it is stated further, that "the increased width has not been adopted from any conviction of its necessity on the part of the judicious and intelligent engineer of the company, or even on the part of the Directors." Why should they then adopt it? an alteration which we are led to suppose forms a very large item in the above-named sum of 442,238*l.*, if they thought it unnecessary. Are a "judicious and intelligent engineer," and a body of Directors of acknowledged experience and judgment, to be swayed by the mere "whim" of Mr. Brunel, a young man who "confessedly has" no experience on *his* side.

But let us return and consider the case in the order laid down in the magazine.

We are there told that the theory lately propounded by the engineer of the Great Western Railway is, that the only proper width for railways is 7 feet (instead of from 4 feet 8 inches to 5 feet), and the only proper diameter for carriage wheels is 7 feet (instead of from 4 feet 6 inches to 5 feet 6 inches.) The editor should, in justice to the public, to individuals, and to himself, be better

informed before he allows assertions to appear in his work, whether written by himself or others, so decidedly erroneous as the whole of this last quotation can be proved to be. Imprimis—Mr. Brunel never, I believe, held the opinion that 7 feet was "the only proper width for railways," for I know he can give reasons for preferring even a wider rail, viz. 7 feet 4 inches; but he took 7 feet as answering most of the objects he wished to obtain, and as being a good *medium*. Do not be surprized, reader, that I say "medium."

The above statement is equally incorrect respecting the diameter of the wheels proposed by Mr. Brunel, and the remark is evidently made by a person who does not know what he is writing about. By the carriage wheels, we suppose is intended the wheels only of the locomotive engine, although any one not acquainted with the subject would naturally infer that the wheels of *all* the carriages running on the road were implied. We must indeed take it for granted that the engine wheels alone are to be understood, as I believe the size for the common carriages is not yet determined; 5 feet diameter, I believe, has been proposed.

With regard, then, to the engine wheels, Mr. B. acted with his usual judgment and discrimination, leaving it entirely to the experienced manufacturers that were entrusted with the orders for engines to use their own discretion, the only restrictions being as to the width of the rails, and a certain relative speed between the motion of the piston and the velocity of the engine.

Three parties, I believe, are thus engaged, but all differ in the size of the wheels, only one of them, I am led to understand, having adopted 7 feet wheels.

Again, "Mr. B. may be in the right and all other railway engineers in the wrong." It might be here inferred that Mr. B. stands alone in his opinion; but this I altogether deny. He has one-half at least of the best engineers and mechanics in this country on his side; few at present agree as to the width most desirable for the rails, but all are unanimous as to the necessity of an increase. Messrs. Stephenson and Son, Locke, and some other great railway men, are too strongly fettered by the opinions they have given, that 4ft. 8½in. is sufficient for the width between the rails, that they cannot be expected to favour a system, which, if successful, must reflect on them for their want of discernment, in not adopting it on their own important lines. A reluctant assent, however, has been drawn from some of

them also, that an addition would possess some advantages.

I believe, indeed, it has been for some time admitted that an increase in the width of the rails was necessary, but no one had the courage to adopt it; no one was willing to incur the charge of innovation and capriciousness, which is here leveled at Mr. Brunel; till he (a man of the highest scientific attainments, and I will add *experience* too,) boldly stept forward, strong in the consciousness of eventual success to carry the measure into effect, and to rescue the country from the fetters that *past usage* and *mechanical science* were like to bind upon it. In this project he was fortunately seconded by the Directors of the Great Western Railway.

We are told, in the above magazine, that other engineers are strengthened in their "adherence to past usage," by the "established principles of mechanical science." This is great nonsense. Who can find in any theory of mechanical science that ever was published or invented, any arguments to prove that 4ft. 8½in. is the right width for a railway, or that 7 feet is not much to be preferred; and, as for his "adherence to past usage," he would desire I suppose to tie us down to 3 feet, or 3 feet 6 inches, which is the width that "past usage" for many years among the collieries would confirm as being the best for railways.

I contend that, by increasing the base on which a body rests, without otherwise materially adding to its bulk or weight, the centre of gravity will be lowered and the body move with more steadiness; besides which, it admits of several important improvements being introduced into the engines, such, for instance, as a large wheel by which the motion of the working gear will be reduced, while the speed of the engine remains the same, tending to preserve it from wear. I could also give many practical reasons, showing the advantages to be derived, both by the engines and carriages, but they would not be generally understood; I therefore leave this subject to make one concluding remark. By "a certain great town in the north," I presume, is meant Liverpool; if so, I beg to inform the writer of this precious article, that no town in England possesses men more capable of judging dispassionately, and with discernment, of any important measure, or men who have more uniformly and successfully advocated railways in all parts of the kingdom.

If I had any *waste time*, or any inclination, I could pick

a few more holes in the coat of the author of these remarks, but, as I know trials will soon be made to prove the result of this "whim of Mr. Brunel's," I leave the subject till then, as a more proper season for removing any prejudice that may exist in the public mind, as to the proposed alterations.

I am, Sir, yours, &c.

A FRIEND TO RAILWAYS.

Mathematico-Mechanical Problem. By F. C.

A TUBE 20 feet long is placed with its high end fixed to an upright wall, and its low end meeting the low end of another tube, the high end of which is 30 feet vertically above the high end of the former, and the two tubes are in such a position that a heavy body will run down each in the same time. Required the length of the other tube?

Parliamentary Committees and Inquisitions on Railway Bills. By the EDITOR.

IT has long been anxiously expected that Parliament would take some steps to relieve itself from the onerous duties of investigating and deciding on railway matters. Probably no tribunals can be less fitted for inquiries of this kind than Parliamentary Committees, of which the House of Commons itself has lately given a demonstrative proof, in the case of the Brighton lines. After Committees of the two Houses had sat nearly the whole of last session, and a Committee of the Commons for thirty-five days of the present; after the Committee's reports had been made on each of the lines, and near 300,000*l.* of the subscribers' money had been wasted, the House of Commons stamped its own opinion of all these labours, by giving them the "go-by," and referring the whole four lines to the judgment of a military engineer. Had the House distinctly resolved "that a Committee is utterly incompetent to decide correctly or justly on the merits of railway schemes," it could not have marked in stronger terms its sense of the fact. Neither ought it to be matter of surprise. The subject of railways is now but new to engineers; and, to men of science, who have devoted their whole time to unfolding the laws of locomotion, there are differences between theory and experience, which,

though giving way daily, are still formidable. How then can men, whose pursuits have been quite different, adjudicate justly on such matters, and determine correctly between testimonies, conflicting not merely on consequences, but on principles? They may be the most honourable and well-intentioned men in the kingdom, and may have attended most sedulously every day, and yet the chances of a just decision are evidently not in their favour. But Members of Committees are not obliged to attend. They may come in, take their seats, and vote without having heard a particle of the evidence, or knowing anything of the matter, just as their whims, their prejudices, their interest, or their friends may wish them. So that, in fact, it may not be the heads, but the noses, which decide. Neither can there be that security individual responsibility would give, and but little chance of a successful appeal from an improper decision. If an appeal is made, it must be to the House, of which the Committee naturally constitute, on the subject in question, the best-informed part; and it is rare, therefore, that the House will throw public discredit on the judgment or honesty of men to whom it has given its confidence. So that in point of fact it can hardly be said there is any appeal at all. A Committee may decide against a measure of the greatest utility and merit, involving a capital of millions and the interests of thousands, with perfect impunity, and possibly by a majority of two or three prejudiced or ignorant of the matter, or who at the time of the discussion may have been hundreds of miles distant. Is it right such a state of things should exist? Or rather, is it not the duty of Parliament to see that it does not exist, and to provide a different tribunal? Three men or one judge would do more, and incomparably better, in a week, than a Committee would in a whole session, and at less than the present expense of a day.

Our opinion upon the simplest means of proceeding, if Committees are to be retained, or if the matter is to be referred to a court of law, is so fully explained, pp. 120 and 121 of Vol. 2, that it would be superfluous to trouble our readers with a repetition of it here. I cannot, however, help noticing a distinction between a court of law and a Committee, which throws so heavy a weight in favour of the former as to admit perhaps of no counterpoise. In a court of law, the judge, jury, and suitors are all distinct parties, the proceedings are governed by certain fixed rules, and the jury never separates from the beginning to the end of the

trial, nor has any communication with the suitors. On the contrary, a Committee is an indefinable compound of a popular assembly and a court of law, regulated by no rules; in which the judges are jurors, and the jurors are commonly linked by interest or relationship to one party or other of the suitors, and during the whole trial are in perpetual communication with them. How differently calculated must this body be from the former, to produce an unprejudiced and an impartial decision! Ordinary mortals may act fairly in the one, but hardly angels could act uprightly in the other.

SELECT COMMITTEES.—So great and extravagant are the powers assumed by these bodies, that we approach them with fear and trembling. We hardly know whether in mentioning their name we may not incur the risk of a visit from the Sergeant-at-Arms; and whether our very thoughts may not render us amenable for a breach of privilege. It is high time the powers and proceedings of these bodies were properly defined. If not we shall presently have a despotic tyranny grow up worse by far than that of the Star Chamber, and such as will render the character, person, and property of no man secure. It is a fixed principle in our laws that no person shall be called on to say any thing, or to furnish any matter, with which to criminate, much less to convict, himself. The evidence to convict must be supplied by the opposing party, not by the one who is to suffer from it. So exceedingly careful is the law in this respect, that in the highest crime villany can perpetrate, where the life of a fellow-creature has been taken, our humane judges often caution the accused to say nothing which can criminate him. Neither is he ever examined. But in these Select Committees parties accused are not only examined, but compelled to furnish evidence for the prosecution, and not merely for the *crimination* but for the *conviction* of themselves. Nay the most confidential conversations and communications are often insisted on being disclosed, though it may appear on the very face of them, that they have nothing to do with the main object. In a railway case that lately occurred, the accused were commanded to produce all their private papers and documents, with which only and alone the prosecution was conducted. A gentleman, who had subscribed a deed for several hundred shares, had paid the deposits, and we believe had proved it by the production of the banker's books and scrip, was asked if the shares all belonged to him, and if not to whom they did belong. One

would have thought that the establishment of the legitimacy of the transaction by the proof of the deposits having been paid was enough, and that farther did not concern the Committee. But no, this would not satisfy the inquisitive Committee, and not even though he added that the matter was *private* and *confidential*. All would not do. He was commanded to give up the names and addresses of the parties for whom he had procured a portion of the shares; and the consequence was that a highly respectable Member of the House, a clergyman, and we believe a lady or two, passed in review before the Committee. What pain must all this cause; what earthly good could it, or did it, produce?

We want to know the principle of these proceedings. The Commons is but one branch of the Legislature, and the lowest. Its fiat is not law. Suppose the Queen, who is the highest branch, was to summon individuals before her and order them under pain of being sent to Newgate, to disclose their private transactions and matters entrusted in the strictest confidence to them, would not the whole nation rise in arms against such a monstrous inquisitorial tyranny and despotism? In what is the authority of a Committee of the Commons then greater than that of the Monarch, that it should exercise a superior power over the liberties of the people?

By such an engine as a Select Committee almost half the merchants in England may easily be sacrificed. Let them be entrapped into signing for a few shares, and then let a worthless fellow gull some cakeling member, ambitious to become a chairman, to present a Petition for referring the Parliamentary deed to a Select Committee; the result is secured. For the merchants have only to be summoned and a little ingenuity in the questions would make them appear gamblers, knaves, or any thing else; and the public would naturally conclude that such questions would never have been put unless on good grounds. Shake the characters of men in this way, trumpet it forth in the cheap reports of the Committee, and thence through the newspapers, and what would be the consequence; but a destruction of confidence, whose end is bankruptcy and ruin.

In courts of law, as we have said, the prosecutor is one party, the judge and jury other parties, all independent of each other and unconnected. The proceedings too are conducted by well defined rules. But in these Select Committees the Member who brings the measure forward is usually the Chairman of the Committee, and his will materially in-

fluences the proceedings, particularly as to the questions. In his single person, therefore, he combines the characters of public prosecutor, juror, and almost judge, and chief controller of proceedings, which disdain all rule, form, or precedent, and which it would appear by the late decision of another Committee no one dare call in question, however tyrannical and outrageous they may be, under the penalty of being sent to Newgate like a common felon.

We have no political prejudices, nor ever had. It is from having witnessed the extraordinary proceedings of some of these select tribunals, and their serious effects on private individuals, we have ventured to make the remarks that we have. It belongs to other and more powerful parties to take the matter up and rivet public attention to it. We cannot, however, terminate our remarks on this most important subject, without recording our humble tribute of praise and gratitude to Lord Chief Justice Denman for his late noble and manly declarations as connected therewith. Had his whole life besides been a blank, these, in our opinion, would have been sufficient to place him among the most illustrious defenders of the "liberties of the country." His Lordship's emphatical observation of "*I know no power above the law*" is well becoming an independent British Judge, and, if assumed as a motto, is that of which his posterity might be justly proud. EDITOR.

Exponential Theorems similar to Bernouilli's. By the EDITOR.

THE following two theorems are extracted from the work mentioned in our 15th No., p. 303, and were sent to Mr. Brougham and others in the year 1827. They are easily derived from Demoivre's, and are applicable to all the cases to which Bernouilli's are, and have the advantage of being much better adapted to numerical computations of the value of $\cos \pi x$ and $\sin \pi x$.

$$\left.\begin{aligned} \sin \pi x &= \frac{(-1)^x - (-1)^{-x}}{2\sqrt{-1}} = \frac{(-1)^{x-\frac{1}{2}} - (-1)^{-x-\frac{1}{2}}}{2} \\ \cos \pi x &= \frac{(-1)^x + (-1)^{-x}}{2} \end{aligned}\right\} (1)$$

By the help of $d_x^n . (-1)^x = \pi^n (-1)^{x+\frac{n}{2}}$ which is true for all values of n, we easily get

$$d_x^n \sin x = \sin (x + \tfrac{n\pi}{2}) \quad \ldots\ldots\ldots (2)$$

And $d_x^n \cos x = \cos (x + \tfrac{n\pi}{2})$

two expressions also from the same work giving the differential or integral coefficients of cos x and sin x, of any order whatever, from which the theorem in No. 15, p. 303, is easily derived. These last expressions have the curious feature of introducing the arbitrary constant by the direct process of differentiation. From the combination of these with another theorem results the solution (if I remember rightly, for I have not the papers at hand) of the following problem, which, had the affair with the Royal Society continued, I intended to try the strength of the mathematical world with.

Given any three conditions of a spherical triangle in degrees, minutes, seconds, thirds, &c. to find any other condition with the use of one figure only. EDITOR.

Great Western Railway.

SINCE we last adverted to the progress of this undertaking, the works have in many parts been greatly advanced, and some further information respecting them, which we have procured from an authentic source, will, probably, be interesting to our readers.

About half the entire line between London and Bristol (or nearly sixty miles), is now under contract, and in process of construction. This comprises the whole distance between Paddington and Reading at the Eastern end, and between Bristol and Bath at the other, with a portion of the line on the Western side of Chippenham, for which the Directors have recently concluded a contract on very satisfactory terms. This contract includes the heaviest work upon the line, and it will form the limit in point of time to the completion of the undertaking. The Directors are proceeding steadily in their purchases of land on the intervening distance, and but a short time, we suppose, will elapse before contracts are taken for the remainder of the line. It is, however, of much less consequence to complete the easier and intermediate portions which are not so favourably placed in respect of traffic, than to secure the timely con-

struction of the line in those parts where the works are heaviest, and where the intercourse is greatest.

The works between London and Maidenhead are in the most forward state, it being the intention of the Directors to open this portion of the line in October next, as there is every probability of their doing. The great viaduct at Hanwell is nearly completed, and forms a very magnificent object. The style of its architecture is simple and severe, but well suited to the work; the mere size of which gives it an air of grandeur. The execution is highly creditable to Messrs. Grissell and Peto, the contractors, and not less so are their punctuality and despatch, in completing it within the time allowed by their contract. A curious accident has occurred to the embankment at Hanwell, on the western side of the viaduct, from a partial elevation of the ground caused by the unusual pressure of the embankment, in which some depression consequently took place. Careful investigation was immediately made, and the cause being found in the peculiar position of a thin stratum of clay, on which part of the embankment rested, effectual means have been taken to prevent any ultimate injury to the work. Most of the road and occupation bridges on this part of the line are either completed or in progress, and are very good specimens of substantial masonry. At Maidenhead, where the line crosses the Thames, an excellent foundation for the bridge has been found in a hard compact bed of gravel, and the abutments are far advanced.

Between Maidenhead and Reading there is some deep cutting in order to avoid tunneling, but no doubt seems to be entertained, that this portion of the line will be completed by June, 1838. Tenders are now out for the erection of two bridges over the Thames, at Gathampton and Moulsford, with the necessary land, arches, and other works. The works will also be carried on eastwards from Reading, so as to allow of the line being opened as far as Didcot, (or the point of junction with the proposed Oxford branch) at the same time as it will be to Reading itself.

At the Bristol end, the progress of the works is satisfactory, though some delay has been occasioned by the unfavourable weather in the first four months of the year. The shafts for the Box tunnel will be completed in a few weeks, and the tunnel itself immediately afterwards commenced. The ground has proved even more favourable than was expected, and no water has been met with to cause the slightest inconvenience, although the shafts are now

carried to a great depth. This circumstance indeed with their great size (28 feet diameter) makes them an object of some curiosity. At Bath the ground is being cleared of many small tenements for the passage of a viaduct, upon which the railway will be carried out of that city towards Bristol. At Salford there is a long embankment, now proceeding with great rapidity, under the active superintendence of Mr. Mackintosh, the contractor. The two next contracts are in the hands of Mr. Ranger, who deserves credit for the excellent workmanship of his bridges and culverts. In this part of the line, the engineer has adopted the gothic arch, and though great simplicity is observed, the effect is good. As a matter of taste, however, we own a predilection for the round-headed or Norman arch, in all works of *civil* utility, as we recognize the peculiar claims of the Gothic for *ecclesiastical* structures. The abutments of the bridge over the River Chew are laid, and the embankment with which it is connected, and which is continued over Keynsham Hams, will be finished in the course of a few weeks. An occupation bridge which occurs near the middle of this embankment, is an excellent specimen of masonry. The embankment itself is almost entirely formed of hard, dry sandstone, which is found in abundance in this district, and forms an admirable material for the bridges and other masonry. Between Keynsham and Bristol there are three tunnels, two of them very short. The drift-way has been carried through them all some months past, and they are now being enlarged to their full dimensions. From the western end of the last tunnel, the railway passes on an embankment, and by bridges over the Avon and the Feeder to the Floating Harbour at Bristol, where another bridge will carry it over to the Depot in Temple Meads. The coffer-dams for this bridge are now being constructed, and the foundation will be shortly laid. We understand that the engineer confidently expects that the line between Bristol and Bath will be opened early in the summer of 1838, or about the same time as the line between Maidenhead and Didcot.

On the entire works at present under contract, there are from 6,200 to 6,300 persons constantly employed, and about 450 horses. There are also four locomotive and two stationary engines, for drawing the waggons, and working the inclined planes. In fine weather this force excavates and carries to embankment from 90,000 to 100,000 cubic yards of earth, &c., *per week*, and if it were necessary, this quantity

could be increased by night-work on those parts where the men are at present confined to day-work.

The Directors have recently taken a contract for the delivery in August of the rails required between London and Maidenhead (about 3,000 tons), at a rate fully 25 per cent. below their valuation in the last estimate submitted to the proprietors. The present is, indeed, a very favourable opportunity for effecting contracts of this nature, and those railway companies, whose works are sufficiently advanced, should not let it escape. On long lines particularly, a saving in this article is of great importance. The Great Western rails are to be made in lengths of 15 to 17 feet, of No. 2 iron, and becoming equal to the best quality of bonâ fide No. 3 iron. They will be laid upon continuous bearings of wood, carefully *kyanized*, and hence their weight is not to exceed 43*lbs.* per yard, though they will be equal in strength to a much heavier bar, supported only at intervals. The Directors have a number of locomotive engines under contract, some of which are nearly ready, and tenders have been made and accepted within these few days for the supply of fifty carriages, for the opening of the road to Maidenhead in Oct.

It will be seen from the above account, that if the expectations of the Directors are realised, portions of the line amounting together to not less than sixty-three miles, will be brought into profitable operation within twelve months from this time, and a smaller, but most important portion (the twenty-four miles to Maidenhead) in the course of the present year. The entire line it is expected will be completed in about three years from this time.

We have heard some murmuring at the PUNCTUALITY with which the Directors have exercised the powers of the Act of Parliament, in calling for instalments every three months. There may be some inconvenience to individuals hence arising, and we have no doubt it has operated, with other causes, in depressing the market value of the shares for a time, but we know, that other companies who were more lenient in this respect, have experienced considerable detriment from want of funds to carry on the work with vigour, when they got the whole line under contract, and their wants increased more rapidly than they could call from the proprietary. When a work, therefore, is so far advanced as the Great Western Railway now is, we should consider it a prudent course for the Directors to keep a larger balance in hand than their immediate wants may require, so that no delay may take place in bringing the whole line under con-

tract, and that they may proceed with the confidence and despatch which the possession of ample means naturally inspires. The only risk is, lest under such circumstances, economy be too little studied, and improvident treaties too easily confirmed, but in the case under consideration, we conceive the personal interest of the directors is sufficient to insure a vigilant attention to the good management of the concern.

On Railways, as Investments. By "R. R."

An important feature in the railway system, which has been too much overlooked, is its bearing upon the national capital as affording an advantageous mode of its investment. If we look to the series of operations involved in the construction of a railway, we trace the collection of capital from numerous sources into a common fund, and its re-distribution through various channels and to various parties; the landowner, the iron-master, the timber-dealer, the mechanic, and, above all, the labourer. Not a penny of the amount goes directly out of the country, and so much of it as is indirectly exchanged for foreign products (such as timber, flax, &c.) is useful in the support of our maritime interests, as that portion of the capital which is exchanged for home products stimulates every branch of native industry. Nothing can be more healthy than a circulation of capital of this kind; it is the very life-blood of our social system. And yet it is very obvious that the greater number of capitalists are not friendly to railway undertakings, and generally stand aloof until the *profit* of the work is known, when their assistance is not wanted. The press, also (at least some portion of it), has done all in its power to disparage the formation of railways, and because, in this, as well as in every other department of industry, some crude and some dishonest schemes have been set afloat, the whole system is to be condemned under the cuckoo-cry of "speculation!" Another objection especially absurd, has been urged by some opponents of railways, viz.—that they will absorb too much of the national capital, and divert it from more legitimate channels. To the latter part of the objection it may be reply enough to ask, What enterprise can be more legitimate than the construction of a railway, where there is a reasonable prospect of a profitable return for the outlay required? *All* railways

certainly will not succeed; there must be some good and some bad projects of this kind, in the nature of things, as there are some ruinous canals, and some unprofitable Insurance Companies. Yet what a vast fund of individual and national wealth has been accumulated by the formation of canals and the establishment of Insurance Companies! As well, indeed, might the capitalist abjure all commercial transactions, because many concerns become bankrupt, as urge against the railway system in general, the defects and mismanagement which attach to particular undertakings of this kind.

In this country, where wealth is held in such large masses, there are many persons who annually invest a large part of their *incomes*, and it might be supposed, looking to the very limited field for the profitable employment of capital, that these individuals would be the first to take advantage of a new mode of profitably employing their surplus funds. For the most part, however, this surplus wealth is in the hands of persons who have little acquaintance with the principles or practice of commerce, and who look with suspicion on all schemes which have not been tested by actual experience. Hence it happens that they who are accustomed to *forecast* consequences, and to anticipate the results of experience, by tracing the operation of certain principles, are the men to whom the public are chiefly indebted for great national improvements. These men have ever been found among the most enlightened of the commercial classes, whilst the great fundholders and landed proprietors (with few exceptions) have hung back from enterprises, which have ultimately been crowned with the most brilliant success.

From the fact, however, of commercial men being the chief supporters of these undertakings, we see why such sudden alternations sometimes occur in their marketable value, and how the semblance of truth is given to the charge of their diverting capital from its legitimate occupation. When men are extensively engaged in commerce, the withdrawal of a large portion of their capital for other objects must occasion some derangement of the ordinary course of affairs, and this of course will be greatly aggravated by the coincidence of a general pressure, such as that we are still suffering under. The blame is then laid upon "speculation," which has to answer for many sins not its own. Were the truth known, indeed, we suspect few concerns, either commercial or manufacturing, could be found, which

are made profitable by any thing but judicious "speculation." When commercial men, therefore, apply their capital extensively in objects of internal improvement, it may fairly be assumed that these objects are in themselves likely to be advantageous, as being supported by those best qualified by education and habit to foresee their results, and also that the ordinary profits of business are too low to remunerate the capitalist.

In such a state of things, again, it cannot but happen that many ill-devised and delusive schemes are encouraged, which end in the ruin or injury of those concerned in them. The same result is not infrequent to those who traffic in shares, and are hence induced to use unworthy means of accrediting or disparaging particular undertakings. In these cases, however substantial the enterprise may be in itself, a wrong character is given to it, for a time at least, in the public mind. In proportion, however, as it advances, this inconvenience is got rid of, and it is left to stand or fall by its own merits, though much time may elapse before its just claims to support are recognised by the public. Many must recollect the time when the Liverpool and Manchester Railway Shares, now at a premium of *cent. per cent.*, were at a discount; and the same was the case for a short time with the London and Birmingham Railway shares, which are now at a premium of upwards of 50 *per cent.* On looking back to such changes as these, many must feel regret that they were wanting in courage to make investments of this kind, at a time when they could have been made so advantageously. It is highly probable (and, to my own conviction, morally certain) that in the course of a very few years the stock of many railway companies, just now in little favour with the public, will be eagerly sought at a high premium, by the very capitalists who refuse at present to buy the same stock at or below par: so over-powering, in common minds, is the force of *present* impressions to the best founded anticipation of the future.

To those who have really studied the railway system, it must be superfluous to point out how the experience of America and Belgium, as well as of our own country, establishes the position, that capital may be invested in these undertakings with great advantage, both to the shareholders and the public. As compared with America, indeed, it may be said, that a conviction of this sort in the public mind of this country, is very weak and partial; but

it is daily gaining strength, and will, there can be no doubt, be confirmed by the early experience of the Grand Junction Line. Whether capital shall be supplied or not, to carry forward the various other lines, now in their earliest stages, will greatly depend on the result of this grand experiment. Let it only be seen by six months' working of that line, that a profit will accrue to the proprietors of 8 or 10 per cent. per annum, and there is little hazard in predicting that the other lines of great intercourse will be amply supported. As surely as water finds its own level, capital will flow into those channels where it will prove the most productive and fertilizing. As long as capital is seeking investment in the public funds, at a rate of interest not exceeding 3½ per cent. per annum, it cannot be wanting for railway undertakings, when the public mind is satisfied by the issue of the trial now pending, that their advantages have not been over-rated. The question, however, with every capitalist should be, "Shall I become a shareholder *now*, and forego some present advantage for the prospect of ultimate profit; or shall I wait till experience has *proved* to all the world the benefit of such investments, and of consequence, has enhanced proportionally the value of the stock?" If monied men generally would reason in this way, a steady and sufficient supply of capital would probably be furnished for all those undertakings which are well planned and prudently conducted; and it is best for the public in every way that all others should be promptly discouraged.

To those who feel or profess any anxiety as to the *amount* of capital likely to be invested in railways, I would submit the annexed summary of statistical facts, with the view of illustrating more clearly than any argument can do, the vast extent of the national wealth. When the Chancellor of the Exchequer can raise in a week a loan of 20,000,000*l.* by offering an interest of little more than 3½ per cent. per annum, let it not be said that the same sum cannot be appropriated out of the immense wealth of this country in the course of five or six years, for the purposes of internal improvement, without diverting capital from its "legitimate" channels.

R. R.

June 20, 1837.

Statistical Facts illustrating the State of the National Wealth, collected from Maculloch's "Statistics of the British Empire," and other authentic Sources.

The amount of the public debt (which is individual property) was on 5th Jan., 1836	£760,294,554
The annual interest paid to the national creditors...	28,505,675
The public revenue (Customs, Excise, &c.) for 1836	50,494,732
The *real* or *declared* value of British and Irish produce and manufactures exported in the year, ending 5th Jan., 1836.....	46,926,370
The *official* value of the imports for the same year	47,463,609
The rent of land, in England and Wales, in 1836, was about.....	29,500,000
The value of the timber in England is estimated 45,000,000*l.* to	50,000,000
Its annual produce at about	2,000,000
The value of the horses in Great Britain (in number about 1,500,000) is estimated at from 18,000,000*l.* to	22,500,000
The amount of *tolls* received annually on 1,108 turnpike trusts in England and Wales is about ...	1,430,000
The capital invested in sixty-two canals enumerated in a respectable sharebroker's list is	13,453,235
The capital required for twenty-seven railways (for which Acts of Parliament have been obtained) in the same list is about..... (About 6,000,000*l.* of this has been raised.)	26,000,000
The yearly value of the cotton manufacture is about	32,000,000
The annual rental of inhabited houses of Great Britain, is *above*	22,237,732
The capital (personal property) on which the legacy duty is paid in Great Britain and Ireland, amounts *annually* to about	43,500,000
The annual *income* assessed to the Property Tax in 1814—1815 was	166,222,128
The capital employed in agriculture is estimated by Mr. Maculloch at from 186,000,000*l.* to	217,000,000
The total *annual* value of agricultural produce of England and Wales (exclusive of timber) is about.....£132,000,000 Ditto of Scotland ..... 23,000,000 Ditto of Ireland 45,000,000	200,000,000
The total *annual income* of the people of Great Britain was estimated by Lord Liverpool, in 1822 at from 250,000,000*l.* to.....	280,000,000
Mr. Maculloch states it as now probably amounting to about	297,000,000

" ROYAL SOCIETY AND MR. HERAPATH."

[The private correspondence which terminated in the exit, expulsion, or forced retirement of Sir Humphry Davy from the Presidency of the Royal Society.]

(X.)

Cranford, January 11, 1821.

Dear Sir,—I beg leave to inform you that, as my family is arrived at Cranford, I shall be happy to hear the determination of the Council, respecting my paper, as soon as convenient. The experiments I mentioned in my two last letters I have completed as far at least as I intended at present to carry them, and only await the decision of the Council to put them in order. Should the Council determine on the publication of the paper, I shall feel happy to attend to any alterations or amendments yourself or they may have the goodness to point out, and, with respect to the experiments, will either give them as a supplement to the present paper, or make them the subject of a separate communication, as you think best. In the latter case, I should have it in my power to subjoin an extensive table of temperature that I have nearly computed, and perhaps *of making, if opportunities offer*, some new and important experiments, which I have in contemplation, on the constitution of bodies in their solid and fluid state.

You have probably heard of my having written to Sir H. Davy, on his election to the chair of the Royal Society. This I did, not only on account of his being about to become one of my judges, and to apprise him of the nature of a paper that was likely to come before him, but as a mark of respect which I thought due from myself to so distinguished a philosopher, who is almost the only one in England whose views of things coincide with my own, and to whose labours I have been much indebted.

I have taken the liberty of writing to you on one of my prospectuses, merely to show you that I have something more at stake than mere literary fame, and that it will be incumbent on me, conceiving as I do, that I am right in my views, and that I have given them a decisive proof by my experiments, to strain every nerve to establish my scientific reputation, as well for the sake of maintaining myself in the good opinion of my friends, as for the benefit which it may be of to my family, in my business.

I am, dear Sir, very respectfully,
Your obedient humble servant,
(Signed) JOHN HERAPATH.

To Davies Gilbert, Esq.

(XI.)

Cranford, near Hounslow, Jan. 11, 1821.

Sir,—As I had some time ago the honour of addressing you a letter respecting a paper I had composed, and put into the hands of Davies Gilbert, Esq., on the cause of gravitation, heat, &c., I beg leave to inform you that I am arrived at Cranford, my future residence, and shall be happy to receive any opinion you may have been pleased to form of this paper, and the determination of the Council on its publication, as soon as convenient. The experiments, as far as I intend at present to carry them, I have completed, and as soon as I hear from yourself, or Mr. Gilbert, shall proceed to put them in some kind of form.

I am, Sir, with great respect,
Your obedient humble servant,
(Signed) JOHN HERAPATH.

To Sir Humphry Davy, Bart., P. R. S., &c.

(XII.)

23, *Grosvenor-street, January* 13, 1821.

Sir,—Mr. Gilbert had put into my hands your paper, on "The Phenomena of the Universe," before I received your first letter, but I was desirous of perusing it, and of taking the opinion of a very able philosopher upon it before I replied to you.

I have read those parts of it which are intelligible, without profound mathematical study, with attention; and highly ingenious as I find your views, I must say I am not impressed with a conviction of their truth.

The pressure of your gravific fluid, for instance, taking away *weight* must depend upon the *motion* of its particles, and yet you counteract this pressure by *heat*, which you consider as *motion*.

Before I return the paper, I shall take the liberty of submitting it to the most acute philosopher (I know) in this country, and I shall be most happy if his opinion is favourable; for I should be sorry that the paper was communicated to the Royal Society without the security of its being published.

There is so much ingenuity and so minute an acquaintance with the progress of discovery displayed in your paper, that I cannot help wishing that its views and objects had been limited to matters of pure experimental inquiry. For instance, the doctrine of heat, and the investigation of its laws, supposing it to be motion. Such a preliminary paper, if satisfactory, would prepare the philosophical world for greater and more abstruse researches. You refer, in your last letter, to some experiments which you have concluded, on heat, and which confirm your general views. Any investigation

of this kind, I shall have great pleasure in communicating to the Royal Society.

Should any thing call you to London, I hope you will favour me with a call; I shall be glad to see you at my house any Wednesday evening, after nine o'clock. You will always find some of our most distinguished men of science with me on that day. I am, Sir, with much consideration,

Your obedient humble servant,

(Signed) H. DAVY.

To John Herapath, Esq.

(XIII.)

East Bourne, January 14, 1821.

Dear Sir,—I have been this morning favoured with yours, from Cranford, and I have immediately written to Sir H. Davy on the subject of your paper, which I put into his hands on the day of his election.

I assisted Sir Jos. Banks during his declining health, but it is obvious that all the business of the Royal Society will now be transacted by the President.

It gives me pleasure to find that you are come so near to London as Cranford. And I most sincerely hope that your Academy will answer every expectation you can have formed respecting it.

Being so near London, perhaps you will allow me, on some occasion, to introduce you to a meeting of the Royal Society.

I remain, dear Sir,

Your very faithful humble servant,

(Signed) DAVIES GILBERT.

To John Herapath, Esq.

(To be continued.)

REPORTS.

LANCASTER AND PRESTON RAILWAY.

Report of the Provisional Committee of the Lancaster and Preston Junction Railway Company, to the Shareholders assembled at the first General Meeting.

At a public meeting held at the Town Hall in Lancaster, on the 12th April, 1836, it was unanimously resolved, "That the "formation of a railway from Lancaster to Preston, thereby "connecting Lancaster with the important manufacturing and "commercial districts of the county, as well as facilitating com-

"munication with the Metropolis, would be of the greatest advan-
"tage to the town and neighbourhood, and it is, therefore, the
"opinion of this meeting, that measures be forthwith adopted for
"promoting the establishment of a railway between the towns of
"Lancaster and Preston;" also, "That a Provisional Committee
"be appointed to direct the necessary surveys and plans to be
"made, and to do all other necessary acts to forward the objects
"of the first Resolution."

The Provisional Committee appointed, immediately proceeded to accomplish the objects in view, and, notwithstanding the opposition of various parties, have now to congratulate the shareholders on having obtained an Act of Parliament for making the railway, and to avoid loss of time, they have called at this early period a meeting of the Shareholders, to lay before them a statement of their proceedings, and to resign the trust confided to them.

They refer to the accompanying account for the particulars of the expenses incurred. From the shortness of the time since some of the claims were sent in, and from the necessity of procuring further information, they leave the settlement of these to the future Directors, but are happy to state that when all claims are liquidated there will remain a balance in favour of the Company.

During the progress of the Bill through the Committee of the House of Commons, the Provisional Committee acting on the advice of counsel, and being strongly urged thereto by several Members of Parliament friendly to the undertaking, entered into an agreement with the Lancaster Canal Company to purchase from them so much of their wharf near Dock-street, Preston, as is required for the railway for the sum of 15,000*l.*

They have also agreed to pay the North Union Railway Company the sum of 1,500*l.*, on condition that the North Union Company continue their line from their station at Butler-street, under Fishergate to Dock-street, and bring it to the level of the terminus of the Lancaster and Preston Junction Railway, thus perfecting the junction of the two lines.

A contract has been made with Messrs. Park and Sons for the purchase of their factory and premises, containing upwards of 4,000 square yards of land, by which an ample space is provided for a station and warehouses very near the termination of the railway at Preston.

The line of the Lancaster and Preston Junction Railway being proposed to cross that of the Preston and Wyre on a higher level, about a third part of a mile from the terminus at Dock-street, that company have agreed to raise their level at their own expense, so as to unite with the Lancaster and Preston Railway. The tolls derived from this source, and from the traffic in the town of Preston, it is considered will amply compensate the additional charge incurred at the Preston end of the line.

The Provisional Committee have succeeded in engaging the able

assistance of Joseph Locke, Esq., the engineer, in laying down the line, and under his superintendence the surveys and levellings have been completed. The Committee have great pleasure in stating that the line is nearly straight, that no gradient exceeds 1 in 500, the greater part of the line being or nearly approaching to a level; that the works are light, and the cuttings of a very favourable description, so that in the opinion of the intelligent and experienced engineer there is no doubt the works may be completed within two years and a half, and at an expense not exceeding his estimates. Indeed, it is confidently expected that the contracts for the excavations may be made at a cheaper rate, and from the great decline in the price of iron, and the fact that useful stone for fences, bridges, blocks, &c. will be found in many of the cuttings, a reduction in the expense, at least equal to the additional outlay at the Preston end, will be effected.

Mr. Locke estimates the entire expense of making the line at 250,000*l.*, and from the accuracy of his calculations, as proved in the completion of the Grand Junction Railway, the Provisional Committee place full reliance upon his estimates, and consequently expect that the Lancaster and Preston Junction Railway will be completed at a less expense per mile, and that being nearly level it will be worked at a less cost than almost any other line hitherto made in this country.

From the statement proved before the Committee of the House of Commons the annual receipts on the railway will be

	£.	s.	d.
For Passengers, (at 2d per mile) . . .	36,241	0	0
Merchandize, cattle, parcels, and mails . .	9,122	14	0
	£45,363	14	0
Deduct for expense of maintaining the road, locomotive power, and other charges in carrying on traffic *to this extent*, according to the estimate of Mr. Locke . . .	20,000	0	0
Leaving . . .	£25,363	14	0

Or upon the capital of 250,000*l.*, a nett return of 10 per cent. per annum. In alluding to this statement of income the Provisional Committee observe, they regard it as greatly below the revenue which may reasonably be expected from the railroad.

On the opening of the Grand Junction Railroad the mails from London to Glasgow and Edinburgh will pass through Lancaster, thus making an increase of four coaches daily, and when the London and Birmingham, the North Union, and the Lancaster and Preston lines are all completed, there can be no doubt the far greater proportion of the passengers between the Metropolis and the northern parts of the island will take this route; the continuation of the line to Glasgow may also be regarded as a probable event. Mr. Locke having examined the line and found it practi-

cable, has already received instructions from a Committee in Glasgow to complete the surveys, with a view to the construction of the railway.

The estimated revenue from passengers is calculated at the average of 2d. per mile, but an increase of this rate of charge on railroads generally is expected, and the charge on the Lancaster and Preston line will of course be assimilated to that on the lines with which it is connected,—an additional half-penny per mile would give an increase of nett income of no less than 9,000*l.* annually.

Only a proportion of the more valuable merchandize now conveyed by the canal and by the road has been included in the Parliamentary statement, and nothing has been reckoned for the conveyance of coal and other articles of considerable bulk, compared to their value. The Provisional Committee are of opinion that not only a larger proportion of the merchandize now conveyed between Lancaster and Preston will come upon the railway, but look also to an increase of the quantity from the growing importance of the manufactures of Lancaster and its neighbourhood.

The North Union Railway passes through newly opened and extensive fields of valuable coal between Wigan and Preston, and as the cost of the transport to Preston will be less than the present cost of conveying coal on the Canal Company's Tram-road from near Bolton, the North Union Company will doubtless supply Preston with a large part of its consumption of this article, and as they can avail themselves of the Lancaster railroad at the tolls fixed by Act of Parliament, the coal on that line may be sent unbroken to Lancaster at a very moderate charge.

The estimate includes only 500*l.* per annum for the conveyance of the mails; from the arrangements already mentioned, this amount may be expected to be doubled, if not trebled, and the same observation may be made with respect to parcels, the income from which has been taken only at 1,306*l.*

The sum of 1,682*l.* 6s. is the estimate for the conveyance of cattle. This would be the charge for conveying less than one half of the number of horned cattle, sheep and horses now passing along the road. When the railway is made, particularly if it be continued northward, the numerous herds which now proceed through Settle and Skipton, to supply the populous districts in the south parts of this country, may be expected to be forwarded by the railway, and the receipts under this head will be greatly increased.

On the whole, the Lancaster and Preston Junction Railway offers a return to the shareholders equal to that of almost any line hitherto projected, with the great advantage of being free from the risk of the traffic being diminished by the formation of any other line. The sea on the one hand, and the hills which divide Lancashire from Yorkshire on the other, effectually prevent any such competition.

Before concluding this Report, the Provisional Committee beg leave to suggest to the meeting the propriety of passing a resolution to make the fees payable by Act of Parliament to the clerk, payable not to the clerk, but to the Company, and to invest the Directors for the time being with power to reduce or remit them altogether, as they may see fit.

(Signed) GEO. BURROW, *Chairman.*

Lancaster, June 19, 1837.

Statement of Account.

Dr.

	£.	s.	d.
To Engineer, in full	358	12	0
— Surveyors, on account	1464	17	2
— Parliamentary Agents, on account	1200	0	0
— Solicitors, on account	1940	5	4
— Travelling Expenses of Directors to London, and during their attendance on the Parliamentary proceedings, including some other Expenses	377	14	11
— General Disbursements, including Office Rent, Printing, Stationery, Furniture, &c.	222	10	10
— Balance of Petty Cash	19	14	1
— Balance in Bankers' hands	3994	0	7
	£9577	14	11

Cr.

	£.	s.	d.
By Amount of Capital received, being a deposit of 2*l.* a share on 4680 shares	9360	0	0
— Interest	217	14	11
	£9577	14	11

Claims sent in but not adjusted.

Dr.

To Solicitors	4261	10	2		
— Paid on account	1940	5	4		
				2321	4 10
— Surveyors	2280	13	2		
— Paid on account	1464	17	2		
				815	16 0
— Parliamentary agents	1408	10	9		
— Paid on account	1200	0	0		
				208	10 9
				£3345	11 7

Cr.

By Balance of Petty Cash	19	14	1		
— Ditto in Bankers' hands	3994	0	7		
				£4013	14 8

THE LONDON AND GREENWICH RAILWAY COMPANY.

No. 26, Cornhill, June 1, 1837.

THE Directors of the London and Greenwich Railway Company cannot but regret, in common with the other shareholders, that the estimated capital has proved insufficient for the completion of the work; but from the result since the opening of the railway to Deptford in December last—from which time to the present 686,571 persons have passed over the line—they feel warranted in reiterating the opinion they have hitherto expressed, as to the success of the undertaking when completed to Greenwich. Under this impression the Directors felt that the interests of the proprietors would be best secured by an immediate completion of the work, and for that purpose they have applied for and obtained an Act of Parliament to enable them to raise a further sum of 200,000*l.*, by addition shares and mortgage, as may be required.

They consider it due to the present proprietors to offer them the option of taking such additional shares of 20*l.* each, in proportion to the number of shares of which they are now holders; and in case the whole should not be taken by the present shareholders, then to offer such as may not be taken by them, to the public. The Directors have thought it most advisable that the new shares should either be paid up at once, or 10*l.* on each share on or before the 15th day of June, and the remainder on the 25th day of July next, at the option of the party taking the same; and that interest from the date of such payments respectively should be paid to the holders, at the rate of 5 per cent. per annum half-yearly, on the 30th of September and the 31st of March, until the profits of the Company allow a dividend, exceeding 5 per cent. per annum, to be paid on the whole number of both old and new shares, when the interest of 5 per cent. on the new shares will cease.

From the various additions found necessary in the progress of the work, not originally contemplated—the great and unforeseen delays, and consequent lengthened payment of interest on the capital—the great expense of compensation to persons whose property was not in the estimate to be taken, but which the Company were compelled by their Act to purchase—it perhaps will not be altogether surprising that the cost has exceeded the original estimate.

The Directors have disposed of some small portions of the surplus property, and are taking measures for the disposal of the remainder, whenever favourable opportunities may present themselves.

The Directors feel great satisfaction in acquainting the proprietors, that the Croydon Railway Company, with which the Dover and Brighton Railways are intended to be connected, are rapidly proceeding with their work, and forming their junction with this line about two miles below London Bridge. The new Deptford pier is in a forward state, and when completed will be united with the Company's line by the junction railway of about 800 yards,

for which an Act was obtained last year; thus affording a safe, economical, and speedy means of transit between Deptford and London, avoiding the dangers and obstructions of the river.

An arrangement has been made (which is now before Parliament for confirmation) with the Creek Bridge Company, by which the Railway Company will be empowered to take toll for passing over the Ravensbourne between Greenwich and Deptford, which will prove an additional source of revenue to the Company.

The Directors in conclusion beg to add that, from the experience they have derived since the opening of the line, they estimate the current expences at about 20,000*l.* per annum; and the proprietors may rest assured that every means will be adopted to keep the expences within the smallest possible limits.

The accounts will be made up to the 30th of June; and a Special General Meeting will be called in July, to declare a dividend out of the clear profits of the undertaking.

The Directors subjoin a statement of the expenditure, and estimate for the completion of the Works.

Statement.

Cr.	£.	*s.*	*d.*
Amount of capital	400,000	0	0
„ of Bonds issued	133,300	0	0
„ received from passengers, to Dec., 1836.	13,800	0	0
	£547,100	0	0

Dr.						
Act of incorporation and amended Bill				4,500	0	0
Amount of lands, &c., now purchased and agreed				304,200	0	0
Cost of building the railway, expended and incurred				314,600	0	0
Cost of carriages, engines, &c.				32,600	0	0
Paid interest on shares, &c.				29,600	0	0
Expences from the commencement to the 31st of December, 1836—						
Coaching department	5900	0	0			
Rates	4200	0	0			
Police establishment	3200	0	0			
Office ditto	6100	0	0			
Incidentals	3100	0	0			
				22,500	0	0
				£708,000	0	0
Estimate of land, &c., to be purchased				20,000	0	0
Engineer's estimate to complete the work				60,000	0	0
				£788,000	0	0
Deduct estimated value of surplus property				100,000	0	0
				£688,000	0	0

The following Amount of the Weekly Receipts is submitted, to show the gradually increasing Traffic on the Railway.

For the Week, ending	No. of Passengers.	Amount received.	£.	s.	d.
14th December, 1836	1387	39 11 0			
21st „ „	19,086	549 14 7	1126	9	10
28th „ „	19,474	536 14 3			
4th January, 1837	16,370	451 0 0			
11th „ „	18,693	510 19 2			
18th „ „	17,693	381 7 3	1758	16	6
25th „ „	15,573	415 10 1			
1st February, „	14,485	395 14 11			
8th „ „	24,403	667 9 0			
15th „ „	22,423	608 15 10	2252	13	4
22d „ „	21,570	580 13 4			
1st March, „	26,760	726 12 10			
8th „ „	29,590	801 1 0			
15th „ „	25,075	677 2 10	4897	10	2
22d „ „	22,606	611 14 6			
29th „ „	76,775	2080 19 0			
5th April, „	32,509	886 17 3			
12th „ „	27,236	731 8 3			
19th „ „	23,943	636 12 2	2867	19	10
26th „ „	22,754	613 2 2			
3d May, „	28,718	775 10 0			
10th „ „	31,595	846 13 1			
17th „ „	76,121	2090 8 5	5622	15	7
24th „ „	37,482	991 14 6			
31st „ „	34,250	918 9 7			

By order of the Board,

J. Y. Akerman, Secretary.

FIRST REPORT FROM THE SELECT COMMITTEE ON THE DEPTFORD AND DOVER SUBSCRIPTION LIST.

(Continued from page 388.)

It has been already stated, that the terminus of the Kent Railway, as announced in the first prospectus of the Company, dated the 28th of May, was not Dover, but Ramsgate; but the instructions given to Mr. Walker, on appointing him to survey the line, were, that he should not limit his views to Ramsgate, but ascertain whether there was a good *bonâ fide* line to Dover (a point which had been disputed before the Committee on the South-Eastern

Bill), and report to the Direction his opinion which was the best line for the shareholders and the public.

From the beginning of May, when he first received his instructions, until the 11th of October, Mr. Walker was engaged in making the requisite surveys; when, having gone over the country, and reported favourably of the line, that fact was publicly announced by the Directors, in an advertisement dated the 12th of October, wherein Dover, as well as Ramsgate, was stated to be a terminus to the line. Mr. Walker, about this time, consented to be appointed consulting engineer; and this appointment was announced to the public for the first time in a prospectus dated the 1st of November. In other essential particulars, this prospectus agreed with the prospectus of the 28th of May; and the capital, as therein advertised, was still two millions.

On the 5th and 16th of August, and on the 11th of October, Mr. Walker made three reports in writing to the Directors; and he believes that besides these he made no other written report. He delivered in his plans before the 30th of November, the day on which they were deposited in the Private Bill Office, and afterwards attended meetings of the Directors, and had communications with the solicitors. During the period that intervened between his making the first and third of these reports, and also at those meetings which he had with the Board, or their solicitors, he does not remember that the probable cost of the undertaking was matter of discussion between him and the Board of Directors, or any member or solicitor of the Board; nor did his reports comprise any statement on the subject of expense. At the meetings which he attended, the subject of cost might be talked about, but he is quite sure, from his general way of doing business, which is never to give an idea of expense without going into detail, that not one word escaped him, either verbally or in writing, that could give the Directors any reason to suppose that he committed himself in any way as to estimate. On his applying to the Board for a resolution, directing him to prepare estimates, the Directors, it appeared, had expected that his proceeding with the estimates was in the course of the instructions they had already given him; but those instructions, which were to prepare and deposit plans, he did not consider as embracing that kind of estimate that he thinks it necessary to prepare to go to Parliament with. Accordingly, on the 6th of December, he received a copy of the resolution of the Directors, directing him to proceed with the estimates preparatory to the application to Parliament; and these he began preparing early in December. He states, that a general view of the probable cost of the line is not to be had, until the whole figures are carried out, and the sum arising from them ascertained. That took place, as regards the engineering department, about the 4th of February, and amounted to upwards of 2,200,000*l.*: this was exclusive of the estimate of the amount af purchases, amounting to 750,000*l.*,

which he did not receive from the surveyor, Mr. George Smith, until about the 11th or 12th of February.

He is aware, that, according to the published prospectus of the Company, the capital was 2,000,000*l.* Colonel Landmann was, in the former year, engineer to the Company; Colonel Landmann made plans, and probably made that estimate. Mr. Walker has seen his plans, but not his estimate. Whenever an estimate appears at the commencement of these things, whether made by engineer or solicitor, it is good for nothing. Mr. Walker considers himself unqualified, with all his experience, to give an off-hand estimate. An engineer, who is in the habit of doing things in detail, is just as little competent to make a gross estimate as any other man. Until the 4th of February, when his detailed estimate as regards the engineering department was completed, he had not, from the data he had collected, any impression on his mind that the cost would very considerably exceed 2,000,000*l.*, any more than any gentleman might have, who formed an idea of the expense of a railroad.

Your Committee beg to direct the attention of the House to the amount of subscriptions contained in the subscription contract at this particular juncture, on or about the 4th of February, when Mr. Walker ascertained that the cost of the railway, as regarded the engineering department alone, would amount to 2,200,000*l.* If, from the total amount of the subscriptions attached to that contract, which is 1,590,150*l.*, there be deducted the subscriptions which were obtained, as nearly as the Committee have been able to ascertain, subsequently to the 4th of February, there will remain a sum amounting to about 970,000*l.*; and this result seems nearly to agree with the persuasion of the officers of the Company as to what the subscriptions amounted to about that time. Mr. Colin Smith, one of the secretaries, knew what that amount was; for he says, that some time before the 14th of February, he had cast up the amount of subscriptions already attached to the deed, and kept a memorandum of that amount: he was aware, moreover, that it was necessary to have a moiety of the estimate subscribed. When he learned, therefore, as he states that he did, from Mr. Woodgate, one of the solicitors to the Company, about a week before the 13th of February, that the estimate would probably exceed 2,000,000*l.*, though to a small amount, he could not but be aware that the subscription list would be barely sufficient to cover the presumed moiety of the capital required.

Mr. Woodgate states, indeed, that, to the best of his recollection, he did not know that the estimate would exceed two millions until Monday, the 13th of February. But, on the other hand, Mr. Walker has stated, that he had frequent applications from Messrs. Woodgate and Co., to know what the amount of the estimate would be, and that it is very likely he might give them an

idea it would be above two millions; but he would not state any amount until he had given the subject consideration.

Lieutenant Brothers, one of the Directors, thinks that it was on the Board day preceding that of the 14th of February, which would be on the 7th, that he first heard of the estimate being increased.

About this time, it being known that the estimate would exceed two millions, though precisely to what amount had not been ascertained, we find that the two secretaries, Mr. Green and Mr. Colin Smith, Mr. Walter, one of the Directors, and Mr. Hamond, who is the chairman of one of the provincial Committees of the Company, began to use extraordinary exertions to procure signatures to the Parliamentary deed. The description of persons who signed at this period, and the circumstances under which they signed, which they appear to have done, not of their own accord, with a view either to permanent investment of their property, or to speculating on a profit to accrue from a rise in the price of the shares, but at the intercession of the parties applying to them, and in order to oblige those parties, will enable the House to judge whether the subscriptions so obtained deserve to be considered in the light of *bonâ fide* subscriptions.

Mr. Hamond thinks that, about a week before the 14th, he asked the master of a ship, to which he acted as broker, John Garth, to sign the deed for 7,500*l.* Garth states, that he went with, and at the request of, Mr. Hamond to the Kent Railway Office, where some one, who he believes was Green, the secretary, asked him to sign, naming what the amount of the subscription should be. He did not know what the deed was, nor what it bound him to; nor did he read it, nor was it read to him. Had he known there was to be anything about it, he would not have signed for any person. He was not aware of the thing; he was not up to this sort of trick.

Bartholomew White is a clerk in Mr. Hamond's counting-house, at a salary of 60*l.* a-year, and, as Mr. Hamond believes, is a minor. About the same time, at the Kent Railway Office, and in Mr. Hamond's presence, Mr. Green asked him to sign the deed, naming the sum for which he was to sign. He signed accordingly for 3,500*l.* He did not understand for whom he signed.

Edward Wilkinson, of Point House, Blackheath, was requested by Mr. Hamond to call at the Railway Office, in order to sign a petition in favour of the railway. He called there, and put his name to what he thought was the petition, when Mr. Green, whom he knew, requested him to put the amount against his name. On Mr. Wilkinson observing, "What occasion is there for that? I have no interest; I have not written for a share;" Mr. Green replied, "That is of no consequence whatever; you will never be called upon; we have plenty of subscribers; you are perfectly safe, and you may put your name down for what you

like." Wilkinson then put his name down for 1,000*l.*, but Mr. Green requesting him to make the sum larger, he altered 1,000*l.* into 4,000*l.*

About the same time Green requested Mr. Hamond to allow his son, Charles Frederick Hamond, to sign; Mr. Hamond assented, but not for any definite amount, and sent his son to sign, who called at the office, where Green took his signature for 5,100*l.*

Of this date are the signatures of six persons residing at Woolwich, whom Green requested to sign the deed, and who signed it on his representation, without paying any deposit, whose subscriptions amount in the aggregate to 14,900*l.*

Of this date, also, are certain subscriptions obtained by Mr. Green through the aid of Mr. Fooks, clerk of the Court of Requests of the town of Dartford, and solicitor to the Railway Company in that town.

One of the subscriptions is that of John Webb, calling clerk or sergeant to the said Court of Requests, an office worth less than 50*l.* a-year. The subscription is for 3,250*l.* It was at Mr. Fooks's suggestion he agreed to take shares. His name on the deed was not written by him, but with his authority, by William Fooks, son of the solicitor. The initials of Green, as an attesting witness, are placed opposite to this name, and to the names of three other subscribers at Dartford, though he did not see them execute.

Another of the signatures so attested is that of Mr. James Chipchase, a clerk in Mr. Fooks's office; the subscription is for 3,000*l.* He signed, not as a subscriber on his own behalf, but at the request and on the behalf of William Fooks, who did not wish his name to appear on the deed.

Mr. Colin Smith states, that about this time, after he had received an intimation that the estimate of two millions would probably be exceeded, he obtained the signature of Edward Hicks Fielder, of Crosby-hall chambers, agent, for 4,750*l.*; but the circumstances of this case are not further explained in the evidence.

Mr. Walter is the Managing Director of the Greenwich Railway, and is one of the Directors of the Kent Railway Company. He admits that he suggested the names of two gentlemen in the Greenwich Railway Office as persons whom he thought he could get to sign the deed; these were, John Yonge Akerman, secretary to the Greenwich Railway Company, who signed for 2,500*l.*; and Henry Tyrrel Watkins, book-keeper to that company, at a salary of 100*l.* a-year, who signed the deed for 4,500*l.*; it is believed that they signed about a week before the 13th. He has induced three or four persons to sign the deed; but except Akerman and Watkins, he does not recollect who they were. If he had met twenty people he considered proper to sign, he would have asked them to go to the office to sign, as a matter of course. He told the secretaries,

of course, to apply to any person they thought proper to sign it. By proper, he means any respectable person, whether possessed of scrip or not; persons who would be responsible for the payment of the deposit-money to the Directors.

It has already been stated, that it was not until the 10th or 11th of February that Mr. James Walker ascertained what the detailed estimate of the Kent Railway amounted to; that amount, including the estimated cost of the purchases, being 3,000,000*l.* Of this, Mr. Walker, at his office, on the morning of Monday, the 13th of February, informed Mr. Colin Smith, who admits that at this time he was aware of the sum to which the subscription amounted (which was rather better than 1,000,000*l.*), and of the necessity there was of increasing that amount. Returning to the Railway Office, Mr. Smith informed his co-secretary, Mr. Green, and Mr. Lancaster, the accountant, of the increase made in the capital, which would require, he remarked, 500,000*l.* more to be added to the deed. Mr. Lancaster says, he was impressed with the peril of the Company, owing to the deficiency of subscriptions, knowing that unless they amounted to a moiety of the estimate, the Company could not go to Parliament this Session. Mr. Green says, that he and Mr. Smith felt it necessary to try to procure subscriptions.

Mr. Smith, the same morning, informed Mr. Woodgate, the solicitor, that Mr. Walker's estimate exceeded far more than he had anticipated, though how much he did not state; that he was making up his deed to deposit in Parliament, and should have to get names to the deed; that he wished the subscriptions made up, and Mr. Woodgate and his partner to subscribe for the shares allotted to them.

Mr. Smith, as soon as he possibly could, after he knew the great amount of capital requisite, began to obtain signatures, stating to those he applied to, the pressure for further subscriptions on account of the increased estimate. The subscriptions of the persons, whose signatures he procured prior to the lodgment of the deed in the Private Bill Office, and who paid no deposits, amount to 66,100*l.* Besides which, he obtained, subsequent to the lodgment of the deed, further subscriptions, to the amount of 18,600*l.*; making a total of 84,700*l.*

He doubts, however, whether he could have obtained any of those signatures, but for the impression the parties were under, that afterwards, if they chose to pay their deposits, they might have their shares.

For the description of some of the subscribers contained in Mr. Smith's list, your Committee beg to refer to the evidence.

(To be continued.)

SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

Conductors of Electricity.—From some experiments of M. Pouillet it appears that platina conducts electricity 2,546,680 times better than a saturated solution of sulphate of copper, copper above 16,000,000 times better, and palladium above 30,000,000 times better than the same solution. It also appears that the above solution has a conductibility to that of the solution increased by one volume of water, two volumes, and four volumes respectively, as 100 to 64, 44, and 31; and to a saturated solution of sulphate of zinc as 1000 to 417, to pure water as 10,000 to 25, and to pure water with 1-2000th of nitric acid as 1000 to 15. M. Pouillet also found that the effect or intensity of electricity was proportional to the time of its operation other things alike: and he deduced the two following consequences.

1st. That the tension of any source whatever is independent of the magnitude of the elements composing it.

2d. That in any pile whatever the tension is always equal to the sum of the tensions of all the sources of all the component elements.

He also arrived at the following curious results; namely, that an electric current in passing from one hand to the other, the hands being moistened and plunged in mercury, was enfeebled as much as if it had traversed 11 leagues of copper wire of ·039 inch diameter; and in passing from one finger to another on the same hand as much as if it had passed through 77 leagues of the same wire. He concludes with four propositions which he says express the general principle. To us they appear hypothetical rather than experimental; we may recur to them hereafter.

Mean Temperature of May, 1837.—It has been found by a comparison instituted by M. Arago that the mean temperature of last May was 1° Cent. colder than that of the coldest May (in 1821) we have had for the last fifty years, and no less than 6°·7 Cent. colder than that of the warmest May (in 1808) during the same period. The lowest temperature however in May, 1837, was not so low by 1°·6 Cent. as in May, 1802; and the May of 1810 had a less maximum temperature by 3°·3 Cent. It has been inferior to any of the Mays for thirty years in the quantity of rain fallen, but not in the number of rainy days.

Percussion Tubes for Cannon.—Mr. J. Marsh has made a considerable improvement in the percussion tubes used for cannon by the employment of a crow or other small quill, instead of a metal tube, which bursts without any danger from the fragments. Several thousand rounds have been fired on board the Excellent at Portsmouth without a single miss, and the Board of Ordnance have

ordered 1,000 guns to be fitted with percussion locks. Mr. M. has also improved the fulminating powder by adding to the sulphate of antimony and chlorate of potash a determinate portion of powdered glass, which, by increasing the friction, renders the explosion more certain and instantaneous. The Society of Arts have awarded to Mr. Marsh their silver medal.

Beet-root Sugar.—An attempt is about to be made to introduce the cultivation of beet-root for sugar in America, and deputies have arrived in France for the purpose.

Electro-Magnetism.—Considerable expectations are excited in America from the application of electro-magnetic power by a Mr. Thomas Davenport, a Vermont blacksmith. The following is an extract from the "New Era" paper of New York:—"1. We saw a small cylindrical battery, about nine inches in length, and three or four in diameter, produce a magnetic power of about 300lbs., and which, therefore, we could not move with our utmost strength. 2. We saw a small wheel, five and a half inches in diameter, performing more than 600 revolutions in a minute, and lift a weight of 24lbs., one foot per minute, from the power of a battery of still smaller dimensions. 3. We saw a model of a locomotive engine, travelling on a circular railroad with immense velocity, and rapidly ascending an inclined plane of far greater elevation than any hitherto ascended by steam-power." Scientific men have long been looking towards electro-magnetism for important consequences in the application of its power, and it is very probable they will not be disappointed; but we confess we do not see anything in the above extract new. However Mr. Davenport is evidently an ingenious man, and by continuing his course right on, if he does not hit the moon he may a star.

Importation of Coal in London.—Mr. Flood, the barrister, at the Committee of the Grand Collier Dock Company last week, stated the importation of coal in the port of London during the last four years, from which it appeared that, in 1833, there were 7077 ships entered, with 2,010,409 tons; in 1834, 7404 ships conveying 2,078,685 tons; in 1835, there were 7958 ships, having 2,298,812 tons; and in 1836, 8162 ships, bringing 2,398,352 tons. There was an increase, he added, in the last quarter, ending 31st March 1837, as compared with the same period in the preceding year of 77,452 tons.—*Mining Journal.*

Church Bells.—A new species of church bell or gong has just been invented by a blacksmith in Thuringia, which is much less expensive than the ordinary church bell, but is, nevertheless, quite as powerful. This bell consists of three bars of steel, forming a triangle.—*Times.*

Glass.—M. Dubus-Bonnel, of Lille, has presented to the Société des Enfans du Nord several specimens of stuff made of woven glass, which are most brilliant in colour and lustre. He is now pursuing his discoveries in order to bring them to still greater per-

fection, but they are already solid and perfectly flexible, and the price of them will be moderate. The Queen of the French has bestowed a gold medal on M. Dubus-Bonnel.—*Mining Journal.*

Mr. Cross's Experiments.—Mr. Cross has lately written to M. Becquerel, that, among a variety of other things, he has succeeded in forming an entirely new substance, which crystallizes in needles, composed of a strong proportion of sulphur, and a small one of lead, of copper, and zinc. In the beginning of its formation it is of a magnificent crimson colour, which afterwards changes to a brilliant scarlet, with an orange colour. The process of procuring it is thus:—An earthen pan is filled with hydro-sulphur of potass, and put in a glass vase, which is filled with a solution of sulphate of zinc. Afterwards is taken a small bow of lead and copper; the lead is plunged in hydro-sulphur of potass; the copper in sulphate of zinc. A copper wire, sufficiently bent, is then plunged in the two solutions, one end in the alkaline sulphur, the other in the sulphate of zinc. Some brilliant red crystals, in the shape of needles, issuing from a common centre, then envelop the extremity of the copper wire in the alkaline solution. This substance experiences no action in muriatic acid, but it then becomes very black. Adding some drops of nitric acid, it is decomposed, and floats, in great part, at the surface; it is then pure sulphur. The remainder contains only lead, copper, and zinc, in small proportions. Mr. Cross writes, that since forming the substance, he had had too little time to examine it, otherwise than with great rapidity.

Among the substances sent to M. Becquerel there were, 1st, some beautiful crystals formed on the positive end of a copper wire, and, on the negative, crystals of sulphur: the solution employed was not mentioned; 2d, some per-oxide of granulous iron (fer mamelonné) on copper, surrounded with a morsel of specular iron, in relation with the negative pole, the liquid employed being a solution of proto-sulphate of iron; also some gold formed *en dendrites* at the negative pole, in a solution of gold, on some clay slightly hardened by fire.

Mummy Cloth.—It has been lately ascertained, by microscopic observations, that the cloth the Egyptians used for enveloping their mummies, was composed of linen, not cotton. The filaments of linen are generally cylindric, but of cotton, flat or laminar; and these different forms are visible even in paper made of cotton and linen. In the cloths used by the ancient Egyptians for mummies, it has been observed that the fibres are always cylindrical; whence it is inferred that they are made of linen: and probably cotton was unknown to the Egyptians.

Anthracite Coal.—The successful results attendant on Mr. G. Crane's experiments of manufacturing iron from anthracite, or stone-coal, have, it appears, in a great measure led to the formation of a company for working the iron mines of Sardinia, where this

description of coal is to be obtained at a light cost, and where iron-stone, or ore of a superior quality, is said to abound. The report of Mr. A. Manby, with a copy of which we have been favoured, certainly holds out the most favourable prospects, from smelting the ore with charcoal; but, if we mistake not, the application of anthracite coal is likely to yield greater advantages, from the improved quality of the iron, compared with that manufactured from bituminous coal. Whether so large a return as 37 per cent., on a capital of 20,000*l.*, is to be calculated upon, we do not pretend to say; but, assuming the data to be correct, we think there can be no doubt of large returns being made.—*Mining Journal.*

Russian Gold Mines.—Important Discovery.—The St. Petersburgh letters are much occupied with a discovery relative to the working of the Russian gold mines, which, if truly stated, may come to have some influence on the circulation of the precious metals. A letter of the 26th ult. says, "There has been found out, it is said, in the Ural Mountains, a new mode of extracting gold from the earth, sand, or ore. The sand or earth has been put into a blast furnace and melted, and the most extraordinary results obtained. By washing, the method hitherto pursued in Russia, if one and a half zolotnicks of gold were produced from 100 poods of sand, &c., the expenses were about covered; two zolotnicks per 100 poods were worth working. Fine sand or earth rarely produced more than three zolotnicks, and five zolotnicks were quite uncommon. By the new process, on 100 poods of melted, they obtained sixty zolotnicks in some cases, in others forty to fifty zolotnicks; and on melting 100 poods of previously washed sand, they got forty to fifty zolotnicks of gold. There is little doubt of the accuracy of these statements, but what the comparative expense of the two modes is, I cannot tell you, nor whether the Ural grows sufficient wood for fuel, and whether coal can be found there. One pound Russian contains ninety-six zolotnicks; 100 poods are about 3550 lbs. English weight."—*Times.*

Physics of the Globe.—M. Arago has made a report to the Academy of Sciences, relative to the level of the sea in the environs of Pouzzol, Naples, from a Memoir of M. Capocci, Director of the Observatory of Naples, from which it appears:—

1st. That anterior to the vulgar era, when the Mosaic pavement in the temple of Serapis, discovered under a more recent marble pavement, was constructed, the level of the sea on these shores, compared to that of the earth, was about 15 Neapolitan palms lower than it is now; (the palm is about $10\frac{3}{4}$ English inches.)

2d. That in the first centuries of the vulgar era, at the epoch when the baths and new pavement were constructed, the level of the sea was $6\frac{1}{2}$ palms above the actual level.

3d. That in the middle ages, the level of the waters was about 22 palms above the actual level.

4th. That at the commencement of the present century the sea was 2½ palms lower than it is at present.

Loffredo writes, in 1580, that fifty years before then, people fished where, in his time, were some ancient ruins between Pouzzol and the Lake Lucrin.

It appears that the cause of these phenomena is due rather to the motion of the earth than to that of the sea. In these regions the inhabitants are afflicted with terrible earthquakes, and in 1538, after a frightful eruption, the celebrated new mountain rose up near the Lake Lucrin.

Internal Temperature of the Earth.—Philosophers have lately been much engaged in determining the rate of increase of temperature as we descend in the earth. Some believe in a perpetual increase towards the centre, and others, on the contrary, consider that the temperature increases only to a certain depth, large perhaps, as regards us, but inconsiderable with respect to the actual diameter of the whole earth. It appears from some experiments made in the beginning of May at Paris, at the depth of 400 metres, or 1312 English feet, that the thermometer stood 12°·9 Cent. or 23° 2 Fahr. higher at that depth than at the surface; and starting from the bottom of the caves of the observatory 28 metres, or 91·9 English feet lower, the temperature for 372 metres, or 1220 English feet of depth, were 11° 8 Cent. or 21¼° Fahr. greater. The former gave a depth of 31 metres for every degree of Cent., or 56½ English feet for every degree of Fahr., and the latter of 31½ metres for every degree of Cent., or 57½ English feet for every degree of Fahr.

This subject was discussed at the British Scientific Association by Professors Phillips and Forbes, (See p. 315 Railway Magazine, vol. i.) and the rate there stated was about 1° Fahr. for every 45 feet. It will here be observed that the rate of increase of temperature is much more rapid in these than in the French experiments. Query, does not this hold generally, that is, that the nearer the equator the slower the internal temperature increases, and the further from the equator the quicker it increases?

Variations in the Quantities of Salt diffused through different parts of the Ocean.—The late Dr. Marcet, some years ago, made some interesting experiments on this subject, and we present our readers with the following, as being the general conclusion which he drew from them.

1. That the southern ocean contains more salt than the northern ocean, in the ratio of 1·02919 to 1·02757.

2. That the mean specific gravity of sea-water, near the equator, is 1·02777; or intermediate between that of the northern and that of the southern hemispheres.

3. That there is no notable difference in sea-water under different meridians.

4. That there is no satisfactory evidence that the sea at great depths is more salt than at the surface.

5. That the sea, in general, contains more salt where it is deepest and most remote from land; and that its saltness is always diminished in the vicinity of large masses of ice.

6. That small inland seas, though communicating with the ocean, are much less salt than the ocean.

7. That the Mediterranean contains rather larger proportions of salt than the ocean.

The salt of the sea, therefore, is considerably influenced, at least at its surface, by the neighbourhood of large rivers, and by permanent accumulations of ice; and in this way the inferior saltness of small inland seas, particularly in high latitudes, may in general be explained, as most of these inland seas are supplied with comparatively large quantities of fresh water from the rivers flowing into them. On the other hand, the superior saltness of the Mediterranean has been ascribed to the immense evaporation from its surface; the consequence principally of its being situated in a warmer climate.—*Prout's Bridgewater Treatise.*

Double Sextant.—A sextant has lately been shown to us capable of measuring an angle of 270°, or double that of an ordinary one. It consists of two, ingeniously fitted together, one larger and the other smaller, having double limbs, index, and horizon glasses, but with one and the same telescope, or eye-piece. The two horizon glasses are nearly one before the other; the index glasses are one above, and the other below the telescope. One of these sextants acts in the ordinary way; the other takes up an image, and as its index moves, carries it in a contrary direction to meet the image of the object (already brought down to any point) with which the angle is to be measured. The instrument appears to be exceedingly simple, and is capable of overcoming many difficulties the old sextant could not reach.

Fibre of the Pine-apple Leaf.—On Thursday evening, the 8th June, a very interesting lecture was delivered by Mr. Zincke, at the Adelaide Gallery, on the Fibre of the Pine-apple Leaf, which promises to be of considerable value in a commercial and manufacturing point of view. "Mr. Lister, the microscopist, has minutely examined this fibre, and has observed that it is a fasciculus or bundle of ultimate fibres, united together by a membrane or a gummy matter. The diameter of an ultimate fibre of pine is found to vary from 1-3000th to 1-7000th of an inch, while the fibre of flax varies from 1-700th to 1-2500th. It has also been observed that the fibre of flax is interrupted by joints, while that of pine has the advantage of being a continuous cylinder. Silk is likewise perfectly cylindrical, and varies from 1-1500th to 1-1700th of an inch in diameter, and a cotton fibre is a flattened and twisted cylinder, its diameter varying from about 1-700th to 1-1000th of an inch. It will be seen that the pine fibre far exceeds the

other threads in fineness, and Mr. Zincke assured the audience that the operation of separating these fibres from the fasciculus, and destroying the unnecessary matter, is simple in the extreme. An experiment was tried on the comparative strength of flax and pine; 7½ ounces were sufficient to break a thread of the former, while 8½ ounces were required to break a thread of the latter. One most valuable quality is possessed by the pine fibre, and that is its capability of receiving and retaining dye, while colouring matter invariably peels off flax. The cost of rearing this plant in the West Indies (no idea is entertained of making it an English article) is so very small, that the fibre could be delivered in England at the expense of 4d. per pound, of course exclusive of duty, while from two to three acres of land are sufficient to yield a ton of the fibre."

Chronometric Steelyard.—A new instrument for measuring the dynamic effects of machines in motion has been contrived by M. Latour. The efforts of the machine are determined by the number of oscillations made in a given time, by the balance of a chronometer fixed to the steelyard by help of a table previously constructed from experiments. The steelyard is of the ordinary kind of cylindric dynameters, with a rectilinear motion. To the cylinder a table is screwed, on which is mounted the chronometer, and the oscillating spring adapted to the balance of this chronometer, is a straight thin plate having a torsion motion. While the efforts on this apparatus cause the moveable piston-rod to go out more or less from its case, this rod itself having a communication with the forked slide by which the oscillating plate of the balance is clasped, obliges the slide to slip along this plate, and thus diminish the length of the vibrating parts, which makes the balance oscillate more rapidly.

REVIEW OF BOOKS.

Tables for finding the Cubic Contents in Excavations and Embankments of Railways, Canals, Turnpike Roads, &c. &c. &c. By DAVID J. HENRY, C. E. Roake & Varty.

AMONG the most troublesome operations engineers have to encounter is that of calculating the earth work. Early sensible of this, Mr. M'Neil conferred a great obligation on the profession by the publication of a set of extensive tables to suit almost every case that could occur. Mr. Bidder followed him in the same track, but on a much more limited scale. The former gentleman's occupied a moderate-sized octavo volume, but the latter was compressed into the size of a royal quarto card. Both have their respective merits: Mr. Bidder's are more portable, and Mr. M'Neil's more economical in the saving of labour. Desirous of aiding in so laudable an object, Mr. Henry has lately published a couple of tables,

with the necessary rules and examples, in one side of a sheet, which are therefore very portable and convenient in practice. We cannot, of course, speak of the accuracy of the computations, but the arrangement is good, and the tables appear to us capable of accomplishing all that Mr. M'Neil's do. Mr. Henry's principle consists in the reduction of the common prismoidal theorem to a very simple form; and of course the tables partake of this simplicity, on which grounds, and their portability, we recommend them to our readers.

Mr. Henry has added a very convenient practical rule for finding the quantity of land in acres, taken by any cutting or embankment, which, as far as we remember, is new.

Elements of the Differential Calculus. By J. R. YOUNG, Esq., Professor of Mathematics in Belfast College. pp. 312, 12mo. London, John Souter. Edinburgh, William Whyte & Co.—We cannot speak of the present work but in terms of approbation. In the exposition of the general principles, the ideas are well expounded and accurately defined. The general rules deduced from these principles, are clear and comprehensive; and the examples by which the rules are illustrated are choice and numerous.

The general principles are made to rest on the method of limits, the foundation on which the fluxionary calculus was originally placed by the great inventor of it.

The work is divided into three sections. The first explains the differentiation of functions in general. The second contains the application of the differential calculus to the theory of plane curves. And the third gives the theory of curve surfaces, and of curves of double curvature. Each section is divided into chapters, and the chapters are subdivided into articles, numbered consecutively from the beginning of the book. The whole is well executed, and seems to be the work of one who is able to take an enlarged and comprehensive view of the subject. But many parts of it are deserving of particular notice. The third chapter of section first is particularly interesting. It is enriched by many of the finest theorems of Euler, Bernoulli, Demoivre, and Cotes. The fifth and sixth, which explain the theory of vanishing fractions, and of maxima and minima, display much acute reasoning, and contain several original remarks, as well as some improved methods of solution. The ninth chapter is devoted to a subject of considerable importance: the failing cases of Taylor's theorem, which Mr. Young has, undoubtedly, investigated more fully and more satisfactorily than any other author. It is here shown that the failing cases are indicated by the differential coefficients becoming infinite; and that preceding analysists have been mistaken in supposing that the theorem fails when these coefficients become imaginary.

The third section is enriched by many beautiful theorems from Euler, Monge Dupin, and Meusnier. The demonstrations of many of them are new, and much more simple and concise than those

originally given by their illustrious inventors. The fourth chapter of this section contains an able exposition of the theory of twisted surfaces; a subject first started in this country, but hitherto cultivated almost exclusively by foreign mathematicians.

On the whole, Mr. Young's book is, without doubt, the fullest and most consistent work on the differential calculus which has as yet proceeded from the hands of any British author. It is neatly printed; and in this edition great care seems to have been bestowed in superintending the press. It cannot fail soon to become the most popular work on the subject.

RAILWAY NOTICES.

Anti-Dry Rot.—The Manchester, Bolton, and Bury—the London and Croydon—and the Newcastle and North Shields Railways, we hear, are all using Kyan's patent for their timbers. We have no doubt this preparation must become universal wherever durability is an object.

American Experiments on Railroads.—It may be interesting to English railroad engineers to inform them that an experiment was tried on the Boston and Lowell Railroad with a new engine, built at Lowell for the Stonington road. The weight of the engine is about ten tons.

A train of 49 burden cars was drawn from Boston to the turnout in Woburn, a distance of ten miles, in 51½ minutes.

The load, exclusive of engine, was as follows:—

25 cars, 373 bales pressed cotton and wool, weighing	117,364 lbs.
195 groceries, &c.	26,142
19 coal, 6,000 lbs.	114,000
49 cars, weighing	191,000
Tender to locomotive	14,400
	522,906

Or 261 tons.

The load, which occupied a length of 820 feet, was started on the bridge at Boston without assistance, was taken up planes ten feet to a mile, and stopped and started again on a plane of that inclination.

On the 18th of January the small engine, Patrick, of nine tons weight, also built at Lowell, took a load of 35 cars, weighing in all 201 tons, in two hours and fourteen minutes, from Boston to Lowell, 26 miles.

In both cases the experiment was made without any previous preparation; the engines, cars, and rails being in their usual working state.—*Letter from Philadelphia in the Chronicle.*

A little suspicious, from experience of Transatlantic calculations,

we have taken the trouble to run over the above figures, and we find, instead of 522,906 lbs., the sum is only 462,906 lbs., or 60,000 lbs. less, and that, instead of 261 tons, it makes only 206⅞ tons. Even the 522,906 lbs. would make less than 236½ tons. We also find, by the general experience of English engineers, that an engine of 10 tons, though all its wheels were in action, could not sustain 184 tons, much less stop and start, with 261 tons, up an incline of 10 feet a mile. This is not the first case of the American marvellous we have had to notice. Our Transatlantic brethren are really very *figuratively* inclined.

Brighton Railways.—The rival companies have at length seen it their interest to endeavour to form a union. We believe we are correct in saying, nothing is yet definitively settled to the satisfaction of *all*, though there is great probability matters will be amicably arranged. How often have we urged this, and how often has it been proposed by one of the parties—Mills's Committee! It ought to have been done twelve months since. The plan, at present in agitation, is to form a union of interests of all the shareholders, and one line out of the five. The line proposed is to take the South-Eastern and Rennie's, over part of the Greenwich to Mertsham, thence across to Gibbs's Line at Capel, and afterwards to meet Stephenson and Mills's at Horsham. Starting from Horsham, it will run on one or the other of the two latter, or in their direction to Brighton. From Horsham another branch will be carried in the direction of Stephenson's, over part of the Southampton Line to Vauxhall-bridge. Horsham is a central spot from which an exceedingly good line is to be had to Portsmouth.

The plan, the bifurcation, and all, is that which in May, 1835, we repeatedly urged one of our engineers to take up.

The line above proposed is, of course, in great part a new line, for which no plans and sections have been deposited. It cannot, therefore, pass in the present session, unless the Standing Orders are suspended.

It will be seen, by our Parliamentary proceedings, that the Commons, after the Committee had decided in favour of Rennie's Line, have referred the four before them to a military engineer (Capt. Alderson) to report on,* for the purpose we presume of selecting the best—not for making a new one. This happened May 30th. On the 6th of June the same House of Commons directed the engineer "to keep in view the formation of one grand southern trunk line out of London,"—a motion which naturally stultified the other passed only seven days before!! Is this legislating on railway matters? The plan of appointing a military engineer is the Commons's *like-wise*.

Birmingham Railway.—The Directors go on the 29th June (after we are in press), and examine the state of the works, for the purpose of fixing on the day for opening the line to Watford.

* See his Report, p. 60.

They seem determined to have every thing so completely ready, that there shall be no chance of hindrance after once they have opened. Some arrangements for the accommodation of an unanticipated increase of traffic have occasioned a little delay.

Birmingham, Bristol, and Thames Junction.—The embankment across Wormholt Scrubs of this line, from its junction with the Great Western, is proceeding steadily forward; and the engineer will very shortly commence the archway under the Grand Junction Canal to form a union with the Birmingham Line. By the time the Great Western is opened, it is fully expected this connecting line will be completed, so as to afford the two great lines, the Great Western and Birmingham, an immediate communication with the Thames.

Bolton and Preston, and North Union Railways.—The Parliamentary contest between these lines continues as brisk as ever. We cannot understand on what principle the former company can apply to Parliament to grant a new line to run for several miles together parallel to, and almost osculating the North Union. From a petition, lately presented to the Commons by the North Union, there appears to be some curious work in the Bolton and Preston. They are accused of having a capital of no less than 88,000*l.* too little on 349,000*l.*; of having presented to the House a deed with one half the subscriptions executed, there being at the same time a *private* deed releasing the parties from the payment in part of the deposits; and that, out of 6,112 shares, they have only 2,009 actually paid up on. Can the House in common fairness or justice pass such a bill?

Bristol and Gloucester Railroad.—The quantity of coal which passed down the railroad in the last six months was nearly equal to the quantity carried down in the year 1835.—*Bristol Gazette.*

Cheltenham and Oxford, and London and Birmingham Union Railway (alias the *Tring line.*)—This project having been lost in Parliament, the Directors have issued a report, proposing a dissolution of the company. Though we felt it our duty to animadvert, in pretty intelligent, and, we think, well-merited terms, on the conduct of the Directors, and though we have no doubt, from what we have seen of the section, the loss of the line will prove ultimately a gain to the shareholders, we are by no means disposed to kick a prostrate party. We however cannot help thinking, that the Directors are now doing what they ought long since to have done. It seems they have received 48,814*l.* 17*s.* 4*d.*, and have spent 31,996*l.* 8*s.* 7*d.*, exclusive of some "small claims" outstanding, leaving a balance at present in hand, of 16,818*l.* 8*s.* 9*d.*, which they expect will return about 30*s.* per share, out of, we believe, 4*l.* They will pay 25*s.* per share immediately, to parties producing the scrip and signing the deed of dissolution.

Dundalk (Western) Railway.—The Standing Orders have been complied with, and a clause has been introduced into the Bill,

restraining the company from altering the level of any turnpike road.

Eastern Counties Railway.—We understand this company now propose, for the next two years, to make the part of the line between Norwich and Yarmouth, and also the part between Brentwood Hill and Bow-wow (Dog) Row, Whitechapel Road, some half or three-fourths of a mile from Whitechapel Church, and near a mile from their proper terminus. The former part may be called the tail-end of the line, the latter the head, minus that part which ought to contain the brains. This company are really the most comic in their management, we ever met with. Near a year since, they obtained their Act, and, as we understood, were red-hot to finish the line in about two years, from end to end; now a year is elapsed, it is to be two years before the tail and a fraction of the head, quite brainless, are to be made. When the body will ever be thought of, heaven only knows. At present, they probably think it enough to make a railroad from Bow-wow Row to the edge (we believe) of Lord Petre's property, for the purpose of showing the Cockneys that naughty man's forbidden soil. As to the tail, from Norwich to Yarmouth, we confess the reason for making it is above our comprehension, unless it is generously intended to enable the good people of Norwich to fetch plenty of sea-water to wash their dirty streets with. The next call, we hear, is to be put off for two years, which, in our opinion, shows great good sense; it would be a sad thing to make a call and get nothing. We have a pamphlet before us, from the secretary to one Mr. Norton, very rich indeed; we think to borrow a few of its treasures, for the benefit of our readers.

French Mails.—It is under consideration to despatch the French mails by powerful steam-boats, from Greenwich, every evening at 9 o'clock. They will reach Boulogne the following morning at 7 o'clock, and the letters will then be delivered in Paris within thirty hours from the time they are despatched from Greenwich.—*Morning Herald.*

Great Western Railway.—Rumours have been propagated of a serious accident which has happened to the embankment at Hanwell. Our readers will find the whole extent of this accident—if accident it can be called—described in p. 21 of our present number. Contracts have been made for the supply of forty carriages, for the opening of the line in October, to Maidenhead; and the Directors appear to be very confident that this time will not be exceeded.

Greenwich Railway.—It appears by a statement issued by the Directors of this company, that to complete the whole line to Greenwich, it will require 80,000*l.*; that a dividend will shortly be declared out of the net profits of the company, which by the end of this month it is expected will amount to 25,000*l.*; and, after

deducting for expenses 10,000*l.* for the half year, will pay a dividend on the old shares of upwards of five per cent. per annum.

Great Railway from London, by Birmingham and Preston, to Glasgow.—We observe from the *Glasgow Argus*, that an important meeting was lately held in that influential city, with the view of forwarding that great national work. The project which the Glasgow merchants have in view, is to carry forward a Railway from Glasgow, through Carlisle to Lancaster, to join the main line southward from thence through Preston, by the North Union, Grand Junction, and London and Birmingham lines, direct to London. This projected arrangement would also afford direct communications with Liverpool and Manchester, the North Union crossing the Liverpool and Manchester line about half-way between these important towns.—*Hull Advertiser.*

"*Grand Junction Railway.*—This Railway will be opened from Newton to Birmingham on Tuesday, the 4th of July next, forming, with the North Union Railway, a complete railway communication from Preston to Birmingham."

A very interesting trip was lately made over this line by a party of gentlemen, but much too long for our pages.

The opening of this line has been looked forward to by all classes, as likely to prove the touchstone of Railway speculations. This is one of the great lines (or indeed we believe the only one) which has been completed within the estimate, much to the credit of the Engineer and Directors, and still more, to the satisfaction of the shareholders. By the advertisement on our wrapper, it appears that six trains (except Sundays, then five only) are to start daily from Liverpool and Manchester on the one hand, and from Birmingham on the other. The first class will occupy 4½ hours from Liverpool and Manchester, and 5 minutes longer in the return; the mixed classes 5½ hours from Liverpool and Manchester, and 15 minutes longer in the return. The regulations are exceedingly good; and show, that the heads which completed this great undertaking, can descend, with equal clearness and success, to minor matters and details.

Harwich Railway.—We understand the intention of the Eastern-Counties party, not to carry their line beyond Brentwood for the next two years, has very much stirred up the good blood of this company; and they now see, that it is not a matter of choice, but of necessity, to bring their line on to London. Do so, and they will do wisely.

Llanelly Railway and Dock.—Three miles of this line are already completed and brought into profitable operation, which, together with the pre-existing two miles, have enabled the company to declare their first dividend, on the profits of the concern, of six per cent. per annum.

London and Southampton Railway.—The works on this line are

proceeding with increased rapidity. The embankments from Battersea fields to Kingston will be completed to the formation level in about eight weeks from this time. The Directors, at the last meeting of the proprietors, stated their intention of opening the line as far as Kingston next spring; but we understand that the subsequent progress of the works will enable them to open to as far as the neighbourhood of Guildford at that time. In this length is included the St. George's Hill cutting.

Northern and Eastern Railway.—We hear this company have saved to their proprietary upwards of 100,000*l.* in consequence of their prudent foresight in refraining from beginning while materials and labour were so high.

Newcastle-upon-Tyne—Edinburgh and Glasgow Railway.—We understand that the survey, from the Reed Water to the Tweed, is now completed, and that the results are highly favourable. We are happy to observe the deep interest which has been manifested by all ranks in the success of this great national undertaking; and that there are no insurmountable obstacles, as had been supposed by many, to its formation. A public meeting will shortly be held at Newcastle, at which deputations from the several committees are expected to attend, and afterwards proceed to examine the whole line, from Newcastle to Edinburgh, and Glasgow. As we understand that the parties who advocate the Eastern line have abandoned their scheme, we sincerely hope that all classes will heartily join in promoting the success of this railway, the practicability of which has now been proved; and the benefits which would result from it to the country through which it passes, cannot fail to be highly conducive to the whole community on both sides of the border.—*Kelso Chronicle.*

North Midland Railway.—The provisional Directors of this railway have given notice to their subscribers, that they have abandoned all further proceedings in Parliament during the present session.—*Leicester Chronicle.*

Notices and Standing Orders.—Last year's *amended* Standing Orders, have entailed, an expense on companies, of 400 per cent. more than the old Standing Orders did! We hear it cost one company 4,000*l.* in respect of their notices only. Really this is "too bad."

Railway Travelling.—The number of passengers who have travelled the Liverpool and Manchester Railroad during the first three months of this year, was greater by 10,000 than during the first three months of 1836.—*Liverpool Courier.*

Among other conveniences provided by the Directors of the Grand Junction Railway for the accommodation of travellers, not the least amusing (and useful) one is a species of conveyance named in the advertisement, "*bed* carriages in a mail-coach!" In other days the man who would have talked of living to see the time when he could *sleep in bed* and be carried through the air at the

rate of thirty, or five-and-thirty miles an hour, would have been deemed a suitable inmate for a lunatic asylum.—*Ibid.*

Sheffield and Rotherham Railway.—The works on this line of railway are proceeding with great expedition. Men are at work on five points of the line. Mr. Stephenson, the engineer, has visited the line this week.—*Sheffield Independent.*

South-Eastern Railway.—The report of this Company by some accident has not reached us until too late to appear in its proper place; we shall, therefore, now merely extract the more important features from it:—

The Amended Bill has passed the Commons, and is waiting for third reading in the Lords. By its powers important improvements will be effected between Croydon Railway and Lympsfield, and between Newington (near Folkstone) and Dover, and the whole line will be reduced to a uniform working gradient, not exceeding 20 feet per mile. The point of departure from the Croydon Railway will be at Penge Common, three miles nearer to London than was proposed by the original Act. By this alteration the improved gradients are secured, and the total distance to Dover is shortened upwards of a mile. Mr. Potter, under Mr. Cubitt, has set out the line from Combe-lane to Marden Park, and the works are commenced at Riddlesdown, south of Croydon. Mr. Barlow has made great progress in setting out the line in the neighbourhood of Tunbridge, and in preparing for contracts in that district. In the Dover district the line is set out between Newington and the terminus at Archcliffe Fort, and a contract has been entered into, on advantageous terms, for the execution of the tunnel through the Shakspeare Cliff. The Directors have been acting on the principle of restricting the expenditure within the smallest limits possible. By the Accounts, up to the 12th of May, it will be seen that the sum of 35,016*l.* 17s. 6d. remains at the disposal of the Company. The improvements, made in the line, and particularly in the upper and lower extremities, have rendered those parts perfectly unobjectionable in an engineering point of view; whilst the whole of the remainder of the line traverses a country scarcely to be equalled in the extent of level it affords. The "*Concession*" for forming a railway from Paris to Brussels has been made by the French Government. This line is to pass from Paris by Amiens and Lille, from which point a branch can with great facility be made to Calais; thereby connecting that port, and consequently England, by lines of railway, with Paris, Brussels, Antwerp, and Liege, on the frontiers of Germany. Total of receipts, 95,357*l.* 16s. 7d.; of payments, 60,341*l.* 9s. 1d.; leaving 35,016*l.* 7s. 6d. in hand.

P. St. L. Grenfell, *Chairman.*

Standing Orders.—We hear the Committee are much disinclined to abbreviate the time for depositing the plans and sections; we are sorry for it. A Standing Order for continuing the lateral

variation of 100 yards, but for confining the vertical line to a variation of only 5 feet per mile, we hear has been for some time under discussion. A more injudicious limitation we think could not be adopted. The House will surely not attempt to destroy the possibility of improving gradients by so extraordinary an order.

Taff Vale Railroad.—The first contract for this line has been just concluded for 40,000*l.*, the work to be commenced immediately.—*Monmouthshire Merlin.*

Victoria Railway, Dundee.—This line was lately opened, and called after her Majesty the Queen. The ceremony of laying the stone was performed by Mr. Sheriff Henderson, and the coins of the last reign (there yet being none of this), some newspapers, and a letter from Sir John Conroy, the Queen's Equerry, were deposited under it.

The York and North Midland Railway.—The works on this line are suspended, in consequence of the Directors not having been able to come to terms with the Rev. Mr. Shields, of Pocklington, who is a landholder on the line.

Kent Railway.—A meeting of the shareholders was held on the 8th June, when a Committee was appointed to collect in, and examine the accounts previous, it is expected, to a dissolution of the company, which would be supremely unwise.

PARLIAMENTARY PROCEEDINGS.

House of Commons.

Progress of Bills since our last:—

Ardrossan and Johnstone, 3d, May 30. Bishop Auckland and Weardale, reported, June 15. Bolton and Preston, reported, June 12; 3d, June 27. Commercial (London and Blackwall), reported, June 19. Dublin and Kilkenny, reported, June 12; 3d, June 26. Dundalk Western, 3d, June 7. Durham Junction, reported, June 5; 3d, 15. Edinburgh and Glasgow, reported, June 8; 3d, June 26. Great North of England (Castle Eden), 3d, May 30. Pollock and Govan, reported, June 1; 3d, June 23. Wishaw and Coltness, 3d, May 30.

May 30.—Capt. Alsager, having observed that the Committee had made a special report on each of the four Brighton lines, in obedience to the orders of the House, in which reports a decided preference was given to Sir John Rennie's line, moved that it be referred back to the Committee to have the clauses settled and the landowners heard thereon. Lord George Lennox, the Chairman of the Committee, observed that the Committee had lasted twenty-seven days, and the average daily attendance was twenty Members; but on the day on which the reports were to be considered, they were honoured with the presence of forty-five Members, six of whom voted for Rennie's line, having attended only one day, and

not heard a particle of the evidence; he therefore moved as an amendment, for the appointment of an Ordnance engineer to survey all the four lines, and report thereon. Mr. Warburton was going into some matters connected with the subscription deed of Rennie's line, when he was called to order by Mr. Wigney. At length, after considerable discussion, in which several Members took a part, Lord G. Lennox's Amendment was carried by 164 to 157.

June 6.—A very animated discussion took place with respect to referring Mills's Brighton line also to the military engineer. Mr. Hume's Motion to this effect was lost by 71 to 43, on the ground that it had not passed the Standing Orders. Mr. Fector subsequently moved "that instructions be given to the military engineer to keep in view the formation of one grand southern trunk line out of London, to afford facilities of approach and prevent unnecessary intersection of the country." This prudent measure was carried by 38 to 36.

15th.—Lord G. Lennox informed the House that all the Brighton Railway Companies had united and struck out a plan to form one line to Brighton, and wished this plan to be laid before the military engineer appointed to examine the lines. Notice of motion to that effect was given for the next day.

Lord W. Bentinck moved for the further consideration of the report of the Pollock and Govan Bill. Mr. Speirs threatened to oppose it unless a clause was admitted compelling the promoters to pass, by a bridge over, or a tunnel under, the Glasgow and Paisley turnpike-road. After several other Members had spoken, Mr. Spier's proposition was lost by 72 to 45, and the report was then agreed to.

Sir A. Agnew made another of his attempts to prevent railroad travelling on a Sunday; but finding it unpalatable to the House wisely withdrew it.

June 16.—Lord G. Lennox made the motion he proposed yesterday relative to the begetting of one line out of the four Brighton, which was agreed to.

June 27.—Capt. Alderson's Report on the Brighton lines was laid on the table. It is too late for us to go into its details, but the following is the cream of it:—He prefers Stephenson's line in an engineering point of view, but does not his London nor his Brighton terminus, the latter is too far west—Gibb's more central—South-Eastern too far east—Direct the best—Objects to a line taking the coast before reaching Brighton—Thinks Stephenson's and Rennie's on a par for heavy goods, but Rennie's the best for passengers—Prefers Rennie's for facilities of branches, and says it is the best working line—Objects to the deep cutting on Rennie's line; prefers tunnelling—Objects to the joint line proposed by the four companies, says it will cause seventy miles to be made instead of forty-two, and thinks it would exhaust more capital than the traffic would pay; gives a decided preference to Rennie's line.

House of Lords.

Since our last, one Bill only has received the Royal Assent; a Commission is, however, expected for June 29th. The following are the stages advanced:—Ardrossan and Johnstone, 1st, May 30th. Birmingham and Derby Junction, 2d, June 5th; 3d, June 16th, W. C. Chester and Birkenhead, 2d, May 30th. Dublin and Drogheda, 1st, June 19th. Dundalk Western, 1st, June 9th; 2d, June 16th. Durham Junction, 1st, June 15th; 2d, June 27th. Edinburgh and Glasgow, 1st, June 26th. Glasgow, Paisley, Kilmarnock, and Ayr, 2d, June 22d. Great North of England, 2d, June 6th. Great Leinster and Munster, 1st, June 27th. Kilmarnock and Troon, 1st, May 26th; 2d, June 27th. Hartlepool, 1st, June 1; 2d, June 13. Leicester and Swannington, 3d, June 27th. London and Birmingham, 3d, June 12th, W. C. London and Greenwich, Royal Assent, June 8th. Manchester, Cheshire, and Staffordshire, 1st, June 2d; 2d, June 16th; Pollock and Govan, 1st, June 23. Wishaw and Coltness, 1st, May 30; 2d, June 16. June 27, Chester and Crewe; London and Southampton; South-Eastern Extension; Great Western Deviation Trowbridge, and Extension Paddington; Durham and Sunderland; York and North Midland, reported specially, with amendments; Manchester, Cheshire, and Staffordshire, Queen's consent signified and reported specially, with amendments.

June 15.—The Marquis of Bute presented a Petition against Sunday travelling on railroads, from some persons in Scotland. The Earl Fitzwilliam asked the Noble Marquis and the Hon. Gent. who agitated it elsewhere, what were the parties and animals that offended. Lord Bute said the Petition had been sent to him, and thus he presented it, but the animals whose labour were called into action, were the men who attended the engine.—Query. Would these men thank any one for their interference, and preventing them from adding a few more shillings a-week towards their families' subsistence?

In fulfilment of our promise of last month we subjoin a list of the Railway Bills which have been thrown out, or withdrawn, during the present session:—viz., Bath and Weymouth; Birmingham, Bristol, and Thames Junction; Birmingham and Derby (No. 1); Bristol and Gloucester; Clarence and Hartlepool Union; Cheltenham, Oxford, and Tring (Charlton King's); Devizes and Melksham; Eastern Counties (London and Norwich); Edinburgh and Dunbar; Grand Connexion (Worcester and Wolverhampton); Great Central Irish (Dublin and Mullingar); Kent (Deptford and Dover); London Grand Junction; London and Brighton (without a tunnel); London and Croydon; London and Exeter (Gillingham); Midland Counties (three Bills); Portsmouth Junction; South-Eastern (Ashford and Canterbury); South Midland Counties (Courtenhall); South-Western (Kingsworthy); Stirling.

PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum paid.	Closing Price of Shares in London Markets on								
					May.	June.							
					30.	2.	6.	9.	13.	16.	20.	23.	27.
			£.	£.									
6,000		(3) Birmingham and Derby	.....	10	.....	3¼	3	.....	2	2¼			
9,500	.....	(3) Birmingham and Gloucester	.....	10	1¼	.....	1	.....	1¼	.....	.....	1	1¼
7,500	.....	(2) Birmingham, Bristol, and Thames Junction	20	3									
15,000	.....	(2) Bristol and Exeter	100	10	.....	.....	.....	.....	.....	.....	1⅛		
660	.....	Calcutta and Saugur	50	2									
850	.....	Cheltenham.....	100										
7,500	.....	(3) Cheltenham and Great Western...	100	7½									
14,000	.....	(4) Cheltenham, Oxford, and Tring...	100	5									
2,000	.....	(2) Clarence	100	100									
12,000	.....	(3) Commercial Blackwall	50	2									
8,000	.....	(4) Dublin and Kilkenny	100	2½	¾	⅞	....	⅞	....	....	¾		
7,500	.....	(4) Durham South-West Junction ...	20	3									
60,000	.....	(3) Durham Junction	100	10									
64,000	.....	(2) Eastern Counties	25	2	⅝	....	½	½	⅝	....	½	½	
5,000	.....	Edinburgh and Dunbar	.....	2									
13,000	.....	(3) Edinburgh, Leith, and Newhaven	20	3									
800	.....	(4) Edinburgh and Glasgow.....	50	2									

2,800	.....	(4)	Glasgow and Falkirk Junction ...	50	3									
		(1)	Grand Junction	100	50									
		(3)	Great North of England.....	.....	7									
25,000	.....	(2)	Great Western	100	45	43½	43	45½	46¾	47½	49½	50	51½	56
2,000	.....	(2)	Hartlepool	100	100									
11,000	.....	(4)	Harwich	20	1									
8,000	.....	(2)	Hull and Selby	50	5									
40,000	.....	(4)	Kent	50	2	⅛								
2,000	.....	(4)	Llanelly Railway and Docks	100	25									
2,100	.....	(1)	Leeds and Selby	100	100									
1,500	.....	(1)	Leicester and Swanington	50	50									
5,100	10*l.* per c.	(1)	Liverpool and Manchester	100	100									
			Ditto, ¼ shares	25	25									
10,000	.....	(4)	LondonandBrighton(Stephenson's)	100	5	1½	2⅛	.....	1¾	2⅜	3	2½	2⅜	
45,000	.....	(4)	——————— (Gibbs) ...	20	1	.....	⅛	.....	.....	¼	⅛	⅛	¼	
16,000	.....	(4)	——————— (Rennie)....	50	3	1¼	¼	⅞	¾	⅞	1¼	1	¾	1¼
8,000	.....	(4)	——————— (Cundy)	100	3	.....	.....	.....	.....	⅜		⅝		
12,000	.....		London and Blackwall	50	3	.....	½							
20,000	8*l.* per c.	(2)	London and Greenwich (ex div.).	20	20	16½	.....	.....	14	14½	15½	14¾	15⅜	15½
			Ditto, Bonds			95								
25,000	.....	(2)	London and Birmingham	100	85	128	131	125	129	130	139	139	141	145
			Ditto, Bonds, 1834.											
20,000	.....	(2)	London and Southampton	50	40	18	17½	13	19½	.....	18½	20	.....	23
16,000	.....	(3)	Ditto, Ditto, New	25	1	4½								
12,000	.....	(3)	London and Croydon	50	20	11	.....	9	13¾	14½	.....	.....	.....	14½
10,000	.....	(3)	Manchester and Leeds	100	10	.....	.....	5	5½	5⅝	6	11½	11½	11½
10,000	.....	(4)	Manchester and Birmingham.....	50	5	4⅛	4	3½	.....	.....	3⅞	4		
10,000	.....	(4)	Manchester South Union	100	5									

PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Price of Shares in London Markets on									
					May.	June.								
					30.	2.	6.	9.	13.	16.	20.	23.	27.	
		(3) Midland Counties	50	5										
15,000	.....	(3) North Midland	100	15	13	12½	11¾	11½	11¾	12¼	12½			
12,000	.....	(3) Northern and Eastern.....	100	6										
2,500	.....	(2) Preston and Wigan.....	.....	20										
2,600	.....	(2) Preston and Wyre	50	28										
4,000	.....	(3) Sheffield and Rotherham	25	6										
1,000	6l. per c.	(1) Stockton and Darlington	100											
1,500	.....	(2) Stanhope and Tyne	100	100										
3,000	.....	(4) South Durham	50	2½										
28,000	.....	(2) South-Eastern and Dover	.....	7	3⅛	2⅛	2	.....	2	4	4			
24,000	.....	(4) Do. Brighton, Lewes, and Newhaven	50	2	½	½	.....	.....	⅝	1¼	.....	.....	1	
		(4) South Midland	50	1										
40,000	.....	(4) South-Western (Stephenson's) ...	50	1										
9,000	.....	(3) Thames Haven	50	2½										
6,600	.....	(4) Victoria	25	1										
1,400	.....	(4) Westminster and Greenwich	50	2							¼			
6,000		(3) York and North Midland	50	3										

The above, as we have stated, are the closing prices of the day. They are the prices at the last business transactions. But it is to be understood, that there is generally a difference of ¼ in the Stock Exchange between the prices a person can sell at, and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the number of Shares wherever we could; but should any errors be left, we shall immediately correct them when pointed out.

THE

RAILWAY MAGAZINE;

AND

Annals of Science.

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On the Principles and Practice of Levelling with the Spirit Level. By the Editor.

Having, in our last number, given extensive and very correct tables for calculating heights by the barometer, it is considered that, to render the matter complete, something should be added on the principles and practice of levelling. Of course experienced engineers will not expect much new on a subject of such extreme simplicity and trite every day practice. It is not, indeed, for them that we write, so much as it is for completing our observations on levelling, and for the purpose of furnishing a few plain rules for the younger and less experienced part of the profession.

Description and Rectification of the Level.

We cannot here enter into details of all the different parts and various constructions of the spirit level; we can give such a general description only as will enable the reader to comprehend the principles of its construction and mode of application. This instrument consists of a telescope, with a spirit level attached. The telescope is hung in two Y's, supported on a strong brass plate, which is itself connected by adjusting screws, and a universal joint, with the top of a tripod, or three-legged stand. Various fittings are put to these instruments, according to the quality and expense or fancy of the purchaser, but the principal parts are those above stated.

Two staves for taking the heights are indispensable appendages. They usually consist of two rods sliding one on the other, of six feet each, with a moveable vane. The staves are generally numbered in feet and hundredths, and sometimes in feet, inches, and tenths too; the former, however, is quite sufficient. After the more common plan, the

vane has a small wire across a square hole in its centre, by which the readings are taken. Equi-distant from this wire, and about an inch asunder, two pieces of ebony run across the vane, the latter being of the lightest-coloured box or holly. In observations this space must be bisected by the cross wire of the telescope. Mr. Troughton's staves have a circular vane "of white holly, with an inlaid lozenge," or diamond "of ebony;" and the readings off are at the bottom. Mr. Gravatt's staves have no vane at all. The divisions are in alternate equal black and white spaces, which may be distinguished at considerable distances; and the figures being large too, are capable of being read off in most cases by the observer without removing the staff. Various opinions are entertained of the respective merits of these inventions. The most accurate reading is, perhaps, to be had from Troughton's, the least liability to err from Gravatt's. Of the compass hereafter.

In the axis of the telescope, and common focus of the eye and object glasses, are usually two cross wires, perpendicular to each other. These are for directing the eye along the optic axis of the telescope; and their adjustment is called the adjustment of the line of collimation. Some have three wires, two vertical and one horizontal. If the eye-piece be drawn out until these wires are accurately defined, and the object glass afterwards to distinct vision, the wires will be in the united foci of the eye-piece and object glass, and will have no parallax. When this is not the case, the moving of the eye upwards and downwards, or from side to side, will cause objects to dance about the wires. Parallax being destroyed, if the intersection of the wires is directed to some well defined part of a distant object, and the telescope be turned round on its axis in the Y's of its support, the coincidence of the intersection, and the part to which it was directed, will continue in every position of the telescope, if the line of collimation be truly adjusted. But when it is not, there are some little screws near the eye end of the telescope by which the adjustment may be made.

The next thing is to see that the level is parallel to the line of collimation; for if this be not the case, the most careful observations are valueless. The best way to ascertain this, is to bring the bubble of the level accurately between the two scratches on it. If, without any other disturbance, (the clasps having been previously opened which keep the telescope in the Y's,) the telescope be taken out and reversed in the Y's, and the bubble then settle in its former position,

it is a proof that the level is parallel to the axis of the telescope. Should the bubble recede towards one end, it must be made to return half the distance, by altering the screw at the extremity of the level. The other half must be made up by the screws of the brass plate. If, on again reversing the telescope, the parallelism is not perfect, the process of rectification must be repeated until it is.

Having effected the preceding adjustments, it remains now to prepare for observation, by making the line of collimation traverse round a vertical axis, or in the plane of the horizon. Bring the telescope over two of the screws of the brass plate, and screw up one and unscrew the other until the bubble is very nearly between the two scratches; in this first step it is not necessary to waste time in attaining perfect accuracy. Then turn the telescope one-fourth round, so as to bring it over the two remaining screws, and do as before, only taking care this time to be as correct as possible. This being done, turn it back to its former position, and carefully repeat the rectification if needful. If any fresh rectification was required, it will be advisable to re-examine and re-adjust the telescope over the second pair of screws.

When all the adjustments have been correctly made, the line of collimation will revolve in the plane of the horizon, and the bubble, during an entire revolution of the telescope through every point of the compass, will steadily retain its position.

Principles of Levelling.—Sphericity of the Earth.

The earth being considered a sphere, every line perpendicular to the horizon will, if continued, pass through the centre of the earth. No two vertical lines, therefore, of different places, can be strictly parallel; neither can their respective horizontal lines or planes. Consequently, if three or more points in the same direction were accurately levelled, by taking short sights, they would not be in a straight line, but in a circle concentric to the earth's centre. Owing to the comparatively great radius of the earth, about 3,958 miles, this however would not become sensible, unless with excellent instruments placed at great distances from each other. Two instruments thus accurately adjusted, would, instead of pointing directly towards each other, point to objects a little above. If they were a mile asunder, for instance, the line of collimation of the one would reach eight inches above the centre of the telescope of the other; if

half a mile, two inches; if a quarter of a mile, one-half of an inch, and so on, as the squares of the distances. At the distance of ten chains, which in practical levelling is a very long sight, it would make only the one-hundredth part of a foot. In all cases of engineering levelling, consequently, it may fairly be neglected. But in the very longest sights, any error of this sort may easily be obviated by setting up the staves at nearly equal distances from the level; for then it would affect each station equally. Or it may be allowed for by subtracting from the apparent altitudes, quantities in the proportion above-named.

Terrestrial Refraction.

Besides the above affection, which arises from the sphericity of the earth, there is another, owing to the refraction of the atmosphere. When a level is accurately adjusted at any place, its line of collimation is a tangent to the general surface of the earth at that point, and the plane in which it revolves round is a tangential plane to the said general surface. All objects, therefore, seen in the line of collimation of the telescope, would be accurately in this tangential plane produced, if there was no atmosphere; but in consequence of the refraction of the atmosphere, rays which come from bodies at a distance do not come in right lines, but in curves concave to the earth. So that, in fact, bodies which are actually beneath the tangential plane, are elevated to appear within it. Hence, therefore, terrestrial refraction tends to correct the tangential elevation, bringing bodies from their true and natural level to the artificial, in which they must be seen, that is from the spherical superficies, passing through the centre of the telescope and concentric with the centre of the earth, to the tangential plane in which the instrument acts. What is very remarkable is, that this correcting power too follows precisely the same law. For example, the angle of terrestrial refraction is as the angle occupied by the distance when seen from the centre of the earth, that is as the distance. But, in very small angles, the linear magnitude of an object (in this case the amount of refractive elevation) is as the angle under which it is seen and its distance conjointly, that is, consequently, as the square of the distance, the same as before. Various estimates have been formed of the amount of terrestrial refraction., Dr. Maskelyne and Delambre estimated it at one-eleventh of the angle, which the distance occupied subtends at the centre of the earth; Legendre, from several

experiments, at one-fourteenth; Colonel Williams, Captain Mudge, and Mr. Dalby, at one-twelfth. It depends, however much on the state of the atmosphere, varying from one-ninth to one-fifteenth, which is probably the cause of so many different estimates. The mean, one-twelfth, is that now usually adopted. At the distance of 69·08 miles, or one degree, it would be, therefore, five minutes, and would cause bodies to appear 530·5 feet higher than they actually are. At the distance of 1,000 feet, this will produce an apparent elevation of ·0039876 feet. But at this distance the sphericity of the earth would create a depression of ·02392 feet. Hence, the combined effect of sphericity and refraction will, at 1,000 feet, cause a depression very nearly equal to ·02 feet; and as the square of the distance for any other measure. So that if the one-thousandth of the distance be squared, and multiplied by ·02, it will give the depression nearly. At 5,000 feet, therefore, it will be ·5 feet.

Now the object of levelling being to ascertain exactly how much one place is above or beneath the level of another, relatively to the centre of the earth, it would seem that when distant places are to be levelled it would be impossible to come very nearly to the truth. For though, by diminishing the length of the sight, the error arising from the two preceding causes would diminish in a much greater ratio, and for any single sight might be rendered altogether inappreciable, yet from the continued multiplication of observations it may be inferred that, in a long distance, the several small errors being all one way, would accumulate to a very significant amount. This, however, is not the case. For, by taking fore and back observations, it is obvious the errors will have a tendency to compensate each other, and should the instrument be equi-distant from the fore and back staff, they will exactly balance each other. Owing to the inequalities of the ground, this equi-distance can but seldom be had, but, in going over a long line of country, it almost ever happens that the advantage of length of sight is sometimes in favour of the fore sight, sometimes of the back; so that, on the whole, the balance is very nearly equal. But if it should not, by levelling backwards, which should be done in all cases where great accuracy is required, the amount of error will be detected. And if in going, the levels of particular points be determined, and the same be done of the same points in returning, any accidental error of reading off or putting down

will be immediately discovered. The accuracy, therefore, of levelling, as far as it depends on external circumstances, is almost as perfect as the most scrupulous could desire. Indeed, it is surprising to what extreme nicety it can be carried over a rugged and difficult country, with good instruments and careful observers.

To determine to what accuracy the errors of adjustment, and, therefore, the errors of observation may be liable, I made the following experiment:—The level used was a small level, with a ten-inch telescope and one and a half inch bubble, and without rackwork. It was, therefore, an inferior instrument, and incapable of the delicacy and accuracy of one of our best levels. Having carefully adjusted the level, and settled the telescope over two of the screws, the upper part of the horizontal wire just apparently grazed the lower part of a row of bricks of a chimney, eleven chains or near 250 yards off. I then turned the front screw until the wire did the same with the three higher course of bricks successively, and carefully measured, with a very delicate gage, the corresponding retreats of the bubble, which were respectively ·105, ·209, ·315, and ·420 decimals of an inch. The four course of bricks, with their strata of mortar, were, as nearly as possible, twelve inches; so that for ·105, or one-tenth of an inch retreat, the error was three inches. Now, every one knows that the tenth of a tenth, or the hundredth of an inch deviation of the bubble, is a very sensible quantity. Consequently, with this instrument, the error of three-tenths of an inch, in a sight of eleven chains, would easily be perceived. But it is very rare that such extraordinary long sights as these are taken, at least in railway levelling, even with the best of instruments; perhaps the average will not exceed a single chain. If great care, therefore, was taken, and the best instruments employed, it is highly probable that the total error would not exceed an inch in a hundred sights, even if the errors all lay one way. These are the errors of the observer, those of the instrument would probably be within the same limits.

Practice of Levelling.

Having chosen some spot which can be easily referred to as the place to be started from, let an assistant hold one of the staves thereon upright, with its figured face towards the instrument, which must be adjusted as before directed at any convenient distance. Give him then signals (which are generally made by a motion of the hand) to raise or lower

the vane until the horizontal wire, at the point of intersection of the wires, exactly bisects the lozenge, or white space between the two black horizontal lines on the vane; and the clamp, if the upper staff is used, should be immediately made fast. If the assistant has been taught to read off, he should do so, and bring the staff carefully to the observer to see that it is right. This must be entered in a column under the title of "back observations." Turn the telescope, without otherwise moving the instrument, towards another staff, held up by a second assistant, at any point selected in advance, and make an observation as before. The assistant should here on no account remove the staff, for fear of losing the point where it stood. As the level is now done with at its first position, it will be advisable the observer should go up to the assistant, and confirm the reading off. This must be entered in the column entitled "fore observations," and on the same line as the preceding observation.

The level is now to be set up at some other situation in advance, and the place of the fore observation in the preceding case becomes that of the back in this, and the new observation on it must of course be entered on the column of "back observations." A new situation for the fore staff is to be chosen, and the same process exactly is to be gone through as before, both as regards the observations and entries.

In this way the whole distance is travelled over, the fore staff in one observation becoming the back in the succeeding. If the true figure of the surface of the ground is required, as in the case of levelling for railways and canals, care should always be taken to have a staff station wherever there is a change in the vertical inclination of the ground in the direction to be levelled, otherwise it would be impossible to calculate the earth work to any nicety, or therefore to make any fair estimate of the expense. Any particular point which may be referred to as a bench mark afterwards, though not exactly in the line, should also be levelled and noted.

It now remains to reduce the observations so that the level of any particular point is shown throughout the whole series. For this purpose there are three other columns added, headed "Rise," "Fall," "Reduced Level." If the back reading exceeds the fore, the ground is rising, and the difference of the two readings must be entered in the column under "Rise." If the fore exceeds the back, the ground is

falling, and the difference is to be entered under the column of "Fall." Each of these differences evidently shows how much the ground rises or falls between the respective staves, or fore and back observations. The first difference is carried out in the column headed "Reduced Level," and marked + if it be a rise, and — if it be a fall. If this reduced level and the second difference are of the same kind, that is, both rises or both falls, add them together for a new reduced level; but if they are of different kinds subtract them, and place the sum or difference under the other for a new reduced level. Proceed in this way with each reduced level and the next difference or rise and fall to the end, taking care to characterise the reduced level by + if it be an actual rise above the original starting point or bench mark, otherwise by —. Each of these reduced levels will show the actual rise or fall above the first bench mark of the ground in the fore observation column corresponding with it.

The relation of the levels of any two other places may be ascertained by taking the difference of their reduced levels, if they are of the same kind, that is, both + or both —, or their sum if one be + and the other —. The result will be the difference of level of the two places.

To prove the work we add up all the back sights and all the fore sights, and if the difference of the two total sums be equal to, and of the same kind as the last reduced level, the work is doubtless right. If it be not, it would be advisable also to add up all the rises and falls and take their difference. If this difference coincides with the final reduced level, it is a proof the error does not lie in drawing the reduced level from the several rises and falls, and it must therefore be sought in deducing these several rises and falls; but should the said difference coincide with that of the sums of the fore and back observations, the error must lie in computing the reduced levels. It must in either case be found out and rectified.

Of Chaining.

When the object is merely the ascertaining of the difference of levels of any particular points, it is unnecessary to regard the distances. But when sections are to be made of the ground, the places of the staves must be determined by simultaneous measurement. For this purpose a column, entitled "Distances," is usually added to the others in the field book, together with a large space for making any obser-

vations concerning remarkable points or objects in the course of survey.

There are two ways in which levellers generally record their distances. One is by measuring from staff to staff, beginning from each staff de novo; the other by running on the distances, and noting down the distance of the several fore sights. In either case the recorded distance always corresponds with the fore observation to which it is opposite. The latter method, that of running on the distance, appears to us decidedly the better. It is more correct by avoiding fractions of links at the fore observations, and furnishes a readier means of laying off from the scale the positions of the staves. It also saves any trouble of subsequent addition in finding the total and intermediate distances. There is, however, one trifling disadvantage it has, namely, that of requiring a subtraction to find the length of any cutting or work; but this is not material compared with its other advantages, and the saving of an extra column, which would be wanted if the distances between the staves were set down.

While I am on the subject of chaining, I cannot help expressing a wish that our engineers would determine, for measuring distances, on having chains of a more convenient length. For instance, if instead of 80 there were 100 chains to the mile, and, as now 100 links to the chain, it would be far better in practice. The chains and links would then become decimals of a mile, which, if needed, might be very easily reduced to the old measures by simply multiplying by ·8.

Passing Woods, Rivers, and other Obstacles.

In levelling for railways, it is usual to divide the distance, if long, into several parts, which are given to as many different men to level, perhaps of 5, 10, 15, or more miles each, according to the time the work is to be done in and the number of hands employed. The engineer, or his managing assistant, generally makes the allotment and settles the points of beginning and ending for each. Unless some town, expensive property, or engineering difficulty stands in the way, the directions are usually to go in the shortest course, that is in a direct line, from point to point. This is done either by previously setting up a series of sticks, or by following the indications of the magnetic needle attached to the level. The former is probably the more accurate way in an open country, but in close confined

places, without the needle, men would soon run themselves to sea. A judicious combination of both is perhaps the most practically convenient. This is assuming that we can follow a straight course, but are confined for room, either from the rough face of the country or from numerous little obstacles. If, however, we come in contact with a sheet of water, an impenetrable wood, or a forbidden soil, we must have recourse to other arts. The simplest is that of turning off exactly in a right angle, and levelling up to a point from which we can clear the difficulty, then turning off in another right angle, so as to run parallel to the original course; and finally turning at another right angle towards the original course produced. If the length of this third digression be equal to that of the first, we shall return to the point we should have reached had we passed right over the obstacle, and at a length from the point first turned off from, equal to the length of the second digression. One more turn at right angles will now put us in the course first pursued.

Should it happen that the digression is large, and the ground very undulating or uneven, it will be advisable to reduce all the measures to horizontal lines by a method well known to engineers, and to calculate all the digressions by these horizontal bases. The unmeasured hypothenuses through the wood, may then be found from the base of the second digression and the inequality of level between the point departed from in the original course and that to which we have arrived in the same course.

Any irregularity in the ground of the wood can of course only be guessed at from the surface of the wood, unless it can be got at and actually levelled.

Another method of eluding the difficulty, is by going round the obstacle and measuring the angles either by the compass or chain in the usual way. This method in skilful hands is equally accurate, but very troublesome. It would be far simpler, and in ordinary hands much more correct, to have a series of perpendicular digressions.

In the above and following methods we have supposed the leveller to be left entirely to his skill and the level and chain. With a theodolite the whole difficulty is easily removed by reducing all the measurements and the sides of any triangles to horizontal lines. But to go into this subject properly would cause us to digress now much too far out of our way.

When a river obstructs our progress, across which we cannot measure with the chain, several means are resorted

to for the purpose of getting its breadth correctly. A very simple one is by measuring a straight line along the bank from any point in the main line and of any length, but the nearer to the supposed breadth of the river the better. At the extremities of this line, and on the farther side of the river in the course we are chaining, are set up poles, and the angles they make one with the other are taken either by aid of the compass, a theodolite, or the chain in the usual way. We shall then easily be able to compute or project the triangle. This is one method, but the following is equally correct, and probably much easier for most persons. Measure as before a straight line along the bank from any point in the main line, the nearer the estimated breadth of the river the better, but if it be a half or more it may be enough. At the extremity set up a pole or stick, and in a straight line with it and with a staff in our course on the opposite side of the river, put up another at any convenient distance. From this measure off a line parallel to the former to meet the main course. Then as the difference between the lengths of the two measured lines, is to the distance between their intersections on the main line, so is the length of the first measured line to the distance of the staff on the other side of the river from the intersection of the main line with the one first measured.

Of the Use of the Compass.

It has often appeared to me a matter of regret that more use is not made of the compass in the course of levellings. If the direction or bearings of the staves were accurately marked at each sight, it would contribute greatly to check errors in the survey. Many of these errors, and much inconvenience heretofore felt from the imperfect plans of various parts of the country, are now however removed by the Ordnance maps. It is only to be lamented, that too many places in these otherwise excellent maps, at least of England, are reputed not to have been filled in with the care they ought. But matters, we hear, are differently managed in the Irish survey. However, to return, if the bearings were correctly noted, together with those of all cross hedges, roads, paths, and remarkable objects, it would, in laying down the line, in a great measure supersede the necessity of a survey until the line was finally fixed. But the chief use of the compass is in following the sinuous bottoms of valleys and ridges of lofty ground for cross sections. Here it becomes of immense utility. When these cross sections

are thus carefully laid down with the main line, and the levels marked thereon, they become almost equivalent to a model of the country, furnishing of course the best possible means, short of a model, for ascertaining at once the most advantageous and inexpensive line. Had this course been universally adopted in the lines for which Acts have already been obtained, how much trouble and expense would have been saved in the almost endless applications to Parliament for alterations and amendments!

For the purpose of entering the bearings here mentioned, two other columns should be added to the field book. Our readers are probably aware, that in the modern instruments the cards are usually divided between the north and south points in a manner contrary to that of nature; that is, the W. is substituted for the E., the S.E. for N.W., &c. By this artifice the readings of the needle show the actual directions of the axis of the telescope, excluding the variation of the needle. This is the way in which our entries are made; they are read from the N. or S. so many degrees as the figures imply from the north or south points. It would, however, be much better, and vastly more accurate, if the needle carried a light card with the points marked in their natural order, and a vernier was placed at the north end of the box, which might always be read off even to minutes with a small lens fixed on the opposite side.

Owing to the length this paper has reached, I must defer some observations on the method of levelling with the theodolite.

EDITOR.

FIELD BOOK.

Back Sights.	Fore Sights.	Rise.	Fall.	Reduced Levels.	Distance.	Observations.
Hundredths of feet.		Links.	Links.	Hundredths of Feet.	Links.	
510, s 11 w	233, N 2 E	277		+ 227	240	Start from corner of Addison-place, near Holland Arms.
842, s 1 w	86, N 1 E	756		1033	650	
1040, s 6 w	15, N 4 E	1025		2058	1214	
619, s 15 w	59, N 44 E	560		2618	1376	To Level 1286.
942, s 23 w	71, N 43 E	871		3489	1725	Do. 1502; lane, Lord Holland's Stables ⅂
1124, s 62 w	197, N 83 E	927		4416	2073	Do. 1939; middle Lord Holland's House ⅂
1030, s 89 w	490, s 62 E	540		4956	2973	Do. 2573; lane (foot path) to Notting Hill ⅂
85, N 74 w	940, s 62 E		855	4101	4103	Do. 3731; corner New-road ⅂
1045, s 2 w	73, N 2 E	972		5073	4453	
1112, s	58, N 21 E	1054		6127	4785	Do. 4633; Sir J. South's Observatory ⌜
1060, s 2 w	45, N 1 E	1015		7142	5153	Do. 4931; road to Duke Bedford's, Ld. Bute's, &c. ⅂
584, s	14, N 1 E	570		7712	5529	Posts in path at Camden-hill Terrace.
781, s 11 E	253, N 10 W	528		8240	5753	Lamp-post top Bedford-place.
74, N	587, N 89 E		513	7727	5953	No. 2, Upper Bedford-place, curb stone.

The above is part of a field book, from an actual survey recently made in the neighbourhood of the Editor.

*** The mark ⅂ implies the place lies on the left, ⌜ on the right.

Memoir on the Theory of the Steam-engine, such as it has been expounded in a preceding Memoir (see No. 15.), on the Calculation of Engines of High Pressure. By M. DE PAMBOUR. *Read before the Academy of Sciences, June 19th. Commissioners the same as before.*

IN a former memoir *on the Calculation of High-pressure Steam-engines*, we have demonstrated the inaccuracy of calculations hitherto in use with regard to these machines; and we have developed a new theory, from which we have deduced formulæ proper to show immediately, and without co-efficients of correction, both the effects and the proportions of machines. In a second memoir, making a continuation of the former, *on the Theory of the Steam-engine*, we have presented a great number of new proofs, deduced from different considerations, which establish in an incontestable manner the principle serving as the base of our theory, and demonstrate anew that the ordinary theory is incorrect. But as one may imagine that this inaccuracy, of which we complain, is of little account, we are going to submit this method with ours to the test of practice. In seeing their workings simultaneously, one will easily judge of the difference between them and of the fundamental causes which influence their results.

The co-efficient of correction for high-pressure steam-engines, without expansion and condensation, not being given by the authors who have treated on these subjects, we propose in order to determine it, the two following facts which have passed under our eyes:—

1°. The Leeds engine, which has two cylinders 11 inches in diameter, stroke of the piston 16 inches, wheels 5 feet, has drawn a load of 109 tons, at a velocity of 20·34 miles an hour, the effective pressure in the boiler bring 54lbs. per square inch, or the total pressure 69lbs. per square inch.

2°. The same day, the same engine has drawn a load of 27 tons, at a velocity of 29·09 miles an hour, the total pressure in the boiler being 69lbs. per square inch, as in the preceding case, and the regulator opened to the same extent. These experiments appear in pp. 252 and 254 (French edition) in our treatise of locomotives.

In calculating on one part the force applied to the piston, after the ordinary calculation, and on the other the resistance opposed by the load plus that of the air against the train, and that of the atmosphere against the piston, since

the engine is a high-pressure one, we find (the area of the two cylinders being 190 square inches):

1st Case.—Force applied on the piston after the ordinary calculation, 190 × 69lbs.	13,110lbs.
Effect produced.....	8,839
Co-efficient of correction	0·67
2d Case.—Force applied on the piston as above	13,110
Effect produced.....	5,847
Co-efficient of correction	0·45
Mean co-efficient of the two cases	0·56

Thus are the two co-efficients very different. If one chooses the former he will commit an error in the second case; if he chooses the second he will commit an error in the first; if he chooses the third he will divide the error between the two. In every way one is sure of error; and it will be sufficient to prove that every method, as in the ordinary theory, which consists in the employment of a constant co-efficient, is necessarily erroneous, whatever may be the co-efficient chosen, and to whatever system of machines one makes the application; for it is evident that the same fact is presented in every kind of steam-engine. Only it will be less marked if the velocities are less different; and it is this which has hindered us to this moment from perceiving the error of the method, because all engines of the same system being copies the one of the other, and travelling at nearly the same velocity, according to a fictitious limit settled for the velocity of the piston, the same co-efficient of correction appears to serve with them all tolerably well.

Besides, in these machines in general, one cannot for want of precise determinations of the frictions, separate in the result the part which is really attributable to them from that which constitutes a veritable error; but here we may convince oneself very easily that these co-efficients of correction, neither the one nor the other, represent, as we have been informed, the losses and different resistances of the machine; for the direct experiments on the engine with which we have been occupied, and consigned in our treatise on locomotives, have enabled us to evalue separately all these frictions and resistances. We shall say then, that in reckoning the friction of the engine at 108lbs., its additional friction at ½lb. per ton of the load, and adding to it in each case the pressure on the opposite face of the piston by

reason of the exit aperture (tuyère) we find for the sum of these different frictions and resistances,

1st Case 1722lbs. or 0·13 of the theoretic result
2d Case 1860 0·14 of the ditto.

Thus one sees that in each of these two cases, the frictions and resistances omitted in the calculation do in reality rise only to 13 or 14 hundredths of the theoretic result; whilst the co-efficients of correction would mount them to ·33 on one part and ·55 on the other, that is from two to four times what they really are. If then from these co-efficients we subduct the true error of the friction we shall find *the theoretic error*, which this method introduces in the calculation under the denomination of friction; it is 20 per cent. of *the total force of the machine* in one case, and 41 in the second. We believe these facts are sufficiently clear, and we shall be able to produce some where the error is greater still.

But we shall now revise the entire calculation, by adopting the mean co-efficient ·56 determined above, in order to approximate the result thus obtained with the effect produced, and to have a calculation immediately comparable with that given by our theory. In taking account in this result produced of all the frictions and resistances, namely, the resistance of the train, resistance of the air, friction of the machine, additional friction of the load, pressure of the atmosphere, and pressure due to the exit aperture (tuyère) we find—

1st Case—Force applied on the piston after the ordinary calculation, 190 × 69 × ·56.....	7,342lbs.
Effect produced, comprising all the frictions and resistances	10,560
Error besides frictions and resistances	3,218
The calculation gives only two-thirds of the real effect.	
2d Case—Force applied on the piston after the ordinary calculation as above	7,342
Effect produced, comprising all the frictions and resistances	7,707
Error besides frictions and resistances	365
The calculation is nearly exact	
Mean error of the two cases	1,791lbs.

Thus in taking account in the calculation of the different frictions and resistances, one finds nothing but the co-efficient conducting to a true result. We may observe,

moreover, that in applying any other co-efficient *whatever*, the error will be only tossed from case to case without ever disappearing; and it is in this way that the co-efficient ·56 has nearly annihilated the error above of the second case, in carrying it back on the first. The extreme co-efficients ·67 and ·45 give 566 and 2356lbs. of mean error; so that between the two extreme co-efficients the mean and inevitable error remains always 1461lbs.

In our theory the effort applied by the machine to a known velocity is given by the formulæ.

$$a\,R = \frac{m\,S\,P}{v},$$

Where a is the area of the piston, v its velocity, P the pressure of the vapour on unity of surface in the boiler, R that exerted by the resistance on unity of piston surface, m the volume of vapour at the pressure P, referred to the volume of water which has produced it, and S the effective vaporization of the engine, which is here 80 cubic feet per minute; it is sufficient then to make the needful substitutions in each case, preserving everywhere the same unity, and we shall find:—

1st Case—Effort exerted on the piston according to our calculation $\frac{413 \times \cdot 80 \times (69 \times 144)}{298}$	11002lbs.
Effect produced, comprising all the resistances and frictions	10560
Difference	442
2d Case—Effort exerted on the piston, according to our calculation $\frac{413 \times \cdot 80 \times (69 \times 144)}{434}$	7562
Effect produced, comprising all the frictions, &c.	7707
Difference	145
Mean difference of the two...	293

We see then that we arrive at the effect produced, with a difference of 293lbs., but trifling for experiments of this kind, where all depends on the management of the fire.

II. To continue the comparison of the two theories, suppose, on the contrary, that one may regard the resistance as known, and calculate the velocity which the engine would acquire with this resistance. In calculating, by the ordinary theory, the velocity, the vapour would take in traversing the cylinder without reduction of pressure, and applying the co-efficient of correction ·56, one finds for the velocity in

feet per minute (the area of the cylinders being 1·32 square feet):—

1st Case—Velocity of the piston, by the ordinary theory,

$$\frac{\cdot 80 \times 413}{1\cdot 32} \times \cdot 56 \quad \ldots\ldots\ldots\ldots \quad 185$$

Real velocity 298

Error in feet per minute 113

The calculation gives only half the real velocity.

2d Case—Velocity of the piston by the ordinary theory as above 185

Real velocity 434

Error in feet per minute..... 249

The calculation gives but a third of the real velocity.

The mean error of the two cases is 181 feet per minute. The co-efficient ·67 would give for the mean error 145 feet, and that of ·45 would give 217 feet per minute. We see then that between these two extremes the mean error will be always about 180 feet per minute, without its being possible by one co-efficient or the other to avoid this result.

In our calculation, making the same substitutions as above, and putting for $a\,R$ its value given in each case, one finds:—

1st Case—Velocity of the piston in feet per minute by our calculation,

$$v = \frac{m\,S\,P}{a\,R} = \frac{413 \times \cdot 80 \times (69 \times 144)}{10560} \quad 311$$

Real velocity 298

Difference . . 13

2d Case—Velocity of the piston by our calculation.

$$\frac{413 \times 3\cdot 80 \times (69 \times 144)}{7.707} \quad \ldots\ldots \quad 426$$

Real velocity 434

Difference . . 8

III. Finally, if one would calculate what quantity of water the boiler ought to vaporize per minute, and transmit to the cylinders to produce, whether it be the first effect or the second, the ordinary theory will still be faulty, and this *whatever may be* the co-efficient of correction employed. For in calculating the consumption of vapour by the cylinder at the pressure of the boiler, and dividing, as the

authors who have treated on this subject have done, by the co-efficient ·56 to augment the production of vapour in proportion to the loss which this co-efficient represents, we find for the vaporization in cubic feet of water per minute (the area of the two cylinders being 1·32 square feet):

1st Case—Vaporization indicated by the ordinary calculation.

$$\frac{298 \times 1{\cdot}32}{413} \times \frac{1}{{\cdot}56} \quad \ldots\ldots \quad 1{\cdot}70$$

Real vaporization . . . . . ·80

Error . . . ·90

The calculation gives double the real vaporization.

2d Case—Vaporization indicated by the ordinary calculation.

$$\frac{434 \times 1{\cdot}32}{413} \times \frac{1}{{\cdot}56} \quad \ldots\ldots \quad 2{\cdot}48$$

Real vaporization . . . . . ·80

Error . . . 1·68

The calculation gives triple the real vaporization.

And observe, that every other co-efficient *whatever* would give a similar mean error. That of ·67 gives ·94, and that of ·45 gives 1·80 cubic feet of water per minute. The error is then inevitable in all cases.

In our calculation, it suffices to make the same substitutions as above, and approximating to the results of experiment, we have

1st case. Vaporization given by our calculation, in cubic feet of water per minute,

$$S = \frac{a\,R\,v}{m\,P} = \frac{10560 \times 298}{413 \times (69 \times 144)} = \quad \ldots \quad {\cdot}77$$

Real vaporization . . . . . ·80

Difference . . ·03

2d Case—Vaporization given by our calculation.

$$\frac{7707 \times 434}{413 \times (69 \times 144)} = \quad \ldots \quad {\cdot}82$$

Real vaporization . . . . . ·80

Difference . . ·02

Consequently, we see that in each of these problems presented in the calculations of engines, the ordinary theory,

even after defalcation of all frictions and resistances, contains still errors which vary from $\frac{1}{4}$ to 3 times the real effect; we could produce some examples where the difference would be much greater still. We may remark that we have arrived at this result, *whatever may be the co-efficient employed*, and we have observed that, in the two last problems the corrective co-efficient aggravates rather than remedies the evil: there can be no doubt then but that such an effect was due to a *fundamental* error in the theory.

In fact by examining the mode of calculation, indicated by this theory in the three problems in question, we easily discover in what this error consists.

1st. If it is required to know the load of the engine for a given velocity, the ordinary theory supposes the pressure in the cylinder equal to that in the boiler, and does not show the principle of difference which is attributed to the following causes: the contraction of the passages, the elbows of the tubes, the transit of vapour, the friction of vapour in the conductors, and condensation. Now all these causes, except the last, which is very nearly balanced by the precautions adopted in practice, must change the *velocity* of vapour, but not its *pressure*. Then this theory does not admit between the two vessels but a negligible difference of pressure. Now on the other side we have proved that the pressure in the cylinder depends not on the pressure in the boiler, but on that of the resistance; from whence it results that it is, *and from causes totally independent of those cited above*, very different from the pressure of the boiler. Hence the ordinary theory, which does not take account of these causes, ought to be so much in error wherever this pressure enters. Behold, then, one cause of error.

Besides, we have seen that the calculation gives the same result for every velocity, since it consists in always multiplying the area of the piston by the pressure of the boiler, and to reduce the result in a certain constant ratio. Now it is evident in principle that the faster the engine travels the less load it can draw. Hence a second reason why the calculation is erroneous.

Thirdly, we remark that this same ordinary theory, when it is required to know the resistance which the machine would move, does not take any account of the vaporization of the boiler; so that the load which the machine could draw at a given velocity would be independent of the force of vaporization, which is impossible. Hence we have here a third cause of error.

One may now perceive how much our theory differs from the preceding. It admits a cause, and a considerable and fundamental cause, of difference of pressure between the cylinder and boiler; this being that the pressure in the cylinder is no other than the pressure of resistance, and thus may be a half or a third of the pressure in the boiler. It takes account of the velocity, for this enters as a divisor in the formula, and of the vaporization of the boiler, for this vaporization appears in it as a factor. Our theory, then, differs essentially from the preceding; we may say that it is separated from it by the rejection or admission of these principles.

2d. If it be a question to know the velocity of the engine with a given load, how does the ordinary calculus proceed? It takes the pressure the same in the boiler and cylinder; neither can it do otherwise, since it does not show how they can materially differ. But, indeed, all the causes which have been invoked before to explain a difference of pressure, are represented here to establish a loss of velocity. Hence is employed with more confidence than ever the co-efficient of reduction. Well, but what happens? This correcting co-efficient augments the evil instead of corrects it. Consequently the theory of the employment of this co-efficient is entirely at fault.

Indeed, since in this theory there is a *loss* of velocity in the transit, the velocity of the piston ought to be *less* than that resulting from the passage of the vapour through the cylinder to the same state of pressure as in the boiler. On the contrary we have proved that it is *greater* by reason that the vapour, in going from the boiler to the cylinder, passes to the pressures of resistance, augmenting the volume in an inverse ratio, a circumstance which does not enter into the reasonings of the ordinary theory. Therefore this theory ought to produce a result diametrically opposite to truth, and the pretended correction ought to make the evil worse instead of better.

Besides, in the calculation of velocity, the ordinary theory takes no account of the resistance which the machine is supposed to move; that is, that it maintains, whatever may be the resistance imposed on the engine, that the velocity ought always to be the same, which is impossible. This is a second cause of error in the calculus.

Our theory, on the contrary, introduces in the calculus a principle very important in its results, namely, that the vapour goes from the boiler to the cylinder, *in taking the*

pressure of the resistance and in augmenting the volume in consequence. Besides, it takes account of the intensity of the resistance. Hence the two theories are separated by the whole interval of the two principles, and proceed in opposite ways the one from the other, the one tending to reduce the velocity of the vapour in the passage, and the other to augment it.

3d. Again, if it be required to calculate the vaporization necessary for a given resistance and velocity, the ordinary theory applies moreover its co-efficient in a sense opposed to truth. Indeed this theory admits an insignificant difference of pressure between the boiler and cylinder; but as this difference of pressure is not accompanied by a proportional augmentation of volume, which constitutes the fundamental principle of the mode of action of vapour, it finds only causes of loss where it has a veritable gain, and thence comes its erroneous result.

Besides, the calculus indicated by the ordinary theory rests only on the velocity and form of vaporization, leaving out entirely the intensity of resistance; which amounts to saying that the same force of vaporization will suffice to draw all loads at the same velocity. This is a new cause of error in the calculus.

In our theory, on the contrary, we introduce the principle of augmentation of volume of the vapour in passing to the pressure of the cylinder, and we take account of the intensity of resistance. Hence we see two principles interposed between this and the preceding theory.

Thus, in the first of our memoirs, we have developed and reduced into formulas our theory; in the second we have established it anew by a great number of proofs and facts; in this lastly we show that it conducts to true practical results, and that the theory of co-efficients wanders on the contrary considerably, and we show at the same time the causes producing those results. We believe, then, that the theory we have expounded cannot be revoked in doubt; and as it proves in the ordinary calculuses errors amounting to two or three times the real effects, we hope this theory will be of great utility in preventing the grave mistakes constantly occurring in the construction of engines, and which have compromised but too often the fortunes of particular individuals, or the success of great enterprizes, or the life even of travellers confided to steam-boats of a power ill calculated for the object intended.

[We really do not know what this ordinary theory is which M. Pambour so gravely accuses. We are not aware that any regular theory ever has been given as applied to locomotives. A few formulas we have met with, partly empirical and partly experimental, but nothing deserving the name of theory. Indeed, we do not think M. Pambour's theorems any better entitled to be called theory. They may, and do probably—for we must confess we have not seen that sort of comparison with experiment to satisfy us—represent experiments with tolerable fidelity, and so far they are valuable. This, however, is a long way from meriting the title of theory.

M. Pambour lays great stress on his principles showing a difference between the pressures of the steam in the boiler and cylinder, and on the throttling of the steam in its passage through the pipes. When did he first adopt these ideas? Was it before or after our observations thereon? For in his treatise on locomotives which he refers to, he distinctly states that the pressures in the boiler and cylinder are the same, and must be the same, when the engine has attained a uniform motion (see Rail. Mag. vol. ii. p. 8); and that the size of the conducting pipes used have been determined by experience, and are sufficient (see Rail. Mag. vol. ii. p. 1), both of which notions we combated and showed to be erroneous in the places alluded to, in our observations on the "Throttling of Steam in Locomotives." We think M. Pambour should show when he found out his errors before he presses so heavily on others.—Ed.]

Sheffield, Ashton-under-Lyne, and Manchester Railway.

[In No. 11, we have given reports of this line by Messrs. Vignoles and Lock, the eminent civil engineers. Our opinion has always been favourable to this undertaking, on account of the prospects of great traffic, and its being likely to pay well. In confirmation of our opinion we have lately read with some interest two letters in the *Sheffield Mercury*, which we understand have produced a great sensation in the surrounding country, and which we think, therefore, may not be unacceptable to our readers, who may feel an interest in the project, but may not have an opportunity of seeing the paper in question.—Ed.]

TO THE EDITOR OF THE SHEFFIELD MERCURY.

SIR,—I feel no surprise that the public have not manifested a great interest in the Sheffield and Manchester railway, when so few are acquainted with its peculiar advantages, which are far greater than the most sanguine have anticipated. It is a fact that this railway, from the absence of canal competition, will be able to obtain as much profit from carrying one ton of merchandize, as other railway companies having such competition, will have from carrying five tons; and there are very few railways without greater competition of some kind. It is well known that those railways which are forced to submit to low charges for carriage of goods, owing to canal competition, realize a very small profit, in consequence of the heavy expenses necessarily attending steam power. These approach so nearly to the entire receipts for the carriage of goods on most railways, that the shareholders even are not sufficiently aware of the great superiority which the Sheffield and Manchester railway must have by enjoying the exclusive advantage of monopoly in quantity, as well as monopoly in price. The expenses of conveyance are the same, whether there be competition or not, or whether the company charge 11s. or 22s. per ton. The price, whether low or high, cannot of course make any difference in the real expense of working the line. On the Liverpool and Manchester Railway the charges are, I believe, 9s. per ton for merchandize, and I calculate the expenses on that species of traffic at 75 per cent. on the gross receipts, which must leave a very small profit for conveyance. (No wonder at the coach passengers being the favourite traffic.) Now should the Sheffield and Manchester Railway Company be able to realize only the same rate of carriage, viz., 11s. per ton, which is in proportion to 9s. per ton from Manchester to Liverpool, the former being two-ninths longer than the latter, the following would be the advantage of one line over the other:—

	£.	s.	d.
Charge for carriage on merchandize per ton, in proportion to the Liverpool and Manchester Railway charge	0	11	0
Expenses, at the rate of the Liverpool and Manchester line, 75 per cent.	0	8	3
Net profit left, only 2s. 9d. per ton	0	2	9

	£.	s.	d.
But suppose the charge 22s., which would destroy all competition.....	1	2	0
Expenses in carriage, 75 per cent. on 11s., it making no difference in expense, whether the company charge 22s., or should be only able to realize 11s., if there had been canal competition	0	8	8
Net profit left, full 13s. 9d. per ton	0	13	9

From the above statement it is clear that when a company can obtain only 11s. per ton for carrying merchandize for forty miles, the profit is but 2s. 9d. per ton, but when they can obtain 22s. per ton for the same distance, it is 13s. 9d. per ton, or five times the profit. Therefore, when a railway has to contend with canal or river competition, it can realize only one-fifth part of the profit which it would, if no such competition existed. Is it not evident that the Sheffield and Manchester railway must gain as much profit on the carriage of one ton, having a monopoly, as it could on five tons, if there were competition?

Much has been said about bad gradients on the Sheffield and Manchester railway; now the worst is only 44 feet per mile, while the Liverpool and Manchester railway has a worse gradient of 59 feet per mile. When the public duly consider this fact, they will doubtless repent of their apathy, as the advantages only need elucidation to convince any reasonable person that the railway is likely to prove one of the most profitable lines in this country. And it is my earnest wish that it may complete its *termini* with

Sheffield, May 25, 1837. SUCCESS.

TO THE EDITOR OF THE SHEFFIELD MERCURY.

SIR,—I was glad to see the letter in your last week's paper, signed "Success," inasmuch as I consider it calculated to awaken inquiry respecting a measure of great general utility and convenience, and of the most paramount importance as regards the town and trade of Sheffield, and because the *two and two make four* kind of argument which it contains, and which shows that the writer is no chimerical speculator, must carry conviction along with it, and give hope and confidence in the minds of all who may have, or feel an interest in the undertaking.

My own opinion of this line of railway has always been

that, if carried into effect, it would prove eminently beneficial both to the public and the subscribers, and that opinion has been based in a great measure upon the same argument as is used by "Success," namely, the advantage it possesses in a monopoly of the carriage of every description of traffic; and although everybody who knows anything of the matter, has seen, and must see, this advantage, still I have scarcely met with a single individual, except your correspondent, who has taken the trouble to ascertain, or been at all aware of, the extent of it; and while I am ready to admit that it is possible even for the most cautious calculator to make errors, yet from the attention I have been able to give the statements contained in "Success's" letter, I believe them to be correct in the main, and that, if they should be erroneous at all, the error will be found to be on the right side; at any rate, as I have before said, his letter is calculated to create inquiry, which I feel satisfied is the only thing wanting to establish the Sheffield, Ashton-under-Lyne, and Manchester Railway, as one of the most useful, as well as one of the most profitable measures of the kind now before the public.

I cannot help fancying, that the friends and promoters of this undertaking must have abstained from publishing a number of its advantages, from a fear that they would, after the failure of the line originally projected, be considered a parcel of speculators and visionaries; but if the noblemen and gentlemen who have taken this measure by the hand had duly estimated their own characters, they need not have been afraid. It is well known that this railway was not, to use a common expression, "got up by jobbers," but that it originated with a number of highly respectable individuals, whose interests were closely connected with the prosperity of this town, and was launched, I may almost say solely, by parties engaged in, or connected with, the trade of the two important places it was intended to unite. It is time now, I think, if these gentlemen are too fastidious, for others to try to open the eyes of the public, and especially of the people of Sheffield, to some of the real but hidden merits of this railway, and I hope you will allow me, through your columns, to add my mite in this endeavour, as well as your correspondent "Success." I believe, on examination of the statement put forth by the Liverpool and Manchester Railway Company, the last half year's expenditure on that line, ending December 31st, 1836, will be found to be 79,628*l.* 14s. 8d., including 6,000*l.* for new

rails, and 9,675*l.* 9s. 4d. for interest on borrowed capital. Deduct the two latter from the first mentioned amount, and it will leave 63,953*l.* 5s. 4d. for the cost of working the line and all attendant expenses. The income of the same half year is, for coach passengers ..... 75,986*l.* 13s. 9d.
And for merchandize and coal ..... 49,293*l.* 6s. 8d.

Total..... 125,280*l.* 0s. 5d.

The average expense on the whole income will, therefore, be about 53¾ per cent., or if taken separately about 35 per cent. on coach passengers, and 75¾ per cent. on merchandize. How then the Committee of this undertaking have concluded to take 50 per cent. as the average expense on passengers and merchandize combined, I cannot imagine, for, if I am correct, they ought to have charged 35 per cent. on the former, and (inasmuch as they will be able to obtain 22s. per ton) 37½ per cent. on the latter. If there had been canal competition, as it is the case with nearly every other railway in the kingdom, and they could only have obtained 11s. per ton, then 75 per cent. would have been correct, but here there is no such competition, and what is more, *never can be.*

It is evident, then, from the above, that 40 per cent. on the whole income will be more than sufficient to cover all expenses, and that the Committee have deducted on this account, 10 per cent. more than necessary, which will make a very material difference in the nett profits. This underrating, (if I may be allowed to use the term,) of the advantages of their railway by the Committee, although done I have no doubt from the very best motives, is not calculated, I can assure them, to advance it in public estimation, and they ought to have had sufficient reliance on their *own good name*, to have emboldened them to state the *whole* truth. I regret, Mr. Editor, (though probably you may not,) that I have not time to go further into the subject of this letter; I hope, however, that coupled with the letter of "Success," it may lead people to deliberate upon, and take the trouble to inquire into, the peculiar advantages and disadvantages which the Sheffield, Ashton-under-Lyne, and Manchester Railway possesses, and I have no doubt whatever, as in my own case, of a satisfactory result.

I am, Sir, yours, &c.

ONE OF THE TOWN AND TRADE OF SHEFFIELD.

Sheffield, June 1, 1837.

Eastern Counties Railway.—An Address to the Shareholders. By a SUFFERING SHAREHOLDER.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—As a perfect stranger to you, it may doubtless be considered intrusive in me in any way to occupy the pages of your valuable Magazine, but having read the very impartial manner in which you have judged the merits of several speculations like the present, I trust your love of justice and truth will form a sufficient excuse for my addressing myself, through the medium of your Journal, to the Shareholders of the Eastern Counties Railway; showing in what manner their money has been expended without giving them any reasonable hope of a return.

The capital of this Company is 1,600,000*l.* The first balance-sheet drawn up by the Secretary was on the 4th of July, 1836, showing the amount of paid-up capital, then in the hands of the Secretary, to be 61,845*l.* 2s. 9d., arising solely from the *deposits* upon shares, and the interests upon such deposits. The different sums disbursed to the same period amounted to 36,561*l.* 16s. 5d., leaving a balance then in hand of 25,283*l.* 3s. 4d.

Since then, the first call of 1*l.* per share has been made, which, added to balance as above, will make the sum of 87,128*l.* 16s. 1d., so that, during the past year, your Directors have had this last amount to expend on the works; and this, added to the expenditure previous to the 4th of July, 1836, will make a total of 123,690*l.* 2s. 6d. of the Company's capital already expended.*

Under these circumstances the Directors, at a meeting of the Board, held the 4th of July, 1837, "feel satisfied that, by the prompt expenditure of 600,000*l.* in addition to the sums already laid out," they will be enabled to open the "two terminal divisions of the line; namely, from between London (near Whitechapel-gate) and Brentwood (eighteen miles), and between Norwich and Yarmouth (eighteen miles.)" So that, after expending the immense sum of 723,690*l.* 2s. 6d., all the Shareholders are to obtain, is the profits, if any, arising from these two "terminal lines." It is true the Directors say that they (the two terminal lines) "may be reasonably expected to yield 150,000*l.* per

* We hope not all; we trust there is something left to pay the salaries, especially the Secretary's.—ED.

annum," which is rather more than twenty per cent.* on the amount which will then have been expended of the Company's capital.

But, I ask, do the *Shareholders* "reasonably expect" such a profit? They cannot. No railway ever has yielded such a profit, even when enjoying far more advantageous prospects than the Eastern Counties Railway. And it is only a set of men calling themselves a "Board of Directors," could ever conjure up such visionary schemes, or attempt to force it on a body of respectable and enlightened shareholders, for the sake of finding some excuse for forming handsome secretaryships,† and numerous other sources for private benefit.

Now, shareholders, will you be content with this? Your Directors intend, after spending 723,690*l.* 2*s.* 6*d.*, to give you only thirty-six miles (of the whole line of 126 miles) opened for your revenue, and for the remainder of the distance (ninety miles) they have only 876,310*l.* of unpaid-up capital to complete it with; whereas, in a letter addressed to H. N. Ward, Esq., by the Secretary of the Company, he states the average cost per mile, between London and Chelmsford, will be 23,000*l.*, and between Ipswich and Norwich, 12,000*l.*; and at this rate 1,280,000*l.* will be required for the ninety miles to complete the whole line—that is, taking eighty miles at the latter rate, and ten miles at the former—so that they will actually want 404,000*l.* more than the present proposed capital; and, in addition to this, there are 2,324 shares to be disposed of at the discretion of the Directors, for the *benefit* of the Company, which, at their present value, or at any value they are ever likely to attain in the market, will not yield more than 3,500*l.*, being about one-third of what they would fetch if sold at par.

It is true the Act allows the Company to raise 500,000*l.* by loan, but the total expenditure comes so near the utmost

* Twenty per cent. on 723,690*l.* for thirty-six miles of railway, divided into two parts, NINETY MILES ASUNDER, one part *terminating in a little fishing town*, and the other in the pretty little village of Brentwood, containing a population of 1,692 souls, including men, women, and sucking babes!! Dear, dear! who could have been the author of so poetical an effusion?—ED.

† What does our correspondent mean? we are very angry; it is *only* 800*l.* a-year the Secretary has, and we don't know that there is a single cheese-paring or candle-end besides. The Company have little or nothing going out for work, have they? How unreasonable, then, to find fault with the "*handsome secretaryship.*"—ED.

limits of the Company, that they must borrow at an enormous rate of interest to induce anybody to advance money upon such an extravagant, if not apparently losing concern.

Shareholders, will you submit to this mismanagement, to say the least against it? Call a meeting amongst yourselves, and sit in judgment on the Board of Directors; call them to account in what way 50,000*l.* or upwards was spent before a stick or a stone was touched towards making your railway. Insist on having the enormous law charges taxed, ascertain in what way more than 1,600*l.* was paid for salaries previous to the first general meeting, which was held three months after the passing of the Act; do not suffer yourselves to be thus led by the Directors,* for, unless you show that you feel an interest in managing your own affairs, your whole capital may be sunk, and you will be without any probability of a return.

These, I think, will be found to be *the facts*, upon any one looking closely into the accounts; but no one would be more rejoiced for the Secretary, or any of the Directors, to be able satisfactorily to disprove them than,

Your obedient, humble Servant,

A SUFFERING SHAREHOLDER.

Great Western Railway. By an ADVOCATE FOR RAILWAYS.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—It being *now* a fact past dispute, that the Liverpool and Manchester Railway has paid, and is paying, a dividend of nine to ten per cent. on a cost of 40,000*l.* per mile, what financial argument can reasonably be advanced against contemplated lines of equal length, where the cost may safely be calculated not to exceed that sum, and between whose termini there exists as many coaches as ran on that road previous to the establishment of the railway?

For cheapness and expedition few roads gave greater facility in coach travelling than the Liverpool and Manchester, for canal traffic perhaps none so much.

If, therefore, a longer line were made, with *much less* capital per mile, and on which it is proved beyond question

* Our correspondent is hard on all the Directors. We know some of them personally and well; and we can assure him that they are thorough men of business, unimpeachably honourable. It is, however, in vain to have men of business in any board, if the majority are not so; they are open to the wiles of any artful intriguer.—ED.

a *far greater* number of coaches at present pay well, and where the canal transit is so defective as to oblige the traders to sustain a caravan and waggon expense, can there be a moral doubt of such line doubling the per centage of the Liverpool and Manchester Railway?

On these broad principles, I beg leave to draw the attention of your readers to the Great Western Railway, some accurate particulars of which I sent you yesterday.*

The additional profit of working a long line of beautiful gradients over one of thirty miles, with two inclined planes fifty-five feet per mile for three miles, will be noticed in my next communication, with a comparative view of the merits of the London and Birmingham, provided you find room in your Journal for a RAILWAY ADVOCATE.

Bristol, June 23, 1837.

Extract of Evidence given before the Committee of the Lords, on the London and Birmingham Railway Bill, 1832:—

Mr. Henry Booth, Treasurer of the Liverpool and Manchester Railway, on being asked, "How many regular coaches were there on the road previous to the establishment of the railroad between Liverpool and Manchester?" answered, "About TWENTY-TWO COACHES."

Extract of Evidence given before the Committee of the House of Commons, on the Great Western Railway Bill, 1834:—

William Sutherland, examined.

Question.—You are a clerk in the Stamp-office, in the coach department?

Answer.—I am.

Q.—Look at that account (handing one to the witness) and tell me whether it is an account showing the number of coaches upon the road between London and Bristol?

A.—The coaches licensed from London to those different places.

Q.—That is made up from the books kept in the stage-coach office at the Stamp-office?

A.—Yes.

Q.—Have the goodness to read it.

[Witness read a list, from which the subjoined statement is made.]

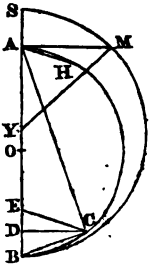
* The communication alluded to is the "Extract, &c.," following.

COACHES TO LONDON.

	Journeys to & from	Equal to each way.	Total each way.		Miles.
From or through					
Bristol	20				
Exeter	19				
Devonport	3				
Taunton	5				
Bath	6				
Bath to Bristol 25, making 304 weekly journeys, or 43 daily, 12 miles added to Bath, 106 miles	— 53	26½	26½	from Bristol . .	118
From or through					
Cheltenham . . .	4				
Gloucester	6				
Hereford	4				
Stroudwater . . .	4				
Marlborough . . .	1				
	— 19	9½	36	" Swindon .	77
Farringdon . . .	1				
Wantage	1				
	— 2	1	37	" Wantage .	61
Oxford	10				
	— 10	5	42	" Didcot . .	52
Wallingford . . .	3				
	— 3	1½	43½	" Wallingford	48
Newbury	4				
Reading	11				
	— 15	8	51½	" Reading . .	36
Maidenhead . . .	1				
Great Marlow . .	1				
High Wycombe .	1				
Henley on Thames	1				
	— 4	4	55½	" Maidenhead	58
Windsor	7				
	— 7	7	62½	" Slough . . .	18
Uxbridge	7				
Harlington	1				
	— 8	70	70½	" West Dayton	13

Averaging the whole distance of 118 miles, equal to 40 coaches.
Posting equal to 8 coaches, or . . . . . 4 each way.
Intermediate coaches, of which there are many running short of London *not* included.

Answer to the Mathematico-Mechanical Problem, in No. 17, p. 15. By F. C., the Proposer.



Make A Y = 15, half the given distance; erect A M perpendicular to it, and such that A M² = twice the square of the given tube. With M Y as radius, and centre Y describe a circle S M B. On A B as a diameter describe another circle A C B; make B C = E C = the given tube, then A C joined will be the tube required.

Demonstration.—By the circle A B · 2 D B = 2 B C²; also A B · A S = A M²; therefore, A S = 2 D B = B E. But Y being the centre of circle S M B, and A S = B E, it follows that A Y = Y E = half the given vertical distance. By the laws of descending bodies on inclined planes, since the time of descent in each tube is equal, the tubes themselves be two chords of the same circle. Make A H = B C or E C, then ∠ H A B = ∠ C B A = ∠ C E B; therefore A H is parallel to E C, but the time down A H equals the time down A C, therefore the time down E C equals the time down A C, and consequently A C and E C are the two tubes resting against the upright wall A D.

Calculation.—In the △ M A Y we have A Y and A M to find M Y = B Y = 5 √41; and $\sqrt{AB^2 - BC^2}$ = A C = 42·5496.

THE SAME OTHERWISE.

Put A C = *a*, E C = *b* and D B = ½ E B = *x*; then by a property of the circle $(a + 2x) \cdot x = ax + 2x^2 = b^2$, the root of which $x = \sqrt{\frac{1}{2} b^2 + \frac{1}{16} a^2} - \frac{1}{4} a = 8{\cdot}5078$, and consequently $\sqrt{A D \cdot A B} = 5\sqrt{34 + 6\sqrt{41}} = 42{:}549$ = A C, the length of the required tube.

A solution has been also given to this problem by Mr. Wm. Stuart, jun., of Plymouth, who proposes to our readers to solve the same problem *when the required tube is a maximum or minimum, the other data in the question remaining the same.*

"ROYAL SOCIETY AND MR. HERAPATH."

[The private correspondence which terminated in the exit, expulsion, or forced retirement of Sir Humphry Davy from the Presidency of the Royal Society.]

January 17th, 1821, I attended Sir H. Davy's Evening Meet,

ings for the first and only time. We had a long chat together in the rooms, in which he spoke very kindly and encouragingly, and hoped, alluding to my paper, that I would not be discouraged by the *opinions of one or two*, laying an emphasis of contempt on the word "opinions," adding, that there are two or three in the Council who are determined it shall not pass." He introduced me to Dr. Young, who, on my asking him, said, he had not seen or heard of the paper, yet, in a few minutes after, discussing the mode of making some experiments, he observed, "but you, in your paper," (referring to this very one) "say * * *." This is the individual alluded to in my letter in the "Times" of July 2, 1827.—J. H.]

(XIV.)

Cranford, January 24, 1821.

Dear Sir,—I have delayed acknowledging the receipt of your very obliging note, until I thought the assembling of Parliament would call you to town. I beg to return you my best thanks for your kind wishes for the success of my business and for the honour of an introduction to a meeting of the Royal Society, which you have had the goodness to offer me, and which I will accept with thankfulness and pleasure whenever its suits your convenience, if you will have the kindness to inform me two or three days before. Should, it, however, be equally convenient to yourself, I should be glad to have this introduction in about a month or six weeks hence, by which time I shall be a little better settled in my house than I am at present.

With respect to my paper, I am exceedingly sorry for the trouble it has given you, and could I have foreseen this, as well as the anxiety it has cost myself, it would never have been presented, but now I have unfortunately no alternative but to proceed, however great the difficulties I may have to encounter, or to retreat with detriment, disgrace, and contempt. I do most heartily condemn my own precipitation and imprudence in having first undertaken to send the communication in question; and could any way be pointed out by which I could get out of my difficulties without risking the good opinion of my friends, and exposing my scientific pretensions to suspicion and distrust, I would most readily take it. This disposition, however, arises solely from an *aversion* to scientific controversy, and not from any doubts respecting the accuracy of the views I have taken, nor of any apprehensions of my being enabled satisfactorily to establish my positions, against which, after an eight months' consideration among some of the ablest men in England, I have had the satisfaction of seeing that not a single objection of any weight has been advanced. But, enough of this subject. I hope this will be the last time I shall have to write to you upon it, and that as soon as I have sent an account of the experiments I have made to Sir H. Davy, who has expressed a desire to have them, those gentlemen who have read my paper

will be induced to put more confidence in the conclusions I have drawn, and to examine attentively their objections before they make up their mind on the merits of the paper.

Should you see Sir H. Davy, I should feel obliged if you will have the goodness to inform him that I will endeavour to send my experiments on the mixture of bodies of unequal temperatures as soon as I can put them together.

I am, dear Sir, your most obedient humble servant,

(Signed) JOHN HERAPATH.

To Davies Gilbert, Esq., M.P.

(XV.)

No. 45, Bridge-street, Westminster, January 30, 1821.

Dear Sir,—I am very glad to find that Sir H. Davy has set you right on a subject which I must have insufficiently explained.

Every Fellow of the Royal Society, who presents a paper is, to a certain extent, held to be responsible for it. On your account as well as on my own, I did not like to present a paper of so much importance, embracing so very wide a field, without consulting two or three members of the Society, most conversant in the subject treated on. I think that one, if not two of them, were not members of the Council. Your paper has, therefore, never been before the Council, nor are three-fourths of this body aware of its existence. With the exception of next week I shall probably be here till Easter, and I shall be extremely happy to take you to the Royal Society at any time most convenient to yourself.

Believe me, dear Sir, your's very faithfully,

(Signed) DAVIES GILBERT.

To John Herapath, Esq.

(XVI.)

Cranford, near Hounslow, February 5, 1821.

Sir,—I have taken the liberty of troubling you with some of my experiments* on temperature, which I trust you will find satisfactory. Every pains that could be taken, I have taken to avoid error, and I hope, therefore, that the striking agreement of these experiments with the theorem given in my memoir on the "Physical Constitution of the Universe," long before I had ever thought of making an experiment, will have some weight with those gentlemen who have opposed my views, and induce them to re-examine their objections. That these experiments, if they are allowed to be correct, are a decisive proof of my theory of the constitution of gases, and,

* These experiments, Sir H. Davy, had expressed a wish to have in his letter to me (see No. 17, p. 30.) of January 13th, 1821, and to present them to the Royal Society himself.—J. H.

therefore, of my theories of collision and heat, no one I think can deny; and, if they are not allowed to be correct, it will remain to be shown wherein I have erred, and what kind of miracle it must have been to produce so imposing an agreement.

As I had in the notes from which I have drawn up these experiments carried my calculations of the corrections to quarters of degrees only, and here to tenths, I cannot take upon myself to vouch for the perfect accuracy of every correction to a single tenth or two; but I took some pains to make them correct, and I shall, if required, have no objection to repeat the calculations.

Should you think this communication worthy of being laid before the Royal Society, I should feel obliged by your informing me of it previous to any attempt being made to have it read; and at the same time with the ultimate decision respecting my other paper. It is not my wish to hurry you or your friends in making up your minds on this subject, but I should be thankful to have your decisive opinions and intentions as soon as you can conveniently give them.

Should the sentiments of your friends, on the subject-matter of that unlucky paper I have sent, be still unfavourable, I hope you will grant me your permission to withdraw them both together,* and to bring them before the public in such a way as shall induce those gentlemen to establish or to abandon their objections. Believe me, Sir, I have not the least desire to enter into a scientific controversy. It is a thing I very much dislike, of which I cannot give a more striking proof, than my having throughout the whole of that paper studiously avoided speaking in any way disparagingly of the works or opinions of others, or in a manner that could in the least tend to engender any other feelings than those of friendship. But I have in the fate of this paper interests at stake, which make it imperative on me, however unpleasant, and whatever it may cost me in mental peace, to pursue this subject, and not to submit to any opinions which do not contain an absolute refutation. I do, however, most solemnly beg leave to assure you and these gentlemen, that to whatever lengths I may be obliged to go, and however much I may differ from them in scientific views, I have not the least or the most trifling feeling of hostility towards them, for the opposition I have experienced. On the contrary, I should feel most happy to do anything that would even tend to show them how much I would prize and value their friendship, the acquisition

* This was the first thing which gave Sir H. Davy offence, and it may have been unwise on my part. I was not, however, ambitious to appear in the "Philosophical Transactions," and felt vexed that a paper on the subject of the highest possible importance, and in which the Royal Society had pretended to take so much interest, should have caused me such great trouble without the slightest substantial reason being given. Mr. Gilbert, a few days after, informed me that Davy spoke in very high terms of the experiments, and wondered why I would not allow him to present them to the Society.—J. H.

of which I should number among the most fortunate events of my life. Anxiously awaiting your reply,

I am, Sir, with the greatest respect, your obedient servant,

(Signed) JOHN HERAPATH.

To Sir H. Davy, Bart., P. R. S., &c.

[Between these letters I had seen Sir H. Davy again, and found him very unlike the kind affable man I had seen him at my first visit, January 17th. He affected the great man—talked dictatorily—was going to upset me at once by some experiments of De Luc, but, though I saw the book under his fingers, he would not take it down, probably well knowing he would have confirmed me, as I then told him the experiments he alluded to would.—J. H.]

(XVII.)

February 28, 1821.

Sir,—I have perused the paper containing an account of experiments on temperature, which you did me the honour to send me, and I have likewise submitted it to a very able philosopher, who has added a note* at the end, which alone would show that in its present state it could not with propriety be communicated to the Royal Society.

The gentleman who for some time had in his possession your observations, on the "Physical Phenomena of the Universe," has at length returned them, expressing precisely the same opinion as those gentlemen to whom Mr. Gilbert referred the communication.

Under these circumstances I beg to know whether [In my last I had requested it.—J. H.] and in what manner I shall immediately return to you the two papers?

As you propose to publish these papers together, I take the liberty of mentioning what I suppose must be a mere verbal error. You speak of mixing mercury in vessels of hammered tin, a metal

* This note amused me much. It was by Dr. Roget. I had stated in my experiments that the volumes of the same quantity of gas under the same pressure, varied as the squares of the *true* temperatures; and, therefore, where the volume sinks to 0, that is (supposing the particles to be infinitely small) at 480° Fahr. below 32° Fahr., the temperature would be 0. This would obviously be the case in whatever power of the volume the temperature varied. Dr. Roget, however, says it must have been at 1043°. Behold the arguments in the celebrated note, written, I presume, that the author might not be mistaken, on the back of a letter directed to himself.

"If (as Mr. Herapath maintains) the temperature of melting ice be to that of boiling water, in the *subduplicate* ratio of 8 to 11, that is, as $\sqrt{8}$ to $\sqrt{11}$, or 1:1·1726: Then the difference of the temperatures, is to the total temperature of ice, reckoned from the real zero, ::1·1726—1 (or 0·1726):1::180°:1043°, and not 480°, as Mr. H. makes it, from having calculated according to the *simple* and not the *subduplicate* ratio.—P. M. R."

This note I intend to have framed and glazed as a perpetual memento, to my posterity, in how few words their ancestors' labour of years had been overturned, by "*a very able philosopher*."—J. H.

which is rapidly dissolved by quicksilver.* I presume you mean iron plated with tin; but even this material is very objectionable for the same reason.

You are mistaken if you suppose there are any hostile feelings towards you or your opinion, entertained by those gentlemen who have read your papers; they do not think them fitted as they now stand for publication in a work devoted to experimental or demonstrated knowledge, such as the "Transactions;" but they give this opinion as private individuals only, and not as members of the Royal Society, or of the Council; and it is a compliment paid to your ingenuity, and promise of future labours, that your communications have been examined with so much care.

I am, Sir, your obedient humble servant,

(Signed) H. DAVY.

Mr. Herapath—I beg to repeat my invitation whenever you happen to be in London on a Wednesday evening.

REPORTS.

REPORT OF THE MILITARY ENGINEER ON THE BRIGHTON RAILWAYS.

THE following is the report of the Military Engineer, appointed in pursuance of an Address of the House of Commons to his late Majesty, on the several lines of Brighton Railway:—

In obedience to your orders of the 2d and 9th of June, 1837, directing me to report in conformity with the instructions from Her Majesty's principal Secretary of State for the Home Department, on the following proposed lines of railway between London and Brighton, viz. Sir J. Rennie's, or the Direct Line, Mr. Stephenson's, Mr. Gibbs's, and the South-Eastern, I have the honour to state, that I have carefully read over the evidence given before the Committee, as well as their report, and attentively compared the several plans and sections submitted to me; that I have also taken a general survey of the sites of the different lines, examining more attentively those portions where works of importance are proposed, and have no hesitation in stating, that the line proposed by Mr. Stephenson, considered in an engineering point of view alone, is preferable to either of the others. Availing himself of the valleys of the rivers Mole and Adur, he avoids the heavy cuttings necessarily consequent on forcing a passage through the

* This is explained in my letter, No. 21, to have been tinned iron with the tin melted off previously, but I cannot here help mentioning a most illiberal piece of conduct and untruth on the part of Davy in reference to this, which happened some years after. A gentleman asked him, what he thought of Mr. Herapath as a philosopher. "What," replied Davy, with a significant shrug of the shoulders, "can any one think of a man, who could make experiments with mercury, *at very high temperatures, in* COPPER *vessels!*"—J. H.

chalk ridges known as the North and South Downs; and, with the exception of two short tunnels, one at Epsom and the other at Dorking, arrives at Brighton, *vid* Shoreham, having only such ordinary difficulties to contend against as are necessarily consequent on undertakings of a similar nature and extent.

As, however, there is but one point for consideration of a main line of railroad, I will now proceed to consider the respective merits of the several lines with reference to the second resolution of the House of Commons.

On referring to the map and the population returns, it will be seen that the country passed through, or approached by either of the lines, as well as on the coast, within reach of railroad communication by branches, containing neither manufacturing nor mineral districts, the town presents only the usual traffic of an agricultural population, and are, as compared with Brighton, of minor importance. It appears to me, therefore, that after attending to one principal point in the construction of any main line, viz. "that its London terminus be central,"—that route between London and Brighton which best unites engineering facilities with convenient termini should be preferred. I will then consider the termini of the various lines with reference to the accommodation they afford to the metropolis at one end, and the town of Brighton at the other. Each of the proposed lines avails itself of a terminus already constructed, or for which an Act of Parliament has been obtained. Mr. Stephenson adopts the terminus of the London and Southampton Railway at Nine Elms, a little above Vauxhall-bridge with a depôt on the banks of the Thames, branching from this line at Wimbledon-common, five miles and a half from the terminus. The Direct line and Gibbs's adopt the Greenwich Railway terminus at London-bridge and avail themselves of railway communication, already sanctioned and now constructing as far as Croydon. The South-Eastern also has its terminus at London bridge, and, in addition to the Croydon, avails itself of 12 miles of the Dover Railroad, branching off at Oxted.

Taking the Middlesex side of Blackfriars-bridge as a centre, and describing circles with the several radii of one, one and a half, and two miles, thus including within the last an area of upwards of 12 miles bearing the densest population in the world, it will be found, that, whilst the terminus of London-bridge is within the smallest of these circles, that, of Nine Elms is without the largest; under these circumstances it may be fairly inferred, that Stephenson's London terminus is not so conveniently situated as that of the other lines, particularly for an extensive passenger traffic, as that of any line connecting Brighton with the metropolis is almost sure to prove.

The Greenwich Railroad being already constructed on a viaduct of sufficient width only for two lines of rails, I doubted whether it would be capable of affording sufficient accommodation for the in-

creased traffic proposed to be thrown upon it, more particularly, as on this line the trains start every quarter of an hour. On inquiry, I found that the Greenwich Railway Company possessed sufficient ground on each side to enable them to widen the viaduct so as to meet any probable increase of traffic, and that a plan and estimate had been framed for this purpose, ready to be carried into effect as soon as possible.

There is still, however, an objection of some importance to any new line adopting either this or the Southampton terminus,—the necessity of limiting the distance between its rails to that of the lines already laid down.

At Brighton, Stephenson's line, as in London, stops at the western extremity of the town, at Chalybeate-street; this is inconvenient for passengers; and, besides, as one of the advantages proposed in connecting Shoreham with Brighton, is, that the latter may obtain coal at a cheaper rate than at present, it is important that that article should be brought as far into town as possible. Gibbs's line, entering nearly at the same point as Stephenson's, extends its terminus farther into the town, and is well situated with respect to Brighton. The South-Eastern, on the other hand, enters Brighton at the north-eastern part of the town, at Carlton Hill, and nearly as much to the eastward as Stephenson's is to the westward, and cannot, therefore, without great additional expense, get a branch to Shoreham. This remark applies equally to Stephenson's and Gibb's lines, with reference to the Lewes and Newhaven branches; and, lastly, the Direct line enters at the north-western part of the town, having a depôt for goods abutting on Trafalgar-street, and a passenger terminus on Church-street, 35 feet above its level, to which an inclined plane from Church-street gives an access for carriages. This appears to be the most central terminus of the four, and that which affords the greatest accommodation to the town of Brighton. And here, too, after alluding to the Brighton termini of the different lines, I must refer to the peculiar character of the property of that place, for I conceive that the second Resolution of the House of Commons, by opening the whole question, has rendered it necessary that I should do so. This town owes its present importance to the proximity of the sea, at that place, to the metropolis, and large sums have been expended there for the accommodation of its numerous visiters; a railroad touching the coast before it reaches Brighton might transfer the advantage of position to another place, and sooner or later prove injurious to the property at Brighton; thereby causing a large capital to have been wasted without any corresponding national advantage; and in this point of view, Stephenson's and Gibbs's lines are both objectionable; not, however, to the extent they would have been had the situation of Shoreham, with respect to the sea, been better.

The termini of the lines having been considered, their relative

facility of construction and subsequent expense of working must be noticed. It will appear that Stephenson's and the Direct line in the heavy traffic are nearly on a par, the former having the advantage by thirteen chains only; that the South-Eastern is next, and Gibbs's line the last; and that in the passenger traffic, the direct line has the advantage of them all, the South-Eastern, Stephenson's, and Gibbs's being the order in which the remainder follow, the South-Eastern and Stephenson's appearing nearly equal. It should also be borne in mind, that, in comparing the Direct line with Stephenson's, about two and a half miles ought to be added to the length of the latter, to make his termini as central as those of the former. It must, however, be observed, that the equivalent horizontal distances are only a comparative measure of the time, in which two lines can be passed over when the tractive power applied is on each line equal; the maximum velocity, as yet obtained, may be given to a train on a gradient of 20 feet in a mile, as well as on a gradient of 16 feet, by using larger engines; this would, however, occasion additional expense; but it is necessary that it should be remembered, since it shows the advantage of reducing the actual distance when passenger-trains are to be very much considered. The Direct line gives branches to Lewes, Shoreham and Newhaven, the two latter being extremely valuable to Brighton by placing it between ports, with a certain and rapid conveyance to each.

The Shoreham branch of the Direct line appears to me incomplete in not communicating with the wharfs like that to Newhaven. Stephenson's and Gibbs's lines give a communication with Shoreham, liable to the same objections as that of the Direct line, and in a greater degree, and altogether exclude Lewes and the port of Newhaven. The South-Eastern gives a communication with Lewes and Newhaven, but excludes Shoreham, and has therefore a corresponding disadvantage in this respect to Stephenson's. Had this line, however, adopted the terminus of the Direct line in Brighton with the addition of its branch to Shoreham, and been able to select a better route from Oxted, it would, from having the smaller quantity of railroad to construct, have been the most desirable. On the other hand, had Stephenson's line more central termini, and, instead of making the coast at Shoreham, proceeded direct to Brighton, it would have had strong claims to consideration, and, if there were no other lines already constructed south from London, deserve a preference over all the others. Gibbs's line appears to unite the principal objection to the Direct line, viz., the extensive cutting at Merstham, with that of Stephenson's line in going round by Shoreham; and though it preserves a better gradient than the Direct line, yet, from its circuitous route, works to less advantage than any of the others.

Taking, then, into consideration the great advantages of the termini of the Direct line,—that it affords by its branches greater

facilities of approach to the other towns on the coast within reasonable distance, avoiding unnecessary intersection of the country; and that it is, on the whole, the best working line, with the least length of railroad to support; for, though the South-Eastern has less to construct, yet each must support, in proportion to its traffic, whatever length of line it travels over, and also, that the Croydon Railway offers greater advantages than the Southampton Railway in the construction of a main southern trunk line; it only remains to be seen, what are the difficulties of construction it has to contend with, and whether they are such as can be recommended to be undertaken, to insure between London and Brighton a line possessing the advantages which it would appear this does over its competitors. On referring to the section, there appear to be three summits to be crossed, viz., Merstham, Balcombe, and Clayton. The former of these, the greatest work on the line, consists of a cutting through chalk, of more than three miles in length, varying from fifty to upwards of one hundred feet in depth, and which it is proposed to open out with slopes of one-sixth. As the prejudice against tunnelling is rapidly giving way, I should imagine that this mode would be resorted to on a considerable portion of this extensive excavation, as it appears to me beyond the point at which open cutting is more advantageous than tunnelling, especially in so favourable a soil. The greater part of the chalk obtained from this cutting must be run out on the adjoining land, not being required for embankment. The next excavation of importance is at Handcross-hill, near Balcombe, at the twenty-third mile, where a tunnel of 470 yards in length is proposed through favourable soil; and the third at Clayton-hill, at the thirty-sixth mile, where a tunnel of 800 yards is proposed; both of which, I think, may with advantage be increased in length, for the reason previously stated. At the southern extremity of the latter tunnel, there is a considerable length of open cutting; the whole of Clayton-hill is, like Merstham, a chalk formation.

Of the embankments on the line, one at the thirteenth mile, one across the river and valley of the Ouse at the twenty-sixth, and those between the thirtieth and thirty-fifth miles, are the principal; but of this description of work, the most objectionable in the construction, though there is less than of excavation, yet there are many short deep valleys to be crossed by embankment, and which, owing to the excavations being concentrated in two or three places, instead of being spread over the line, must be formed from side cuttings. After getting through Clayton-hill, the line runs nearly parallel to, and to the westward of, the turnpike-road to Brighton, to its terminus in Church-street, on a viaduct from its depot in Trafalgar-street.

It will then appear, though the embankments are extensive, that on this line the amount of excavation through chalk forms the principal item of expense; and, from the conflicting evidence

given before the Committee of the House of Commons, for the Direct and Gibbs's line, relative to the properties of chalk, and the best mode of excavating through it, and on which the correctness of the estimate for the former in a great measure depends, I thought it necessary to inspect, with great attention, the quarries of Merstham and Clayton, as well as one near Lewes, which is as deep as any of the proposed cuttings, and which has not been worked for ten years. In none of these quarries could I see any thing to induce me to adopt the plan proposed by the direct line at Merstham and Clayton, viz., vertical cutting, or with a slope of one-sixth; on the contrary, I was convinced that, in excavations through every descriptions of chalk, more or less of debris would be found to accumulate, even were the sides not subjected, as in the present instance they would be, to a constant vibratory motion from the traffic, in addition to the action of the wet and frost; and that, in order to afford security to the public, tunnelling, or, if open cutting, benching, of slopes of one to one, as proposed by Mr. Gibbs, ought to be resorted to.

In comparing these objections, in an engineering point of view, with the advantages the Direct line possesses, I am of opinion the latter are not too dearly purchased, and that it is the best line between London and Brighton. In giving this opinion, however, I beg distinctly to state, that I do not pledge myself to the estimate; I think, in all probability, it would be found inadequate. I may be permitted to remark, with respect to estimates generally, that, were they fairly and impartially framed, which experience has shown is not the case at present, they would, with other information arranged in a tabular form, enable even unprofessional men, with the assistance of a good map, to decide between two or more proposed methods of obtaining the same object.

Having proceeded thus far prior to receiving the plan of a joint line agreed to by the Committee of the four Brighton Railway Companies, I shall now, in obedience to your orders of the 22d instant, proceed to report on it, in conformity with the instructions contained in the letter from Her Majesty's Principal Secretary for the Home Department.

It is proposed in this joint line that there should be two termini in London; one at London-bridge, and the other at Nine Elms, near Vauxhall; also two lines going south, one through the valley of the Mole, and the other through the Merstham Pass, meeting at or near Capel; and from thence there should be one line to Brighton, *via* Shoreham, adopting at Brighton the terminus and branches of the Direct line.

It is thus intended to construct between London and Brighton nearly seventy miles of railroad, independent also of using upwards of fourteen miles of railway constructed, and this, too, through a country possessing neither manufactories nor minerals, and with no town on the line, excepting Croydon, of more than 5,000 inhabit-

ants; and which, therefore, must principally look for support from the towns of its termini, only fifty miles apart.

In the present uncertain state of the return which railways will make for the capital expended, and the absence of any great national advantages proposed to be obtained, I cannot think it advisable to venture on so great an outlay of capital, or that the traffic is such between London and Brighton as to demand it.

The Company proposing, therefore, as a part of their plan, to come to Croydon through the Mertsham Pass to Earl's Wood Common, the distance from thence to Brighton (twenty-nine miles) by the Direct line, is all that is required to be constructed to render the communication complete between the two great termini; whereas, in the proposed joint line, nearly seventy instead of about forty-two miles of railroad will have to be constructed and maintained, as well as a second terminus and depot, without any additional traffic except what may be afforded by the towns on the line.

Under these circumstances, it appears to me, that continuing the route proposed by the Direct line from Earl's Wood Common to Brighton is better for the interests of the Company, and affords to the public all the accommodation required.

I, therefore, adhere to the opinion already given in favour of the Direct line.

I have the honour to be, Sir,
Your most obedient, humble Servant,
ROBERT ALDERSON, Capt. Royal Engineers.

London, June 27.

REPORT OF THE GREENWICH RAILWAY COMPANY, JULY 21, 1837.

THE Directors of the London and Greenwich Railway Company have convened this meeting of the shareholders, for the purpose of laying before them a statement of the accounts of the Company, and with a view to taking their opinion as to the best means of completing the railway to Greenwich.

In order to arrive at the present state of the Company, it will be necessary to call the attention of the shareholders to the report made by the Directors at the last meeting.

At that time the Directors were fully persuaded that the capital authorized by the Act to be borrowed would be adequate to complete the undertaking. In that opinion they were fortified by the estimates of the engineer and surveyor of the Company, and it is to the Directors a matter of sincere regret to be compelled to state, that on that information, they have been grievously disappointed.

Pursuant to the resolution at such last-mentioned meeting, the sum authorized by the Act to be borrowed, was raised and

expended on the work, and they are sorry to say, that, in addition large sums are due to the contractor and others.

In December last, the railway was completed, and opened to the public.* The returns have exceeded the expectations of the Directors, and afford the almost certain prospect that, when the whole line is completed, the present income will be nearly doubled. Under this conviction, the Directors applied to Parliament, and obtained an Act in the late session, to enable them to raise a sum of 200,000*l.* in shares, having an advantage over the old ones, inasmuch as they bear an interest of 5*l.* per cent. per annum, until a dividend on all the shares in the undertaking amount to that sum.

At the time of their application to Parliament for that Act, the shares were at a premium; and it was the anxious desire of the Directors to avoid injuring the interests of the old shareholders by giving the new ones any further advantage than was necessary to induce the public to take the new shares. They were, however, disappointed, for just about the time of passing the Act, a change in the money market took place, and the present shares fell to a considerable discount; which, the Directors may be allowed to observe, is a price without reference whatever to their actual value.

By the accounts now submitted to the shareholders, they will be enabled to judge of the prospects of the undertaking, and form their own opinion as to the probability of its affording a handsome return when completed to Greenwich.

The proprietors are aware of the important fact that the Royal assent has been given to the Act for making a railway to Brighton, which will join the Croydon line, at this moment connecting with the Greenwich Railway.

As many absurd rumours respecting the stability of the work have been too long in circulation, the Directors beg to call the attention of the shareholders to that part of the Report of their engineer, contractor, and surveyor of the Company, and of other gentlemen, regarding the strength and durability of the arches, and they feel assured that they can do so with confidence.

The Directors beg, in conclusion, to state to the proprietors that, as this is the proper season of the year for the completion of a work of this nature, they hope the shareholders will unite with them in their efforts to accomplish this most desirable object, and take among them the new shares not disposed of, to be paid up by instalments of 5*l.* each.

1st payment	on the	28th of July.
2d	„	28th of August.
3d	„	28th of September.
4th	„	28th of October.

* From London-bridge to Deptford.—Ed.

The Directors feel confident, that when this railway becomes—as it inevitably must become—the main trunk of all lines to the southward, a most ample return for the capital invested may justly be expected.

Finally, the Directors have to observe that they have but one common interest with the shareholders, and, therefore, in urging them to this step, they do so well knowing the responsibility; while, on the other hand, should the railway not be completed in May next, the powers of the Act in that respect will cease.

MIDLAND COUNTIES RAILWAY.

Report of the Directors to the first General Annual Meeting of Proprietors held at Loughborough, June 30th, 1837.

THOMAS EDWARD DICEY, Esq., Chairman of the Board of Directors, in the chair.

IN reporting the proceedings which have taken place during the first year of the existence of the Company, the Directors cannot refrain from observing in the outset that, while it has been a period of no ordinary importance with regard to the interests of all railway companies, and peculiarly so, in many respects, to those of the Midland Counties Company, the result of their exertions has been such as to afford them a sure and well-founded cause of congratulation to the shareholders on the present position and future prospects of the Company.

The present session of Parliament commenced under circumstances of an apparently unfavourable import towards this Company. A line of railway, called the South Union, had been projected from Manchester by Stone to Tamworth, and there to be joined by another railway, projected by the Birmingham and Derby Company, and to be carried from Tamworth to Rugby. This last, though denominated an "extension" of the Birmingham and Derby line, was, in fact, a continuation of the South Union; and the effect of it, if carried, would have been to establish a formidable competition for the very valuable portion of the expected traffic of the Midland Counties Railway proceeding from Derby and the parts northward of it towards London. The Directors found that to defeat the Tamworth and Rugby project was of great importance to the Company, and their best energies and exertions were, therefore, turned to this object. The South Union was no less the object of jealousy and apprehension; but more particularly with reference to that portion of it extending south of Stone. It happened also that the project for carrying a line of railway from Stone to Rugby was almost equally obnoxious to the Grand Junction and the London and Birmingham Companies: and the remaining part of the South Union being also a competing line with the Manchester and Cheshire Junction (at the

same time preparing for Parliament), a formidable opposition was soon arrayed against the rival lines, though their power and influence in Parliament were supposed to be almost irresistible. The promoters of them did, however, labour under one great disadvantage, namely, that it was clear that they were brought forward as matter of private speculation, and involved a vast expenditure of capital, without any adequate public advantage. Besides which, a large number of the landowners, particularly on the Tamworth and Rugby line, were not only dissentient, but joined heartily in the opposition, and contributed to it a material accession of strength. The first decisive blow was struck against that part of the line the opposition to which fell more immediately into the hands of this Company. This was the Tamworth and Rugby line, which, after a hearing of considerable duration before the Committee on Standing Orders, and an obstinate and protracted struggle subsequently in the House of Commons, was at length finally rejected. The loss of this line most materially influenced the future proceedings, with regard to the South Union Railway. It left the portion of that line south of Stone perfectly defenceless; and induced the Committee of the House of Commons to resolve that it was unnecessary; a Resolution which was carried by the decisive majority of 46 to 17. The case being thus narrowed down to a contention between the South Union and the Cheshire Junction Companies, for the line from Manchester to Stone, the Committee recommended an amalgamation of the two Companies, which was carried into effect; and a line was selected, under the direction of a military engineer appointed by the Government. The whole progress, and the termination of these proceedings (combined with other circumstances), have been such as to produce in the minds of the Directors the strongest conviction that a similar competition will not again be attempted;—or if it should be, that it will as signally fail.

A confirmation of such a view of the subject is happily afforded by the relative position in which this Company and the North Midland Company are now placed. It will be remembered that at the general meeting, held after the passing of the Act, it was determined that the application to Parliament for a branch to Pinxton should not be renewed, in consequence of a project which was then before the public, on the part of another Company, to form a line of railway from Sheffield to the northern terminus of the Midland Counties Railway at the Trent. The Directors, however, finding that the Company alluded to were not in a situation to apply to Parliament for any part of their line, thought it their duty, under the then existing circumstances, to give notice of an application for an extension of the Midland Counties Railway to a junction with the North Midland at Clay Cross, which was sanctioned by a special meeting of proprietors, convened for the purpose, and the application was accordingly made. This, being

to a certain extent a competing line with the North Midland, was opposed by that Company (who were themselves before Parliament for considerable deviations), and, in consequence of a technical difficulty, which from the nature of the case could not be avoided, the proposed extension was rejected by the Committee on Standing Orders. The collision thus produced, led to a negotiation between the two Companies, which has been carried on with the mutual feeling of amity which ought to subsist between Companies whose interests are so closely allied: and though time has not yet sufficed to settle finally the terms of carriage and other matters of minute detail, the Directors have the satisfaction of announcing to the meeting that the basis of an arrangement has been fully agreed to, by which it is distinctly stipulated that the traffic of the North Midland Railway from Derby southwards is to be *secured* to the Midland Counties Company.

In another respect (in which however this Company has been precluded from interfering, by the terms of an arrangement entered into last session,) the proceedings in Parliament during the present session have been highly favourable to the interests of the Company. The proposed South Midland Railway Company made their application for a line from Leicester to Blisworth, in the hope of superseding the portion of the Midland Counties line between Leicester and Rugby; but their Bill, instead of being read a second time, was referred to a Select Committee, to inquire into the sufficiency of the subscription contract, to which it was alleged that there were fictitious signatures, or parties of an irresponsible description, to a considerable amount. The Committee have not even yet made their report, but it is generally believed the result will be such as to put a stop to the scheme altogether.

The Directors have further the satisfaction of reporting, that contracts have been entered into for the formation of the whole line from Derby to Nottingham, which has been already commenced; and it is engaged to be completed by the first of November in the ensuing year.

The Directors thought it right to turn their first attention to this portion of the line, as it is the easiest and the cheapest in point of execution, and will afford a return for the capital expended at an earlier period than could have been effected on any other part of the railway.

The Directors have also caused the whole of the line from the Trent to Leicester to be staked out, and the plans, surveys, and working drawings to be completed, and it is now in a state for the letting of contracts at any moment.

The Directors being perfectly alive to the difficulties which at present surround every undertaking requiring a quick outlay of capital, have used their most anxious endeavours so to arrange the progress of the works as to press as lightly and as gradually as

possible upon the resources of the shareholders. They have made but one call of 5*l.* per cent. since the passing of the Act; and the caution which they propose to exercise, while it will not prevent them from a steady continuance of the works, will enable them to dispense with requiring the payment of any further call earlier than the month of October next. The Directors are decidedly of opinion that the line between Leicester and Rugby should be proceeded with, at the earliest period allowed by the restrictive clause in the Act, which will be on the 1st of August. The two-fold object will be thus effected, of making progress with some of the heaviest works, and securing the communication with London. The Directors are also of opinion that no time should be lost in securing the land along the whole of the line, in order to prevent the necessity of a further application to Parliament.

The Directors have prepared a statement of accounts up to the present time, by which it will be seen that the receipts of the Company have been £75,254 18 7

Their disbursements 37,376 13 8

Leaving a balance in hand of . . . £37,878 4 11

Notwithstanding the unparalleled state of depression of the money market, more than half of the last call has been paid. The payments are gradually continuing, and the whole of the shares (with some trifling exceptions) have been ascertained to be held by persons of undoubted responsibility.

Upon the whole, the Directors have the greastest confidence in assuring the shareholders that the events of the past year have but served to establish the Midland Counties Railway upon a firm and sure basis; and they look forward with a well-grounded hope that their future exertions will be attended with a success beneficial alike to the public and to the individuals who have embarked their capital in the undertaking.

General Account of the Receipts and Disbursements of the Midland Counties Railway Company, to the 20th of June, 1837.

1837. *Dr.*	£.	s.	d.	1836. *Cr.*	£.	s.	d.
June 20th, To Calls of £10. per cent. on £. s. d. £1,000,000. 100,000 0 0 Less by Calls in arrear . . . 25,283 0 0	74,717	0	0	Aug. 12th, By Expenditure in obtaining the Act (as per Abstract A)	28,776	1	5
To Interest on Exchequer Bills	408	9	1	1837. June 20th, By Payments on account of Parliamentary Expenses in the Session of 1837	2,503	3	0
To Interest on Banker's Balances and Calls in arrear	129	9	6	By General Expenditure since the Act was obtained (as per Abstract B) . .	6,599	0	6
				By Exchequer Bills . . .	16,296	5	5
				By Cash	21,078	8	3
	£75,254	18	7		£75,254	18	7

(A).

Abstract of Parliamentary and other Expenses previous to, and in obtaining the Act, from the Year 1833, *to August* 12*th*, 1836.

	£.	s.	d.
Advertising, Printing, Travelling, and Directors' Expenses in obtaining the Act	2,089	12	1
Law Expenses, Expenses of Witnesses, &c.	7,912	2	0
Engineering and Surveying	12,415	8	11
Parliamentary Agents, including Counsel and Parliamentary Fees	4,299	17	6
Salaries, Sundries, &c., from 1833	2,059	0	11
	£28,776	1	5

(B).

Abstract of Expenditure since the Act was obtained.

	£.	s.	d.
Land	1,076	0	0
Works	1,100	0	0
Engineering and Surveying	1,656	7	1
Printing and Advertising	273	7	6
Direction	1,000	0	0
Office Expenses, Salaries, &c.	702	19	4
Travelling Expenses and Sundries	790	6	7
	£6,599	0	6

SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

Vinous Fermentation.—A French chemist, M. Latour, has lately been pursuing the subject of vinous fermentation by the aid of the microscope, and the following are the conclusions he comes to:—

1st. That beer yeast is an assemblage of small globulous bodies, susceptible of being reproduced, consequently organized, and not a substance inert or purely chemical, as supposed.

2d. These bodies appear to belong to the vegetable kingdom, and to be regenerated in two different manners.

3d. They appear not to act on a solution of sugar, except whilst they are in what may be called a living state; from whence we may conclude, that it is very probable they disengage carbonic acid from this solution, and convert it into a spirituous liquor.

M. Latour also considers that yeast, as an organized matter, merits attention.

1st. Because it may be engendered and developed in some circumstances very promptly, even in the midst of carbonic acid, as in brewers' vats.

2d. Because its mode of generation presents peculiarities of a kind, which have not been observed, in regard to other microscopic productions composed of isolated globules.

3d. Because it does not perish by very great cold, not more than by the privation of water.

New Method of Calking Ships.—Mr. Yetts, of Yarmouth, has taken out a patent for a new method of calking sea-boats, which renders them water-tight, and prevents the oakum from being pressed out by the straining of the planks. Mr. Yetts effects this by introducing a narrow strip of caoutchouc (India rubber) on each side of the threads of the oakum on the outer sheath of the vessel.—*Norwich Mercury.*

Oscillation of the Fixed Points of Thermometers.—A series of experiments by M. Despretz have lately shown, that the fixed points of thermometers oscillate in experiments sometimes as much as $\frac{1}{3}$ of a degree of Cent. For instance, if they have previously been kept at a very high temperature, the boiling and freezing points are sensibly lower, and if at a low temperature these points are sensibly higher than their mean state. The same effects take place in stretching, compressing, or twisting bodies; they do not return to their natural state exactly when once materially put out of it, at least unless after a long interval of time.

Calculating Boy.—A boy, named Vito Mangiamele, the son of a shepherd in the neighbourhood of Syracuse, who has never had any instruction, has been examined before the Academy of Sciences, and has given extraordinary proofs of powers of calculation, which would require in other individuals some knowledge of mathematics. The first question put to him was to find the cube root of 3,796,416, which he answered in $1\frac{1}{2}$ minutes to be 156. A second was to find such a number that five times its square added to its cube should equal 42 times the number increased by 40; in less than a minute he answered 5. This is the solution of a cubic equation. A third question required the solution of an equation of the fifth degree, namely of

$$x^5 - 4x = 16779.$$

After four or five minutes, he answered, hesitatingly, 3; but on being told he was wrong, in a few instants after he gave the true answer, 7. The fourth was to find the 10th root of 282,475,249, which in a very short time he gave, 7. A commission, consisting of several mathematicians, have been named to push the inquiry further and to report thereon.

Cement.—The following receipt for a cement is given in one of the scientific journals of France. Steep an ounce of isinglass for twenty-four hours in half a pint of spirits of wine, then dissolve it over a slow fire, keeping it covered, that it may not evaporate;

then take six cloves of garlic, previously pounded in a mortar, and squeeze the juice through linen into the isinglass; cork the whole together for a short time, and the mixture will cement either glass or crystal.—*Mining Journal.*

Covering for the Roofs of Buildings.—A commission of the members of the Academy of Sciences has lately been sitting for the purpose of inquiring into the best covering for the cathedral at Chartres. They have reported and decide against the use of lead, because of its weight, the necessity for frequent repairs, and the danger to the men from its melting in case of fire. Though iron plate is successfully employed in Russia for coverings, they do not think it would suit the climate of France on account of the expense of maintaining it. The commission had a considerable leaning towards recommending iron plates tinned, because of a new process with this metal by M. Sorel, which enables it successfully to resist oxidation, even when under the influence of more active agents than air and humidity; but they thought the proofs had not been sufficiently long to justify their recommending it for public buildings. After considering at some length the rival merits of copper and zinc, they decided in favour of the latter; first, on account of the expense, which would be about two-thirds that of copper; and, secondly, because an experience of above twenty years has shown that when the superficies of zinc is oxidised to an insensible depth, the thin film of oxide adheres so closely to the subjacent metal, as to become a sort of a preserving coat to it, and oppose the progress of alteration. There were some objections to the employment of zinc by reason of its great combustibility at very high temperatures, and the commission rejects it whenever wooden rafters were employed, but the cathedral in question having iron rafters, alters the case. They recommend the zinc plates to be simply fastened with clasps, for the purpose of allowing the utmost freedom to contraction and expansion on account of changes in the temperature, and to avoid any contact with plaster or calcareous mortars, which rapidly corrode it.

Inroads of the Baltic.—This sea on the side of Prussia has been making slow and steady encroachments on the land. There existed, between seven and eight centuries since, a province named Witlandie, which has been, by little and little, yielding up its soil to the sea, and is now entirely covered with the waters.

Railway Novelty Extraordinary.—Accident gave us a glimpse the other day of one of the drollest specimens of ingenious absurdity we ever remember to have seen. It was no less than a model of a railway to take an invalid up to bed!! A moveable railway is laid up the stairs with a curve at the top, the inventor saith not of what radius, and a suitable carriage provided on which the invalid is to be placed. He is then drawn *secundum regulam* by a servant, with the aid of a system of pullies, to the first landing. Being quietly deposited in one corner, there he must wait

while the servant carries up and places the rails on the next flight of stairs. Another pulley hauling gets him to the second landing. The rails have to be again removed, and the invalid proceeds on his third stage; and so on to his last lift. How he is to get into bed when he is arrived up stairs we are not informed. Probably the ingenious inventor has not yet recovered from the exhaustion his mental powers must naturally have experienced, in so great an effort, to be able to decide on this yet. It will doubtless come forth in a second edition quite new and worthy of the first.

Fucus natans.—In the Atlantic Ocean on the west of the Azores, is an immense bank of floating weed, known to sailors under a variety of names, the curiosity of which is that it always retains its situation in longitude and latitude, is of an extent nearly equal, says Mr. Arago, to that of all France, and is in a part of the ocean which has not been fathomed, neither has it any apparent communication with the bottom, or any known lands. Three conjectures have been started with respect to its cause. One party supposes the weeds are generated and propagated, like some fresh-water weeds, where they are; another that they are brought by the Gulf of Mexico current across the Atlantic to the place they occupy; and a third that they grow at the bottom of the sea under, or very nearly under, where they are found, and ascend to the surface after being accidently detached from their roots. This last opinion has been confirmed, almost to demonstration, from the observations of Captain Bennet. During a calm, with a brilliant sun, and the vessel at rest, he has observed this weed gradually ascending from a great depth, at least thirty yards or more. When it first reaches the surface it is of an apple-green colour, but shortly fades and turns to a reddish, and afterwards to a brown colour. It then soon decomposes, separates as a powder, and disappears. The different appearances in the various stages towards dissolution, Captain Bennet thinks, may account for its having been considered to be an assemblage of different kinds of weed. He has no doubt that with a very long line the bottom in that place might be reached.

Structure in the Ashes of Plants.—The Rev. J. B. Read has lately published, in the "Philosophical Magazine," some interesting experiments tending to prove the existence of structure and an "*osseous system*" in plants. "I procured," says this philosopher, "a platinum spoon and a large spirit lamp. Portions of plants were then submitted to an intense heat until the carbonaceous parts were entirely dissipated, and only a few apparently white ashes remained. The specimens thus incinerated consisted chiefly of grasses, together with barley, wheat, &c., and in all of them I have been able to discover, by means of the microscope, a most beautiful, and in many a most elaborate, structure. Even the white ashes of 'slaty coal' furnish most beautiful examples of vegetable remains." The magnifying power used was about 300 linear.

Electro-Magnetism.—In our last we mentioned an application of electro-magnetism to locomotive carriages, by a Mr. Thomas Davenport, an American blacksmith. The following is a description of it from "Silliman's Journal:"—

"*The Rotary Machine, composed of revolving Electro-Magnets, with fixed permanent Magnets.*—This machine was brought to Newhaven, March 16, 1837, by Mr. Israel Slade, of Troy, New York, and by him set in motion for my examination. The moving part is composed of two iron bars placed horizontally, and crossing each other at right angles. They are both five and a half inches long, and they are terminated at each end by a segment of a circle made of soft iron; these segments are each three inches long in the chord line, and their position, as they are suspended upon the ends of the iron bars, is horizontal.

"The iron cross is sustained by a vertical axis, standing with its pivot in a socket, and admitting of easy rotation. The iron cross bars are wound with copper wire, covered by cotton, and they are made to form, at pleasure, a proper connexion with a small circular battery, made of concentric cylinders of copper and zinc, which can be immersed in a quart of acidulated water. Two semi-circles, of strongly magnetized steel, form an entire circle, interrupted only at the two opposite poles, within this circle, which lies horizontally; the galvanized iron cross moves in such a manner that its iron segments revolve parallel and very near to the magnetic circle, and in the same plane. Its axis at its upper end is fitted by a horizontal cog-wheel to another and larger vertical wheel, to whose horizontal axis weight is attached and raised by the winding of a rope. As soon as the small battery, destined to generate the power, is properly connected with the machine, and duly excited by diluted acid, the motion begins, by the horizontal movement of the iron cross, with its circular segments of flangers. By the galvanic connexion, these crosses and their connected segments are magnetized, acquiring north and south polarity at their opposite ends, and being thus subjected to the attracting and repelling force of the circular fixed magnets, a rapid horizontal movement is produced, at the rate of two hundred to three hundred revolutions in a minute, when the small battery was used, and over six hundred with a calorimotor of large size. The rope was wound up with a weight of fourteen pounds attached, and twenty-eight pounds were lifted from the floor. The movement is instantly stopped by breaking the connexion with the battery, and then reversed by simply interchanging the connexion of the wires of the battery with those of the machine, when it becomes equally rapid in the opposite direction."

Since then a machine has been exhibited to Professor Silliman, the same in structure, but composed entirely of electro magnets, both in its fixed and revolving members. Professor Silliman seems to be decided in thinking this machine will be perfectly

competent to produce rotory motion with a power "indefinitely prolonged," and "probably beyond any limit which can be, *with certainty*, assumed."

The subject has been taken up with great zeal in France, and, we believe, under the auspices of the *Academie des Sciences*.

Notice, or Alarm Gong.—A very ingenious instrument, of which we have seen a model, has been invented by Captain George Smith, R.N., intended to give warning of the approach, and to announce the course a steamer is sailing on in a fog. It consists of a gong, on which a hammer is made to strike every ten seconds a certain number of blows, by very simple machinery, according to the course a steamer is sailing on. For example, if she be sailing north, the gong is struck once; if east, twice; if south, thrice; and if west, four times, every ten seconds. By this systematic method the position, course, and proximity of a steamer will be clearly announced to any other vessel. In rivers Captain Smith proposes the gong to emit single sounds every ten seconds, which would be enough to give warning. He also proposes to apply the instrument to railway trains, by the blowing of a trumpet. The peculiar merit of the invention appears to us to lie in the equability of intervals, and of intensity of sound, which cannot be equalled by any human means.

Colossal Steamers.—An immense steamer, upwards of 200 feet long, was lately launched at Bristol, for plying between England and America; but the one now building at Curling, Young, and Co.'s, Limehouse, for the American Steam Navigation Company, surpasses anything of the kind hitherto made. She is to be named after our Queen, the Victoria, will cost from 80,000*l.* to 100,000*l.*, has about 150 men now employed daily on her, and is expected to be finished in about November next. The extreme length is about 253 feet, but she is 237 feet between the perpendiculars, 40½ feet beam between the paddle-boxes, and 27 feet 1 inch deep, from the floor to the under side of the spar deck. The engines are two of 250-horse power each, with 6 feet 4 inch cylinders, and 7 feet stroke. They are to be fitted with Hall's patent condensers, in addition to the common ones. She displaces, at 16 feet deep, 2,740 tons of water; her computed tonnage is 1,800 tons. At the water line every additional inch displaces 18½ tons. The average speed is expected to be 200 nautical miles per day, and consumption of coal 30 tons. The best Welsh coal is to be used. It is calculated she will make the outward voyage to New York in eighteen days, and the homeward in twelve, consuming 540 tons of coal out, and 360 home. Expectation is on the tiptoe for the first voyage of this gigantic steamer, alongside of which other steamers look like little fishing-boats.

Fat Meat and Weak Stomachs.—When fat meats, or sauces composed partly of butter are taken, and cold drink directly after, the butter and fat are rendered concrete, and separated from the

rest of the aliment. This congealed oily matter, being then specifically lighter than the remaining contents of the stomach, swims on the top of the food, often causing heavy, uneasy, and painful sensations about the cardia and breast, and sometimes a feeling of scalding and anxiety; at other times, when the stomach regains its heat, this fatty matter is rejected, by little and little, from weak stomachs, in oily regurgitations, which are very disagreeable. In such cases, a little compound spirits of hartshorn, with a glass of warm water and sugar, will convert the fat into a soap, and give instant relief.—*Sir James Murray's Medical Essays.*

Natural History.—A student in natural history informs us, that this year is singular for the fewness of butterflies, and the want of brilliancy in the colours of those that appear. Also for the weakness of the gnats that feed on reeds, and inhabit ponds on which willows grow, and the length of the proboscis of those which are found near marshes. He also has noted a peculiar fragrance in the honey taken in the month of June. This fact is not confined to one district, nor to one soil. He inquires whether these facts, which have fallen under his own notice, have attracted the attention of other naturalists? It is by such observances important information may be obtained.

Question for the Royal Society.—An important question has been proposed to us, the solution of which we cannot give. It has been asked, What steps have been taken by our Royal Society to carry into effect the proposal made to its Royal President by Baron Humboldt, for establishing in different parts of our extensive dominions places for ascertaining the nature and effects of terrestrial magnetism? The subject is of great importance to science in general, and to navigation in particular, especially as the charts already published on the subject abound in discrepancies. When, too, we are informed that France, and some other nations, have afforded the greatest facilities for accurate investigations, it cannot be questioned that, if the resources of the Royal Society are not adequate to the undertaking, the Parliament would afford its aid. This would be a noble commencement of a new reign, and contribute to give it the stamp of advancing the safety of travellers and the security of commerce.

Effects of Tunnels.—A correspondent observes, that, after the cutting down of forests in France, subsequent to the revolution, it was made a subject of inquiry whether the temperature was the same after the forests were cut down, and whether the rains and storms were less frequent; he infers that, at the ensuing meeting of the British Association, a proper subject for discussion would be, what will be the effect of the tunnels and cuttings of our railroads on our springs; and will the drains formed produce any alteration in the elevation or depression of our rivers? These are topics our engineers have not made parts of their calculations, though they may affect our domestic comforts, and perhaps the navigation of some parts of the kingdom.

Another circumstance has not been contemplated by shareholders in railroads, of which a new, if not the present Chancellor of the Exchequer may be expected to avail himself; especially if the agricultural interest persevere in urging the repeal of the malt-tax, or the inhabitants of towns unite in demanding the taking off of the window-tax; viz., a tax on railroad conveyances. This will only be doing justice to coach-proprietors, and to those who lend horses for hire, as well as to the Commissioners and bond-holders of our turnpike-roads.

Railway Telegraphs.—Experiments are about to be made on the Birmingham line, respecting the practicability of telegraphic communication. The principle is to give motion to certain keys at one place, by the action of galvanism through insulated wires from the other. Words may in this way be spelt, and sentences communicated, almost as rapidly as they could be written. The question is, can the wires be sufficiently insulated, and the intensity sufficiently strong, to produce the effect desired at the distance required? A very interesting letter on the subject appeared in the "Times," of July the 8th, by Mr. William Alexander of Edinburgh, in which many of the details are gone into at length, and it is said, experiments are to be made on a line of 50 or 100 miles long.

Calculations of Cocking's Parachute.—The unfortunate experiment of Mr. Cocking, in his descent on the 24th ult., with the parachute, has excited so painful a feeling in the public mind, that we shall be excused for saying a few words on the subject. It appears that Mr. Cocking's apparatus was an inverted frustum of a cone, thirty-four feet diameter at the top, and three or four at the bottom, which was open. We are informed the upper ring was a tin tube, about two inches diameter, and the lower a wooden hoop; the superficies of the cone was strong linen or canvass, and the whole, with the basket in which he was, weighed about 150 lbs. He took up, we are informed, two cwt. of ballast, making, with himself, a total of about five cwt. We know not the proportion of the axis of the frustum to either diameter of the cone, but, supposing the parachute a flat circle, which would have been a better form for resistance, of the thirty-four feet diameter, it would expose a resisting area of little better than 900 square feet. With these dimensions the mass would have descended with a velocity of near thirteen miles an hour, three times greater than safety would permit; but from the bad formation of the machine, and the great hole in the middle, the resistance must have been less, and the velocity greater. Could he have rid himself of the two cwt. of ballast, he must have descended more than ten miles an hour, that is near three times as fast as he ought. In every way it was an ill-contrived, ill-judged experiment; the tube was too weak, and, we are informed, it came unsoldered the day before he went up. To descend with a velocity of five miles

an hour, rather too much for perfect safety, requires a resisting area of 1,000 square feet for every 100 lbs.; Cocking's had only 900, for more than five times the weight. His distance was near sixty feet from Mr. Green, too much for easy communication.

It has been stated, that several scientific men had approved of calculations of the safety of Mr. Cocking's parachute. We can hardly believe it; we ourselves, at four o'clock, gave our opinion against it to friends who asked us. From the height, 5,000 feet, stated by Mr. Green, and the time of descent, seventy seconds, or more, observed by Mr. Bishop, we perceive that our computation of the maximum velocity, thirteen miles an hour, would have been very near the truth, had the parachute not have collapsed. A very simple rule for calculating very nearly the velocity of reaching the earth, is the following:—*Divide the total weight of the whole mass in lbs. by the greatest horizontal area of the parachute in feet, seek the quotient in the third column of the table, p. 95, Vol. I. Railway Mag., and corresponding to it, in the first column, is the velocity in miles per hour.*

RAILWAY NOTICES.

Anti-Dry Rot.—The process for preserving timber from the dry-rot, known by the name of Kyan's Patent, is now spreading with a rapidity equal to the tardiness with which it began. Trials of its efficacy were begun nearly four years ago by the Board of Ordnance, on a variety of substances. Eighteen months after, the bodies were examined, and not the slightest effect appeared on those which had been prepared, whilst on several of the duplicates of unprepared, the process of destruction had made rapid strides. It was then determined to replace all the bodies in their original positions, for the purpose of undergoing a second examination at another interval of eighteen months. This has been done, and the following is Colonel Hardinge's report thereon:—

"*Royal Carriage Office, Woolwich, Sept.* 28, 1836.

"Sir,—In furtherance of your directions, that a second examination should be made at the end of *three years*, to try the effect of Kyan's Patent, I have again to report, (and referring to my former one to you of the 25th of March, 1835,) that this day, accompanied by the same persons as on the first occasion, namely, the deputy store-keeper and constructor of this department, and with Mr. Terry, on the part of Mr. Kyan, we examined the different pieces of wood, canvass, and rope submitted for experiment.

"1st. We agreed in considering that, on the 'prepared' woods, canvass, rope, and cord laid down in contact with dry-rot, under the floor of the cadet-hall, no impression has been made, and on the duplicate pieces 'unprepared,' very little effect has taken place

on the woods, but the canvass, and more particularly the rope and cord, are very much decayed.

"2d. Of the pieces of wood partly driven into the ground, under the eaves of a building, and exposed to the united action of sun, rain, and damp-earth, we also agreed, that all the five pieces of oak, ash, elm, Memel-fir, and American-fir 'prepared' with the patent, are quite sound; whilst of the duplicate pieces 'unprepared,' the elm and ash were rotten, and the progress of decay had commenced in the three others, the oak being least affected.

"The woods used in the foregoing trials had, previously to being put down, been seasoned two years.

"We then proceeded to examine what you, at Mr. Terry's request, had placed under the same test as the last described woods, it appearing to be the most severe trial, viz.; a piece of oak five feet long, three inches diameter. A piece of ash, two feet five inches and a half long, six inches and three quarters diameter. A piece of elm, five feet one inch long, three inches and one-eighth diameter. All of which came here quite in a green state, and with the bark and some leaves on them, and after being split down the middle and marked, half of each specimen of wood was returned to be saturated with the patent, and when sent back again the whole were put down, on the 31st of March, 1835. They were taken up a few days ago to dry, and we find at the end of the year and a half, that the '*prepared*' pieces, even to the preservation of the *bark and sap*, are perfectly sound, and the 'unprepared' quite rotten.

"I have the honour to be, Sir, &c. &c.,

(Signed) "RICHARD HARDINGE, Assistant Inspector.

"To Colonel Sir John May, K.C.B.,

Inspector, Royal Carriage Department.

"P.S. After Mr. Terry was gone, the quality of the prepared two-inch rope was tried with heavy weights, against a piece of new rope, of the same description, when the strength of the former did not appear to have been at all affected by the three years it had remained under the floor of the cadet-wall.—R. H."

Birmingham Railway.—This line opened for the public to Boxmoor, about twenty-five miles, on the 20th July; but for several preceding days the Directors and their friends made daily excursions to see that all was right. The average speed of the trains is twenty-two miles and a half an hour, including stoppages, and twenty-five, excluding them. The carriages are made convenient and comfortable, particularly the first class, but at present they work rather stiffly. Considerable order and system are manifested in the arrangements. There are three classes of trains which run each once a day from either end at periods, stated in the advertisement on the wrapper. We understand the conflux of passengers was so great that the Company found considerable difficulty in accommodating them. No fair criterion, however,

can be formed of the revenue of this or of the Grand Junction line, until the former is finished to Birmingham, so as to complete the railway connexion with London, Birmingham, Liverpool, and Manchester.

Bolton and Preston Railway.—An amicable arrangement has at length been come to between the Directors of the intended Bolton and Preston Railway and those of the North Union. The terms on which the agreement has been made are, we believe, to the following effect:—The Bolton and Preston Company are to be at liberty to use the North Union line from Euxton to Preston on payment of a toll, hereafter to be fixed.—*Preston Pilot.*

The Birmingham and Gloucester Railway Company have been for some time confining their operations to the purchase of land and office preparations, but are now about to press their works forward with all possible rapidity.

Birmingham, Bristol, and Thames Junction Railway.—The works of this railway are advancing steadily and satisfactorily. The gallery under, and bridge over the Paddington canal will be commenced during the present month, and the construction of the railway so far advanced during the present autumn, as to render its completion by the time the whole of the London and Birmingham line is opened, a matter of certainty. We are glad to find that this Company by the re-sale of the estate they have purchased at Shepherd's Bush, are likely, through the medium of our friend, George Robins, to realise a profit sufficient to purchase the whole of the land required for their line for nothing.

Brighton Railway.—The union of the Companies alluded to in our last number has been completed, and an Act has been passed giving effect to the arrangement, which on reference to the Act is as follows:—

Messrs. Stephenson's Co.	have	seven	Directors,	and	11,000 shares
——— Rennie's Company	"	five	"	"	11,000 "
South-Eastern Brighton	"	five	"	"	6,600 "
Mr. Gibbs'	"	three	"	"	5,400 "
— Mills' or Cundy's	"	——	"	"	2,000 "
Making a capital of					36,000 shares

of 50*l.* each, the whole of which are rateably to be allotted by the Provisional Directors of each of the five Companies among the holders of shares in those Companies respectively. A provision is made in the Act, that each Company shall defray its own expenses up to the 13th day of June, 1837, and in order to equalize the capital, the shares in the new Company will be issued as having paid 5*l.* on each share.

By the Act the proportion of shares to each Company with reference to its original capital will be as follows:—

	New.	*Old.*
Stephenson's Company	11 for	10
Rennie's	11	16
South-Eastern Brighton Company . .	1	2
Gibbs' . .	1	5
Mills' or Cundy's . .	1	5

The value of the exchange to be thus made must depend on the extent of expense incurred by each Company up to the time specified.

The four first mentioned Companies are to declare their option or intention to take shares within six weeks after passing of the Acts (the Act received the Royal Assent July 15, 1837), and failing this, the shares are forfeited, and the party released from all liability under the Act in respect of his subscription. It appears the South-Eastern Company have the power of purchasing the entire line from Croydon to Merstham within a given period.

Dublin and Kilkenny Railway Company.—It will be perceived by reference to an advertisement in our present number, that the Act for incorporating this Company has been passed, and we understand it is the intention of the Directors to carry it into effect with as little delay as possible.

Eastern Counties Railway.—New Method of Raising the Wind.—The Liverpool and Manchester shareholders in this line, who, we believe, subscribed a half or more of the capital, have declined at present to pay any more calls, without naming when they will. This, we must allow, is very naughty conduct, but it seems cannot be controlled. However, it is valuable, inasmuch as it has given rise to one of the prettiest expedients to get a little of the "needful" ever contrived, and which deserves, therefore, to be widely known. It is proposed to raise 600,000*l.*, not by way of call, but by way of "*voluntary advances.*" This is to be laid out to make eighteen miles of this end of the line to the charming village of Brentwood, containing no less than 1,692 inhabitants of all sorts, sexes, ages, and sizes; and eighteen miles of the other end between Norwich and Yarmouth, we believe a declining city and a dull fishing-town. It has been calculated, *mirabile dictu*, that these two fragments, ninety miles apart, will "*yield an annual revenue of upwards of* 150,000*l.*," THAT IS ABOVE 25 PER CENT.!!! Ten per cent. per annum out of this is to be paid to the volunteers when these prolific parts are completed, that is, if the money comes in, eighteen months hence, and four per cent. from hence to thence. We know not who the inventor of this pretty scheme and calculation of profits is, but he well deserves to be framed and glazed; we shall shortly see the result of his novel and amusing bait. Meanwhile we just beg to remind our readers, that, by the last census, Norwich has a population of only 61,110, and Yarmouth of 21,115, while Liverpool has a population of 165,175, and Manchester of 270,961; yet these two towns of more than

five times the population, which carry on perhaps the greatest trade of any two of equal size in England, and have probably forty times the trade and intercourse of the two former, return an annual profit of *only* 10 per cent. What the trade of Brentwood is we cannot learn, but we are told it is a fine air, and therefore, can be recommended to the cockneys as a good place to put children out to nurse, which may be the traffic calculated on.

We have heard of an amusing expedition of the chairman, a director, the secretary, and the engineer, to view the works on the 11th ult., which we are told they did find by dint of perseverance, and we are only sorry our limits will not allow us to give an account of it. We are told they gave a dinner to 500 workmen. If this is not a misprint for 50, will they be kind enough to give us the names of 100, and tell us where they are employed?

French Railway.—The French Chambers have just voted a railroad from Alais, in the mountains of Cevannes, to Beaucaird on the Rhone, passing by Nismes. The Government lends 240,000*l.* to the undertakers, the latter promising to furnish coal to the French Government steamers at Marseilles at 20 per cent. under the present price. By means of this railroad English coal is to be undersold at Marseilles; and, according to the report, these mines were to supply, not merely the Mediterranean ports, but Bordeaux itself.—*Newcastle Courant.*

The Gravesend, Dover, and Kent Railways.—A general Meeting of the shareholders of these Companies, now united in the Kent, was held at the George and Vulture Tavern, July 6th, Thos. Philpotts, Esq. in the chair. The substance of the report was, that a compromise had been proposed to the different claimants against the Company, which, if sanctioned by the meeting, would leave a disposable balance of 1500*l.*, with which five shillings per share might be immediately paid off to the holders of scrip receipts, or certificates, in the Gravesend Company; that another meeting should be called at the end of six months, to determine what should be then done with the balance in hand; and that the Committee, appointed to examine the state of the Company's affairs, recommend the meeting to apply to Mr. Godwin to dissolve the injunction, the Company paying the costs. Very high, and, we believe, well-deserved compliments, were paid to the upright conduct of the Directors, by the before-mentioned Committee, which was felt and acknowledged by the meeting in very handsome resolutions. One man, who, we hear, had figured in getting up the late petitions against companies, annoyed the meeting with a long, rambling, rigmarole about what he thought the "*dooty*" of the Directors, which was listened to with patience, and received with decorous contempt by the meeting. The Chairman soon settled the matter, by offering at once to answer then and there any questions which could be put to him. This was a piece of business-like promptitude and candour highly gratifying to the meeting, but

evidently too much for the object of the cackling individual, who was thereby almost instantly reduced to silence.

Great Western Railway.—The contract for the rails between London and Maidenhead (about 3000 tons) has been taken at 25 per cent. below the last estimate submitted to the proprietors.

Gigantic Train.—On Monday week the "Atlas" engine brought down on the Newcastle and Carlisle Railway, from Milton to Carlisle, a train of one hundred waggons of coals, lime, and coke, the weight of which could not be less than 450 tons, and the length nearly a quarter of a mile. The distance ($10\frac{3}{4}$ miles) was accomplished in three-quarters of an hour. This is, we believe, the greatest mass ever moved by a locomotive engine over the same space in so short a time.—*Carlisle Journal, July* 8.

Grand Junction Railway.—This great line opened with much *eclat* on the 4th ult., and the trains have continued to run since with regularity and certainty. The whole length of the line from Birmingham to Liverpool or Manchester, is 97 miles, which it was calculated could be run in $4\frac{1}{2}$ hours—a little above $21\frac{1}{2}$ miles per hour. We have, however, been assured by an eminent engineer, that great difficulty is experienced in averaging more than 20 miles an hour throughout the line, with an ordinary load. It has appeared to us that a mean of 30 miles an hour might be attained; but we have always thought the miraculous velocities anticipated by some will never be realized for any length of road. This line will shortly put it to the test, and whatever can be done we have no doubt the Grand Junction Directors will do. The receipts are rapidly increasing; but, as we have observed in the Birmingham, no fair criterion of the actual revenue can be attained until the connexion with London is complete. By this line the mails between London and Liverpool, it is stated, are already accelerated about 12 hours, and, when the Birmingham is finished, it is computed the whole length (206 miles) will be done in 8 hours—better say 10.

Greenwich Railway.—The proprietors of this line held a general meeting on the 21st ult., at the City of London Tavern. From two to three hundred persons were present, and the discussion was long and warm, but utterly destitute of order or regularity. The Secretary read a report, which appears in another part of this journal. Afterwards, a report of Col. Landmann was read, proving the stability and strength of the arches, which was confirmed by a second from Mr. Joseph Gibbs, engineer of the Croydon line, and a third by Mr. Smith, the Company's surveyor. Indeed, from every thing we can learn, nothing can be more absurd than the silly rumours which have been propagated on this subject. A statement of the accounts was read, from which it appears, that the Company have received 400,000*l.*, the original capital, and 133,000*l.* in bonds, or 533,000*l.* in all; that it will take 50,000*l.* to finish the line, which, with liabilities of near 150,000*l.*, will be amply covered by the new capital of 200,000*l.*, for which an Act

has been obtained. The line will therefore cost 733,000*l.*, less 100,000*l.* in land, which the Company have, and await the fitting time to sell. The real cost will therefore be 633,000*l.* By an actual examination of the Company's books, we find for 10 weeks, ending July 19, the receipts from the traffic were 10,105*l.* 1s. 6d., or 50,000*l.* per annum; the expenditure, we are assured, is only 20,000*l.* leaving a profit of nearly 5 per cent on the total capital of the line, supposed to be finished. This is the present state of the Company's financial affairs from the best information we can get. As to the future, it is confidently asserted by men who understand it, that as soon as the line is completed to Greenwich, the revenue will be at least doubled, while the expenses can only increase in a very trifling degree, they say not 5000*l.* per annum; but if the traffic increased only half, and the expenses 10,000*l.*, it would leave a profit exceeding 7 per cent., without considering any rent from the arches, or any traffic from the Croydon, Brighton, and Dover lines, for which Acts have been passed to run on it; and without taking into account any extension of the line to Woolwich, Gravesend, Rochester, Chatham, Canterbury, &c., which ultimately must take place.

Such, from the best inquiries and investigation we could make, appear to be the position and prospects of the Company.

A Committee of nine shareholders are now going into the Company's affairs, whose report will be laid before the shareholders, to be summoned at a week's notice. This was the result of resolutions passed at the meeting. Others were, "That if the shares to be created for the new capital of 200,000*l.* be not taken up by all the present holders, according to their proportions, they shall be at the option of other holders, and then of the public." 2d, "That no part of the money now to be raised by the new shares shall be applied to any other purpose than disbursements of current expenses, until the report of the Committee be received."

It has been suggested, and we think may be recommended by the Committee, that the new shares of the 200,000*l.* shall have a preference over the old, and be guaranteed 5 per cent. interest out of the revenue for a certain term (ten or fifteen years); but that when the clear profits reach 5 per cent. and above on the entire capital, the old and new merge into one. We think this plan fair and judicious, and no doubt would be successful. It is evidently the interest of the shareholders to raise the new capital, and as speedily as possible; neither is it but right if there be any preference, that it should be given to the new shares.

We are sorry to hear that Mr. Walter, the managing Director, has resigned. It has been stated, that there is a difference about a sum of money due to him for expenses incurred in the service of the Company, by order of the Board of Directors. We know not the merits of this, but we do know, and it is known to every man who knows the Company, that if it had not been for him the Act

would *never have been obtained, nor the line have existed;* and it is equally notorious, that he has since served the interests of the Company with an industry and zeal which may almost bid defiance to comparison in any company or concern whatever.

Harwich Railway.—We regret to hear that this railway is at a complete stand, owing to the backward state of the Eastern Counties. We think the Directors (query, Secretary?) of the Eastern Counties have not behaved well to this Company, in not informing them of their intention to stop at Brentwood, and thus occasioning them an unnecessary outlay by the depositing plans, &c. for the next session. We think, too, the Eastern Counties Company are not justified in forming the useless part of their line between Norwich and Yarmouth, until at least they have completed it to the former place, and thus given the branches the means of joining them.

Irish Commission.—The Commissioners are gone to Ireland, to inspect, with the engineers Messrs. Vignoles and McNeil, the lines intended, in *propriis personis*. This is the proper and business-like course; their eyes will be much more faithful informants than their ears.

Midland Counties Railway.—For the proceedings of this Company we refer our readers to the Directors' report, in the present number.

Newcastle and Carlisle Railway.—About 1500 men are now, we believe, employed on the middle portion of this line, between Haltwhistle and Haydon Bridge, which leaves no doubt of its being finished before the end of the year, when the line between Redhugh and the Canal Basin at Carlisle (a distance of 60 miles) will be finished. The revenue is now, on the part completed, gradually increasing, and for the four weeks ending the 8th July, we are informed the receipts have been as follows:—Week ending 17th June, 895*l.* 6s. 11d.; ending 24th June, 1004*l.* 12s. 11d.; ending 1st July, 1085*l.* 15s. 3d.; ending 8th July, 1144*l.* 6s. 8d.—*Newcastle Journal.*

Newcastle, North Shields, and Tynemouth Railway.—The first ground broken, the west end of the line, is at the east end of the late Lord Stowell's garden, in front of Ridley villas. A tunnel is to pass under the turnpike-road, between 80 and 90 yards long, and 16½ feet in height. The road is to be raised about 2½ feet. A large handsome stone bridge is to cross the Ouseburn, of five arches, three of 116 feet span, and two of 110 feet. The height from the Burn will be 106½ feet. The Company are desirous to have a station at the Manors if they can. From the station in the Manors to Byker Hill the line will be very nearly straight; then a slight curve of 1¼ miles, and afterwards it continues straight for three miles, to Willington Dene. The formation of the line is necessarily at present going on in patches. The ravine at Willington is to be crossed by a bridge of seven arches of 120 feet span

each, and 74½ feet above the level of the ground. The station at present proposed for the termination of the railway at Shields is on the South side of Northumberland-square, with a branch to the Steam Ferry at the new Quay, and the Company intend to continue the railway in a direct line to Tynemouth Haven, for which they are now seeking Parliamentary powers.

Preston and Wigan Railway.—Great exertions are making to expedite the completion of this undertaking, two thousand two hundred and forty-eight workmen are now employed on it. The progress made with the bridge over the Ribble has been rather retarded by a want of timber used in constructing the arches. In the neighbourhood of Leyland, for several miles, the line is so forward as to permit the Directors to have an excursion along it.

South Western Railway.—At a meeting lately held of this Company it appeared that 29,000*l.* had been received in deposits, and the balance now in hand was 14,186*l.* It was considered the New Standing Orders would render it necessary to dissolve the Company, and resolutions requiring the Directors to call a meeting of the shareholders for that purpose were passed.

Southampton Railway.—The works of this line to Kingston are fast proceeding towards completion. They would be able to open to Guildford much earlier than the time proposed, next spring, but it is thought advisable not to be too quick, and to allow the embankments time to consolidate.

Standing Orders.—The New Commons' Standing Orders require a deposit of 10 per cent. in the Bank of England or Government securities, previous to proceedings in the House. Their other regulations are also such that nothing short of actual working plans can be deposited. The variation of the level is limited to two feet in towns, and five feet in open places, without the consent of the owners of the soil; and the inclination is no where to be altered more than three feet per mile. The effect of the two first cases will be to raise 15 per cent. at once on the total capital, which will, we apprehend, be the means of stopping this species of improvement nearly altogether. The two next are another fetter on the money of companies for the advantage of landowners, and a new stimulus for them to carry on their extortions and plunder, even after the Act is obtained; for unless the companies "come down" to the satisfaction of the landowners, they can make comparatively no alterations, however necessary, but if they do, they may accomplish whatever they like. The Lords' Standing Orders, with respect to the subscription contract, are made with much more judgment. They require the contract to have been entered into subsequent to the previous session; three-fourths of the capital to be subscribed for; and 5 per cent. paid on all subscribed shares.

PARLIAMENTARY PROCEEDINGS.

House of Commons.

Progress of Bills since our last:—

Bishop Auckland and Weardale, and also the Commercial (London and Blackwall), read a third time June 9th.

Progress of Bills in the Lords since our last:—

Thirty-two Bills have received the Royal assent since our last, and only nine all the session before; so that out of 118 notices given, only 41 have passed. The Bills passed since our last are—Bishop Auckland and Weardale; Birmingham and Derby Junction; Bolton and Preston; Chester and Birkenhead; Chester and Crewe; Clarence (Durham); Clarence (Hartlepool); Cork and Passage; Dublin and Drogheda; Dublin and Kilkenny, or Great Leinster and Munster; Dundalk Western; Durham Junction; Durham and Sunderland; Glasgow, Paisley, and Greenock; Glasgow, Paisley, Kilmarnock, and Ayr; Great North of England (Castle Eden); Great Western (Paddington); and ditto (Trowbridge); Kilmarnock and Troon; Leicester and Swannington; London and Birmingham; London and Brighton, Rennie's; London and Greenwich, 2d; London and Southampton; Manchester, Cheshire, and Staffordshire; Maryport and Carlisle; Polloc and Govan; Slamannan; South-Eastern, London, and Dover; Taff Vale, Merthyr Tydfil; Wishaw and Coltness; York and North Midland.

THE LORDS' STANDING ORDERS FOR RAILWAY BILLS, AS AMENDED 1837.

1. That all Standing Orders relative to Railway Bills heretofore in existence be repealed; and that in lieu thereof the following Orders be the Standing Orders relative to Railway Bills.

2. That at the commencement of every session of Parliament a Standing Order Committee shall be appointed, consisting of forty Lords, besides the Chairman of the Committees of the House of Lords, who shall be always Chairman of such Standing Order Committee.

3. That three of the Lords so appointed, including the Chairman, shall be a quorum.

4. That previous to the Second reading of any private Bill relating to Railways in the House such Bill shall be referred to the Standing Order Committee, before which the compliance with the Standing Orders relative to notices, to the depositing of plans and sections and books of reference, lists and estimates, and to applications for the consent of the owners and occupiers of lands, and to any other matters which may be required by the Standing Orders to be done by the parties promoting such Bill previous to the second reading of such Bill, shall be proved.

5. That any parties shall be at liberty to appear and to be heard by themselves, their agents and witnesses, upon any petition which may be referred to the Committee, complaining of a noncompliance with the Standing

Orders, provided the matter complained of be specifically stated in such petition; and that such petition be presented on or before the second day after the introduction of the Bill into this House.

6. That such Committee shall report whether the Standing Orders have been complied with; and if it shall appear to the Committee that they have not been complied with, they shall state the facts upon which their decision is founded, and any special circumstances connected with the case, and also their opinion as to the propriety of dispensing with any of the Standing Orders in such case.

7. That three clear days notice be given of the meeting of such Committee.

8. That no Committee on any private Bill relating to railways shall have power to examine into the compliance with the Standing Orders, nor into any part of the contents of any notice, list, application in Writing, estimate, book of reference, or contract, or of any copy of any notice, list, application in writing, estimate, book of reference, or contract, nor of any plan or section, or copy of any plan or section, which are or may be hereafter ordered by any Standing Order of the House to be given, made, deposited, or produced by the parties applying for such private Bill previously to the second reading thereof in the House, excepting only in so far as may be required to enable such Committee to report as to the sufficiency of the estimate to be proved in evidence before them, according to the Standing Orders of the House.

9. That all private Bills relating to railways, which shall have been opposed, and in which any Amendments shall have been made in the Committee, shall be reprinted as amended previously to the third reading, unless the Chairman of the Committee shall certify that the reprinting of such Bill is unnecessary.

Standing Orders, Compliance with, to be proved before the Committee on Standing Orders.

1. Notices.—That when any application is intended to be made to Parliament for leave to bring in a Bill for making any railway, or for varying, extending, or enlarging any railway already authorized to be made, or for continuing or amending any Act passed for any of those purposes, or for the alteration of the existing tolls, rates, or duties upon any such railway, notices of such intended application be given, except in those cases where notices in conformity with the existing Standing Orders for the session next after the present session of Parliament shall have been given in the months of February and March in the present year.

2. That such notices, except as hereinafter mentioned, do contain the names of the parishes and townships and extra-parochial places from, in, through, and into which any such railway is intended to be made, varied, extended, or enlarged; and shall state the time and place of the deposit of the plans, sections, and books of reference; and if an alteration in any existing tolls, rates, or duties is intended to be proposed, the intention of proposing such alteration be expressed therein. But in case any such Bill shall be for the purpose only of altering any existing tolls, rates, or duties, or of continuing or amending any former Act, solely for the purpose of tolls, it shall not be necessary to insert in such notices the names of the several parishes and townships and extra-parochial places.

3. That such notices be inserted in the London, Edinburgh, and Dublin Gazette, as the case may be, twice in each of the months of October and November immediately preceding the introduction into Parliament of the

Bill for which such application is intended to be made, and also twice in each of the aforesaid months, in some one and the same newspaper of every county in or through which any such railway is intended to be made, or in which any railway already authorized to be made is intended to be varied, extended or enlarged, or if there is no such paper printed therein respectively, then in the newspaper of some county adjoining thereto.

4. That the notices mentioned in the preceding Order shall also be given at the general quarter session of the peace which shall have been holden for every and each county, riding, or division in or through which any such railway, or variation, extension, or enlargement of any railway, authorized to be made, shall be situated, at Michaelmas or Epiphany preceding the session of Parliament in which such application is intended to be made, by affixing such notice on the door of the session-house of each and every such county, riding, or division where such general quarter session shall be holden, save and except as to any Bill for such purposes in Scotland; in which case, instead of affixing such notices on the door of the session-house, such notices shall be written or printed on paper, and affixed to the church door of the parish or parishes in or through which such railway, variation, extension, or enlargement is intended to be made, for two Sundays in each of the months of September, October, and November immediately preceding the introduction into Parliament of the Bill for which such application is intended to be made.

5. PLAN.—That, (except in those cases where maps or plans and sections, books of reference, and copies or extracts from the same, in conformity with the heretofore existing Standing Orders for the session next after the present session shall have been deposited and lodged as required by such Standing Orders,) a map or plan and section, and also a duplicate of such map or plan and section, of the whole of such intended railway, and also of any intended variation, extension, or enlargement of any railway authorised to be made, upon a scale of not less than four inches to a mile, shall be deposited for public inspection at the office of the clerk of the peace of every county, riding, or division in England or Ireland, and in the office of the principal sheriff clerk in Scotland, in or through which such railway, or such variation, extension, or enlargement, is intended to be made, on or before the 30th day of November immediately preceding the introduction into Parliament of the Bill for which such application is intended to be made, which map or plan shall describe the line of such intended railway, or of such intended variation, extension, or enlargement, and the lands in or through which the same is intended to be made, together with duplicate books of reference, containing a list of the names of the owners or reputed owners, lessees or reputed lessees, and occupiers of such lands respectively; and where such railway, or such variation, extension, or enlargement, is intended to pass through any buildings, yards, court-yards, or land within the curtilage of any building, or through any ground cultivated as gardens, an additional plan of such buildings, yards, land, and ground, and of the said railway, shall be laid down upon a scale of not less than a quarter of an inch to every 100 feet; and that where it is the intention of the parties to apply for powers to make any lateral deviation from the line of any such railway or intended variation, extension, or enlargement of any railway authorized to be made, all lands included within the limits of such deviation shall be marked upon the plan; and that in all such cases an additional plan of any building, yard, court-yard, or land within the curtilage of any building, or of any ground cultivated as a garden, included within the limits of the said deviation, shall be laid down upon a scale of not less than a quarter of an inch to every 100 feet.

6. SECTION.—That the section shall be drawn to the same horizontal scale as the plan, and to a vertical scale of not less than one inch to every 100 feet, and shall show the surface of the ground in the line of railway marked on the plan, and shall also have marked on it a line showing the railway line when finished (which line shall correspond with the upper surface of the rails), and a datum horizontal line, which datum line shall be the same throughout the whole length of the railway, and shall be referred to some fixed point stated in writing on the section near either of the termini.

That a vertical measure from such datum line to the line of the railway shall be marked in feet and inches at each change of the gradient or inclination, and that the proportion or rate of inclination between each such change shall also be marked.

HEIGHT OF RAILWAY.—That the height of the railway over or under the surface of every turnpike-road, public carriage-road, navigable river, canal, or railway, or junction with a railway, shall be marked in figures at every crossing thereof; and if there shall be no such crossing in any half mile, then the height over or under the surface of the ground shall be marked once in that space; and if any alteration in the present level or rate of inclination of any turnpike-road, carriage-road, or railway be intended, then the same shall be stated on the said section.

TUNNELLING.—That where tunnelling as a substitute for open cutting, or arching as a substitute for solid embankment, is intended, the same shall be marked both on the plan and section.

7. CLERKS OF PEACE, AND FEE.—That the clerks of the peace, or their respective deputies, do make a memorial in writing upon the maps or plans, sections and books of reference so deposited with them, denoting the time at which the same were lodged in their respective offices, and do at all seasonable hours of the day permit any person to view and examine the same, and to make copies or extracts therefrom, such person paying for the same the sum of one shilling for every such inspection, and the further sum of one shilling for every hour during which inspection shall continue after the first hour.

That one of the two plans and sections and books of reference so deposited with the clerk of the peace, shall be sealed up and transmitted by him by post to the office of the clerk of the Parliaments, on or before the 31st of December next after such deposit with the clerk of the peace.

8. DEPOSITING PLANS, &c.—That (except in those cases which are mentioned in the fifth of these Standing Orders) on or before the 31st of December immediately preceding the introduction into Parliament of the Bill for which application is intended to be made, a copy of so much of the said map or plan and section, so to be deposited as aforesaid, as relates to each parish through which any railway is intended to be made, varied, extended, or enlarged, together with a book of reference thereto, shall be deposited with the parish clerk of each such parish in England, the schoolmaster of each such parish in Scotland, and the postmaster of the post town in or nearest to such parish in Ireland, for the inspection of all persons concerned, at all seasonable hours of the day, such person paying for each inspection the sum of one shilling.

9. That copies of so much of the Standing Orders of this House on private Bills as relates to the deposit of plans, sections, books of reference, and other books and writings, or extracts or copies of or from the same, with the clerks of the peace of counties in England or Ireland, sheriff clerks in Scotland, parish clerks in England, schoolmasters in Scotland, postmasters in Ireland, and other persons, be made out and printed; and that one copy be delivered

to every such clerk of the peace, sheriff clerk, parish clerk, schoolmaster, postmaster, and other person, at the same time, with the plan or other writing, or extract or copy of or from such plan or other writing, deposited with him.

10. That, previous to any Bill for making any railway, or for varying, extending, or enlarging any railway already authorized to be made, or for continuing or amending any Act passed for any of those purposes, being brought to this House from the Commons, in which any alteration has been made in its progress through Parliament, a map or plan and section of such railway, showing any variation, extension, or enlargement which is intended to be made in consequence of such alteration, shall be deposited in the office of the clerk of the Parliaments; and that such map or plan and section shall be on the same scale, and contain the same particulars, as the original map or plan and section of the said railway, or any variation, extension, or enlargement of any railway already authorized to be made.

11. APPLICATION TO OWNERS, &c.—That before any application is made to Parliament for a Bill for making any railway, or for varying, extending, or enlarging any railway already made, previous application in writing, according to a form hereafter specified marked (A.), be made to the owners or reputed owners, lessees or reputed lessees, by being sent to their usual place of abode in the United Kingdom, or, in their absence from the United Kingdom, to their Agents respectively, and to the occupiers of the lands through which any such railway is intended to be made, varied, extended, or enlarged, or within the limits of the deviation intended to be applied for; which application in writing shall point out the particular land or building belonging to such owners or reputed owners, lessees or reputed lessees, which are purposed to be taken for the purpose of such railway, and shall also state whether such railway is intended to pass through such land or building upon the level or upon an embankment or cutting, together with the greatest height of such embankment or the greatest depth of such cutting respectively, with a reference to the number on the plan deposited with the clerk of the parish wherein such land or building is situated; and that such applications shall be made on or before the 31st day of December immediately preceding the introduction into Parliament of the Bill for which such application is intended to be made; and that separate lists be made of the names of such owners, lessees, and occupiers, distinguishing which of them, upon such application, have assented to or dissented from such intended railway, or such variation, extension, or enlargement, or are neuter in respect thereof: provided always, that no power shall be granted in any private Bill relating to railways to deviate from the line laid out, without its being specified in the advertisement that such a power will be applied for, and to what extent.

12. DEPOSITING LISTS, &c.—That previous to any Bill for making any railway, or for varying, extending, or enlarging any such railway already made, being brought to this House from the Commons, the lists mentioned in the preceding Resolution, and estimates of the expense, and of the probable time within which the whole of such work may be completed, if not prevented by inevitable accident, written in words and not figures, and signed by the person making the same, together with a statement of any alterations in the book of reference which may have arisen since the same was deposited, be lodged in the office of the Clerk of the Parliaments, and that the receipt thereof be acknowledged accordingly by one of the clerks of the said office.

13. DEPOSITING ALTERATIONS.—That where any alteration shall have been made, or shall be desired by the parties to be made, after the intro-

duction of the Bill into Parliament, in the line of railway, or any variation, extension, or enlargement of any line of railway already authorized to be made, the plans and sections for which shall have been deposited and the notices for which shall have been given as before mentioned, a plan and section of such alteration on the same scale and containing the same particulars as the original plan and section, together with a book of reference thereto, shall be deposited with the Clerk of the Peace of every county, riding, or division in England or Ireland, and in the office of the Sheriff Clerk of every county in Scotland, in which such alteration is proposed to be made; and a copy of such plan and section, so far as relates to each parish, together with a book of reference thereto, shall be deposited with the parish clerks of each such parish in England, the schoolmaster of each such parish in Scotland, and the postmaster of the post town in or nearest to each such parish in Ireland, in which such alteration is intended to be made, one month previously to the introduction of the Bill for making such work into this House; and the intention to make such alteration shall be published in manner before directed in the London, Edinburgh, or Dublin Gazette, as the case may be, and some one and the same newspaper of the county in which such alteration shall be situate, or if there be no such paper printed therein, then in the newspaper of some county adjoining thereto for three successive weeks previously to the introduction of the Bill into this House; and personal application, with a notice in writing in the form herein-before mentioned, shall be made to the owners or reputed owners, lessees or reputed lessees, or in their absence from the United Kingdom to their agents respectively, and to the occupiers, of lands through which any such alteration is intended to be made; and the consent of such owners or reputed owners, lessees or reputed lessees, and occupiers, to the making of such alteration, shall be proved to the satisfaction of the Committee on Standing Orders.

14. PLANS, &c., PRINTED.—That previous to the second reading in this House of any Bill for making any railway, or for varying, extending, or enlarging any railway already authorized to be made, the map or plan of the said railway, or of any variation, extension, or enlargement of any railway authorized to be made, shall be engraved or printed upon the scale of an inch at least to a mile, and annexed to the printed copies of the Bill, and shall be laid upon the table of this House.

15. CORPORATIONS.—That no Bill to empower any railway company already constituted by Act of Parliament to execute any work, other than that for which it was originally established, shall be read a second time in this House, unless the Standing Order Committee shall have specially reported—

1st. That a draft of the proposed Bill was submitted to a meeting of the proprietors of such Company at a meeting held specially for that purpose:

2d. That such meeting was called by advertisement inserted for four consecutive weeks in the newspapers of the county or counties wherein such new works were proposed to be executed; or if there are no newspapers published in such county or counties, then in that of the nearest county wherein a newspaper is published:

3d. That such meeting was held on a period not earlier than seven days after the last insertion of such advertisement:

4th. That at such meeting the draft of the proposed Bill was submitted to the proprietors then present, and was approved of by at least three-fifths of such proprietors.

That in case any proprietor of such Company, or any person authorized to act for him in that behalf, shall at such meeting as aforesaid have dissented, such proprietor shall be permitted, on petitioning the House, to be heard by the Standing Order Committee, by himself or his Agents.

16. SUBSCRIPTION CONTRACTS.—That no such Bill shall be read a second time unless the Standing Order Committee shall report that a subscription to the amount of three fourths at the least of the estimated expense shall have been entered into by persons under a contract binding themselves, their heirs, executors, and administrators, for the payment of the money so subscribed.

That all subscription contracts shall contain the Christian and surnames, description and place of abode of every subscriber, his signature to the amount of his subscription, and the name of the party witnessing such signature, and the date of the same respectively.

That no subscription contract shall be valid unless it be entered into subsequent to the close of the session of Parliament previous to that in which application is made for the Bill, and unless the parties subscribing to it bind themselves, their heirs, executors, and Administrators, for the payment of the money so subscribed.

That no subscription contract shall be valid unless it be proved to the satisfaction of the Standing Order Committee that previous to the introduction of the Bill into this House five per cent. upon the amount of each share subscribed for has been paid, and has been expended, or remains applicable to the purposes of the railway at the discretion of the Directors of the proposed Company.

That previous to the introduction of the Bill into this House, copies of the subscription contract be printed at the expense of the promoters of the Bill, and be delivered at the office of the Clerk of the Parliaments.

17. NOTICE TO OWNERS, &c.—That before any Bill is introduced into this House to vary any railway authorized by any former Act, notice in writing of such Bill be given to the owners or reputed owners, lessees or reputed lessees, and occupiers of the lands in which the part of the railway authorised by the former Act intended to be relinquished by the Bill is situate.

18. RAILWAY NOT TO BE PROCEEDED WITH TILL CERTAIN PLANS, &c., DEPOSITED.—That in all such Bills there be inserted the following clauses:

1. And be it further enacted, That it shall not be lawful for the said company to proceed in the execution of the said railway herein-before authorized to be made unless the said Company shall have, previously to the commencement of such work, deposited with the Clerk of the Peace of the several counties in England or Ireland, and in the office of the principal Sheriff Clerk in every county in Scotland, in or through which the said railway hereby authorized to be made is intended to pass, a plan and section of all such alterations from the original plan and section as shall have been approved of by Parliament, on the same scale and containing the same particulars as the original plan and section of the railway; and also with the clerks of the several parishes in England, the schoolmasters of the several parishes in Scotland (or in the Royal Burghs with the town-clerk), and the postmasters of the post towns in or nearest to such parishes in Ireland, in or through which such alterations shall have been authorized to be made, copies or extracts of or from such plans and sections as shall relate to such parishes respectivcly; and all persons interested shall have liberty to inspect and make extracts from or copies of the said plans and sections, or extracts or copies thereof, paying to the officer having the custody of such plan and section, or of such extract or copy, the sum of one shilling for every such inspection, and after the rate of sixpence for every one hundred words copied therefrom.

2. SECTION ALTERATIONS.—And be it further enacted, That in making the said railway it shall not be lawful for the said Company to deviate from the levels of the said railway as referred to the common datum line described

on the section so approved of by Parliament, and as marked on the same, to any extent exceeding in any place five feet, or in passing through towns two feet, without the consent of the owners, lessees, and occupiers of the land in, through, or over which such deviation is intended to be made; or in case any street or public carriage-road shall be affected by such deviation, then the same shall not be made without the consent of the trustees or commissioners, or if there be no such trustees or commissioners, without the consent of two or more justices of the peace in petty sessions assembled for that purpose, and acting for the district in which such street or public carriage-road may be situate, or without the consent of the commissioners for any public sewers, or the proprietors of any canal or navigation affected by such deviation; and that no increase in the inclination or gradients of the said railway, as denoted by the said section, shall be made in any place to any extent exceeding the rate of three feet per mile; and where in any place it is intended to carry the railway on an arch or arches, as marked on the said plan or section, the same shall be made accordingly; and where a tunnel is marked on the said plan or section as intended to be made at any place, the same shall be made accordingly; unless the owners, lessees, and occupiers of land in or through which such tunnel is intended to be made shall consent that the same shall not be so made: Provided nevertheless, that it shall be lawful for the said Company, with such consent as aforesaid, and not otherwise, to make a tunnel or an arch or arches as aforesaid not marked on the said plan or section, so that no such tunnel shall be of greater length than two hundred yards, and that no two tunnels be at a less distance from each other than one hundred yards measured on the line of the railway: Provided always, that notice of every petty sessions to be holden for the purpose of obtaining such consent as aforesaid shall, fourteen days previous to the holding of such petty sessions, be given in some newspaper circulating in the county, and also to be affixed upon the church-door of the parish in which such deviation or alteration is intended to be made, or if there be no church, on some other place to which notices are usually affixed; provided also, that for the purpose of consenting to any such deviation from the said sections, and to any tunnelling or arching as aforesaid, the word "owners" shall be deemed and taken to mean such persons as are herein capacitated to agree for the sale of and to convey land for the making of the said railway; and the consent of such persons, with or without the consent of any other persons interested as owners in the said lands, shall be deemed and taken to be sufficient for such purposes.

3. CURVES.—And be it further enacted, That it shall not be lawful to diminish the radius of any curve as described on the plan deposited with the clerk of the peace or principal Sheriff Clerk, unless such radius exceed one mile, nor to diminish it in any such case so that it shall become less than one mile, nor to diminish any greater radius by more than a quarter of a mile, unless where it exceeds two miles, or by more than half a mile, unless where it exceeds three miles on the said plan.

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1. MATTERS OF INQUIRY BY COMMITTEES ON BILLS.

That Committees on Railway Bills do inquire into the following matters; and that they report specially thereupon, except in the cases hereafter provided:—

(1.) As to the proposed capital of the Company formed for the execution of the project, and the amount of any loans which they may be empowered to raise by the Bill; the amount of shares subscribed for, and the deposits paid thereon; the names and places of residence of the Directors or Provi-

sional Committee, with the amount of shares taken by each; the number of shareholders who may be considered as having a local interest in the line, and the amount of capital subscribed for by them; and the number of other parties, and the capital taken by them; a statement of the number of shareholders subscribing for 2,000*l.* and upwards, with their names and residences, and the amount for which they have subscribed.

(2.) The sufficiency or insufficiency for agricultural, commercial, manufacturing, or other purposes of the present means of conveyance, and of communication between the proposed termini, stating the present amount of traffic by land or water, the average charges made for passengers and goods, and time occupied.

(3.) The number of passengers, and the weight and description of the goods expected upon the proposed railway.

(4.) The amount of income expected to arise from the conveyance of passengers and goods, and in what proportion; stating also generally the description of goods from which the largest revenue is anticipated.

(5.) Whether the proposed railroad be a complete and integral line between the termini specified, or a part of a more extended plan now in contemplation, and likely to be hereafter submitted to Parliament, and to what extent the calculations of remuneration depend on such contemplated extension of the line.

(6.) Whether any, and what, competing lines of railroad there are existing, and whether any, and what, are in progress or contemplation; and to state, so far as circumstances will permit, in what respects the proposed line is superior or inferior to the other lines, if there be any: Provided always, that no line of railway shall be deemed a competing line in contemplation unless the plans and sections for the same, such as are required by the Standing Orders respecting railway Bills, shall have been deposited with the clerk of the peace and in the office of the clerk of the Parliaments on or before the first day of March then last past.

(7.) To state what planes on the railway are proposed to be worked, either by assistant engines, stationary, or locomotive, with the respective lengths and inclinations of such planes.

(8.) To advert to any peculiar engineering difficulties in the proposed line, and to report the manner in which it is intended they should be overcome.

(9.) To state the length, breadth, and height, and means of ventilation, of any proposed tunnels, and whether the strata through which they are to pass are favourable or otherwise.

(10.) To state whether, in the lines proposed, the gradients and curves are generally favourable or otherwise, and the steepest gradient, exclusive of the inclined planes above referred to, and the smallest radius of a curve.

(11.) To state the length of the main line of the proposed line of the railroad, and of its branches respectively.

(12. To state generally the fitness, in an engineering point of view, of the projected line of railroad.

(13.) If it be intended that the railroad should pass on a level any turnpike-road or highway, to call the particular attention of the House to that circumstance.

(14.) To state the amount of the estimates of the cost or other expenses to be incurred up to the time of the completion of the railway, and whether they appear to be supported by evidence, and to be fully adequate for the purpose.

(15.) To state what is the estimated charge of the annual expenses of the railroad when completed, and how far the calculations on which the charge is estimated have been sufficiently proved.

(16.) Whether the calculations proved in evidence before the Committee have satisfactorily established that the revenue is likely to be sufficient to support the annual charges of the maintenance of the railroad, and still allow profit to the projectors.

(17.) The number of assents, dissents, and neuters upon the line, and the length and amount of property belonging to each class traversed by the said railroad, distinguishing owners from occupiers; and in the case of any Bill to vary the original line, stating the above particulars with reference to such parties only as may be affected by the proposed deviation.

(18.) To state the name or names of the engineers examined in support of the Bill, and of those, if any, examined in opposition to it.

(19.) To state the main allegation of any petition or petitions which may have been referred to the Committee in opposition to the preamble of the Bill, or to any of its clauses; and whether the allegations have been considered by the Committee, and if not considered, the cause of their not having been so.

(20.) To state, in addition, any circumstances which, in the opinion of the Committee, it is desirable the House should be informed of.

(2.) Specific Replies.—That this House will not proceed, except in the cases hereafter provided, with the further consideration of report of any Bill until it has received from the Committee specific replies in answer to each of the questions contained in the first of the Standing Orders with regard to the proceedings of Committees on railway Bills.

(4.) Petitions.—That in those cases where no parties shall appear in support of a petition in opposition to any Bills for railways before this House, or where the opposition shall have been withdrawn, it shall be in the discretion of the Committee to determine how far it may be necessary to inquire into the facts required to be proved by the first of the Standing Orders with regard to the proceedings of Committees on railway Bills.

(5.) Provisions for Mortgage.—That no such Bill shall be read a third time in this House unless provision be made:—

(1.) That no such company shall be authorized to raise, by loan or mortgage, a larger sum than one-third of their capital; and that until fifty per cent. on the whole of the capital shall have been paid up it shall not be in the power of the company to raise any money by loan or mortgage.

(2.) Level of Roads.—That where the level of any road shall be altered in making any railway, the ascent of any turnpike-road shall not be more than one foot in thirty feet, and of any other public carriage-road not more than one foot in twenty feet; and that a good and sufficient fence of four feet high, at the least, shall be made on each side of every bridge which shall be erected.

(3.) Crossing Roads.—That no railway whereon carriages are propelled by steam shall be made across any turnpike-road, or other highway on the level, unless the Committee on the Bill report that such a restriction ought not to be enforced, with the reasons and facts upon which their opinion is founded.

(4.) Failure of Completion.—That in case the work intended to be carried into effect under the authority of the Bill shall not have been completed, so as to answer the objects of such Bill, within a time to be limited, all the powers and authorities thereby given shall thenceforth cease and determine, save only as to so much of such work as shall have been completed within such time, with such provisions and qualifications as the nature of the case shall require.

FORM (A) REFERRED TO IN PAGE 135.

_____ *Railway.*

No.

Sir,—We beg to inform you that application is intended to be made to Parliament in the ensuing session for "An Act [*here insert the Title of the Act*], and that the property mentioned in the annexed schedule, or some part thereof, in which we understand you are interested as therein stated, will be required for the purposes of the said undertaking, according to the line thereof as at present laid out, or may be required to be taken under the usual powers of deviation to the extent of yards on either side of the said line which will be applied for in the said Act, and will be passed through in the manner mentioned in such schedule.

We also beg to inform you that a plan and section of the said undertaking, with a book of reference thereto, has been or will be deposited with the several clerks of the peace of the counties of [*specify the counties in which the property is situate*], and that copies of so much of the said plan and section as relates to the parish in which your property is situate, with a book of reference thereto, has been or will be deposited for public inspection with the clerk of the said parish on or before the 31st day of December instant, on which plans your property is designated by the numbers set forth in the annexed schedule.

As we are required to report to Parliament whether you assent to or dissent from the proposed undertaking, or whether you are neuter in respect thereto, you will oblige us by writing your answer of assent, dissent, or neutrality in the form left herewith, and returning the same to us with your signature on or before the day of next; and if there should be any error or misdirection in the annexed schedule we shall feel obliged by your informing us thereof, at your earliest convenience, that we may correct the same without delay. We are, Sir,

Your most obedient Servants,

To

PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum paid.	Closing Price of Shares in London Markets on								
					June.	July.							
					30.	4.	7.	11.	14.	18.	21.	25.	
			£.	£.									
6,000		(3) Birmingham and Derby	.....	10	.....	4 1/2	4	.....	.....	2 1/2	2 1/2		
9,500	.....	(3) Birmingham and Gloucester	.....	10	.....	2 3/4	1 3/4	.....	.....	1 1/2	1 1/4		
7,500	.....	(2) Birmingham, Bristol, and Thames Junction	20	3									
15,000	.....	(2) Bristol and Exeter	100	10									
660	.....	Calcutta and Saugur	50	2									
350	.....	Cheltenham	100										
7,500	.....	(3) Cheltenham and Great Western...	100	7 1/2									
14,000	.....	(4) Cheltenham, Oxford, and Tring...	100	5									
2,000	.....	(2) Clarence	100	100									
12,000	.....	(3) Commercial Blackwall	50	2									
8,000	.....	(3) Dublin and Kilkenny	100	2 1/2	.....	7/8	3/4	.....	3/4	5/8			
7,500	.....	(4) Durham South-West Junction ...	20	3									
60,000	.....	(3) Durham Junction	100	10									
64,000	.....	(2) Eastern Counties	25	2	9s.	.....	.....	5/8	1/2	3/8	5/8		
5,000	.....	Edinburgh and Dunbar	.....	2									
13,000	.....	(3) Edinburgh, Leith, and Newhaven	20	3									
800	.....	(4) Edinburgh and Glasgow	50	2									

2,800	.....	(4)	Glasgow and Falkirk Junction ...	50	3								
		(1)	Grand Junction	100	50								
		(3)	Great North of England.....	.....	7								
25,000	.....	(2)	Great Western	100	45	57	58	55	51⅜	54½	56¾	53	55
2,000	.....	(2)	Hartlepool	100	100								
11,000	.....	(4)	Harwich	20	1								
8,000	.....	(2)	Hull and Selby	50	5								
40,000	.....	(4)	Kent	50	2								
2,000	.....	(3)	Llanelly Railway and Docks	100	25								
2,100	.....	(1)	Leeds and Selby.....	100	100								
1,500	.....	(1)	Leicester and Swanington	50	50								
5,100	10*l.* per c.	(1)	Liverpool and Manchester	100	100								
			Ditto, ¼ shares	25	25								
10,000	.....	(4)	LondonandBrighton(Stephenson's)	100	5	3	3	3	3	2½	2⅜	2¾	
45,000	.....	(4)	——————— (Gibbs) ...	20	1	⅝	⅝	12s.	13s6d	12s6d	12s6d	½	10s9d
16,000	.....	(3)	——————— (Rennie)....	50	3	2⅓	2¼	2	1⅞	1⅞	¾	1⅜	1¼
8,000	.....	(4)	——————— (Cundy)	100	3	.....	.....	.....	⅝				
12,000	.....		London and Blackwall	50	3	⅝	⅛						
20,000	3*l.* per c.	(2)	London and Greenwich (ex div.).	20	20	15½	15½	15¼	15	15¼	15	12½	14
			Ditto, Bonds										
25,000	.....	(2)	London and Birmingham	100	85	143	.....	143	136	139	144		
			Ditto, Bonds, 1834.										
20,000	.....	(2)	London and Southampton	50	40	25	26	24	22	28½	24		
16,000	.....	(2)	Ditto, Ditto, New.....	25	1	.....	12	9	8½	9½	.....	.....	8
12,000	.....	(3)	London and Croydon	50	20	17	19	18	.....	.....	17		
10,000	.....	(2)	Manchester and Leeds	100	10	13	.....	13¼	13½	.....	13¾		
10,000	.....	(4)	Manchester and Birmingham.....	50	5	4¾	5	5¾	4¾	...5⅛	6		
10,000	.....	(4)	Manchester South Union	100	5								

PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Price of Shares in London Markets on								
					June.	July.							
					30.	4.	7.	11.	14.	18.	21.	25.	
		(2) Midland Counties	100	5									
15,000	.....	(2) North Midland	100	15	16	17½	16¼	15	15½	17	15¾		
12,000	.....	(3) Northern and Eastern.....	100	6									
2,500	.....	(2) Preston and Wigan.....	.....	20									
2,600	.....	(2) Preston and Wyre	50	28									
4,000	.....	(3) Sheffield and Rotherham	25	10									
1,000	6*l.* per c.	(1) Stockton and Darlington	100										
1,500	.....	(2) Stanhope and Tyne	100	100									
3,000	.....	(4) South Durham	50	2½									
28,000	.....	(2) South-Eastern and Dover	.....	7	.....	.....	.....	3½	.....	.....	3½		
24,000	.....	(4) Do. Brighton, Lewes, and Newhaven	50	2	2	1	1⅞	.....	1½	.....	1¼		
		(4) South Midland	50	1									
40,000	.....	(4) South-Western (Stephenson's) ...	50	1	.....	.....	.....	.....	.....	6s6d.			
9,000	.....	(3) Thames Haven	50	2½									
6,600	.....	(4) Victoria	25	1									
1,400	.....	(4) Westminster and Greenwich	50	2									
6,000		(3) York and North Midland	50	3									

The above, as we have stated, are the closing prices of the day. They are the prices at the last business transactions. But it is to be understood, that there is generally a difference of ¼ in the Stock Exchange between the prices a person can sell at, and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the number of Shares wherever we could; but should any errors be left, we shall immediately correct them when pointed out.

THE

RAILWAY MAGAZINE;

AND

Annals of Science.

No. XIX. SEPTEMBER, 1837. New Series.

Principles and Practice of Levelling. By the Editor.

Simultaneous or Intermediate Levels.

Where the ground is irregular or much undulating within a short distance, levellers elude the trouble of several adjustments of the level, by fixing on a spot commanding a number of them at a moderate distance, on one side of the line to be levelled. In the ordinary way of fore and back observations, a little inaccuracy of the level, or in its adjustments, will not show itself, because on an average the distance of the fore and back observations are about equal, and therefore inaccuracies, or want of perfect adjustment, nearly balance each other; but in the cases of intermediate levels, it is much more needful that the instrument be a good one and truly adjusted. It is also advisable that the instrument be set up as nearly as possible equi-distant from the first and last positions, particularly if they are any great distance from it.

The following plan of registering simultaneous levels is from the managing surveyor of a very eminent engineer. For fewness of entries, it is preferable to one we have been in the habit of following. But we think ours has the advantage in simplicity and detection of error. We shall describe both.

The first of a series of simultaneous levels this gentleman enters as a back sight, and all the rest, including the last, as fore sights. No intermediate back sights whatever are entered, as in the annexed specimen. The differences between these fore sights and the back sights, give their respective rises or falls. He, however, only reduces the first and last sight, and recommends all the intermediate one to be left to the last, "that the addition or subtractions

of them may not be mixed up with the general running levels." He also advises their rises, falls, and reduced levels to be entered in red ink, which will always mark their character; or he otherwise puts a mark against the last fore sight, as, for instance, against 1·50 and 4·52 in the following specimen. To find the reduced levels of these intermediate points, their rises and falls are separately referred to the former principal reduced level. For example, in the following field-book, we start at an elevation above some point of 240 feet; and therefore 3·35, 1·85, 2·20 are severally added to, and 4·60 subtracted from 240·00 to obtain their respective reduced levels. In the same way 2·80, 4·60, 1·00 are also separately added to, and 2·80 subtracted from 244·50 to have their corresponding reduced levels.

Back Sights.	Fore Sights.	Rise.	Fall.	Reduced Levels.	Distance.	Observations.
Back Sight on Canal.				Feet.	Chs. Lks.	
				+ 240·00		On Surface of Canal.
6·00	2·65	3·35	...	243·35	4·50	
	4·15	1·85	...	241·85	.....	At corner of hedge on right.
	3·80	2·20	...	242·20	...	20 Links from house on left.
	10·60	.....	4·60	235·40	7·10	In Hollow.
	1·50	× 4·50	...	244·50	9·00	On Brow of Bank.
9·20	6·40	2·80	...	247·30	12·00	On Line.
	12·00	.....	2·80	244·70	13·00	Ditto.
	4·60	4·60	...	249·10	....	To right of last distance 200 lks.
	8·20	1·00	...	245·50	....	To left ditto 150 links.
	4·52	× 4·68	...	249·18	17·50	On line (at corner of fence).

By the same method, which is very simple and economical, all the intermediate reduced levels are separate independent reductions, and no succeeding reduced level will afford any test of the truth of the preceding. It is true the operations are very simple and easily gone over again; but always in figures it is considered an object, where errors are so likely to creep in, to make, if possible, the last computation a proof of the accuracy of all the preceding. This is our plan, which is done by entering each of the intermediate sights a fore sight to that one which precedes it, and a back to the one which follows it. We then proceed precisely as in the case of ordinary running sights. Thus we should make 2·65, 4·15, 3·80, 10·60 respectively back observations to 4·15, 3·80, 10·60, 1·50; and so likewise 6·40, 12·00, 4·60, 8·20 respectively back observations to 12·00, 4·60, 8·20, 4·52. In the addition of verification, however, these intermediates would have the pen drawn across them, and be left out. So

that we should leave no more figures to add up than the preceding method, while the reduced levels would all be dependant, and betray at the end any error in the previous parts.

We may also save labour in using the rises and falls as verifications, by striking out all but those which stand opposite to the last of the fore observations. By this means our addition in the columns of "rise" and "fall" is reduced to the same as the preceding method. We have described the two, leaving it to our readers to use whichever they prefer. As we said above, we admit the former to be more economical in entries, but we think the latter more uniform and secure against the existence of error.

Cross Sections.

Whenever the country is to be instrumentally examined for a line of railway, it is usual, when carrying on the operations of levelling, to take a number of cross sections at various points, connecting them all with the main system of levels, so as to be referable to one common datum line. Some engineers, having settled in their own mind nearly the line they intend to follow, simply direct cross sections here and there to be made for short distances, with the view of seeing where and how any little deviation can be made to advantage. Others procure the best maps they can of the country, and order all the roads, lanes, and paths if laid down, to be levelled for miles round, and the levels of the principal points to be marked on the maps. By this means they get a pretty correct representation of the face of the country. Others, again, direct a system of reticulated levellings carried through the lowest parts of valleys and the highest ridges of hills, which they also carefully lay down on a map. This is the best possible method next to modelling a country; for the most advantageous line can afterwards be determined in the closet to the greatest nicety, and better than it could in the field.

Where the surface of a country is very irregular, it is not merely cross sections to the principal line of levels that are taken, but cross sections to the cross sections themselves, even to the third, fourth, and higher degrees. In all these cases it will be the best, and in the end the least expensive, as it will be the most correct way, to make a survey of the country first, unless good maps can be obtained, and enter on the plan itself the levels. But these are matters that do not belong to observations on levelling strictly speaking. I

merely mention the matter to show young engineers the immense labour that is required for settling the best line between two given points, when the ground is troublesome. Upwards of 1,000 miles, I am informed, were levelled before the line of the Midland Counties was finally fixed on.

Levelling with the Theodolite.—General Description of the Theodolite.

It would take up too much room for us to go into a full description of this very useful instrument. We must therefore refer our readers for details to a neat little work on the "Principal Mathematical Instruments used in Surveying, Levelling," &c., by F. W. Simms. We may observe generally, that the object of a theodolite is to measure vertical and horizontal angles. For this purpose it is constructed on two brass, circular, horizontal plates, chamfered off at the edges, easily sliding on each other, and round a common axis. The circumference of the lower plate is divided into 360 degrees and half degrees, and sometimes into quarter degrees, or less. On the upper is one, and occasionally two or three, noniuses, for the purpose of subdividing the divisions on the lower plate into minutes or less of a degree. With these plates the horizontal angles are measured; the upper one generally carries two small levels at right angles to each other. The telescope has a spirit level attached to it, and is mounted in Ys, as in the common level; but these Ys are fixed to an axis supported on two upright arms on the upper plate, and to a portion of a graduated circle beneath them. A vertical motion is thus given to the telescope, and the graduated circle slides close to a fixed nonius, by which its divisions are subdivided into minutes or less. For moving the instrument very accurately, and by very small quantities, there are various clamps and tangent screws, or rack work, to which it is unnecessary more particularly to advert.

On the other side of the graduated arc, there usually is a series of divisions marked "*difference of base and hypothenuse;*" and another marked "*perpendicular in* 100 *of base.*" According to the angle of elevation or depression, the former shows how many the base is of the same denomination less than the hypothenuse, supposed 100, whether it be chains, links, feet, &c. The latter also shows how many of the same denomination the perpendicular is, the base being 100.

We might here observe, that as there is no instrument

more useful than the theodolite, so there is none that has been made in a greater variety of shapes and forms, which has arisen from the numerous attempts to improve it.

Rectification and Adjustments.

The first adjustment is to fix the crossing of the wires in the optic axis of the telescope, which is described p. 66 of the last number.

The second is that of determining the error of the vertical reading vernier, or of ascertaining the position of the telescope when its axis is parallel to the plane of the plates. Turn the upper plate round until each of the levels on it is parallel, or nearly so, to a pair of the adjusting screws beneath, like those in the level. Then by aid of these screws, and guided by the said levels, set the plate as correctly as possible level. Turn the intersection of the cross wires now to a particular part of some distant object, and read off the apparent elevation or depression of it on the part of the vertical circle by aid of the nonius. Take the telescope out of the Ys (previously thrown open for fear of disturbance), and reverse it. Then turn the upper plate half way round, and point the intersection of the cross wires again to the beforementioned particular part of the distant object. The reading of its apparent elevation or depression will now be on the contrary side of zero on the vertical arc. If the two readings are the same, the nonius is correct; if not one-half the difference from the limb zero towards that side on which the greater reading was, is the true position of the zero. In all vertical angles, therefore, this half difference must be added to readings on the opposite side of the limb zero, and subtracted from those on the same side as the true zero is.

Third Adjustment.—Having set the plates level, and brought the true zero of the limb just found to the zero on the vernier, the axis of the principal level, that attached to the telescope, may be set very nearly parallel to the line of collimation of the telescope, by simply turning the screw at one end of it until its bubble settles in the middle. But the accurate adjustment must be made and proved as described in pp. 66 and 67, No. 18.

Fourth Adjustment.—The preceding adjustments enable us to set the axes of the telescope and level parallel to each other, and to a line in the plane of the plate under the telescope. The next and last adjustment we shall notice is that of making the vertical plane in which the telescope

moves, truly perpendicular to the plane of its horizontal motion. Ordinary levels have no adjustment of this sort provided: the instrument is supposed to be turned out true in this respect from the hands of the maker. In very fine theodolites the frame carrying the pillars which support the axis round which the Ys turn, is fastened by three screws to the upper plate. With these the adjustment is easily made. When the adjustment is perfect, and the plane of the plates is set truly horizontal, if the intersection of the wires be turned on some well-defined elevated object—the more in reason the elevation the better—and then without moving the instrument the telescope be turned on the horizontal axis, until the said intersection fall on the reflected image of the body in any good liquid, as mercury, it will cut it in precisely the same point. If the intersection passes to the right or the left of the point, the adjustment is not complete, and must be altered.

Practice of Levelling with the Theodolite.

Though of much greater power and capability than the ordinary level, the theodolite is not so much used in practical levelling. This arises partly from its greater expense, partly from its more complex construction and liability to get out of order, and partly from its greater weight and inconvenience.

When the theodolite is substituted for the common spirit level, the point of true zero is brought to the zero on the nonius and clamped to it, after which the operations are precisely the same. But the method peculiar to the theodolite, and that in which it has a decided advantage over other instruments, consists in finding from a single sight the difference of level of any two places within view of each other, whose direct distance is given or can be measured.

For this purpose the theodolite is set up at one of the stations, and the height of the centre of the level is measured by taking a mean, if the ground inclines much, of the heights of the eye and object ends of the telescope, when turned in the direction to be levelled. Perhaps this mean is best obtained by holding the two staves, one before and the other behind the telescope, with the vanes at the same height on each, and near the guessed height of the telescope, when by inclining it parallel to the vanes, its mean height is immediately seen. The wire crossing the middle of the vane being set to this height, the staff is carried to the other station, and the apparent angle of elevation or depression

read off, allowing for the index error, or quantity, the true zero of the arc differs from that marked on it, as before directed.

For the purpose of insuring accuracy, it is best to repeat the operation by reversing the positions of the instrument and staff, taking care to have the vane reset to the true height of the telescope in its new position. The mean of the angles of elevation and depression will be the true angle in either case. By this means any error in the parallelism of the telescope and level, or of the position of the true zero, will be corrected.

To the log-sine of this angle, add the log of the direct distance between the staves in feet, if the difference of level is wanted in feet, and the sum, minus 10 from the index, will be the log of the instrumental difference of levels. Correct this for sphericity and refraction in the way described p. 69, No. 18, and the result will be the true difference of levels.

If an arithmetical operation is wanted, take out the number cut by the bevelled edge of the fixed nonius marked "diff. of hypo. and base," which take from 100. Take out in like manner the number cut by the same bevelled edge of the nonius marked "perp. to 100 of base," and multiply the foregoing remainder by a 10,000th part of the product of the hypothenuse, and the number last taken out; the product will be the instrumental difference of levels in the denomination of the hypothenuse, which must be corrected as before.

This is a very easy and correct mode when the angles of depression and inclination are such that the divisions exactly coincide with the bevelled edge of the nonius; otherwise it is a mere approximation.

Example.—The vane being adjusted to the height of the level and set up fourteen chains, or 924 feet off, the angle of depression was found to be 1° 9′, and the division corresponding to "perp. in 100 of base" was very exactly 2, that corresponding to "diff. of hypo. and base," not being any thing.

Here, then, we have the base sensibly the same as the hypothenuse, and consequently $\frac{1}{100}$th of 924, or 9·24, multiplied by 2 gives 18·48 feet, the fall sought. By previous levelling with the common spirit level it was found to be 18·64.

Secondly, If to 8·30255 log-sine of 1° 9′ we add 2·96567 the log of 924, we shall have 11·26822, and taking away 10

from the index 11, leaves 1·26822 the log of 18·55 feet, very nearly the same as before, and as it was found by levelling, or thus:—

1° 9′ log sin	8·30255
924 log	2,96567
18·55 log	1·26822

When the theodolite is used for levelling in this way, the field-book contains a column for the angles of elevation and depression, distinguished with an *e* and *d*, or the characters + and — before them; a column for the hypothenuse lengths; three for the rises, falls, and reduced levels; and another for the base lengths.

Angle of Elevation or Depression.	Hypothenuses.	Rise.	Fall.	Reduced Level.	Bases.
° ′	Chains.	Chains.	Chains.	Chains.	Chains.
2 52 *d*	12·73	. . .	·6365	— ·6365	12·71
4 1 *e*	6·29	·4403	. . .	— ·1962	6·27
8 3 *e*	7·34	1·0276	. . .	+ ·8314	7·27
17 28 *d*	11·71	. . .	3·5130	— 2·6816	11·17

The sum of all the bases (here 37·42) is the total base or horizontal length. We have here given the rises, falls, and reduced level to four decimal places, because being given in chains it is needful, if accuracy is required.

In most practical cases I doubt whether it is not quite as short and convenient a process for finding the rises and falls, to take from a table of natural sines the sine of the angle and multiply the hypothenuse by it, according to the rule of contracted multiplication of decimals, as it is to turn out the logarithms, unless the object is to reduce it to any other measure. And the same with respect to finding the bases, which are the products of the cosines of the said angles by the hypothenuses.

We have not made any allowance for sphericity and refraction in the above observations, because in the greatest distance (840 feet) it is hardly worth notice, and our chief object was to elucidate the method rather than to run into minutiæ. In our future observations these details may form a subject for discussion.

System of Safety Railway. By Donald Currie, Esq.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

Sir,—Being aware of your readiness to afford every encouragement to the advancement of useful and scientific improvements, I am therefore induced to offer you the following observations, in the hope of being inserted in your valuable and useful journal.

Railway communication is one of the most important improvements of the present age, and from which the public may expect much benefit and accommodation; but the great bar to the extension of the present railways arises from the large expenditure required in the construction which it is doubtful may be beneficially employed, and also from the permanent injury occasioned to the land, which scarcely can be compensated, so that the public are at present benefited at the expense of individuals: but as railway science is only in its infancy, it may be expected that such improvements will be made as may render this important object to be of mutual benefit and advantage to all parties interested therein.

The objections to the present railways are, that veins of water will be cut, springs dried up, and sloping fields so deprived of water, that they will become sterile and unfit for pasturage or agriculture. That whole estates and fields are cut asunder and disfigured by deep cuttings, and divided and separated by immense embankments, without any other access or communication between portions of an estate than by bridges over surface railways and cuttings, or by archways through embankments, and that only at intervals of considerable distance from each other, thereby materially interrupting the agricultural operations of any property through which these railways may pass, as well as opposing the most serious and dangerous obstruction to the local intercourse of the inhabitants generally on each side lines of railways.

In order to obviate these serious and well-founded objections to the present railway, and as the rapidity of railway communication creates well-grounded alarm and apprehension for the safety of the inhabitants along the lines, I propose to place the *Safety Railway* out of the reach of *injury* to *persons* or *property*, by being constructed of *timber* or other materials, and *raised* at least *ten feet above* the ground, and supported upon bearers of timber or other materials when passing over gardens, ornamental grounds, arable

lands, and any low or level country, allowing underneath the railway free and uninterrupted access and communication, thereby leaving the country open, and removing every obstruction to agricultural operations, as well as to the local intercourse of the inhabitants, who may pass by night or day without risk or danger.

That in establishing the Safety Railway, it offers perhaps the only opportunity which may hereafter occur of placing this most useful and important object upon a system of perfect uniformity, thereby forming a complete and uniform chain of rapid communication throughout the country. It is proposed to be constructed upon one uniform and regular system, so that all the carriages may run upon every line of railway throughout the kingdom. And in order to render it more extensively useful and beneficial to the country, I propose to adopt certain trunk or main lines from the Metropolis, viz.: the Edinburgh, the Liverpool, the Glasgow and Carlisle, the Newcastle, the North Wales and Irish, the South Wales, the Bristol, the Exeter to the Land's End, and also a cross main line from Exeter by Bristol, Gloucester, Birmingham, to York; and another cross line from Lancaster to Cambridge, which cross all the other main lines, thereby opening a more direct chain of rapid communication between the mining and manufacturing districts, at both ends of the kingdom, without passing through London. These main lines are so arranged that three-fourths of the principal inland towns and the sea-ports are within *twelve miles* of some one of these main lines; consequently it may occasion great saving of capital to railway companies, by directing their respective branch lines, which may seldom exceed ten or fifteen miles, towards these main lines, rather than single towns or districts running separate lines of railway to London. That, as the Safety Railway admits of a straighter line than the present railways, it may therefore be better, with a view to the future improvement of railway communication, to proceed in the beginning upon the principle of *direct* lines, by drawing a straight line from one terminus to the other, and constructing the railway as near to this line as the nature of the country and the state of railway science will admit of, as it may be expected that subsequent improvements will be directed to reduce the sinuosity, it being contemplated that inclined planes may ultimately be ascended without stationary engines, thereby rendering cuttings, embankments, and tunnels unnecessary, and occasioning great saving of

capital. That the Safety Railway lines may be altered or removed without causing any permanent injury to the land, or occasioning very little damage to the materials of which it may be constructed.

In the course of my investigation of this subject, it has appeared to me, in which I am joined by some eminent and experienced engineers, that it will be generally found that railways will absorb the light traffic contiguous to the lines, while at the same time the heavy traffic will continue to move as at present, in its usual channels, by water and waggons. Upon this principle I have considered that the home or internal traffic of the country may be divided into the heavy and light traffic, viz.

Heavy traffic, being such as is now conveyed by water and waggons. 1st. Agricultural produce of every description. 2d. Coals, minerals, and the raw materials, whether foreign or domestic. 3d. Manufactured goods, and other property, capable of being made up into heavy bales and other large packages, for home or foreign consumption.

Light traffic, such as is now conveyed by coaches, vans, &c. 1st. Passengers and their travelling baggage. 2d. Light and valuable goods, and other property requiring care, safety, and expedition in the conveyance. 3d. The Royal mails, which may ultimately be expected to be conveyed by the railways.

This principle being once admitted, the immense capital required for the present railways being the great obstacle to the more general adoption of this new and rapid mode of conveyance, may in some measure be surmounted by the Safety Railway, which is capable of being economically constructed, maintained, and worked, in proportion to the traffic expected on any proposed line. In this respect very extensive improvements are in contemplation by the adoption of lighter vehicles, lighter power, and consequently less expensive railways.

It may be considered that the adoption of the Safety Railway may open a new medium of communication by means of the galvanic telegraph, to which it may be attached with ease and convenience to any extent, at little expense, instead of being sunk under the turnpike road, as proposed by Mr. Alexander, at very great expense.

I have the honour to be, Sir,
Your most obedient Servant,
20, Regent-street, Aug. 17, 1837. D. CURRIE.

On the Amended Railway Standing Orders, in a Letter to the Duke of Wellington. By the EDITOR.

MY LORD DUKE,—I know no individual to whom I can with greater propriety address myself on the Standing Orders of Parliament, relative to Railway Bills, than to yourself. The promptitude with which you attend to suggestions affecting the interests of your country, and your high station and influence in the councils of the empire, naturally point you out as one above almost any other in the kingdom, before whom matters pressing on the public weal may readily and successfully be brought.

It is not now a question whether the substitution of railways for turnpike roads between distant commercial places will be beneficial to the public or not. Experience has settled an affirmative beyond the possibility of doubt. What remains for us, then, to consider is, how far any legislative enactments tend to forward or fetter the introduction of sound and useful projects for the formation of railways. For our part we are against all legislative interference whatever, except perhaps that of seeing that the places are in want of a railway, and that the one chosen is the best that could be selected; for it commonly happens that laws are made too late; and when they are made, they are generally such a mass of incomprehensible absurdity as to answer any other purpose but that for which they were intended. Better by far would it be to leave things to take their own course, and to find their own level.

The legislative interference I now chiefly allude to is that of the Standing Orders. Though these regulations are not laws, they have all the force and power of laws, inasmuch as no Bills can proceed in either House until they are complied with. No better proof can be given of the inefficiency of these semi-laws, than the fact of their having been altered session after session; nor of their general absurdity than this brilliant specimen, namely, that they actually provided that one man may assign to another the payment of his debts. That is, my Lord Duke, if I purchased 1000 shares in any railway, I might have made an assignment for you to pay the amount for me—a deed perhaps that you would have less reason to be pleased with than I should. Where could so rare a sample of legislative wisdom be found, except that of "sticking up the house of parties about to be married in some conspicuous part of the church;" or of punishing a culprit "with flogging and fine, one-half of which was to go to the king?"

By the amended Standing Orders of the Commons, agreed to July 13, 10 per cent. of the whole capital is to be locked up in the Bank of England or in public securities. This alteration Mr. Warburton boasts of having caused. The honour of it no doubt is to be divided between him and Mr. Daniel Whittle Harvey, who delivered himself of this very monster several months before in the House. These gentlemen assign as a reason for the order, that "it is to be a protection against speculation, and a security to the House and the public that the project is intended to be carried out." More futile reasons it is scarcely possible to conceive, and one cannot help wondering at the inexperience of the individuals who were deluded by them. Is speculation stopped in the Southampton line, in which four-fifths of the capital has been paid? in the Great Western, in which 45 per cent.; in the Birmingham, in which 85 per cent.; or in the Greenwich, Liverpool and Manchester, Grand Junction, &c. in which the whole has been paid? If such heavy sums do not stop speculation, how is it likely 10 or 15 per cent. will; and of which two-thirds are known to be secure? The idea is too absurd to be countenanced for a moment. One purpose, however, it may answer exceedingly well: that is, should any Members of the Legislature ever be so wicked—which heaven forbid—as to barter their interest in the House for a given number of shares, they will not have to lament that all their *valuable* time has been thrown away; for each share will be worth at least 10 per cent.

We cannot suppose that such naughtiness as this has ever existed in the land. No, no, it is beyond supposition; and it is very praiseworthy, we admit, for Honourable Members gratuitously to take care of the money of the public. But, my Lord Duke, should not their kind attention be returned, by seeing that no evil temptation of taking too much care of themselves with it is thrown in their way? Under the sunbeams the purest snow will melt, and so, we are told, will the loudest public virtue, when exposed to the rays of almighty gold. Let therefore some plan be devised not to peril so valuable a jewel.

But to return. They add that the locking up of this 10 per cent. during the progress of the Bill, will be a security to the House and the country that the measure is intended to be carried out. Wherefore, I ask? The 10 per cent. is to be subject to restraint only until the Bill is obtained. Do these wise legislators not suppose that this

will be immediately met by an alteration in the contract between the directors and shareholders? For example, it may be covenanted that this 10 per cent. shall remain intact, and the whole or any portion of it be returned to the shareholders the instant the Bill has passed, is thrown out, or the session is closed. The real security therefore will be not one jot more than it was before, nor the risk to the parties a sixpence greater. But the inconvenience of having so much money advanced at once, and lying dead for a session or more, may be exceedingly great, and will probably deter many from embarking in this species of national improvement, if not drive them to invest in similar projects abroad, where the encouragement is greater and the trammels are less. Most baneful indeed would this be to the interests of the country, not only by retarding so indispensable an improvement, but by sending that capital out of the nation which might be employed with tenfold benefit to all within.

A great outcry has been raised against the subscription contracts being signed by people of small means, and in a low station. Could a measure more calculated to produce this very circumstance be contrived than the Standing Order in question? The shares hitherto made have been 100*l.* shares, 50*l.* shares, or 25*l.* shares; rarely lower. To meet this unwise Order, they will now probably be reduced so low as to lead many of the labouring classes themselves to subscribe. Suppose it so, could any one justly object to a capital wholly made up of such subscribers, if the amounts did not exceed their probable means? Positive and real surplus property never can be made the criterion, surrounded as it is with so many difficulties; and it would be an unlucky test to apply to all the Members of either House. Thus, then, Messrs. Harvey and Warburton's sage Order will in all probability throw future railway deeds into the hands of that class of persons against whose subscriptions Mr. Warburton figured so Quixotiely in the late Parliament.

Let us now examine the matter in another point of view, in which the inconvenience will be attended, not with a negative loss from the inactivity of the money locked up, but with an absolute and positive loss from the operation of this stupid and senseless Standing Order. Last year, that is in 1836, the amount of capital for Bills which actually passed into law is, by the excellent summary of Mr. Thompson in our 9th Number, about eighteen millions; and by the

summary of the same gentleman in the present number, the capital for the fourteen new lines, exclusive of sums for increased capital, on railways, for which Bills existed, amount to 9,732,500*l*. But the total capital involved in Bills before Parliament at the beginning of the session of 1837, not including those projected but abandoned for this session, exceeded twenty-eight millions, according to Wishaw's Analysis, that is near three times the amount of the new lines passed. Therefore, in the beginning of the last session, had the present Standing Order existed, near three millions of capital must have been purchased into the public securities and locked up in the Bank of England, before a single project could have been proceeded with; and about half the amount more would have been required for expenses. Now what would have been the effect of purchasing three millions of stock, but that of raising the prices of it considerably; and, of course, when these three millions came to be sold out, the prices must be equally depressed. So that for this beautiful Standing Order, this whim of Messrs. Harvey and Warburton, railway companies must not only bear all the heavy and multiplied expenses of surveys, legal and Parliamentary fees, and the fees of those honest men who *sell their interest three or four times over in the course of a session*, but they must now be compelled to make a considerable loss on one tenth of their whole capital besides, by buying stock at advanced and selling it at reduced prices. Is this Parliamentary justice; is it Parliamentary encouragement to works of public utility; or does it exclusively belong to the legislative wisdom and foresight of the two Honourable Members?

The regulation of the Lords with respect to the subscription contract, is infinitely better, and is one of sound judgment, calculated to crush bubbles, and not to oppress projects bona fide made. It requires (see our last Number, p. 137) proof satisfactory to the Standing Orders Committee, "that five per cent. on three-fourths of the capital has been paid and expended, or remains at the disposal of the directors for the purposes of the railway." No fault can be found with this nor with any part of the Lords' Standing Orders relating to subscription contracts, except, perhaps, that which requires it to be entered into for one session subsequently to the close of the preceding. This is raising a difficulty that we do not see the object or utility of, but it is one that may be satisfied.

Neither do we complain of the restrictions imposed on the plans and sections. Engineers ought certainly not to be allowed to proceed in the loose and slovenly manner in which some of them have; limits should be set to their alterations. The amended Orders provide that no level shall be altered more than two feet in passing through towns, or more than five feet in open places, from the sections deposited, without the consent of the owners of the soil. Certain other alterations with respect to arches and tunnels, are likewise subjected to the same control of the landowners. Now there can be no objection to afford every protection to owners of land from any disfigurement by unsightly or injurious alterations; but here is a law,* which leaves the party no power of proving the necessity or benefit of the alteration. No, he is entirely at the mercy of the landowner; and without he obtains his consent, which the landowner never fails to value at a pretty high rate, he must not proceed, even though it might be, from unforeseen circumstances, a matter of indispensable necessity, and possibly better for the landowner himself. I know it will be argued, that if better for the latter, he will not fail to perceive it and agree to it; but experience shows otherwise. Wherever consent has been a matter of necessity, generally nothing but gold has cleared the sight of the lords of the soil. We will cite a few cases. A certain powerful landowner had interest enough to throw out a railway Bill for one session; 1,000 shares in the next, with only paying the deposits, convinced him that the line might pass. From the shares he must derive about 10,000*l.* per annum, and it is said his own property has increased in annual value between three and four times the amount besides, by the operations of the railway. In another instance, the removal of a line a very short distance would enable the company to avoid an expensive tunnel. "What would the tunnel cost?" inquired the counsel of the opposing party. "About 50,000*l.*," was the reply. "Give us that sum and we will withdraw our opposition." Ultimately 30,000*l.* was agreed for. Other cases we could give, but enough these to prove our position, and to show Captain Pechel that landowners have sufficient protection, and know how to use it. Is it fit, I would ask your Grace, that matters should stand thus, and that "*I will not*" should be the argument on one side, and nothing but

* It is not a law of itself, but these Orders are interwoven in the Act as so many clauses.

pounds weight of gold on the other? My Lord Duke, it is not the landowners that want protection, it is the companies, and through them the public, from the manifold and scandalous robberies that are daily committed on them by the land and other owners, under the names of sales, compensations, &c. One case of claim for compensation must not be omitted. The proprietor of a school in a town to which a line was projected, it was found out, would suffer great injury from the railway, though no other person in the town in the same line, of which there were several, would. 5,000*l.* were settled as the amount for compensation. The specific injury is unknown. Whether it was that the railway would bring mammas too often to their darlings, or carry the little dears too often to their mammas, remains a secret. The worthy proprietor was said to have great interest where it could not be neglected.

It is to these points, and to the case of railways generally, that numbers are anxious to call the attention of a man of your Grace's influence, of one who is superior to those obliquities of conduct, which, in spite of all their noisy trumpetings of virtue, stick to some others, the public imagine, like leprosy to the skin of a leper. The question is, should railways be unnecessarily fettered with obstructions? Above all, should they be subjected to the enormous Parliamentary expenses which they are? We have been informed, by gentlemen whose information, we think, may be relied on, that the total expense for obtaining the Bill on the Brighton lines, will fall little, if any, short of 300,000*l.* Ought so shamefully extravagant an expenditure to have been permitted? Are not the whole circumstances of this case alone proof irrefragable of the utter unfitness of Parliamentary tribunals for railway questions? Why, then, are they continued? Must the public believe that there are some sweets about them which cannot be parted with? Exert yourself, my Lord Duke, we beseech you, to convince the world that it is not so, by getting railway questions out of the jurisdiction of Parliament. Send them to the courts of law; send them to a commission; send them any where, even to a council of cobblers, rather than let them remain under such injudicious and expensive control.—I have the honour to be, my Lord Duke, with sentiments of the greatest respect, your Grace's obedient humble servant,

THE EDITOR.

[We regret to say that Mr. Thompson's summary, alluded to in the above, owing to that gentleman's ill health, reached us too late for the present number.—ED.]

Calking Vessels. By JAMES CADETT, M.D.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

22, *Harley-street, August* 7, 1837.

MR. EDITOR,—I observed in your last number a notice of a Patent being taken lately, by Mr. Yetts, of Yarmouth, for a new method of calking sea-boats, by means of slips of India-rubber placed on each side of the threads of the oakum, on the outer sheath of the vessel, for the purpose of preventing the working out of the oakum from the seams. As I have been a great deal at sea at different times, and have some knowledge of ship-building, I beg to notice that I think a much better method might be adopted, and that it would answer the purpose quite as effectually, and would be no additional expense to the builder on the old method. This I think could be as fully effected, by the means of running one or two square grooves along the planks, with intervals, say of a foot apart; the interval not to exceed one inch in length, which would prevent the planks from being weakened at the seams to any consideration. The oakum being forced into the seams would fill the groove as well as other parts of the seam, and obtain a bed in every part of it; and being previously well tarred, and afterwards pitched, I think it would resist, much more firmly than cement could do, all the labouring that a vessel could undergo short of breaking up.

I am, Mr. Editor,
Your very obedient servant,
JAMES CADETT, M.D.

Railway Prejudice. By A TRUE BRITISH HEART.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

London, July 18, 1837.

MR. EDITOR,—Your Magazine being an advocate for an object of such general utility to mankind, as that vast improvement in science is, namely, the method of locomotion by railway, I consider it a true friend to your country, and you also, its benefactor. It is astonishing that notwithstanding the general manner in which education is now spreading throughout this empire, and amongst a people so full of natural intelligence as are its inhabitants, one so full of love for his country's benefit [who is meant here?], so thoroughly proud of her, and so proud to advance almost any scheme by which she may be bettered and ennobled, and so jealous lest

she should be outshoned by any other, should still hold in many quarters such an antipathy, almost amounting to a spite, against this great improvement. Its utility does not require experience to prove it, nor its pecuniary advantages, where it has had fair play, (a maxim so nobly dear to an English heart). We may have a few instances pointed out to us as examples to the contrary, such as, for instance, the *Greenwich Railway*, and there may be many superficial observers who would be prone to snatch at this, as a specimen of disprofit, and hold them out as scares, without examining into the just statement of the circumstances relating thereto. To me, if such a sample of failure was held out, I would ask such questions as would make the person feel rather awkward in answering; such as the following, "Has the Kent Railway obtained its Act, and been completed? Is the Croydon Railway affording its benefits yet? Do the passengers from Croydon, Brighton, and the intermediate places from the fairs of Croydon, from and to the races at Epsom, &c. &c. &c., pass over this line yet? But is the railway even yet completed to Greenwich, and does it yet enjoy its full complement of passengers from that town? Are its arches yet so dry as to admit of their being let as abodes, shops, stores?" &c. &c. &c. Such, Mr. Editor, would be awkward questions to be answered, compatible with such examples of failures. Had the Kent Railway succeeded in obtaining its Act, which I have no doubt it would have done had it not fallen into the snares of base conspiracy, the Greenwich would at the present moment have held a very different station in public opinion. But as the cowardly cobra de capello snaps at the inoffensive traveller whilst it lays secure in its lurking-place, its bite often proving mortal, let it be remembered that it often likewise meets its destruction, and that its bite is not always fatal; and that although the sneaking enemies of the Kent Railway may have injured it, its treacherous gripe is not quite mortal with all its venom. The line chosen by the Kent Railway Company, embraces too large a population to be thus laid aside, and even if the present company was to be dissolved, another will speedily be formed, to carry its object forward; the undertaking is, therefore, not lost, but merely slumbers; let the public only thoroughly experience the great advantage that will be enjoyed when the London and Birmingham is completed, and it, and the Grand Junction from Birmingham to Liverpool and Manchester, are brought fully into operation; when they come to divide enormous dividends, as they no doubt

will do, you will then see if such praiseworthy undertakings will be kept down; conspiracy may increase its difficulties to some length, but the public voice will rise in its favour and save it. The Legislature no doubt considered that they were acting for the best, when they declared that each proprietor should pay up ten per cent. on the nominal capital, before the undertaking should be considered to have conformed to the Standing Orders. I say, Mr. Editor, such a conclusion, should it ever be put in force, would be the greatest blow that could have been struck against improvements of any kind in this country; there are few capitalists (let them be ever so wealthy), who would be willing to lock up ten per cent. of their capitals in any undertaking, before knowing whether it will be incorporated by the Legislature or not; two or three pounds a share are considered as sufficient to pay preliminary expenses—it lies with proprietors to know if the undertaking is worthy of any outlay, and with the Legislature to know if it should be countenanced—if the undertaking turns out a failure, it will not much affect the capitalist, whereas ten per cent. would be a loss of consideration, and few would be willing to embark so large a sum; but I have little doubt that our wise Legislature will perceive its error by the next meeting of its members; they are too patriotic to lay such a clog on the improvements of this already great country, for it would throw it behind in the scale of nations; nor is this to be forgotten by electors, even should we keep out of view the quantity of employment that all public works afford to the labourers. Whilst we have been doing our utmost endeavours to throw difficulties in the way of this great national improvement in our country, we find that other nations are profiting by our blunder, and that France, Belgium, Austria, Prussia, and even Italy, are alive to its advantages. We have, besides, the example of America before us to be our guide; and although we lay the blame of the late distress which commerce has lately felt there to over speculation, when she shall have recovered from this panic, we shall then perceive the advantages which she has gained, and feel those we have lost. The public must keep their eyes open, or those who pretend to be their best friends will turn out to be their worst enemies.

I am, Mr. Editor, your obedient servant,

A TRUE BRITISH HEART.

Railway Guage. By A CONSTANT READER.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

Sheffield, July 15, 1837.

SIR,—In your number of this month you have some remarks respecting the guage of rails, and that Mr. Brunel has adopted seven feet in the Great Western Railway. W. D. Holmes has proposed in his estimate for a line in this neighbourhood (the Midland Grand Junction), what I think a further improvement, and what may be found a necessary one where the guage of railways is increased above what has been considered hitherto the standard (4 feet 8½ inches); viz. Mr. B. proposes the guage to be seven feet, but to provide also for the trains of the London and Birmingham and other lines, he proposes to introduce an extra rail* between the two, which form the seven feet guage, which with one of the outer rails will give also the other and more general guage.

Your obedient servant,

A CONSTANT READER.

Queries on Levelling. By A YOUNG ARTIZAN.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

Newcastle, August, 1837.

DEAR SIR,—May I beg a place in your valuable Magazine for the following queries, and I shall feel obliged to you or any of your scientific readers for solutions.

In your observations on levelling, in the number for August, I think you do not sufficiently explain this part of the subject.

1st. I wish to know the true difference of level between the points A and B, allowance being made for the curvature of the earth and for terrestrial refraction, the height of the instrument at A is 5 feet, and the observed height of the object at B 12 feet, their distance asunder is 1000 yards.

2dly. What will be the true difference of level between the points C and D, the height of the instrument at C is 5 feet, and the height of the object at D only 3 feet, the distance asunder is 1000 yards, allowance being made for the curvature of the earth and refraction.

A YOUNG ARTIZAN.

P.S.—According to an example given by Barlow in his "Mathematical and Philosophical Dictionary," the answer to the first query would stand thus:—

* This plan the Directors of the Birmingham, Bristol, and Thames Junction Railway are adopting in their line.—ED.

	Ft. Pts.	Ft. Pts.
Observed height at B		12·000
Height of instrument at A	5·000	
Correction for curvature of the earth (for 1000 yards).....	2·570	
Terrestrial refraction	·367 = 2·213	7·213
True difference of level		4·787

Barlow further says, "By reason of this refraction, too, it happens, that it is necessary to diminish by $\frac{1}{7}$ of itself the height of the apparent above the true level."

[Our correspondent must be in error. We have not the very useful work here alluded to at hand; but we have no doubt he has misread inches for feet. Mr. Barlow's answer to the first question would, therefore, be the difference between 12 feet and 5 feet 2·2 inches, or 6 feet 9·8 inches, the staff station lower than the instrument. By our rule p. 69 the correction will be ·02 × 3 × 3 = ·18, which subtracted from 12 feet leaves 11·82 feet. From this take the height of the instrument 5 feet, and we have 6·82 feet = 6 feet 9·84 inches, very nearly the same as Mr. Barlow's. The difference arises from his different estimate of the refraction; he estimates it at $\frac{1}{7}$, we take the mean now commonly received $\frac{1}{12}$. In the same way in the second question, the place of the staff is found to be 5 — (3 — ·18) = 2·18 feet = 2 feet 2·16 inches higher than that of the instrument. The total effect of sphericity for a mile is only 8 inches.—Ed.]

Construction of Roofs for an extensive Span.*

By Mr. James Hacket.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

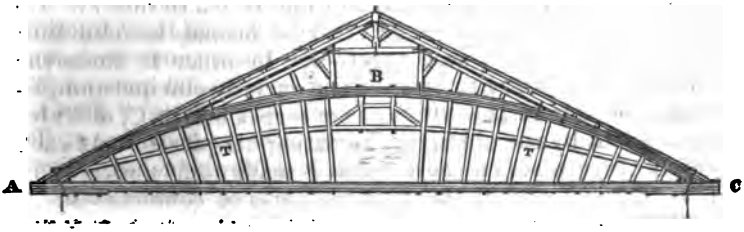
Sir,—At the request of a few friends I am induced to submit to your notice my plan for constructing roofing trusses with timber and wrought iron, requiring no interior support between the walls. You will easily perceive that the trusses are not liable to contract or expand in length, but form a complete bond or tie across the building they are intended to cover; consequently affecting the walls no more than the same weight laid vertically upon them would.

* We publish the present paper with pleasure, knowing it to be the production of a gentleman of great ingenuity in these matters. We have not had time to consider it with sufficient attention to speak decisively ourselves, but it appears to us to be well deserving the attention of engineers and architects.—Ed.

This kind of roofing presents many advantages where a clear unobstructed space is required. The numerous gutters for such a span in small roofs, their expense and annoyance, are avoided, by adopting this single roof, rising no higher than is absolutely necessary to carry off the rain. This kind of truss, with some modification, is also applicable for floors, bridges, centres for bridges, and other purposes. If you think this subject and the plans worth your notice, I shall feel highly complimented by their insertion in your valuable and scientific work. I am fully aware of the opposition the introduction of new plans generally produces; yet I have sufficient reason to feel confident of the utility of the plan proposed,—founded on various experiments that I have made upon models of its strength exceeding my sanguine expectations,—and on the approval of some of the first architects of the present day.

I have the honour to be, Sir,
Your humble Servant,

41, West Strand. JAMES HACKET.



The chief difficulty of roofing over a greater space in clear of support between the walls than 60 or 70 feet, is occasioned by the limited length and scantling of timber. Beams are often united by scarfing for the extent named, causing a considerable waste on the length of the beams so joined. But that process not answering for an extensive span, another method becomes necessary, which I am about to propose. The plate shows the plan of a truss prepared for roofing over 230 feet span; the principal parts are formed by artificial beams, with timber and iron in two thicknesses, so effectually as to possess the quality of one complete beam suited for the purpose intended. The manner of constructing them is very simple. A number of half pieces of Riga, or the best American pine baulk, are selected, not less than 30 feet in length, and of sufficient

size, squared to the dimensions required for the beam. The pieces that are to form the beam being placed so as the heading-joint of the one side piece shall be located at the centre of the other side piece of half baulk opposite. There are grooves half an inch deep on the external side of each piece, to admit the continued flat iron bars being fitted on the two external and opposite sides of each artificial beam, from one end of the beam to the other. There are holes at proper distances in these continued flat irons to pass the screw bolts through them and the pieces of baulk described, with nuts and screws to secure the beam together. At the heading-joint of each piece of half baulk, composing the artificial beam, are oak keys, fitted and driven therein until solid. These artificial beams are essential to make the principal and tie-beam of the truss. The single beams are sufficient to form a truss for roofing to the extent of 150 feet, increasing the number as the extent of the span or other circumstances may require. The tie beam A C of the truss for 230 feet span is composed of two straight artificial beams one over the other, bolted and otherwise secured together. The curved principal of 225 feet radius is also made in the same manner by two circular artificial beams, secured with irons, and likewise bolted together. In order to form the truss it is necessary to connect the curved principal and tie-beam together at the points of contact A and at C, and also throughout by the aid of the radiating tie-pieces. At each end of these pieces a short tenon is made to fit a mortise in the principal and tie-beam at the parts of contact. There are screw-nuts also inserted, about 18 inches from the end of each radiating tie-piece, to receive the screw-bolts, that serve to unite the circular principal and tie-beam together. Between the radiating tie-pieces are braces T (continued in the form of an arch) with a tenon on each end to fit the mortises in, and shouldered to the radiating tie-pieces. On the truss are erected principals, rafters, &c., prepared for slate, which is an excellent covering for roofs. Should metal be preferred, the roof need not rise higher than the curved principal of the truss, which will be a moderate elevation for such a span.

All the timbers are to be of Riga, or the best American pine, prepared by Kyan's process to prevent dry-rot, and to facilitate the seasoning. The iron work to be made with sound wrought iron, and of the best workmanship.

It may be necessary to state the functions which the different parts of the truss perform. In the first place, the

tie-beam A C is a straight beam. Its use is to prevent the curved principal A B C from expanding at the points of bearing on the base A C, and is also useful to retain the curved principal in its proper position by means of the radiating tie-pieces. The curved principal A B C resists the perpendicular weight or pressure laid on the truss, by causing it to descend through the line of circumference to the points A and C of the tie-beam. The curved principal also supports the tie-beam in its horizontal position by the aid of the radiating tie-pieces, which unite the tie-beam to the curved principal, by means of screw-bolts and nuts, in order to prevent the tie-beam from sinking between the points of bearing. These tie-pieces also serve to keep the curved principal in its proper form, causing it to thrust the weight received on the truss, to the points of bearing on the tie-beam at A and C.

Between the radiating tie-pieces the braces T are introduced in order to strengthen them, and by their position, render the curved principal and the whole truss stronger, permitting at the same time the formation of an extensive room in the roof. The principals as prepared for slate tend rather to strengthen the truss; and the struts supporting them between, at the points of bearing, are placed in a position perpendicular to the plane of the principals; being the most direct method to prevent the principals becoming hollow or concave on the back. The struts on one side of the roof act in an oblique direction towards those on the other, by which means they tend to counterbalance any derangement in the roof.

Let a beam of considerable length be placed in a horizontal position, each end bearing upon a wall; if unsupported between the walls it will gradually sink in the form of an inverted arch and finally become fractured by its own weight.

As the quality of the truss chiefly depends on the structure and solidity of the artificial beam, we shall pay some attention to the manner in which it is constructed. It is in two thicknesses with continued flat iron bars inlaid on two external and opposite sides, bolted together with nuts and screw-bolts. The heading joints of the timbers are rendered sound by the keys, and sustained by the continued flat bar irons, and by the whole side pieces passing and binding the joints in the most favourable position to resist longitudinal pressure, and cross strain. When the powerful effect of the continued flat bar irons combined with the baulk in this artificial beam are taken into consideration, the power of

resisting longitudinal strain or compression is immense. These flat bar irons are no less effectual in assisting the timbers in the beam to resist cross strains. In the perpendicular strain the flat irons resist the pressure on edge, presenting two pieces of flat bar iron half inch thick and three and half wide, in concert with the timbers, likewise on edge, and secured in that position by the bolts, &c. above described, which gives a powerful resistance to perpendicular strain. In the horizontal strain the flat iron bars on the side of pressure offer a resistance on one side by not compressing in length, and on the other side by not stretching in length. It must be remembered that the iron bars are bound to their positions by the screw-bolts. It has been mentioned before that the solidity of this artificial beam is finally accomplished by the powerful effect of the keys or wedges, stiffening the beam longitudinally most particularly, and also in the transverse position; therefore, little doubt can remain as to its solidity of construction and efficacy for the purpose intended. The pressure which the beams have to sustain is longitudinal, or endwise being the strongest position for timber, or other materials composing the truss. Thus, there are three principal parts in the truss: the tie-beam, the curved principal beam or beams, and the inferior tie-beams. The strain on the tie-beam has a tendency to stretch it. The strain on the principal beam is the reverse of the tie-beam, namely a tendency to compress or shorten it in length. The inferior tie-beams are subject to alternate strains, sometimes in a direction to shorten them, and at others to lengthen them; whilst the inferior tie-beams resist the pressure endwise at one side of the truss, those at the other side have to resist a longitudinal strain, which is but little in a roofing truss, where the load on each side is nearly equal. We have only to consider that if the tie-beam is sufficient to resist the longitudinal strain, and that the curved principal also composed of the same materials is equally capable of resisting the forces to shorten it in length, and that all the radiating tie-pieces completely connect all the parts of the truss together, it will be evident that the truss so constructed must be more than equal to sustain any weight that may be necessary to load it with.

Since writing the above I have made some experiments on the strength of the truss described, which have exceeded my expectations, but they are not yet in a state to publish.

J. H.

Taxation on Internal Communication. By R. R.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—I beg to forward for insertion, in your useful Magazine, some extracts from the Report of the House of Commons' Committee on the taxation of internal communication. The subject is one every way suited to your pages, and deserves the serious attention of all those interested in steam communication by land and water. I have selected from the evidence those points only which are of most general interest, or have an immediate bearing on *railway traffic.* In your next number, I shall, with your permission, offer some remarks on the subject generally, and on the views embodied in the Report of the Committee. It is to be hoped, for the best interests of the kingdom, that the object of *equalising* taxation on the different modes of conveyance, will be accomplished, *not* by imposing a tax on those means of conveyance which are at present free from it, but by abolishing *all* taxes which check the free interchange of commodities, and that social inter-communication, which is the very life-blood of a nation's prosperity. No object can be more worthy the efforts of a *reforming* Government, than to render the power of locomotion perfectly free and unshackled; thus giving every facility for inquiry, equalizing the advantages of different districts, counteracting selfish and local prejudices, and, in fact, doing more to *educate* the people and make them feel the benefit of free institutions than any other measure that can be devised. I will venture to say that any Government that would have the courage to reduce to the *minimum* rate the tax on the conveyance of *letters* by post, and at the same time repeal all taxes on personal inter-communication, will do more to civilize the country in ten years than all the schools they could found would do in fifty, and this without any ultimate injury to the revenue.

I am, Sir, yours, &c.

Aug. 21, 1837. R. R.

Minutes of Evidence taken by the Select Committee on the Internal Communication Taxation, May, 1837.

COMMITTEE.—Mr. Gillon (Chairman), Mr. P. Thompson, Sir H. Parnell, Mr. Dugdale, Sir H. Verney, Mr. Foster, Mr. Lock, Sir G. Sinclair, Mr. E. Denison, Mr. Parker, Mr. Handley, Sir J. Freemantle, Mr. Mackinnon, Mr. W. Miles, Mr. M. Phillips.

(Mr. Benjamin Worthy Horne called in and examined.)

Qu. 1. You are extensively engaged in business as a proprietor of stage-coaches, are you not?—I am.

6. With the prospect of a great extension of steam conveyance by land, as well as by water, do you expect that your business will continue to be a remunerating one?—I expect it will be annihilated.

7. To what do you attribute this prospect?—To the effects of railroads.

9. Do you attribute any part of it to the taxation which affects you?—Decidedly it does affect us, but that alone would not relieve us; it would relieve us on certain parts where the railways do not directly operate against us, but on any particular line of road, for instance, say direct to Birmingham, of course we could not maintain our position one minute; but in the surrounding neighbourhood, for instance, fifteen or twenty miles from the railroad, by a reduction of the duty we might be enabled to carry on our business.

12. Do you think that if you were relieved of taxation, you could compete with the railway in a parallel line, or in an immediately contiguous line?—It is a most difficult task to answer that question: not unless we have relief by tolls as well as by duty; quite impossible?

22. Have you made any calculation as to the difference of duty by carrying passengers on any certain line of road, say the Birmingham road, according to the duties which you pay, and according to the railway scale?—Yes.

(The statement exhibited, showing a difference of 26,462*l.* per annum.)

23. Then the statements you have made hitherto refer to the direct Birmingham and Liverpool coaches?—And Manchester.

24. But I suppose when the Birmingham Railway is opened, there will be other lines of road affected also?—Materially.

25. Have you made any similar calculation with regard to those coaches?—It is only imaginary; of course it cannot be otherwise at present; I presume one-half of them would be discontinued.

45. And you apprehend, in the event of running against a railway, you will not be able to keep on your coaches, even if the duty were abolished?—We fear we shall not, unless we were to compound other matters of business which we perchance might do, such as tolls and various other taxes.

54. Have you made any calculation of the total amount of duty you paid upon your coaches during the last year?—I have: the amount of duty paid was 26,717*l.* 5s. 6d.

55. Which sum must be entirely taken off to put you on an equality with your competitors?—Where steam power is in operation, either taken off, or the other increased to meet it, so as to bring it to the same thing as both being free.

(Mr. Robert Gray.)

61. You are extensively engaged in business as a proprietor of stage-coaches, are you not?—I am.

62. On what roads principally?—Chiefly the western road and the south.

65. Looking to the probability of a vast increase of steam conveyance by land as well as by water, do you conceive that at the present rate of duty you pay, you will be able to maintain your coaches?—I certainly consider that I shall not be able, particularly on the western road, when the [Great] Western Railway takes place; I consider that the greater part of my business will be in that state that I shall not be able to compete with them.

66. Do you concur with Mr. Horne in the opinion of your inability to compete with railways in a direct line, even if free of all duty?—I do certainly; I consider to Bath and Bristol that it will be impossible for us to compete there with the railway, if even the whole of our duty is taken off.

67. With regard to parallel lines of road, if the duty remains at its present rate will you be obliged to put down your coaches?—I think, without a reduction, we shall be obliged to put them down; but in going parallel lines varying from the railroad, I think with a reduction of duty that they might be kept on.

73. Have you any suggestions to make as to the mode of relief?—I do not know what can be done when the railroads are established, unless our duties can be reduced, and a duty put upon that kind of conveyance for the public who travel in that way.

74. It would suit your purpose equally well if the duties were abolished upon both, would it not?—Why, yes; I consider the public would have the advantage in going at a cheaper rate: we should be able to do it at a cheaper rate then.

75. Would you be able to compete with the railroad if they were abolished entirely?—No; I do not consider we could.

76. You are aware that the railroads are charged duty, not on the number licensed, but on those they actually carry?—So I understand, but I have not myself taken any notice of it.

77. Could you suggest any means by which a similar mode of charge might be adopted in regard to stage-coaches?—It would I think, be almost impossible.

(Mr. Henry Gray.)

80. You are extensively concerned in the posting business, are you not?—Posting and jobbing generally.

108. Have you taken into consideration what will be the effect of the railroads on your business, when completed on those lines of road through which your business extends?—I should say to the postmasters and innkeepers on that line of road it would be utter ruin.

109. Annihilation?—Yes.

110. You do not conceive some people will prefer the mode of travelling by horse-power?—Not while they can travel so much cheaper.

111. You think it will not be adopted as a luxury?—No: a great deal of attention has been paid with regard to the travelling from Edinburgh to London and from London to Edinburgh; there we find they can travel so much cheaper that they go by water.

112. I am speaking by land, where railroads are completed on lines of road through which your business extends?—Nothing short of a total abolition of the duty will enable postmasters to compete with them.

113. Supposing the taxation was abolished with regard to both modes of travelling, can you compete with the locomotive engines with your animal power?—I think we might: we could compete easily with steam-packets, and I think with the railroads, but that I am not certain of.

(Mr. John Warsop.)

190. You carry on the business of posting at Alconbury Hill, in Huntingdonshire?—Yes, I do.

193. Has that business improved or gone back during the last ten years?—Gradually decreased.

199. To what do you attribute this alteration in your business?—Entirely to steam; that we cannot compete with the travelling.

202. If a further extension of this steam-conveyance should go on by land as well as by water, do you anticipate a still further pressure in the way of your business?—I do; it makes a very great difference to the public, the mode of travelling; they will go a circuitous route to get to the steam, and avoid coming on our road in consequence of the cheaper rate of travelling.

208. Have you lowered the fares?—The fares have been obliged to be lowered in consequence of the cheap conveyance by steam: they will branch off to take a route anywhere to get by steam, rather than travel by coaches, because, from the price of provender, and the enormous prices that we are obliged to give for horses, we cannot carry them at the rate; it is impossible.

214. Of course a reduction of the mileage duty to one-eighth of a penny, instead of one-fourth, as at present, would enable you materially to diminish the fares upon coaches?—It would make some difference, but it would not be sufficient to relieve it, in my opinion.

215. Are you not aware that that is what railway companies pay, one-eighth of a penny per mile on the passengers conveyed?—That is on each passenger conveyed; but a coach must pay its duty whether there are passengers or not.

(Mr. Thomas Fagg.)

227. You are extensively connected as an owner of stage coaches, are you not?—I am.

228. On what lines principally?—On the Dover line, the western line, and slightly on the northern line.

229. Do you find that your business has been lately increasing or diminishing?—Diminishing materially.

230. To what do you attribute this diminution?—Principally to the competition of steam by water.

238. If the mileage duty were altogether abolished, do you conceive you could be able to compete with steam-power?—Yes, by water; but I think we should be more benefited if half the duty were taken off, and a proportionate duty placed on steam by water.

240. Do you conceive that if the line of railway, for which a Bill has been obtained, from London to Dover were complete, it would annihilate the coaching trade altogether?—Speaking generally, Yes; there might be one coach left.

241. Do you imagine that if the duties were abolished, you could compete with the railway in a direct line of road?—Certainly not.

242. Do you conceive that upon parallel lines of road, which would be to a certain extent affected by the railways, a reduction or abolition of the duty would enable you to continue to run?—I think that in many cases, if the duty were reduced or altogether abolished, we should be enabled to maintain coaches to towns and situations not very remote from the railways.

243. You contemplate a still greater diminution of the coaches from the extension of steam conveyance?—Certainly; I was about to state that if our present duties continue, and the railway from London to Birmingham is completed, that Stamford, although 40 miles from the line of road, both as regards expense and time of travelling, parties will go from Stamford to Northampton to join the Northern Railroad, and thus save time and expense in coming to London.

244. Then in fact all you have to suggest is, that you should be put in point of taxation, upon an equal footing with steam conveyance?—Just so.

256. Have you ever considered any mode of composition or otherwise by which you might be put upon an equality with the railway coaches in regard to the mode of charge?—I have not.

257. Do you conceive that a composition would be practicable with the stage-coach proprietors?—In many cases I think it would, in most of the long stages running long distances. We pay in the winter time generally duty for eight and three, total eleven, and in the summer time four and eleven, total fifteen, and yet the average throughout the year does not exceed nine passengers in and out.

Mr. Joseph Hearn.

260. Are you a proprietor of stage-coaches and waggons?—Yes.

265. Do you conceive you are interfered with by steam in the prosecution of your business?—I shall be very much.

266. Both as a conveyer of passengers and goods?—Both.

267. Has the business of stage-coaches not been so remunerating within the last five or six years as it formerly was?—Certainly not.

268. Do you anticipate that from a further extension of steam conveyance by land as well as by water, your business would be still more seriously interfered with?—There is no question about it.

269. Do you think you will be able to run your coaches at all upon the Birmingham road?—I think not; my coaches running to Aylesbury and Tring, Berkhamstead and Watford, must be withdrawn, I expect next month, when the railway opens.

275. What alteration would you suggest to put you on an equality with your steam competitors by land and water?—That they should pay a duty, as we do, for passengers.

276. It would equally serve your purpose if the duty was removed from you?—It would have some effect, of course.

277. Would it not put you on a perfect equality, if the duty were removed from you?—I apprehend it would.

279. Are the apprehensions you entertain yourself, entertained generally by the body to which you belong?—I think they are, they all appear to be of the same opinion.

[To be continued.]

"ROYAL SOCIETY AND MR. HERAPATH."

[The private correspondence which terminated in the exit, expulsion, or forced retirement of Sir Humphry Davy from the Presidency of the Royal Society.]

(XVIII.)

Cranford, March 4, 1821.

Sir,—Your favour of the 28th ult. did not come to hand until this morning. You say "a note has been added" by the gentleman who has read the paper containing my experiments, "which alone would show that this communication, *in its present state*, cannot with propriety be communicated to the Royal Society." I am very anxious to see his observations, of which I can form no idea, and shall therefore be thankful to have the papers sent directed to me at Cranford, under the care of the guard of the Bristol Regent coach, immediately, if you please. This coach

I believe leaves the Gloucester Coffee-house, Piccadilly, precisely at half-past four every afternoon.

I feel much obliged to your goodness for having alluded to the vessel in which I mixed the mercury. My not having stated the particulars was an oversight, arising from the haste in which I drew up the paper. The vessel was made of what I believe is called sheet-iron, covered with tin, which, before I made the experiments, I melted off, by putting the vessel in a strong fire, and raising it to a red heat. A vessel so prepared could, I presume, have no influence on the results of the experiments.

You inform me "that the opinion of the gentleman in whose hands you have put my paper on the 'Phenomena of the Universe,' is precisely the same as that of the gentlemen whom Mr. Gilbert consulted." What the opinions of these were, I rather expect, I don't know, from the way in which you have referred to them. The only objections which have yet come to my knowledge are, that Mr. Gilbert "read the paper over, and although," says he, "I must confess myself not satisfied with the ultimate deductions, yet I was much pleased with the great ingenuity displayed throughout the whole, but I entertained strong doubts on the propriety of laying before the Royal Society any thing so abstruse and metaphysical. I therefore desired two of the best mathematicians in London TO LOOK AT THE PREMISES, and their opinions have confirmed my doubts. They say such a work should be laid before the public in a separate form. I cannot present it to the Royal Society in opposition to their opinion." In the only letter besides, that contains any thing in the shape of an objection, this gentleman observes: "You would of course wish to avoid the inconvenience of its being read before the Society, and then not ordered for printing by the Council. I therefore endeavoured to ascertain the opinions of some members of the Council usually looked up to on such occasions, and they considered the investigations as too theoretical for the 'Transactions,' without taking on themselves to judge of the mathematics." These are all the objections of which I have yet heard from Mr. Gilbert: if there have been any others mentioned, I should feel much obliged to be made acquainted with them. The opinion of your friend I expect presses much more heavily on the merits of the paper than these, and I should therefore be very happy to know it. Possibly it may induce me to alter my opinion, by presenting the thing under a new point of view.

Your letter informs me that the gentlemen who have read my papers have given their opinions as private individuals, and not as members of the Council. I hope by this and some other observations of the same kind, which I have lately received, it is not expected I should *maliciously* attempt to throw any reflections on the Council or the Royal Society. Whatever may be the result of this affair, I trust it will not be found that I shall act in

an ungentlemanly manner, or that I shall do more than my defence against such opponents will require; but when the whole circumstances of the case are brought before the public, these, and the line of conduct the Royal Society shall then pursue, will enable the world to determine to whom and to what the discouragement and trouble I have experienced ought to be attributed; and whether the manner in which I have handled the subject I have written on, will justify me in maintaining, from all which has yet come to my knowledge, that after a consideration of upwards of nine months, not one tenable objection has been made to the validity or the accuracy of the views I have taken.

I beg you will do me the honour to accept my best thanks for the repetition of your kind invitation. As the summer approaches I shall be happy, when opportunities offer, to avail myself of it.

Permit me now to acknowledge my obligations for the kind trouble you and your friends have had the goodness to take with my papers; and allow me to observe, that I hope in the sequel to convince you and them that I have given the subject in question much deeper thought, in all its various bearings, than I apprehend you and they seem to think I have, and that I am not in the habit of advancing new notions without well considering them. This is one, and almost the only consolation, I expect to derive from this troublesome and extremely unpleasant affair.

I am, Sir, with much respect, your obedient servant,

(Signed) JOHN HERAPATH.

To Sir H. Davy, Bart.

No. XIX. was a letter to Mr. Gilbert, merely respecting the time of accepting the invitation to the meeting of the Royal Society.

(XX.) *March* 6, 1821.

Sir,—I shall this day send your papers in the way you propose, with this note.

Having considered a good deal the subject of the supposed real zero *, I have never been satisfied with any conclusions respecting it. I cannot see any necessary connexion between the capacity of bodies for heat, and the absolute quantity they contain; and temperature does not measure a quantity, but merely a property of heat. I have the honour to be, Sir,

Your obedient, humble Servant,

To Mr. Herapath. (Signed) H. DAVY.

* It is a curious fact that in this, the only objection Davy ever ventured to start—for the observation about heat and motion in letter No. XII. is no objection at all, the solution of the problem answers it—I was confirmed by Laplace not long after; and about the same time MM. Clement and Desormes arrived at precisely the same result.

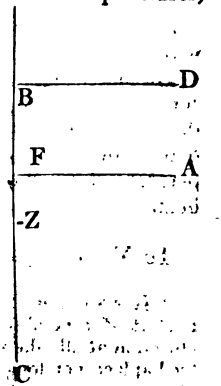
(XXI.)

Cranford, March 8, 1821.

Sir,—With the utmost surprise I last evening read the note of P. M. R. "which alone," you were pleased to say, "would show that *in its present state* it (the paper containing my experiments) could not with propriety be communicated to the Royal Society." How P. M. R. could have read even the last four sentences of my experiments, and then write such a note, or how any one could suppose that a man who is capable of being the author of these papers could have concluded with such a blunder as that with which P. M. R. would charge me, I am at a loss to conceive. He says, "If (as Mr. Herapath maintains) the temperature of melting ice be to that of boiling water in the *subduplicate* ratio of 8 to 11, that is as $\sqrt{8} : \sqrt{11}$, or 1 : 1·1726, Then the difference of the temperatures is to the total temperature of ice, reckoning from the real zero, :: 1·1726—1 (or 0·1726) : 1 :: 180° : 1043°, and not 480°, as Mr. H. makes it, from having calculated according to the *simple*, and not the subduplicate ratio."

I will not stop to make any comments on this extraordinary note, and the still more extraordinary mistake which P. M. R. has himself made by a singular confusion of things, and which he has nevertheless had the goodness to place to my account, but will give, for his satisfaction, a concise geometrical proof of what I have advanced.

Let C B be any indefinite right line representing Fahrenheit's scale, and let F be the freezing, and B be the boiling points of water, and Z Fahrenheit's zero. At the points F and B erect two perpendiculars F A and B D of any length, but in the ratio of $\sqrt{8}$ to $\sqrt{11}$; and through the points D, A, with B F produced for an axis, draw a parabola cutting B F in C, which will be its vertex. Then by *my* theory the semi-ordinates will be as the temperatures, and their distances on the axis from Z the corresponding indications of Fahrenheit, plus or minus, as the ordinate falls above or below Z. Hence, therefore, C is the point of absolute cold counting on *Fahrenheit's* scale, and B F is to F C as 180 to the number of *Fahrenheit's* degrees, at which the point of absolute cold is below the melting of ice. Let p be the parameter of the parabola, then $p \times C F = F A^2$ and $p \times C B = B D^2$, therefore $\frac{B D^2}{F A^2} \left(\frac{11}{8}\right) = \frac{C B}{C F} = \frac{180}{C F} + 1$ and consequently $C F = \frac{1440}{3} = 480$,



I will now beg to mention a thing, which in the hurry of putting together my experiments, I overlooked, but which will as much surprise P. M. R., I expect, as his note did me, especially as it has escaped the notice of himself and that of all the philosophers of Europe. It is this, that the point of absolute cold may be determined independent of my theory, from data well known. For since the increments of volume in a given portion of gas and the degrees of *Fahrenheit* are made to go on *pari passu*, if we divide the augmentation in volume of a given portion of gas, from the temperature of water freezing to that of water boiling, into 180 equal parts, then the number of these parts, which the volume of this gas contains at the temperature of water freezing, will exhibit the number of Fahrenheit's degrees of the point of absolute cold from the melting of ice. Let v be that volume, then $v + 180$ will be the volume at the temperature of boiling water, but $v : v + 180 :: 1000 : 1375 :: 8 : 11$. Therefore, $v = 480$ the same as I have given above.

I have written thus far to give P. M. R. an opportunity of discovering and acknowledging the cause of his error, if he chooses, though if the Royal Society will, after such unsuccessful attempts to refute my ideas, oblige me to come before the public in a hostile manner, his note may be of some service to me. With respect to your note, you are aware that I conceive heat to consist in motion, and that the temperature of a body is the intensity of the intestine motion of its particles, estimated, when you compare the temperatures of different bodies, not by their velocity but their momentum. The degree, therefore, of absolute cold is where the particles have no motion, and my object has been to ascertain this by determining the ratio of the intestine motions at two fixed points, as those of ice melting and water boiling.

What is called "the capacity of bodies for caloric," I have demonstrated in my memoir to be owing to the numeratom of the bodies, that is the number of particles which there are in a unity of volume. If, therefore, two equal portions of different bodies be mixed together, the temperature of the mixture will always deviate from the arithmetical mean in favour of that body, which, under the same volume, contained the greater number of particles. Thus, if a given portion of water contain a greater number of particles than the same portion of mercury, as I have computed it does in the proportion of 2 to 1, the temperature of the mixture of equal portions would always be in favour of the temperature of the water. To know whether the numeratom of one body (I speak of fluids and solids only) exceeds that of another, I observe which of them expands most with the same increment of temperature, and that body I say has the greater numeratom, because its greater expansion is an indication that its particles are less, and, therefore, more numerous. It is as impossible to give a universal rule for the numeratoms of bodies, so differently constituted as some of the

solids and fluids are, as it would be difficult here to enter into a complete development of my views, but the following rule may easily be tried in solids as well as in fluids, and will, I think, in general, if not always, be found to be correct. *If equal magnitudes of any two bodies, which do not act chemically on one another, be mixed together at unequal temperatures, the temperature of the mixture will be in favour of the temperature of that body which expands the most with the same addition of temperature.* In trying this rule with two solids, or with a solid and a fluid, it will be necessary to take the required magnitude in the solid, and then divide the body into little parts, by which means the mixture might be easily made, and the temperature rapidly equalized, even in bodies which transmit heat the worst. If this rule be found to be correct, which I have no doubt it will, though I have not tried it, it is evident what a field is here opened for discovery, and what a powerful instrument this rule and a little mathematics would furnish us with, for prying into the inmost recesses of bodies, and discovering the various arrangements and associations of the primitive atoms to form particles, and of the particles again to form the different solids and fluids. But enough of this subject.

I am, Sir, your very obedient humble servant,

(Signed) J. HERAPATH.

To Sir H. Davy, Bart., P.R.S.

Shortly after this, I resolved to bring the paper before the world, and determined to try the strength of the parties publicly. Accordingly I sent the chief paper to Mr. Phillips, then editor of the "Annals of Philsosophy," and it appeared in that journal April 1st, 1821, with the following letter to Mr. Phillips.

"A Mathematical Inquiry into the Causes, Laws, and principal Phenomena of Heat, Gasses, Gravitation, &c." By John Herapath, Esq.

Cranford, near Hounslow, March 21, 1821.

Dear Sir,—The following mathematical investigation of the causes, laws, and principal phenomena of heat, gasses, gravitation, &c., was drawn up about ten months since, for the purpose of being laid before the public in the Transactions of the Royal Society. A knowledge that the Royal Society had been desirous of having these subjects investigated, and a belief that they would, therefore, have been pleased with this mark of my respect, and have caused the subject to be sifted to the bottom, were the motives which induced me to present them with the first fruits of my labours. Having, however, notwithstanding the marked kindness of the President, and another highly distinguished and enlightened member of that Society, experienced from others an unlooked-for, and, I might almost venture to say, an illiberal opposition for upwards of nine months, I have thought it expedient to withdraw

this paper, together with another which I composed at the suggestion of Sir H. Davy, confirming, by experiment, my views on the more material points, in order to bring them both before the public through a different channel.

It is not my intention here to detail the discouraging and extraordinary line of conduct which has been pursued in this affair, because I shall have it in my power, at the end of these papers, to enter fully into particulars; but I request you will have the goodness to print the communications just as they now stand; for the circumstances of the case being such that it will be necessary publicly to invite the attention of the whole Royal Society to this subject. I wish to make no alteration, but to give those who have opposed me a fair opportunity of overturning that against which they have not, in so long a period, produced one valid objection; or of justifying a conduct which, though but belonging to a part, might, possibly, in the eyes of the world, from the importance of the subject, produce serious reflections on the whole of a Society, so long distinguished for its candour, liberality, and prompt encouragement of scientific pursuits.

I have the honour to be, dear Sir,
Your most obedient servant,

To Richard Phillips, Esq. JOHN HERAPATH.

REPORTS.

BIRMINGHAM AND GLOUCESTER RAILWAY.

ON retiring from office, under the provisions of the amended Act of Parliament, the Directors are anxious to state the nature of the difficulties with which they have contended, to submit to the proprietors the precise condition of the affairs of the Company, and not shrink from the responsibility which has attached to them under circumstances which have been discouraging, and of considerable anxiety to those whose interests they have endeavoured to protect.

At the last General Meeting of Proprietors, the Directors expressed their belief that the funds required for the progress of the undertaking would be forthcoming at the periods necessary for prosecuting the works with vigour, and they proceeded to advertise for contracts; it is scarcely necessary to refer to causes which are so thoroughly known and felt by the shareholders generally, to account for the delay which has arisen; a period of unexampled monetary difficulty followed; the outstanding claims upon the shareholders were not met by the contemplated payments; a great reaction had taken place in the public feeling with regard to similar undertakings; and the Directors felt that they would be doing a great injustice to those shareholders who had regularly paid the calls made upon them, if they proceeded with contracts

for works which would have expended the sums so paid, whilst a large proportion of the calls remained unpaid; they felt that such a course would have endangered the expenditure of the sums paid up, without securing the ultimate completion of the undertaking; they determined, therefore, to suspend the commencement of the works until a period when nearly the full amount of arrears would be secured; they have now the satisfaction of reporting that only 4,650*l.* on the second instalment remains due; that a considerable proportion of the arrear will be shortly received; that nearly the whole is secure; and that, on the instalment of 2*l.* 10s. per share, due on the 1st August, the amount of 9,892*l.* has already been paid. The Directors, therefore, feel that they have succeeded in placing the affairs of the Company in a condition which enables them to recommend the commencement of the works immediately, but which a hasty course of proceeding might have endangered, and they trust that the delay occasioned has also been attended with many other important advantages; a great reduction has taken place in some descriptions of materials, which may enable the Company to make contracts at lower prices; the engineer has had the opportunity of revising his plans and calculations, and effecting great saving and improvements, particularly in the inclined plane over the Lickey Hill; his staff have been engaged in carefully surveying and staking out the entire line of railway, in preparing correct plans of the property through which it will pass, and the early delivery of those plans has enabled the Directors to effect several purchases, and to enter into negotiations more satisfactorily than could have been done if the purchases had been delayed until the contracts were ready: agreements have been made to such an extent as will ensure possession of the land at the periods required, and it has become generally known, that whilst the Company are prepared in all cases to give a full value, they will stedfastly resist every attempt at extortion; in only two cases have they appealed to juries, and in both the result has been most satisfactory. In the one case 3,027*l.* was demanded by the landowner; 650*l.* was offered by the Directors; the jury awarded 752*l.* 11s.: in the other case 2,983*l.* was demanded; 600*l.* was offered by the Directors, and 852*l.* 11s. was accepted after the decision of the jury in the first case; thus a positive saving of 4,405*l.* has been effected, besides avoiding the construction of very expensive additional works, which the landowners required.

Pursuant to the instructions given by the proprietary at the last General Meeting, the Directors applied to Parliament for an Amended Act to enable the Company to form branch lines of railway to Worcester and Tewkesbury, in conformity with the subsisting agreements with the inhabitants of those important places, and to amend some of the provisions of the former Acts; they have been successful in their application; the number of Directors to be chosen for the future management of the Company

is reduced from eighteen to twelve, by which considerable advantages may be obtained.

By the accounts which are now submitted to you, the cash balance and assets of the Company on the 30th June last amounted to 51,047*l.* 14s. 6d., since which period the sum of nearly 10,000*l.* has been received on account of the call of 2*l.* 10s. due on the 1st instant, making the present total amount of assets upwards of 61,000*l.*

Your Directors feel confident that nearly the whole of the remainder of the calls due will be shortly paid up, and may be estimated at an additional receipt of about 19,000*l.*, by which the capital in hand will be increased to 80,000*l.*; they have, therefore, great pleasure in congratulating you that the period has arrived when the works may be safely and vigorously commenced, and that the present condition of your affairs is such as to insure the ultimate completion of the undertaking, and the fulfilment of all the expectations of advantage originally held out to the public; that confidence is thoroughly sustained by a reference to the estimated traffic for this railway, laid before Parliament, and the comparative results which have been given upon those railways now open to the public, particularly with that one, "The Grand Junction," whose passenger traffic is so immediately connected with the object of this Company. It will be in your recollection, that according to the evidence admitted in Parliament, a gross income will be produced to this Company of 94,743*l.* per annum, FOR PASSENGERS ONLY, but the experience of nearly every important railway yet opened, has established the fact that the superior facilities of this mode of travelling, have so greatly increased the actual number of passengers, that the income which may be derived from that source alone, would give a larger dividend to the proprietors than was originally held out by the promoters of the undertaking, for the whole revenue expected from passengers, merchandize, and cattle. The Directors believe that in proportion to the amount of capital expended, the traffic on this line will be little inferior to any railway in the kingdom; it will be the grand connecting link between the whole of the West of England, South Wales, and South of Ireland, Liverpool, and the great manufacturing districts of the North.

Your Directors having now developed the present position of the affairs of the Company, beg leave to direct your attention to that duty which immediately belongs to the business of this day,—the appointment of their successors for the management of your affairs:—your choice must now fall upon twelve gentlemen to fill the office of Directors for the ensuing year, and your present Directors would respectfully suggest, as their opinion, that a very considerable saving and a better system of management would be insured, by you electing the greatest number of Directors resident either in Birmingham or Gloucester, or their respective

is to secure a full attendance in either place, as the gement, and that saving the great expences of a second . The Directors have carefully considered the pro- ising the system, and have no doubt their successors rned by the same anxiety to unite a rigid system of every branch of the affairs of the Company with a due aintaining effective and vigorous management.

Sheet of the Birmingham and Gloucester Railway Company, June 30, 1837.

	Dr.			£.	*s.*	*d.*
30th,						
deposit on 9,500 shares				47,500	0	0
first call	47,500	0	0			
Due from sundries	5,755	0	0			
				41,745	0	0
amount received on second call				302	10	0
interest,—per bankers' accounts	1,121	18	2			
ditto,—on calls over due	245	13	11			
				1,367	12	1
				£90,915	2	1

837.	*Cr.*	£.	*s.*	*d.*
e 30th,				
By Parliamentary and law charges		12,000	16	1
By engineering, surveying, and works		13,164	16	4
By expences of collecting traffic evidence		1,873	2	2
By deputation expences		1,769	5	9
By direction		1,415	8	5
By printing and advertising		424	5	7
By stationery		174	13	1
By furniture and fixtures		426	12	6
By office charges and salaries		2,413	8	6½
By compensation paid to Worcester Canal Company and others		6,505	7	4
By land purchased		1,245	1	8
By tram road		17,500	0	0
incidental expences		96	1	1
petty cash		30	3	2½
bankers' balances		31,876	0	4
		£90,915	2	1

GREAT NORTH OF ENGLAND RAILWAY.

REPORT of the Directors, submitted to the Half-yearly General Meeting of the Proprietors, held at the Company's Office, in Darlington, on the 14th of August, 1837. G. H. Wilkinson, Esq., of Harperly Park, in the Chair:—

In presenting a report of their proceedings during the past six months, the Directors conceive that the first point, on which the shareholders will expect to be informed, is the extension of the railway from near the river Tees to the city of York.

In pursuance of the orders of the last Half-yearly General Meeting the line was re-surveyed, new estimates were prepared, and the requisite Parliamentary notices given. The Directors cannot more correctly describe the extension than in the words of their own circular of January last. "The length of the proposed extension will be about forty-one miles, it traverses a nearly level country, with an almost uniform declivity towards the south, its utmost deviation (and that in one place only) from a direct line is only about three-quarters of a mile, and it will require but a comparatively small capital, and about two years, for its execution."

At a very early period of the Session, the Company were threatened with a formidable opposition from some of the principal landowners in Yorkshire. To obviate if possible the objections urged, and to avoid any interference with the property of the parties in question, the engineer was instructed to survey the country, both to the East and West of the Parliamentary line. The results of those surveys convinced the Directors that the adoption of either of them would have been more expensive, and would have caused a wide deviation from a direct course; it was, therefore, resolved to adhere to the original line, from a conviction of its being, under all circumstances, the one most eligible for the public and the Company. This opposition was ultimately withdrawn. Petitions against the Bill were presented by the Ouse Navigation Company, and a few other parties, who, on having protecting clauses inserted, withdrew their opposition. The Company are also required to commence the Shincliffe viaduct, (an important work on the Durham part of the line,) within six months after the passing of the Act.

The Bill received the Royal Assent on the 30th day of June.

It is incumbent on the Directors to state to the proprietors the reasons which induced them to depart from the intention expressed in their circular of January 10, 1837, and to defer commencing the Northern or Durham portion of the line, for which considerable preparations had been made at the time of the last Half-yearly General Meeting.

Those reasons are as follow:—

First, That, while the Bill for extending the line to York was before Parliament, the formidable opposition already alluded to

was threatened, which if successful would have materially diminished the value of the northern part of the line. It was, therefore, thought most prudent to wait the issue of the Bill before any further steps were taken in the county of Durham.

Secondly, The extraordinary difficulties which the money market presented, and by which private and public credit were seriously affected, made it imperative on the Directors to suspend any operations that involved an outlay of so large a proportion of the capital, until those difficulties should have subsided.

Thirdly, On carefully comparing the engineer's estimates of the York line with those of the line north of the Tees, it was clear that the Company's interests would be best consulted, by first directing their attention to the completion of the latter work. And although the Directors, in common with the other shareholders, may regret the delay which has occurred in the prosecution of the works on the northern part of the line, they feel assured the course they have adopted has been the one which sound discretion dictated, and they doubt not the shareholders will concur in its propriety.

The Company's engineer has expressed his firm conviction, that by prosecuting the works with vigour, the whole length of the line, from Darlington to York, may be opened to the public in about two years from breaking ground. He and his assistants have for several weeks past been employed in setting out the line for execution, which is now completed;—and no time will be lost in letting the works, when the plans and sections are prepared.

Contracts for land to a very considerable extent have already been entered into on this division; and the Directors anticipate no difficulty in negotiating for the remainder at an early period, and on reasonable terms.

The fence railing from the Tees to Thirsk is let, and a large quantity delivered on various parts of the line.

The only bridges of any considerable magnitude required on the extension, are those across the Tees and the Ouse. The Directors have in these works employed eminent bridge architects in conjunction with their own engineer to furnish plans, specifications, and estimates in detail, and propose to enter into contract for their execution as soon as the plans to be adopted are selected.

The Directors have now to submit to the shareholders an account of the receipts and disbursements of the Company to June 30th.

RECEIPTS.	£.	s.	d.	£.	s.	d.
Amount received as deposits and instalments	46,907	10	0			
Interest	316	13	5			
				47,224	3	5

PAYMENTS.	£.	s.	d.	£.	s.	d.
Amount of expenses previous to the General Meeting, August, 1836	16,645	2	7½			
Since August 10, 1836.						
Parliamentary expenses	3,881	9	0			
Engineering, surveying, plans, &c.	3,674	0	11			
General disbursements, including salaries	2,038	17	0½			
Printing, stationery, and advertising	621	4	9			
Office rent and charges	218	5	10			
Board of Directors, viz.—						
For direction £865 3 0						
For travelling expenses when on deputations, and in attending the Board 232 19 0						
	1,098	2	0			
Land, compensation, and fence railing	16,624	18	0			
				44,802	0	2
Balance in hand, 30th of June, 1837				£2,422	3	3

The Directors feel bound to state, that a considerable amount is still due on the calls which have been made; arising, no doubt, principally from the commercial difficulties of the country. When the severe pressure on the money-market began to abate, the Directors caused a circular to be sent to every person whose calls were unpaid; and they have the pleasure of stating, that the defaulters are now rapidly paying up their arrears—upwards of 5000*l.* having been received within the last fortnight; and, from the known wealth and high respectability of a large proportion of the shareholders, no doubt can be entertained of the prompt payment of such instalments as yet remain in arrear.

The Directors now beg the earnest attention of the proprietors to the consideration of the early completion of the railway from the Tees to York.

The first question which arises is, whether it is expedient for the Company to press that line to completion in the shortest possible period: the next relates to the means by which this is to be effected.

On the first point, the meeting will bear in mind, that the engineer considers that the railway may be easily completed within two years. It must be also remembered, that railways are in progress south of York, which are expected to be in simultaneous operation, and to be opened about the same period; communicating with each other, and with the London and Birmingham line; as well as with railways to Hull and Selby, and to Leeds, Manchester,

and Liverpool: and with the railways in the county of Durham. So that by finishing the Yorkshire portion of the Great North of England Railway within the stated period, it is evident that uninterrupted railway communication will be at once established between the North of England and the Metropolis, the principal manufacturing towns, and the leading ports of the kingdom; by which means, a large passenger-traffic (which is by far the most profitable) will be at once secured, on about forty-four miles of way, besides a great amount of merchandise, and the principal part of the coals required along the line to York, and for many miles on each side of it.

The income expected to arise from these sources, is as follows:—

	£.	s.	d.
Coach passengers	94,132	10	8
" Parcels	1,870	0	0
Posting transferred to the railway	1,040	0	0
Merchandise	6,397	10	0
Coals	40,000	0	0
Cattle	6,666	13	4
Sheep	1,166	6	8
Fish	2,000	0	0
	£153,273	0	8

From this table, it is evident that there will remain, after allowing 42,468*l.* (which is the estimated annual expenditure for working the line), such a surplus as warrants the most confident expectations of a profitable return on the amount to be invested; which, upon this portion of the line, is 450,995*l.*; and being thus brought into revenue at so early a period, the Company would be enabled to apply themselves vigorously to the execution of the line to Newcastle.

The greatest pains were taken in preparing the estimates of income, to ascertain the real amount of land carriage moving in the direction of the Great North of England Railway, and the actual charges paid thereon. The sea-borne traffic on each coast was excluded, as well as that from many parallel roads, which will undoubtedly augment the revenue to a considerably larger extent. And upon this basis of existing traffic, the calculations of expected income were founded, on the lowest scale of increase which has been supplied by the experience of other railways.

The estimates in the engineering department were prepared by Mr. Storey, whose experience for many years in the construction and working of railways furnished him with that practical knowledge which is essential to making correct estimates, and the Directors have every reason to be satisfied with those which their engineer has supplied.

The paramount importance of first forming the York line, and

the decided advantage which the shareholders will obtain by its speedy completion, being thus evident; the second question, regarding the means for securing this object, is one on which the Directors have perfect confidence, provided the calls, which will be regulated with a view to the convenience of the shareholders, as far as is compatible with the rapid execution of the works, are punctually responded to by the proprietors. And they trust that this will be the case, without their being compelled in justice to the other shareholders to resort to the powers for ensuring payment, with which they are invested by the Act of Parliament. On their part, the Directors pledge themselves to use every exertion, to see that the capital with which they may be entrusted, is expended in the most advantageous manner. And they would here observe, not with any wish to boast of their own acts, but simply for the information of the shareholders, that with a view to curtailing as much as possible the expenses of the Board, without impairing its efficiency, the Directors have lately adopted the plan of meeting only once a fortnight, instead of weekly, as heretofore, and they have appointed a Committee of eight of their own body to meet every alternate week, to transact the necessary business.

Since the last Half-yearly General Meeting, the Company has suffered a loss in the decease of its late treasurer, James Backhouse, Esq. It will, therefore, be necessary for the present meeting, to appoint a successor.

It will be necessary for the Company to apply to Parliament for powers to make certain deviations and improvements in their present line, for which the requisite notices have been given, with a view to forming such a communication with Newcastle, by means of a higher level, as may facilitate the formation of the railway now in agitation from that place to the capital of Scotland.

[For the Resolutions see Advertisement on the Wrapper.]

REPORTS ON THE BRIGHTON LINES.

In our last we gave Captain Ralph Alderson's Report to the House on the Brighton Lines, but not having had the original Report by us, we omitted the following Table alluded to: showing the total length of each line of railway between London and Brighton, the portion to be constructed by each, the estimated expense, equivalent horizontal distances, &c.

Lines.	Part adopted from other Lines.	Part to be constructed.	Total length of Main Line.	Horizontal distances equivalent to Main Line.		Estimate for the part to be constructed, including one-tenth for contingencies and price of land.	Length of Railway to be constructed, including Shoreham.	Estimate.	Length of Railway to be constructed, including Lewes and Shoreham.	Estimate.	Length of Railway to be constructed, including Lewes, Shoreham, and Newhaven.	Estimate.	Time required for completion.	Remarks.
				Heavy trains, supposed 100 tons.	Light or passenger train, supposed 50 tons.									
	M. CH.					£.		£.		£.		£.		
The Direct Line ..	9 3	41 59	50 62	61 5	56 11	897,073	47 47	983,725	55 54	1,098,107	61 42	1,199,906		The Lewes and
Stephenson's	5 30	49 66	55 16	60 72	57 77	974,016	49 66	974,016	—	—	—	—		Shoreham branches
Gibbs's.....	9 21	47 56½	56 77½	64 52½	59 23	1,040,834	47 56½	1,040,834	—	—	—	—		are single lines of
The South-Eastern	20 0	32 12	52 12	62 28	57 73	949,955	—	—	41 40	1,171,018	—	—		railroad.

Mr. Robert Stephenson's Report, on Captain Alderson's Report to the Directors of the Western Line of Railway from London to Brighton.

GENTLEMEN,—I have received Mr. Till's (secretary to Stephenson's line) letter of the 27th July last, requesting me to furnish you with such observations as appear to me to be called for by Captain Alderson's Report, and also to report to you my opinion generally of the line selected by him, in order that such opinion may be laid before the subscribers to the Western line, that they may individually consider the propriety of availing themselves of the option of taking shares in the Direct Line, under the terms of the Act which has passed.

Many of the points raised by Captain Alderson in his Report are of so much interest to the profession of which I am a member, and involve consequences of so much importance to the public as subscribers to railroad undertakings, that I shall feel it my duty to reply to them in a more detailed manner than is, perhaps, absolutely necessary upon the present occasion.

It may be sufficient for the present purpose to observe, that Captain Alderson asserts, that the Western Line is the best in an engineering point of view, but recommends the adoption of the Direct Line, for the following reasons:—that it accommodates Lewes and Newhaven; that it secures to Brighton exclusive advantages which it at present possesses, and of which it ought not to be deprived; and that the termini are preferable, especially that in London; the Greenwich Railway being, in his opinion, well calculated for a main trunk line southward, and that Company having, as he was informed, the means of adapting it to the increased traffic which would in consequence fall into it.

Upon each of these points I will offer some brief observations; and, first, with respect to Lewes and Newhaven. Captain Alderson has not pledged himself to the accuracy of the estimates; on the contrary, he states that he believes those for the Direct Line to be insufficient; but he has nevertheless adopted them as the basis of a tabular calculation, from which it appears that the estimated cost of the Western Line and of the Direct Line to Brighton, are within a fraction the same, and that there is an increased cost in the Direct Line of upwards of 200,000*l.* for the branches to Lewes and Newhaven. As those branches run from Brighton, and not from any intermediate point, it is obvious that the Direct Line affords no greater facilities for them than the Western Line does, either in point of expense or otherwise; I have never advised their adoption, though I was well aware that *Parliamentary interest would be gained by doing so,* because I have been satisfied that they never would pay the expense of their own maintenance, and would therefore prove a ruinous drawback from the fair profits of the concern.

Looking also to what I have considered to be the interest of the subscribers, I freely admit that I have not taken the same view that Captain Alderson has of the claims of the people of Brighton: I have been anxious to consult their convenience in the selection of the terminus as far as was consistent with the adoption of a line of cheap and easy construction, and the prospect of an extensive traffic; but, acting as I have for shareholders, whose money is to be embarked in the undertaking, I could not recommend the sacrifice of their interests to the maintenance of a supposed monopoly, and I am, besides, convinced that no such monopoly can be maintained; for when railroad communications are opened to Southampton, Dover, and other places on the coast and elsewhere, it will be found that a cheap line and low tolls will be the only real securities, and that the accommodation or exclusion of Shoreham or Worthing are to the people of Brighton themselves matters of very secondary importance.

With respect to the Greenwich Railway, and its capabilities for adoption as a main trunk out of London, little need be said: the character of that line, and its want of a depôt, so essential to the very existence of any line of railroad, are matters of public notoriety; and the probability of the Company having the means to add an additional width to the road to accommodate any increased traffic, the necessity of which is stated by Captain Alderson, can be estimated by yourselves: there are, however, other difficulties of an engineering nature in this line, which have always influenced me, but which do not seem to have occurred to Captain Alderson, and the same apply to the Croydon line, in connexion with it, in which there is the inclined plane of one in one hundred for two miles and five-eighths, not even adverted to by him. Had Captain Alderson sufficiently considered these points, had he adhered to his former principle * (which he stated to be a near approximation to accuracy) that 20 feet rise may be regarded as equivalent to one mile in distance, instead of being only equivalent to a fifth of a mile, which last principle he now, for the first time, adopts in his Report on the Brighton lines, and thereby gives an undue advantage of near five miles in distance to the Direct Line; and, had he considered the interests of the subscribers, as well as those of the inhabitants of Brighton, I have no doubt that he would have come to a different conclusion; but the Legislature having now passed a Bill for the Direct Line, in consequence of his Report, I now proceed to the second point which you require of me, namely, my opinion of the line selected by Captain Alderson.

In doing this I find some difficulty; because, though Captain Alderson has pointed out several objections to the plan of the Direct Line, and has suggested various modes of correcting some

* Vide Captain Alderson's Report on the Manchester and Cheshire and South Union Railways.

of them, I have nothing before me to show which of these modes, or to what extent it is proposed that they should be adopted.* Captain Alderson states, that the cost of the Direct Line from Croydon to Brighton is likely very much to exceed the Parliamentary estimates; and, however it may be altered or modified, I entirely concur in this opinion; and, without going into any detailed statement of the engineering difficulties, I find myself called upon to state generally, that, having now had to struggle practically with works of more than ordinary magnitude and difficulty on other lines of railway, and having had ample opportunities of carefully weighing those circumstances which justify the adoption of such works, I am satisfied that the views which have hitherto guided me in laying out the Brighton Line will be found ultimately correct; more especially when it is remembered, that the average works of excavating, embanking, and tunnelling, per mile on the Direct Line exceed by nearly 50 per cent. those of any other railway in existence, or, I believe, seriously contemplated; and in taking this simple view of the case, it must be borne in mind that the difficulties and dangers attendant on works of this kind arise more frequently from their unusual magnitude than from the other minor features. An important question, however, for consideration is, of what is the Brighton Line to consist; is it to be a line from the Croydon Railway, or from Earlswood Common to Brighton. Looking to the clause in the Act, which gives to the South-Eastern Company the option of taking, after completion, the twelve miles of the road, upon which alone a double traffic can be contemplated, and for the construction of which the Brighton Company are, I observe, to find the capital (I mean the twelve miles from Croydon to Earlswood Common), I consider that the Brighton Line will, very probably, be confined to twenty-nine miles, viz. from Earlswood Common to Brighton; in that case three companies, and in the other case two companies, will possess a power of a very dangerous character over the interests of what will remain of the Direct Line; and if circumstances should compel them to exercise this power by the infliction of their maximum tolls, the Brighton Company might be left without the means of making any return to the shareholders; so that, in point of fact, the interests of the Brighton Company are absolutely dependent upon the very doubtful prospects of the other lines.

Another subject of the greatest importance is the traffic; and with reference to this question I must look at the relative merits of the Direct and of the Western Lines. On the Direct Line there is not one town or place of any importance which is likely to bring

* In consequence of this Report, a tunnel of 1,320 yards has been adopted at Merstham. The length of the tunnel at Balcombe has been increased from 470 yards to 880 yards, and the tunnel at Clayton Hill has been increased from 850 yards to 1,700 yards; but I have nothing before me to show whether any or what alterations are to be made in the slopes.

traffic into it: the only towns near which it passes being Cuckfield and Crawley, it can derive no material advantage from any branches connected with it; for on the one side the eastern traffic will necessarily be absorbed by the South-Eastern Railway; and, on the other side, if branches should be made to connect the line with any of the western districts, such branches will be rather for the benefit of the Greenwich, Croydon, and South-Eastern Companies, than of the Brighton Company, on whose road such traffic would pass for a very short distance; and if the South-Eastern Company should avail themselves of their power to purchase the Merstham portion, they might not run upon any part of it. Upon the Western Line, on the contrary, there are the following places:—Ewell; Epsom, with its crowded races; Leatherhead; Dorking, placed in a neighbourhood of almost unrivalled attraction; Horsham, the site of an important corn-market; Henfield, Beeding, Steyning, and Shoreham. In addition to these towns actually upon the line, there are Arundel, Worthing, Chichester, Bognor, and Portsmouth, the traffic to which places must use the Western Line for at least twenty-eight miles; and there is the intercourse between Brighton and Windsor, and Oxford through Horsham, which also must use the Western Line for twenty miles. Taking all these circumstances into account, I am convinced that a Western Line would have a very large intermediate and ulterior traffic, of which the Direct Line will be destitute.

I shall conclude by stating, that in giving my consideration to a Brighton railway, it has always appeared to me that it was essential, in justice to the shareholders, that the line should be so designed as to embrace as much collateral and ulterior traffic as possible; and that as Brighton, in common with other watering-places, owes its present importance mainly to fashion, every security ought to be taken that the line should be as much as possible removed from the risk of caprice. For this purpose I have uniformly recommended the Western Line; and when I consider the local and lateral advantages which it will possess, and the importance of the districts that it will accommodate, I cannot but think that it will at no very distant time be executed; and whenever it is, I am of opinion that the cheapness of its construction, together with its local advantages, will enable it to carry the Brighton traffic on terms which would be ruinous to the Direct Line.

For these reasons, gentlemen, I adhere to the opinion which I gave long since, and at a period when I might fairly be considered to be unembarrassed by prejudice: I have now carefully reconsidered that opinion, and I am more than ever convinced that the Western is the only line which, with safety to the subscribers, can be adopted. I am, gentlemen, yours very faithfully,

Great George-street, Westminster, August 15, 1837. ROBERT STEPHENSON.

LONDON AND SOUTHAMPTON RAILWAY.

REPORT OF THE DIRECTORS.

THE Directors, in this their Sixth Half-yearly Report, have to congratulate the proprietors on the improved state of the Company's affairs and prospects since the special general meeting, which was held on the 8th of May last. The difficulties which had then arisen, and in consequence of which it became necessary to call that meeting, have been surmounted; the arrangements proposed by the Directors, and adopted by the proprietors, have been carried into effect; subscriptions for the capital required for the completion of the Railway have been obtained, and the amended Bill, granting all necessary powers for that purpose, is now an Act of Parliament. The Directors have also the greatest satisfaction in being able to state that the favourable anticipations expressed by them on that occasion are amply justified by the result so far, as well in respect to the progress of the works, as their cost.

It will be in the recollection of the proprietors, that it was promised to open the line as far as Kingston on the 1st of May next. The progress made during the last three months leaves no room for doubt on that point. The Battersea embankment, which on the 15th April last required 135,000 cubic yards, now requires little more than 40,000 cubic yards to effect its completion, and is proceeding at the rate of from 4 to 5,000 yards per week. With the exception of the Hogsmill valley embankment, where something less than 20,000 yards are required, the rest of the line to Kingston is formed, and the ballasting is being proceeded with.

On the opening of the line to Kingston, a considerable traffic in passengers will at once arise, from the proximity of the line to Hampton Court, and other favourite places of resort, as well as from the more regular demands of the country, but the Directors have felt that if it were possible to open the line at the same time to some point so far distant from London as to furnish a sufficient inducement to the passengers travelling to and from Guildford, Portsmouth, Southampton, and other parts of Surrey and Hampshire, to join the Railway, instead of coming through by stage-coaches, a more important, and consequently more profitable, result would be obtained. This the Directors confidently believe they will now be able to effect, and that on the 1st of May next the line will be opened to Woking Common, the nearest point to Guildford, and twenty-three miles distant from London.* The

* In order the more satisfactorily to exhibit to the proprietors the nature of the works in progress, and the actual state to which they are advanced, a section of the line from London to Basingstoke has been prepared with minute accuracy, and is attached to this Report [to the Company's, not this reprint.—ED.]: those parts of the different cuttings and embankments completed up to the last monthly return on the 5th of August instant being coloured red.

grounds for that belief are, that the experience of the past has proved to the Directors the practicability of accomplishing the work that now remains to be done, and that it is in the hands of a very able contractor, who has given security for its completion within that time. As to the general progress of the works, the Directors beg to refer to the following report of Mr. Locke, the engineer of the Company:—

MR. LOCKE'S REPORT.

To the Directors of the London and Southampton Railway Company.

Gentlemen,—Since I last had the honour to report to you the state of the works on this Railway, several changes in the mode of management have been made, and several items of expense, which then rested on opinion, have been *satisfactorily* set at rest. In the then state of the works I felt it almost impossible to say precisely what sum would be required to complete them; and I could only approximate by attaching prices founded on experience elsewhere to quantities that were assumed to be required to finish the work. Since that period a contract has been entered into with Mr. Brassey, a very able and responsible contractor, to execute all the remaining works from Wandsworth to the river Wey navigation, a distance of about fifteen miles, and I am happy in being able to state that its amount will not exceed my anticipations.

Beyond the river Wey no changes in the persons carrying on the works have been made, but they are proceeding on a new footing, —each contractor, for a consideration in price, finding his own materials. I cannot precisely state what will be the absolute cost of these works as compared with my former estimate; because the form of the contract unavoidably remains somewhat different to that which I should under other circumstances have adopted; but here again I have reason to believe that my former estimate will not be exceeded.

The admeasurements for the works on the deviation line between Basingstoke and Winchester are now nearly ready, and I expect in a few days to enable you to make a contract for their entire completion upon terms within my former estimate.

The remainder of the works from Winchester to Southampton, you are aware, is under contract to Mr. M'Intosh. The form of this contract is not such as I would have adopted, but, from the well known responsibility of the contractor, there is every reason to expect that the works will be satisfactorily completed during the next summer.

On that part of the line from London to Woking Common, a distance of twenty-three miles, the necessary arrangements have been made, and contracts entered into, for enabling you to open it for the purposes of general trade by the first of May next; but although there is every reason to expect this to be done, I am desirous of stating that, in the construction of such works, delays

and accidents may arise to render it expedient to defer the opening until the 1st of June, when the solidity and permanency of the works will be more fully established.

This partial opening will be of advantage in enabling you to prepare for the more extensive operations of working a long line; at the same time it will yield a return during the progress of the other works; and this principle will be further developed in the spring of 1839, when the line to Basingstoke, forty-six miles from London, will be completed.

All the other works will be finished in the spring of 1840.

I remain, Gentlemen, your obedient servant,

London, 21*st August*, 1837. JOSEPH LOCKE.

A careful review of the estimate for the comparatively small quanity of land not absolutely agreed for, leads to no apprehension of any excess of outlay in that respect, beyond the sum stated in the last report.

The circumstances of the times having been deemed favourable for the purchase of iron rails, the Directors have purchased largely, and as the price is much below that which was contemplated in the last estimate, they have thought it right still further to increase the weight of the rails, and thus acquire an additional degree of stability in the Railroad, as well as reduce the cost of maintenance.

Contracts have also been entered into for carriages and locomotive engines, which will be delivered in time for the opening in May next.

The amount of traffic on the line of this Railway, and consequently of revenue to its proprietors, is a matter of so much importance that the Directors have felt it to be their duty to enter into minute inquiries on the subject, and to frame a special report thereon, which they beg to submit to the investigation of the proprietors, in full confidence that the more closely its contents are scrutinized the more justly will the advantages which the undertaking promises to the proprietors be appreciated.

Referring, therefore, for particulars to the summary in page 216 of this report, the Directors will only here quote from that summary the fact, that a very moderate estimate of the traffic to which they have a right to look on the completion of the railway gives a *net revenue* of nearly 15 per cent.* on the estimated cost of 1,700,000*l.*

* Estimated cost of Railway	£1,700,000	0	0
The net annual income as shown in page 217, is	247,865	18	1
And deducting interest to be paid on 300,000*l.* to be borrowed, at 5 per cent. .	15,000	0	0
There will remain for dividend . . .	£232,865	18	1

It will also be seen that there are many sources of probable revenue which are not included in the estimate, but some of which are enumerated, so that every proprietor may judge for himself how far the result is likely to exceed the present estimate.

The Directors are far from wishing to hold out to the proprietors any expectations beyond those confidently entertained by themselves as to these estimates, and they feel it their duty to lay the grounds of those expectations fully and clearly before the proprietors, in order that the value of the undertaking may be understood by those who are most deeply interested in its success, the Directors, for their own part, being fully impressed with the conviction that, in point of permanent advantage to its proprietors, this Railroad will ultimately be inferior to none in the kingdom.

The proprietors are of course aware that of the original shares there remains only to be called one instalment of 5*l.* per share, and on the new shares the full amount of 25*l.* each.

It is the intention of the Directors to proceed in the execution of the whole line with the greatest practicable celerity, which will lead to the necessity of making the remaining calls as early as possible; it has, therefore, been considered that it might be convenient to the proprietors to know at once the days on which these different calls shall become payable, in order to facilitate any arrangements that may be requisite for making the same, and a list of these calls, with the dates of their becoming payable, is accordingly stated.

The remaining call on the old capital will be due and payable on the 12th November.

The first call of 5*l.* per share on the new shares will be due and payable on the	20th January, 1838.
2d call of 5*l.*	20th April, 1838.
3d call of 5*l.*	20th July, 1838.
4th call of 5*l.*	20th October, 1838.
5th call of 5*l.*	21st January, 1839.

It being also considered that it might be convenient to many proprietors to pay up these calls at once, receiving the discount on such anticipated payments, which is authorized by the Act of Parliament, the Directors accordingly give notice that, on the payment of any or all such calls before they become due, interest at the rate of 5 per cent. per annum will be allowed.

By order of the Directors,

WILLIAM REED, *Secretary.*

Being 16*l.* 12s. 8d. per cent. on 1,400,000*l.* the *real* capital,
Or 12*l.* 18s. 9d. per cent. on 1,800,000*l.* the nominal capital.
Say 6*l.* 9s. 4½d. on each original 50*l.* share,
And also 6*l.* 9s. 4½d. on each new share of 25*l.*
Or 12*l.* 18s. 9d. per cent. on original shares.
And 25*l.* 17s. 6d. per cent. on new shares.

An Account of Receipts and Payments to the 30th June, 1837.

Receipts.

	£.	s.	d.
On Calls	748,453	0	0
Interest	3,365	12	11
	751,818	12	11

Payments.

	£.	s.	d.	£.	s.	d.
Expended in raising the capital, procuring the Act of Parliament, &c.	39,793	6	6			
Land and compensation, including charge for surveying and valuing	203,870	14	6			
Conveyancing and law charges . .	4,278	7	0			
Cuttings and embankments, bridges, culverts, and stores for the same, fencing, draining, &c.	299,264	13	10			
Iron rails, chairs, and sleepers . . .	86,185	18	2			
Engines, waggons, implements, and tools and stores for the same . .	64,366	10	9			
Temporary buildings	4,313	12	9			
Surveying and engineering	14,132	3	11			
Salaries, wages, rent and taxes, printing and stationery, postages, travelling, and all other incidental expenses	10,862	5	8			
Directors' expenses and fines from the commencement of the undertaking	2,150	0	0			
				729,217	13	1
Cash and Exchequer Bills in hand				16,600	19	10
Funded property, in 3 per Cent. Consols, invested as required by the 14th clause of the Act of Parliament				6,000	0	0
				751,818	12	11

REPORT ON THE TRAFFIC.

The Directors being fully impressed with the importance of causing the merits of the undertaking to be understood, have taken considerable pains to ascertain what are the sources and probable amount of the revenue which may fairly be expected when the railway shall be completed; and they have been the more solicitous on this point, because of the somewhat general impression that the traffic will not compensate the shareholders, which impression has, doubtless, had a considerable effect in preventing this railroad from holding that place in the public estimation to which, as well

from its own intrinsic merits as by comparison with others, it is justly entitled. The dividend ultimately receivable by the shareholder will be as is the cost of construction and maintenance, to the traffic. Having, therefore, obtained and placed before the proprietors the best information as to the cost, the Directors now proceed to do the same as regards the traffic. And they begin by reciting the statement made in the original prospectus, which was fully borne out by evidence before the Committees of both Houses of Parliament previous to the obtainment of the Act of incorporation.

Original Statement of Traffic as published in the prospectus, and proved before Parliament.

Present Traffic, estimated at Railway prices.

	£.	s.	d.	£.	s.	d.
Coach passengers . . .	118,498	18	0			
Posting	7,082	8	0			
Coach parcels . . .	12,711	16	8			
Waggon-traffic . . .	29,768	6	0			
Cattle-traffic . . .	27,155	0	0			
	195,216	8	8			
Cost of maintenance of way and locomotive power	87,798	11	5			
				107,417	17	3

Prospective Traffic, additional to the actual Traffic.

	£.	s.	d.	£.	s.	d.
Torbay fishery, upon the present amount of fish caught . . .	23,333	6	8			
100 per cent. increase on passengers	118,498	18	0			
Increase on country-killed meat .	4,666	13	4			
Increase on heavy goods . . .	5,569	4	0			
	152,068	2	0			
Cost of maintenance of way and locomotive power on increased trade.	52,000	0	0			
				100,068	2	0
Total or supposed profit				207,485	19	3

The original prospectus goes on to state the fact, that "nothing is assumed in the above calculations for an increase of passengers by private carriages, post-chaises, or coach-parcels, nor is any revenue assumed for the carriage of cargoes which may be discharged in the Southampton water; for passengers travelling in gigs, an increase of the Torbay fishery, or for the transport of agricultural, dairy, or garden produce, timber, building materials, chalk, and other manures." To which it may be added, that

neither is anything assumed for the conveyance of coals or any goods now passing by canal. The coach-passengers were estimated on the average of nine passengers to a stage-coach, and five to a mail coach, on 107 daily coaches which were proved by official persons from the Stamp-office to be running from and to the following places, viz.:—

London to	Alton.	London to	Hersham Green.
"	" Basingstoke.	"	" Kingston.
"	" Blackwater.	"	" Portsmouth.
"	" Bridgewater.	"	" Salisbury.
"	" Chertsey.	"	" Southampton.
"	" Devonport.	"	" Wandsworth.
"	" Esher.	"	" Weymouth.
"	" Exeter.	"	" Weybridge.
"	" Godalming.	"	" Wimbledon.
"	" Gosport.	"	" Taunton.
"	" Guildford.	"	" Chichester.
"	" Hampton.	"	" Newbury.

Also from

Southampton to	Reading.	Southampton to	Newbury.
"	" Oxford.	"	" Winchester.*

The coach parcels were estimated very low, and the wagon traffic was put down at a sum actually proved by the wagon owners on the line.

The evidence thus recited was satisfactory to the original shareholders, and to Parliament; but in consequence of the impression already referred to as to the supposed deficiency of traffic, and which impression appears to have been in part produced by interested misrepresentations, as actively as malignantly circulated, and in part by the very *name* of the railway, leading careless observers to look only to its extreme terminus at Southampton, without considering the immense traffic to the south-western parts of England, it has, therefore, been thought proper to obtain the latest and best possible information on the subject of traffic, and to review the whole question of probable revenue.

For this purpose, the Directors acceded to a request made to them by some of the influential shareholders at Manchester, to employ Mr. Pare, of Birmingham, a gentleman unknown to the Directors, but who was represented to them as having had considerable experience in estimating the traffic on lines of railway in the north of England. The Directors, have also availed themselves of the knowledge possessed by Mr. Lacy, of Manchester, the extensive mail-coach contractor, who is well acquainted with the country to be affected by the Southampton Railway; and the proprietors will also have the benefit of Mr. Chaplin's statement

* It will be observed, that nothing was originally or is now taken for coaches travelling to Bath or Bristol.

of the traffic, founded upon actual observation and inspection of the books of the various extensive concerns in the same line. Mr. Chaplin's experience, in all matters relating to the conveyance of passengers, is too well known to render any recommendation of his opinion on that subject necessary.

The Directors proceed to place before the proprietors each of these statements, together with observations thereon.

MR. LACY'S STATEMENT.

Mr. Lacy's statement is confined to stage-coach passengers, travelling from London to Southampton, Portsmouth, Gosport, Salisbury, Weymouth, Basingstoke, Alton, Chertsey, Guildford, Godalming, Kingston, Hampton, and Hampton-wick, and he makes the *existing traffic, at railway prices*, equal to a gross revenue of £102,784

There is, however, omitted from this statement the proceeds of coaches running from Southampton to Reading, Newbury, Oxford, and Winchester, which will produce £3,896

And those running from London to Esher, Hersham, Weybridge, and Wimbledon, the existing traffic of which will produce . . . 11,497 } 15,393

£118,177

It will be observed, that this sum is very nearly the same as that assumed in the original prospectus, the former being 118,177*l.*; the latter, 118,498*l.* 18*s.* Mr. Lacy has excluded from his estimate all the passengers travelling by the Exeter, Taunton, Bridgewater, and Devonport coaches. The propriety of doing this will be considered hereafter; but even without the traffic by these coaches, the account of Mr. Lacy is sufficiently confirmatory of the Parliamentary estimate.

MR. PARE'S STATEMENT.

Copy of a Letter from Mr. Pare to Mr. Reed.

Birmingham, June 27, 1837.

Sir,—I send herewith the estimate of revenue of the London and Southampton Railway, which I have made up after the most careful and patient investigation.

Had the object been to have swelled the income to the largest possible amount, I could easily have made it much larger; for I have not estimated anything for the carriage of grain, hay, coal, brick, lime, timber, manure, &c., now carried by *land* or water. Nor have I estimated anything for market produce; the carriage of fish from Torbay, or the carriage of the mails: nor, as you will perceive, has anything been calculated for an increase in general merchandise, though there can be no doubt this will take place. My endeavour has been to keep within the limits to which the estimate might have been carried.

Should any further particulars be required, I shall be happy to furnish them. I am, Sir, your obedient servant,

(Signed) WILLIAM PARE.

To W. Reed, Esq.

DATA UPON WHICH THE ESTIMATE OF REVENUE IS FOUNDED.

June, 1837.

The whole is the result of observations made in the months of April and May, 1837, at nine different stations on the Southampton and Portsmouth roads, and on the Basingstoke canal; the inspectors remaining a fortnight at each station.

The coach table has been made up from the Stamp-office list, as published in December 1836, and which is, I believe, rather under an average for the year. The Exeter, Devonport, and Taunton coaches are omitted, upon the assumption that the passengers will go by the Great Western, and Bristol and Exeter Railways. The Wandsworth coaches and omnibuses are omitted, because it is doubtful (considering the terminus of the railway, and the way in which it passes Wandsworth) whether, for so short a distance, the railway will offer equal advantages with the present conveyances.

It will be seen that only three passengers per journey have been estimated by the coaches, &c., between London and Hampton, although they are licensed to carry twelve. This very low average has been taken upon the supposition that many of the passengers carried by the present conveyances are for intermediate distances, on a line of road not traversed by the railway. With the exception just stated, the number of passengers by coach, per journey, are estimated as follows, namely, nine to a four-horse coach, six to a two-horse coach, and five to a mail. The result of nearly 2,000 observations of the coaches on this line of road gives a somewhat higher average.

The number of persons travelling with post horses were counted, and upon the number so obtained (which gives an average of three persons to each pair of horses) the calculation is founded. One half of the number, however, passing through Basingstoke and Popham for the West, have been thrown out of the calculation, upon the assumption that they were destined for Exeter, or places west of Exeter, and would, therefore, go by the Great Western and Bristol and Exeter Railways, when completed.

One half only of the persons travelling in cars, flys, gigs, and private carriages have been estimated to travel by the railway.

One half only of the persons *observed* travelling in stage-vans, waggons, and spring and market-carts have been estimated to travel by railway. With respect to those travelling by stage-vans and waggons, it may be safely stated, that not one half of them *could be observed.*

In estimating the amount of revenue from coach-parcels, I have taken, as a general guide, the estimates of the London and Birmingham, and other principal railways, which were founded on the

testimony of coach-proprietors, and have considered the relative importance of the towns upon the London and Southampton Railway line, as compared with towns on other lines, and the probable wants of the population in this respect. Upon a careful review of this item, I believe it to be rather *under* than *over* estimated.

The weight of merchandise by stage-vans and waggons has been estimated upon the assumption, that each horse employed draws upon an average fifteen cwt. Vans and waggons travelling between London and places west of Salisbury have not been estimated.

During a fortnight's observation upon the Basingstoke canal, there passed 371 tons of the lighter description of general merchandise, and 859 tons of coal, timber, grain, stone, gravel, &c. The 371 tons of general merchandise only has been estimated to go by railway.

Between London and Southampton there are six regular trading smacks and schooners, each of about 100 tons register. Upon an average there are two trips per week, and for the purposes of this estimate, it has been assumed that each carries an average weight of 50 tons, and that one half of this, or 25 tons per week, would be absorbed by the railway.

The cattle and sheep counted on the road during the fortnight's observation in April and May have, in this estimate, been taken to be the average for the year. There can be no doubt, however, that the number observed is greatly under the average number; the time of the observation being unfavourable for this species of traffic.

The rates to be charged by the railway have been assumed to be as follows:—Passengers, 2*d.* per head, per mile. Goods of the description now taken by land, 4*d.* per ton, and those taken by water, 3*d.* per ton, per mile. Beasts 3*d.* per head; and sheep, calves, and pigs, 1½*d.* per head, per mile.

The mode I have adopted of adding 100 per cent. to the present number of passengers travelling by coach, post, gig, &c., in order to arrive at the probable number which will travel by the railway, is the usual method adopted in estimates of this nature. I am not aware, however, of any precedent, *in fact*, for this course. The increase in the number of passengers upon those railways which are in active operation has, I believe, *always* been stated in comparison with the number who previously travelled by *coach alone*, throwing out of the calculation passengers by all other modes of conveyance: and this I think to be the fairest mode. Applying this principle, then, to the line under consideration, and assuming that the number of passengers will be *treble* the number now travelling by coach (and this, I believe, is less than the minimum of increase on any railway at present in operation), the *net* annual revenue would be 230,594*l.* 5*s.* 4*d.*, being 13½ per cent. upon the capital sum of 1,700,000. (Signed) WILLIAM PARE.

COACH TRAFFIC.

Places between which coaches are licensed.	Number of coaches (*i.e.* Vehicles) travelling.	Number of weekly journeys performed.	Average number of Passengers per journey.	Average number of Passengers weekly.	Miles by London and Southampton railway.	Aggregate number of miles travelled weekly by railway.
London and Alton	1	6	9	54	31	1,674
" " Basingstoke	2	12	9	108	46	4,968
" " Blackwater	1	12	6	72	31	2,232
" " Chertsey	1	12	6	306	20	6,120
" " Ditto	2	26	9			
" " Chichester	3	36	9	324	23	7,452
" " Chobham	1	12	6	72	23	1,656
" " Esher	2	24	6	144	12	1,728
" " Godalming	1	12	9	108	23	2,484
" " Gosport	2	12	9	108	76	8,208
" " Guildford	2	24	9	216	23	4,968
" " Hampton	11	174	3	522	12	6,264
" " Hersham Green	1	12	6	72	15	1,080
" " Kingston	1	16	9	144	10	1,440
" " Portsmouth	17	112	9	1078	76	81,928
" " Ditto, mail	2	14	5			
" " Salisbury	4	24	9	216	55	11,880
" " Southampton	12	78	9	772	76	58,672
" " Ditto, mail	2	14	5			
" " Weybridge	2	24	9	216	16	3,456
" " Weymouth	2	12	9	108	55	5,940
" " Wimbledon	1	28	9	252	6	1,512
Southampton and Bath	2	12	6	72	30	2,160
" " Cheltenham	2	12	9	108	30	3,240
" " Gloucester	1	6	6	36	30	1,080
" " Reading	1	6	6	36	30	1,080
" " Newbury	1	6	6	36	21	756
" " Oxford	2	9	12	108	21	2,268
" " Alresford	1	9	12	108	12	1,296
" " Winchester	1	6	12	72	12	864
				Total miles per week		226,406

226,406 miles per week is equal to 11,773,112 miles per year, which, at 2d. per mile, is 98,109*l.* 5s. 4d.

(Signed) WILLIAM PARE.

Birmingham, June 1837.

ESTIMATE OF REVENUE.

Passengers.

	Carried 1 mile annually.	Equal to No. carried the whole length of Railway.	Rate per Mile.	£.	s.	d.
By coach	11,773,112	154,909½	2d.	98,109	5	4
By post	1,359,748	17,891½	"	11,331	4	8
By car, fly, gig, &c., being half those observed	1,173,029	15,434½	"	9,775	4	10
By van, waggon, and spring-cart, being half those observed	857,831	11,287¼	"	7,148	11	10
	15,163, 70	199,522½		126,364	6	8
Add 100 per cent. for increase	15,163,720	199,522½		126,364	6	8
	30,327,440	399,045		252,728	13	4
Coach parcels				16,688	2	0
Total revenue from passengers and small parcels						269,416 15 4

Goods and Live Stock.

	Tons.	Tons.				
By van and waggon	2,507,882	32,998½	4d.	41,798	0	2
By canal and sea	641,316	8,438⅛	3d.	8,016	9	0
	3,149,198	41,436⅝				
Live stock				8,309	14	2
Total revenue from goods and live stock						58,124 3 4
Gross annual revenue						£327,540 18 8
Deduct for expenses of annual repairs, locomotive power, management, &c., &c., as follows:—						
From passenger and small parcel revenue, 33⅓ per cent.				89,805	11	9
From goods and cattle revenue, 60 per cent.				34,874	10	0
						124,680 1 9
Net annual revenue, being 12 per cent. nearly on the capital sum of £1,700,000.						£202,860 16 11

(Signed) WILLIAM PARE.

Birmingham, June 1837.

Mr. Pare's account evinces considerable ability. There are, however, some items which appear to be not quite correct. For instance, it may be doubted whether the coaches from Southampton to Bath will use the railroad at all, until a line is formed to Salisbury; on the other hand, the coaches going from Southampton to Oxford and Newbury will use the Southampton Railway to

Basingstoke, being thirty miles instead of twenty-one. The main point, however, which deserves consideration, is the correctness, or the contrary, of the principle adopted both by Mr. Lacy and Mr. Pare, of excluding, as a means of revenue, from the Southampton line, all the passenger-traffic by the Exeter, Devonport, and Bridgewater coaches. These coaches at present go through Basingstoke, which is on the line of the Southampton Railway, and thence to Salisbury; and it is evident that many of the passengers conveyed by them, go to and from places no further distant from London than the Southampton line extends in a westerly direction. It is a curious fact, that not a single coach is licensed to go *to* any town west of Salisbury and east of Exeter, from which it necessarily follows, that all coach passengers to and from towns situated between these two cities, are conveyed by the Exeter, Bridgewater, and Devonport coaches. The principle assumed by both Mr. Lacy and Mr. Pare is, that when the Great Western, the Bristol and Exeter, and the Southampton lines are completed, all persons who now travel by the Exeter, Bridgewater, and Devonport coaches, will go by the former two of these lines; but the right principle seems to be, that passengers going from or to the district included by the three lines, will seek to join *some one of these railways at that point which will enable them to perform the journey in the least time and at the least expense.* A very little reflection must lead to the conclusion that this latter is the right principle, and the operation of that principle will be to preserve to the Southampton Railway, more than one half of the passenger-traffic by the Exeter, Devonport, and Bridgewater coaches. That this is not assuming too much, is proved by the following statements, taking from the books of the proprietors of the Exeter mail *via* Dorchester, *viz.*, of 169 passengers booked in the twenty-eight days preceding the 24th June last, 108 were going to and from places between London and Dorchester, all of whom would use the Southampton Railway.

From similar data, Mr. Chaplin furnishes the following statement as to four other coaches, during the space of twenty-eight days.

Name of Coach.	Passengers who would use the Southampton line.			Passengers who would use the Great Western, and Bristol and Exeter lines.		
	Inside.	Outside	Parcels.	Inside.	Outside	Parcels.
Exeter Herald	34	180	482	42	119	411
Exeter mail *via* Yeovil	48	94	409	27	22	224
Devonport mail	17	38	182	82	66	1070
Exeter coach *via* Yeovil	111	380	1064	31	174	506
	210	692	2137	182	381	2211
	902			563		

It is evident, therefore, from these figures, that one half the passenger-traffic by the Exeter, Devonport, and Bridgewater coaches, will still continue on the Southampton Railway, even after the Great Western, and Bristol and Exeter lines, shall be finished, and that Mr. Chaplin in stating this, which he does in the following account, has not assumed so much as existing facts would warrant.

It will be observed that the foregoing statements, as well indeed as most or all other estimates of the traffic on railways which have been presented either to Parliament or the public, have been founded on an assumption of a certain number of passengers to each coach; the following statement, with which Mr. Chaplin has favoured the Directors, possesses the most desirable quality of being founded on absolute fact, the number of passengers and parcels having been ascertained by actual observation, or by an inspection of the books of the coach proprietors.

A Statement of the Number of Passengers and Parcels carried per Journey during the Months of January, February, July, and August, 1836. By Mr. CHAPLIN.

No.	COACHES.	Journey per Week.	Average Passengers In-side and Out.	Number of Passengers per Week.	Number of Miles by Railway.	Aggregate Number of Miles travelled weekly by Railway.	Number of Parcels each Journey.	Annual Number of Parcels.	Charge per Parcel.	Annual Amount of Parcels.
									s. *d.*	£. *s.* *d.*
1	Alton	6	11	66	31	2,046	8	2,496	0 8	83 4 0
2	Basingstoke	12	10	120	46	5,520	12	7,488	1 0	374 8 0
2	Blackwater	12	8	96	31	2,976	4	2,496	0 8	83 4 0
2	Esher	24	8	192	12	2,304	4	4,992	0 4	83 4 0
2	Hersham	12	8	96	15	1,440	2	1,248	0 4	20 16 0
1	Bridgewater	6	10	60	46	1,380	25	3,900	0 10	162 0 0
4	Chertsey	31	8	248	20	4,960	4	6,448	0 6	161 4 0
2	Devonport (mails)	14	5	70	56					
4	Exeter (mails)	28	5	140	56	22,512	25	70,200	1 0	3,510 0 0
10	Exeter (coaches)	66	9	594	56					
2	Godalming	12	9	108	23	2,484	5	3,120	0 6	78 0 0
2	Gosport	12	8	96	77	7,392	15	9,360	1 0	468 0 0

Only half this number taken into calculation.

Half deducted

4	Guildford . . .	24	10	240	23		5,520	9		11,232	0	6	280 16 0
18	Hampton . . .	126	9	1134	12		13,608	2		13,104	0	4	218 8 0
4	Kingston . . .	30	11	330	10		3,300	4		6,240	0	4	104 0 0
10	Portsmouth (day)	60	11	660	77		50,820						
2	Ditto (night)	14	11	154	77		11,858	15		78,000	1	0	3,900 0 0
2	Ditto (mail)	14	5	70	77		5,390						
2	Ditto (van)	12	11	132	77		10,164						
4	Salisbury . . .	24	9	216	56		12,096	15		18,720	1	0	936 0 0
14	Southampton . .	90	11	990	77		76,230	12		64,896	1	6	4,867 4 0
2	Ditto (mail)	14	5	70	77		5,390						
18	Wandsworth . .	268	9	2412	4	Only half taken.	4,824	2	Half deducted.	13,936	0	4	232 5 4
2	Weymouth . .	12	9	108	77		8,316	14		8,736	1	0	436 16 0
2	Weybridge . .	12	8	96	16½		1,584	4		2,496	0	6	62 8 0
4	Wimbledon . .	28	8	224	6		1,344	2		2,912	0	4	48 10 2
1	Little Hampton .	6	9	54	23		1,242	10		3,120	0	6	78 0 0
2	Moushill . . .	12	8	96	23		2,208	4		2,496	0	6	62 8 0
3	Chichester . . .	18	10	180	23		4,140	10		9,360	0	6	234 0 0
2	Chobham . . .	12	6	72	23		1,656	3		1,872	0	6	46 16 0
2	Cheltenham . .	12	9	108	30		3,240	5		3,120	0	6	78 0 0
2	Gloucester . .	14	5	70	30		2,100	6		4,368	0	6	109 4 0
1	Reading . . .	6	6	36	30		1,080	3		936	0	6	23 8 0
1	Newbury . . .	6	6	36	30		1,080	4		1,248	0	6	31 4 0
2	Oxford	12	9	108	30		3,240	4		2,496	0	6	62 8 0
4	Winchester . .	24	8	192	12		2,304	2		2,496	0	4	41 12 0
142							285,748						16877 17 6
								Add 20 per cent. for amount of carriage for parcels carried by weight.					3375 11 6
													20253 9 0

SOUTHAMPTON TO

The result of the statement of Mr. Chaplin is, that the number of miles now travelled weekly is 285,748, or *annually* 14,858,896; which, at 2*d.* per mile, is—

	£		
	123,824	2	8
The carriage of parcels	20,253	9	0
Total of the existing coach-traffic estimated at railway prices	144,077	11	8

Accompanying the foregoing statement is the following

LETTER OF MR. CHAPLIN TO THE CHAIRMAN OF THE DIRECTORS OF THE LONDON AND SOUTHAMPTON RAILWAY COMPANY.

Lad-lane, 4th August, 1837.

My Dear Sir,—On handing you a statement of the stage-coach traffic in the district through which the Southampton Railway passes, I cannot refrain from expressing my opinion, that the great difference between the marketable value of its shares, as compared with those of the Liverpool and Manchester, or other railways leading to those towns, is mainly to be ascribed to the importance which is attached to their being places having each of them a large population, and to their great manufacturing and commercial character, and it has been supposed that on this it necessarily follows that a far greater number of passengers pass between London and those towns, than between London and the towns situated on the Hampshire coast. That this is not so, will, however, be at once apparent from the fact, that during the last seven years the number of coaches running direct from London to Portsmouth and Southampton, have exceeded the number of those running direct from London to Manchester and Liverpool, in the proportion of seventeen to thirteen.

This may arise from the circumstance of Liverpool being a port into which all foreign and colonial produce is imported, and from Manchester being a place where goods are manufactured, and can, therefore, be obtained without recourse to a distant market; but whatever the cause may be, the fact is what I state.

On looking over the Report of the Directors of the Liverpool and Manchester Railway, dated 26th May, 1836, it is shown that the coach-traffic was computed upon twenty coaches, running forty journeys per day, between those two towns, and the extreme amount of income to the railway from this traffic was estimated at 20,000*l.* per annum; whereas, the average receipt from the coach department on this railway for the first 5½ years has been 104,225*l.* 18*s.* 5½*d.* per annum. This sum divided by thirty, the number of miles, gives 3,474*l.* 3*s.* per mile. To produce this sum, the number of passengers between the two towns have been nearly *quadrupled*. Now, if the number of passengers on the Southampton line, as shown by the statement I now send you, is only *doubled*, and the parcels taken at what they now are, it will make a revenue

from the coach department of 267,901*l.* 14*s.* 4*d.*, which, divided by seventy-seven miles, gives a revenue per mile of 3,479*l.* 4*s.* 8*d.* Surely this comparison ought to be satisfactory, more especially as we shall have the advantage of the experience derived from the more early railroads. The Liverpool and Manchester Railway has stood the test of several years' experience: the knowledge now existing on the general subject of railways is mainly to be attributed to this circumstance, but more to the liberal and candid conduct of the Directors in making the results of its operations publicly known. I am, my dear Sir, yours faithfully,

(Signed) WILLIAM CHAPLIN.

To the Chairman of the Directors of the
London and Southampton Railway.

Of the preceding statements, the Directors prefer that of Mr. Chaplin, not because it is the most flattering as regards the interests of the proprietors, but because it is founded upon positively existing data—upon facts, and not upon assumption; and because the experience of Mr. Chaplin in such matters entitles his opinions to great respect. It only remains to be said that Mr. Chaplin's account of the number of parcels carried is not a matter of estimate, but of fact.

Some estimate of the importance of Southampton may be made from the fact, that 66 coaches arrive at and leave that town every day, besides steam-packets to London, to Havre, Portsmouth, the Isle of Wight, Guernsey, Jersey, and various ports on the south-western coast of England.

Having thus more than substantiated the original estimate of traffic, as regards stage-coach passengers and coach-parcels, the other, and less important items, remain to be inquired into. The posting is put down at so small a sum, that it scarcely requires any comment. When it is once seen that the estimate contemplates the carrying of all those persons who now travel by post-horses, together with the carriages of some of them, for less than 20*l.* per day, a length of 77 miles, on a road where a very large number of post-horses are kept, it must appear, as it really is, much understated. The original estimate contemplates a revenue of 7,082*l.* 8s., from this source. Mr. Pare makes it 11,331*l.* 4s. 8d.

As regards the waggon traffic, the original estimate contemplates a revenue of 29,768*l.* 6s. Mr. Pare makes it 49,814*l.* 3s. 2d. This may be partly accounted for, from the fact that the original estimate did not include any goods now sent by water-carriage. Mr. Pare contemplates a revenue from goods now conveyed by canal and sea, of 8,016*l.* 9s., being a charge for conveying 8,438 tons annually, the whole distance, at 3d. per ton per mile. The goods at present conveyed by van and waggon, Mr. Pare estimates as equal to 32,998 tons, conveyed the whole distance annually, to which he assigns a charge of 4d. per ton per mile, making a sum of 41,798*l.* 0s. 2d. Assuming that Mr. Pare is right as to quantity (and it will be seen, on reference to his description of the

mode in which his information was obtained, that there is no reason to believe it to be overstated), it is worth while to consider whether the rate of charge is not too low. It is not unfrequently the case that lines of railway have to compete with canals, having the same termini, and running through the same country. This is not the case with the Southampton Railway. The Basingstoke Canal, the river Wey navigation, and the Thames, afford a line of water-conveyance between London and Basingstoke. The river Itchen having been made navigable between Southampton and Winchester, affords a similar medium of transit between those two places, but the connecting link from Winchester to Basingstoke is wanting, and will, in all probability, ever remain so, by reason of the difficulties of the country, and the impossibility of obtaining a supply of water. In the conveying of goods from London to Southampton, or *vice versâ*, the railway therefore has no competing canal.* The only competition, as regards either the charge for conveyance, or the speed, is to be found in the common stage-waggon or cart, on the turnpike-road, and the charge for conveying goods by these is from 10d. to 1s. per ton per mile. Surely it will be a sufficient boon to the public if the present charge is diminished one-half, and the time reduced from three *days* to less than half a day. Taking, therefore, the quantity of goods, as ascertained by Mr. Pare, at a charge of 6d. per ton per mile, the annual amount receivable from this source of income will be 62,697*l.* 0s. 3d., instead of 29,768*l.* 6s., as assumed in the original estimate, and this, too, without calculating on a single ton of goods now conveyed by sea or by canal. In now adopting the former sum as the more probable approximation to the amount which will be actually received, the Directors are aware they are taking what may appear to be too great a leap, but they are of opinion that the amount derivable from the conveyance of goods will then be much understated, and their reason for that belief is that, to make that sum, it is only necessary to calculate on half the present charge for conveying such goods as are now conveyed by public land carriers. Nothing, for instance, is put down for conveying coals, which are now conveyed by land from Southampton as far north as Basingstoke, from which source alone a large additional revenue must inevitably accrue to the railway; nor is anything put down for the conveying of many other articles which will almost necessarily be sent by the railway.

The next item in the original estimate of revenue, is the sum which it is presumed will be receivable from the conveying of cattle, sheep, and other live stock, which it was estimated will produce 27,155*l.* per annum. Mr. Pare makes this item only 8,309*l.* 14s. 2d.; and in his account of the data on which his cal-

* It is a remarkable fact that, owing to this circumstance, and the consequently greater existing necessity of resorting to land conveyance, the London and Southampton Railway will cause the discontinuance of more waggons than will the London and Birmingham, in the proportion of 62 to 54.

culations are founded, he says, "The cattle and sheep counted on the road during the fortnight's observation in April and May, have in this estimate been taken to be the average of the year. There can be no doubt, however, that the number observed is greatly under the average number, the time of the observation being unfavourable for this species of traffic." In support of the original estimate, it may be said that it was proved before Parliament by persons practically acquainted with the matter, resident in the country through which the cattle pass, and interested in that species of trade; persons who were fully capable of appreciating the advantages that would result to the farmer, the grazier, and the public, from the avoidance of what is technically called "sinking" in the animals, by carrying instead of driving them, as well as avoiding the expense of the latter. It must, however, be admitted, that there is no evidence from actual experience on this head. The cattle and sheep by which Liverpool is supplied come by sea from Ireland and Scotland, and those which are sent from Liverpool to Manchester are found rather to recover the effect of the previous sea voyage by the walk to Manchester, than to suffer any further detriment thereby. But this will not be the case with cattle fresh from the pasture or the stall. The object of the grazier will be to send the animal into market with all his flesh and all his best condition, and it will be to his interest to pay for the conveyance by railroad rather than the somewhat lesser charge of driving, accompanied as it is by positive depreciation. It is believed that these reasons will justify the estimate so far as cattle are concerned; as for sheep and lambs, they are conveyed in great numbers on the Liverpool and Manchester line, and will doubtless be carried in still greater quantities from the pastures of Hants and Wilts to London. This is the last item in what was denominated "*the present traffic*," in the original prospectus.

"*The* PROSPECTIVE TRAFFIC, *additional to the actual traffic*," consisted,

First, of a revenue to be derived from the carriage of fish from the Torbay fishery, estimated at 23,333*l.* 6s. 8d. It was proved before Parliament, that much of the fish caught at the Torbay fishery, although of the most superior quality, was rendered useless, or sold at comparatively small prices, by reason of the distance from London. The time expended in conveying it by ordinary means destroyed the quality of the fish; and the cost of carriage by coach (a mode sometimes resorted to all the way from Exeter) is such as to render it unprofitable; but that if the fish were brought by steam-boats to Southampton, and thence by railroad to London*, the whole journey from the fishing ground would be

* The passage up Channel from off Cowes to London, by steam-boat, requires an average of 28 hours. When the railroad is completed, it will be accomplished in from four to five hours. The effect of this in respect to passengers arriving in or quitting the English Channel, can scarcely be calculated on.

performed in little more than twelve hours, and at a trifling expense as compared with that which must now be paid for a less degree of expedition. Persons well acquainted with the business gave their decided opinion, that the certainty of finding a quick mode of conveying the fish from Southampton to London would cause such a quantity to be brought to the former place, as would at a moderate charge produce the sum named. The proprietors will form their own judgment upon the matter, which evidently is, at present, one rather of opinion than of fact.

The next item in "*the prospective traffic*" is expected to arise from an increase of 100 per cent. on the passengers now travelling. No instance can be produced where the opening of a line of railway has led to so small an increase as 100 per cent. In the case of the Liverpool and Manchester Railroad, the passengers have nearly quadrupled, and have increased twenty-fold on the Stockton and Darlington; hence there cannot be a doubt that this calculation will be more than borne out by the result. There are in addition to those sums already noticed, two comparatively small amounts set down as a revenue to arise from the carriage of country-killed meat (4,666*l.* 13s. 4d.), and an increase on the carriage of goods (*5,569l.* 4s.)

The result of this review of the traffic has been to satisfy the Directors of the absolute certainty of an ample revenue; which they feel themselves perfectly justified in stating thus, viz.:—

Present Traffic at Railway Prices.

	£.	s.	d.	
Stage-coach passengers, according to the statement of Mr. Chaplin . .	123,824	2	8	
Parcels, as stated by Mr. Chaplin . .	20,253	9	0	
Posting, as stated by Mr. Pare . . .	11,331	4	8	
Waggon traffic, taking the quantity stated by Mr. Pare (but excluding all that now goes by sea or canal), 6d. per ton per mile . .	62,697	0	3	
Cattle traffic, as stated in the original estimate	27,155	0	0	
				245,260 16 7

Prospective Traffic.

	£.	s.	d.	£.	s.	d.
Torbay fishery . . .	23,338	6	8			
100 per cent. increase on passengers now travelling by stage-coaches .	128,824	2	8			
Country-killed meat	4,666	13	4			
Increase on heavy goods	5,569	4	0			
				157,393	6	8
				402,654	3	3
Deduct for cost of maintenance of way, power, and all expenses relating to the conveyance of passengers and parcels, 33⅓ per cent., say one-third of 279,232*l.* 19s. . .	93,077	13	0			
Deduct 50 per cent. on the remainder, say one-half of 123,421*l.* 4s. 3d. .	61,710	12	1½			
				154,788	5	1½
Leaving a net annual income of				£247,865	18	1½

N. B.—No increase is taken on those persons travelling with post-horses.

In thus setting forth their own opinions on the revenue which they believe they have a right to expect from *existing circumstances*, the Directors neither have any wish nor any interest beyond that of the proprietors in making the undertaking appear more promising than it really is: they have therefore thought it right to be thus circumstantial in giving not only their opinions, but the data on which those opinions are founded, and they have a perfect reliance that the more the matter is inquired into, the more satisfactory it will appear to the inquirer. Owing to the want of that inquiry, and the too ready belief of detracting reports, the property of the shareholders has been and still remains depreciated. If proof of this were wanting, it is to be found in this simple fact, that the present coach and posting traffic on the line, without any increase, without conveying a single ton of goods, without convey-

ing cattle, sheep, fish, agricultural produce, or any one thing besides, and deducting one-third for expenses, would realize a net revenue of 103,605*l.* 17s. 1d.,* which is upwards of six per cent. on the sum that, according to the estimate of Mr. Locke, will be required for the completion of the railway. It is, however, perfectly obvious that there must be a very large increase in this department of revenue. Experience has proved that the public will avail themselves of the great measure of convenience which is afforded by a railway, and there is no reason to suppose that the inhabitants of the district through which the Southampton Railway passes, or to which it leads, will be more slow to appreciate that convenience than the inhabitants of other parts of the kingdom. On the contrary, the Directors feel they are justified in expecting as large a rate of increase in the trade on the line of the Southampton Railway as has occurred on any line in the kingdom. Some opinion of the growing importance of Southampton may be formed from the fact that, in the 20 years between 1811 and 1831, the population has *more than doubled*, as may be seen from the Parliamentary census. If this has been the case hitherto, what may not be expected when the natural beauties and facilities of Southampton, the Isle of Wight, and its neighbourhood, are made available in the far greater degree which they will by the construction of the railroad? It cannot be too often impressed on the minds of the proprietors, that the foregoing statements are based upon things *as they now exist;* that nothing is assumed on account of Southampton being possessed of the finest harbour for mercantile purposes on the southern coast of England, a harbour which is about to be made still more available for those purposes by means of the construction of docks; or because its situation is singularly eligible, not only as a point from which foreign and colonial produce can be distributed over a vast extent of country when the railroad is in use, without being charged with the additional cost of passing first up to London and then down again; or because it will afford even to London itself, by the creation of the railroad, the means of avoiding the delays, the dangers, and the consequent expense and loss, incurred in navigating the English Channel and passing round the North Foreland and up the Thames. To what extent the mercantile interests of the metropolis may find it desirable to avail themselves of this facility time alone can determine, but that it will be to a considerable extent cannot be doubted.

	£.	s.	d.
* Present stage-coach passengers .	123,824	2	8
Parcels	20,253	9	0
Posting	11,331	4	8
	155,408	16	4
Deduct one-third for expenses .	51,802	19	3
	£103,605	17	1

It is highly worthy of remark, that the circumstance of this railway having one of its termini at the water's edge in Southampton harbour, and the other at a wharf on the banks of the Thames, affords every convenience which nature and art combined can give for such a traffic. With respect to the situation of the London terminus, as it bears upon the convenience of passengers, the following statement of the distances from the Royal Exchange and from Charing Cross of the termini of the London and Birmingham, the Great Western *, and the Southampton Railways, will show the local merits of each.

Distance from	To Charing Cross.	To the Royal Exchange.
The terminus of the London and Birmingham Railway at Euston-square	1 mile 65 chains.	3 miles 16 chains.
The terminus of the Great Western Railway at Paddington .	2 „ 60 „	4 „ 26 „
The terminus of the London and Southampton Railway at Vauxhall	1 „ 77 „	3 „ 9 „

In addition to the usual accommodation by omnibuses, arrangements are being made by which the passengers will be conveyed in small steam-boats, and landed at any point between Vauxhall and London-bridge within a few minutes of the time of their arrival at the station. These small steam-boats will be in waiting at the terminus wharf, for the arrival of the different trains, and in like manner they will start from the different points of embarkation along the river in time to reach the station before the departure of the trains.

In concluding this part of their Report, the Directors beg to refer to the accompanying plan, showing the places from whence passengers will be conveyed by this railway, by which it will be seen that it is not a railway to Southampton alone, but that, while it affords to the inhabitants of the metropolis a cheap and expeditious mode of travelling to one of the most delightful parts of England, it confers a corresponding benefit on the greater part of the county of Surrey, on the whole county of Hants (including the Isle of Wight), also on Guernsey and Jersey, and on a considerable portion of Wiltshire and Dorsetshire, which counties contain a population of no less than 1,199,072 souls.

* Taken from a recent publication, entitled "Analysis of Railways," by Francis Whishaw, Esq., Civil Engineer.

SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

Safety Lamp.—A modification has been given to the Davy lamp in France. It consists chiefly of making the lamp, instead of a whole cylinder, the half, the part cut away being supplied by a reflector, by which means near double the light is at the disposal of the miner to throw on any particular spot.

Parachutes.—(By the Editor.)—The late accident seems only to have sharpened the appetite of men for perilling their lives and limbs in these, to all appearance, useless machines. No sooner does one man fall a victim to his temerity, than we hear of many others ambitious for the honours of similar notoriety, and, if it was not for the seriousness of the consequences, under the most laughable circumstances. For example, have we not had an instance of a man offering to ascend with skyrockets, and descend in a parachute? Could stark staring madness itself go much further? In France a proposal is under consideration of a commission of the Academy, to enable aeronauts to raise or lower themselves by means of a parachute, without discharging ballast in one case, or gas in the other. If this be realised, it may turn ballooning to some more useful account.

A gentleman with whom we are very well acquainted, informed us that he passed the evening with Garnerin on the day of his descent, who told him, that notwithstanding the frightful oscillations to which he was subjected in his descent, he felt the most perfect security against being overturned. He was suspended about 40 feet below the parachute, in a basket attached to it, and not as the late unfortunate Cocking was, close up to it. This tended very much to counteract the oscillation, which probably would have been very little had he dropped as Cocking did with the parachute fully distended directly over his head. But he precipitated himself at once from the balloon, and fell with the parachute a considerable distance, upwards of 1,000 feet, before it opened. Garnerin descended very steadily afterwards for about a minute, when he came in contact with a strong current of air, which caused the oscillations experienced. He had often descended on the Continent without any oscillation whatever. Our friend above alluded to, who is a man of science and practical application of it, suggested to us a very simple and, likely enough, successful method of preventing in a great degree such violent vibrations. He recommends that all the ballast which it is needful to carry should be suspended by a rope of a tolerably good length to the bottom of the car. The machine would then become a system of two pendulums of unequal length, which would operate much to check each other's vibrations, and to keep the body steady in its descent. As soon, also, as the ballast or suspended weight reached the

ground, it would lighten the machine, and check its descending velocity—precisely what is wanted.

It is not for a moment to encourage such rash and dangerous experiments that we give any suggestions on parachutes, but merely as a subject of philosophy and science. The form best adapted for steady descent, to avoid oscillations from horizontal currents of air, and to secure guidance in any direction with or against the wind, appears to us to be that of a thin flat circle, if the figure could be maintained, which, we apprehend, would not be difficult. Such a form would afford the least possible edge or horizontal resistance, and we think quite as much vertical as any other. It would likewise require less material, and would therefore be lighter than any other figure, while, by an easy arrangement of the cords, any disposition to collapse or crush might be obviated. If this figure was at all departed from, we should recommend a small funnel in the centre, something like the tops of the parasols lately carried by ladies, cut off some distance from the uppermost point. The rushing of the air through this aperture might be a trifling loss to the power of the parachute, but would tend to keep it distended and in its true position.

If such a circle was a little inclined to the horizon, it would advance with great rapidity horizontally while it descended, and in almost any direction, whether the wind favoured it or not, provided it was not too violent. It is difficult to make computations that can come very near the truth, unless all the data were correctly given; but if a parachute of this form was made 80 feet diameter, about enough to let a weight of 500lbs., including itself, fall to earth with a velocity of 5 miles an hour, an inclination of 1° to the horizon would give it, with the ordinary appendages, a horizontal motion of perhaps near 15 miles an hour; of 2° of near 21 miles an hour; and of 3° of about 25½ miles an hour. Now this inclination is very easily given and changed at pleasure to any thing else, so that a man, while he is descending, may sail about hither and thither just as he pleased, land nearly where he liked, and exhibit innumerable gambols in the air.

Should he be sailing along too rapidly when he approaches the earth, he has but to reverse the inclination, and he would arrest his horizontal progress; at the same time his vertical descent would be checked by an effort to ascend, which the resistance would occasion; so that he may drop down with a sort of hop, just as we see rooks and large birds do. Of course it would not do to suspend a weight beneath, as above suggested, when horizontal motion was wanted near the earth.

Retardation of Vegetation.—A method has been lately proposed to the French Academy of retarding the maturation of plants, &c., so that fruits, which are usually not eaten after September or October, have been retarded until December. M. Deslongchamps (a very suitable name by the bye) is the inventor of this process.

Explosion of Steam-boilers.—The valves being in order, it is generally considered that explosions arise chiefly from the sinking of the water below a certain level. M. Sorel has proposed a method to obviate this by the introduction of a tube into the boiler descending a little lower than the said level. The orifice of the pipe is to be kept closed by means of a valve carried by a float, which sinking, as the water descends, beneath the desired level, opens the valve and permits the steam to pass out.

Monkeys.—It is said troops of monkeys inhabit the rocks of Gibraltar, which, when a passenger happens to pass, amuse themselves with throwing stones down upon him from their elevated positions. They are supposed to come from Africa, and, like all of the human shape which set foot on British soil, are considered as free, and protected by the Governor.

Force of the Wind.—Few persons can have any idea of the excessive power of the wind in high velocities. It appears from our table, No. 3, that at 40 miles an hour, which is a high wind, the force is no less than 6 lbs. to the square foot. How many of our glass windows would stand even this pressure with doors open behind them? At 80 miles an hour, which is a hurricane, the pressure is no less than 24·56lbs. per square foot. Against such a wind as this, it would be exceedingly difficult for the strongest man to keep his legs; to walk against it would be out of the question. At 100 miles an hour, it is said the wind would sweep every thing before it; the pressure would be 38·36lbs. to a square foot. There are few houses of any size, which, standing singly, would not present 1,000 square feet. In such a hurricane the power of the wind would be no less than 38,360lbs., or above 17 tons, against a house with 1,000 square feet of surface. Its chance of resisting so enormous a force would therefore be very little.

Medal Striking.—We have much pleasure in announcing to the friends of the fine arts, that Mr. Pistrucci, chief medalist in the Royal mint, has discovered a method by which he can stamp a matrix or a punch from a die which has never been touched by an engraver, and shall yet make the medal identically the same with the original model in wax, an operation by which the beauty and perfection of the master's design are at once transferred to any metal, whether gold, silver, or copper, by striking it according to the usual process. It will at once be seen that this is a very different operation from that by which cast medals are manufactured. It is as simple as it is ingenious, and Mr. Pistrucci having no intention of taking out a patent for the discovery, and being anxious to give to the public the full benefit of it, in the different processes of manufacturing plate, jewellery, and all kinds of ornamental work in metal, announces that the whole of the process consists of the following method:—The model being made in any substance, wax, clay, wood, or other fit material, a mould of it is taken in plaster, from which mould, when dried and oiled to harden

it, an impression is taken in sand, or other similar substance which may be preferred, and from this again a cast is obtained in iron as thin as possible, that the work may come up sharply, and the iron attain the hardness almost of a steel die hardened. This cast-iron impression is then flattened mathematically true on the back, and fixed in a steel die, the hollow of which is turned to the exact size of the cast-iron, and it is set within the rim or border, hammered as close as possible, so as to form a collar. The metal upon which the impression is to be struck (to form either the medal itself or a steel matrix, if desired), is to be fashioned into the shape of a cone in the ordinary way, perfectly flat at the base, heated red hot, and placed at the bottom dish of the press. When the die, fitted as above, having been previously placed at the top dish, and the workmen quite ready to give the blows instantly, three or four, as may be required, a perfect impression of the cast-iron will be attained without the least injury to it. Of course it will be necessary, previous to the die being used, for the artist to polish the surface.

Mr. Pistrucci's first experiment was successfully performed upon a punch of hard copper, with his model of the medal of Sir Gilbert Blane, being nearly three inches in diameter; and he has no doubt that it will equally succeed on a steel punch, perhaps, too, without its being necessary to heat it.

When the process above described shall have been brought to the perfection of which it is capable, there can be no doubt that in the execution of works of this description it will not only be the saving of the labour of months or years in the engraving of dies, and, consequently, of great expense, but the work to be executed will in all points be, in an instant, an exact fac-simile of the original conception of the artist, instead of representing, as at present, merely the handiwork of the engraver, copied from such original. It will also dispense with the use of the very expensive machinery, such as the *tour a portrait*, introduced into the mint by Mr. Pistrucci several years ago, which, however apparently correct in its productions, can never give a perfectly true semblance of the original, even to the limited extent to which it is applicable. And we may possibly be led by it to discover the mode by which the artists of antiquity succeeded in producing those beautiful coins, in which the softness and boldness of the fleshy parts have never yet been equalled by any modern engraver in steel.—*From a Correspondent of the "Times."*

Invention to Supersede the Use of Steam.—An invention, we have heard, is shortly expected to be laid before the public, by which steam will be, in a great measure, if not wholly, superseded. We are unacquainted with the particulars of the invention, but we have been assured, from two several quarters, that it is simple and efficacious; and is now waiting for the completion of one point in

the universal application, which, it is supposed, cannot be long an obstacle.

Steam-Engines within the Borough of Birmingham.—By a report made to the Birmingham Philosophical Institution, October, 1836, it appears that 169 steam-engines had been erected from 1780 to that period, of which 17 had been erected in 1834, and 22 in 1835. The total horse power was equal to 2,700 horses. Within the same period engines equal to 162 horses' power had become void, or removed. Of those erected and estimated in horse power, 275 were used for grinding flour; 1,770 for working metals; 279 for pumping water; 87 for glass grinding; 97 for working wood; 44 for paper making and glazing; 37 for grinding clay; 61 for grinding colours and chemicals; and 50 for sundry purposes. The estimated consumption of coals is 216 tons per day; estimated number of persons employed, 4,000 males, and 1,300 females; and the estimated amount of power hired out, equal to 450 horses. These estimates are confined to engines within the borough, and, of course, do not include the great Soho works of Boulton and Watt.

Of the 1,770 horse power employed in working metals, it is computed that 162 is used by iron founders, first applied in 1788; 570 in rolling copper, brass, and other metals, first applied in 1790; 150 in drawing wire, first applied in 1808; 201 in iron forges, and wrought iron mills, first applied in 1810; 74 in nail cutting, first applied in 1813; 104 in screw making, first applied in 1819; and 34 in drawing metal tubes, first applied in 1822.

Glass Cloth.—Richard Barker and Son, of Ossett-street-side, near Dewsbury, have found out an improvement in glass, and have it so pliable that they can make a cloth or fabric of the finest texture. They have pieces of this glass two yards and a-half long and from nine inches to thirty-six inches in breadth; they have also made some very fine ladies' head-dresses or ornaments from this material, which are considered both very curious and useful.—*Doncaster Gazette.*

A Crowbar a Magnetic Needle.—The following case of natural magnetism has no equal known at present:—"A bed of magnetic iron ore not only magnetized so powerfully the iron instruments used to break it up as to adhere to them in large tufts of the fragments of the iron ore, but a crowbar suspended freely over the iron ore takes the position in the magnetic meridian, and thus becomes a true but gigantic needle."—*Report on the Geology of Maine, United States.*

British Scientific Association.—This body will meet at Liverpool, Sept. 11th, and the probability is, that the next meeting will be held at Newcastle. Considerable preparations are making at Liverpool for their reception, and it is expected the meeting will be a very interesting one.

Silk-worms.—The cultivation of the mulberry-tree, and the raising of silk-worms, has been adopted in Switzerland with great success. At Basle August, in particular, this new source of wealth has been astonishingly productive.—*Mining Journal.*

Large Meteoric Stone.—A recently-received Halifax (Nova Scotia) paper says, that while several of the inhabitants of Montmorot, in the Jura, were at work in the vineyards which are close to the old castle there, they heard a noise which sounded like a distant clap of thunder, and saw a mass fall down into the vineyard of an innkeeper, named Michaud. On being examined, it was found to be about five feet high and three feet broad. It is of a grey colour, resembling pumice-stone, but marked with ferruginous particles.—*Mining Journal.*

New Lock.—M. Lettestu has invented a lock, by which the bolt is drawn into the staple by a circular instead of a rectilinear motion. When shut it is said to resist, by its construction, both the opening of the door and the slipping of the frame, (chambranle). The key to move the bolt acts in a nut composed of several little rundles (rondelles); springs carried by some, fastened by others, and unfastened by projections conveniently constructed on a bit of the key, form the garniture or guard of the lock. The several pieces composing the nut, although of similar exterior dimensions, are various within, and may be replaced from one look to the other.

Improvement in the Steam-Engine.—Professor Nollet, employed in the Museum of the State, has just completed a most important invention; viz., a steam-engine exempt from all danger of explosion, not expensive, occupying but little space, and the moving power of which, at the same temperature as the ordinary machines, has a power six times as great, reducing by one-fifth the consumption of fuel, which is an immense advantage, not only in respect to economy, but to the smaller space which may be required for the stock of coals.—*Brussels Paper.*

Cavendish's Experiments.—Government has granted 500*l.* to the Royal Astronomical Society towards repeating the experiments of the Honourable Mr. Cavendish, made about half a century since, and Mr. Francis Baily has offered the use of apartments in his house. With the experience of the present day great discoveries, towards unlocking the secrets of many phenomena, are expected to result from the inquiry. It will take from one to two or more years to finish them when begun.

Colossal Steamers.—In addition to the information we supplied of the great steamer building at Curling and Young's in our last, the "Morning Herald" has furnished the following:—

After deducting her engine-room, she will have ample accommodation for 500 passengers, 25 days' fuel, and 800 tons measurement goods, exclusive of luggage, provisions, and stores. The enterprising spirit evinced, may be readily gathered from the

following estimated expenses of the voyage out and home again. They are as follows:—

Wages, provisions, and stores for crew .	£ 666	0	0
Coal out and home	1,140	0	0
Port charges, &c.	1,378	0	0
Insurance, interest, wear and tear, &c. .	2,000	0	0
	£5,184	0	0

Mont Blanc.—It is established that the glaciers which lay heaped upon each other upon the gorges and sides of Mont Blanc reach to the height of 8,000 feet perpendicular, and that the snows of the upper parts occupy an additional space of 4,000 feet perpendicular, thus making together a mass of 12,000 feet of ice and snow, without including the irregularities of the surface.—*Mining Journal.*

New Plan for Propagating Apple-trees.—A new plan for increasing plantations of apple-trees has lately been carried into extensive practice by the horticulturists of Bohemia. Neither seed nor grafting is required. The process is to take shoots from the choicest sorts, insert them in a potatoe, and plung both into the ground, leaving but an inch or two of the shoot above the surface. The potatoe nourishes the shoot, while it pushes out roots, and the shoot gradually grows up, and becomes a beautiful tree, bearing the best fruit.—*Suabian Mercury.*

Rotary Steam-Engine.—We hear that an engine has been completed on the simplest and most efficient principles, which, in the opinion of competent judges, will accomplish the great desideratum of a uniform and equable action, and on the most economical plan.

RAILWAY NOTICES.

Birmingham, Bristol, and Thames-Junction Railway.—The works are proceeding steadily, and are being well-executed, though we must confess, not quite so rapidly as we expected from the well-known ability of the engineer. We look forward with some anxiety to the commencement of the gallery and bridge at the Paddington Canal, which, from the plans we have seen, will, if well executed (and we have no doubt of their being so), be one of the most curious pieces of engineering, and one of the most beautiful objects in the neighbourhood of the metropolis—a canal, a railway, and a road, crossing each other at the same spot.

Birmingham Railway.—Complaints were at first made of the want of accommodation, &c. The public do not consider the extreme difficulty of perfect arrangement in the outset of a great

undertaking like this. We are, however, pleased to hear that these troublesome, though small points, have been got over, and that ample accommodation is now afforded. The trains occasionally take immense loads; as many as 40 carriages have been taken in one train. We beg again to remind our readers, that no just estimate can be formed of this or the Grand Junction line, until the whole shall have been finished, and a complete railway communication established between London, Birmingham, and Liverpool and Manchester. The daily receipts in the part opened have increased to 189*l*. The line to Tring, 32 miles from town, will be opened in October; to Denbigh Hall, 48 miles, and from Birmingham to Rugby, 16 miles, in January; Denbigh Hall to Blisworth, 13 miles, in May; and finished, from Blisworth to Rugby, in the autumn of 1838; the total distance being 112½ miles.

Brighton Railways.—We doubt much whether peace is restored to these Companies by the decision of Parliament. Stephenson's party, to use a vulgar expression, has "bolted," or will have nothing to do with the line chosen. We have been silent, but not inattentive observers of the proceedings of all, and have an opinion, which we may, at a fitting time, speak out plainly.

Brussels and Antwerp Railroad.—During the month of June, and the first ten days of July, the number of passengers by the railroad from Brussels to Antwerp was 172,631, and the receipts amounted to 152,519 fr.

Calcutta and Saugur Railway.—We are sorry to hear that great dissension exists among the component parts of this undertaking. Heavy charges have been made by one party, which we have heard flatly contradicted by the other; even blows have been had recourse to. If the concern is good for nothing, break it up, but let the parties not forget the conduct of gentlemen. From what we hear, a dissolution seems inevitable; but it is expected a new Company will be started which will reap where the others have sown; for, if our information be in any degree correct, it is a thing that must answer.

Commercial Railway.—This Company held their general meeting on the 14th ult., when some discussion arose respecting the accounts, and ability of the concern to proceed. On the motion of Mr. Tyars, auditors were appointed to examine the accounts, and it was the general impression that the concern should not proceed without pecuniary assistance, from the two Dock Companies.

Taff Vale Railway and Lady Charlotte Guest.—The first stone of the Rhondda bridge, at Newbridge, was laid with workman-like skill by Lady Charlotte Guest, on the 16th ult. As we have a lady Monarch, it is not unfit to have a lady mason; is is indeed quite evident Venus is become lady of the British Ascendant.

Eastern Counties Railway.—Death of the New Method to Raise the Wind.—It is with deep feelings of pain and regret that we announce to our readers the death of that charming project noticed in our last (page 125) to raise a little of the needful. Only 600,000*l.* were wanted, for which the Secretary made it appear, as plain as assertions could do, that 150,000*l.* per annum, or 25 per cent., would be returned; yet, would it be credited, in this age of credulity, that only 20,000*l.* were tendered, of which it is calculated 19,000*l.* were all "moonshine?"

Ah me! what sad mishaps combine
To mar the prettiest design,
To make a little railway line.

We have asked who the author of this delectable scheme of finance, this *rara avis*, this paragon of scheming is? but can get no answer. Are the Directors afraid they will not be able to keep him—every one will so catch at him—if known? The shareholders, by-the-by, must have been very stupid not to see and support the wonderful merits of the plan. We, who have no interest in it, and who have never shown any outward signs of grief for the best of Kings, are so affected with the loss of this matchless project in railway scheming, that we have ordered our notice to have a mourning border round it. Besides, we apprehend it will only be anticipating by a few months, unless some miracle be wrought in its favour, what we shall have to do for the whole concern.

When we sent our last number to press, it was currently reported that some parties had offered the Directors 20,000*l.* per annum!!! to be permitted to make at their own cost the line between Norwich and Yarmouth. Not having been accepted, the said parties returned, we suppose, to the moon, from which high altitude, probably, they had seen the advantages of this part of the line, and the Directors and Co. determined to make it themselves, to secure the whole transport of Yarmouth herrings for the shareholders. At the same time it was discovered that the line between Dog Row (what an ugly name!) and 1,692 adults and little babes at Brentwood village, was to be wonderfully profitable. In one short month all has melted away; *sic transit Gloria Mundi.* Norwich and Yarmouth are no longer worth looking to; Chelmsford is now the focus of attraction, the future mine of endless wealth to the Eastern Counties Railway. They only want 570,000*l.* and two years, with ample faith in the shareholders, and 170,000*l.* per annum will be realized! Before it was 600,000*l.* to produce 150,000*l.* per annum. What wonderful things are figures in the hands of some men! We recommend another revision of the calculation,

and we have no doubt it will only take 300,000*l.* to make the line to Colchester, and produce a profit of 3,000,000*l.* per annum.

The Directors, we hear, have ordered the works to be at once carried over Lord Petre's and Mr. Labouchere's property; the 120,000*l.* due to the former, by deed sealed, signed, and delivered by six Directors, the injunction of the Court of Chancery, are all bagatelles compared with this mighty dictum!! "Know, young man," said Cæsar, "it is easier for me to kill thee, than to say I will." A call of 1*l.* per share is now to be made, and the payment to be enforced, with 7,474 shares in default. We advise the Directors not to try the experiment. Are not their shares utterly unsaleable as it is? Have they 3,000*l.* assets in hand above their liabilities, and do they not owe, on every principle of honour, law, and equity, 120,000*l.* to Lord Petre before they can proceed, that is 2*l.* per share, what then would a call of 1*l.* per share do, even if the shareholders would be good-natured enough to pay it? We rather advise the Directors seriously to examine their situation, to inquire what confidence the public has in the management, and if they find little or none, search out the cause, and manfully excise it. This may save the concern, and would be better than to bluster and be laughed at.

French Railway.—The French Chambers have just voted a railroad from Alais, in the mountains of Cevannes, to Beaucaird on the Rhone, passing by Nismes. The Government lends 240,000*l.* to the undertakers, the latter promising to furnish coal to the French Government steamers at Marseilles at 20 per cent. under the present price. By means of this railroad English coal is to be undersold at Marseilles; and, according to the report, these mines were to supply, not merely the Mediterranean ports, but Bordeaux itself.—*Newcastle Courant.*

Grand Junction Railway.—This noble undertaking is already paying most handsomely, although the Company have not yet begun to carry goods, and although the London and Birmingham line is not yet open. The receipts from the 4th to the 8th of July were 3,189*l.*; the receipts during the week commencing on the 9th, and ending on the 15th, were 4,898*l.*; and the receipts from the 15th to the 22d, 5,449*l.* The total cost of forming the line has been a million and a half, and, allowing one half of the gross receipts for expenses, the present rate of receipts will leave a profit of between eight to ten per cent. It is probable that when the whole line from Liverpool to London is in full work, that this profit will be at least doubled.—*Birmingham Advertiser.*

Great Railway from London, by Birmingham and Preston, to Glasgow.—An important meeting was lately held in Glasgow with the view of forwarding this great work. The project which the Glasgow merchants have in view, is to carry forward a railway from Glasgow, through Carlisle, to Lancaster, and join the main line southward, from thence through Preston, by the North Union, Grand Junction, and London and Birmingham lines, direct to London. This projected arrangement would also afford direct communications with Liverpool and Manchester, the North Union crossing the Liverpool and Manchester line about half way between these important towns.—*Hull Advertiser.*

Great Western Railway and the Landowners.—We lay before our readers the results of two trials lately decided at Bath, as specimens of the properly liberal feelings on the part of railway Companies, and the modest claims of landowners. James Grant Smith, Esq., claimed for land taken by the Great Western Company, and compensation, 6,780*l.*, the Company offered him 4,500*l.* for the mere purpose of saving litigation. This would not satisfy him; he went to a jury, which gave only 4,223*l.* Lord Manvers, again, claimed 9,000*l.*; the Company generously offered him 4,500*l.*, but the jury decided that 3,375*l.* was quite enough. What says Captain Pechell to these examples of the modesty of the poor hard-used landowners? It is now quite evident that they want protection, and do not know the true value of their own property.

Great North of England Railway.—It was our intention in the present number to give a map of this line, showing its various connexions, &c., with other lines, and a description of it from materials we have collected; but we could not get the map, &c., ready in time, and are obliged, therefore, to defer our observations until the next number. In the meantime we have given the report, which we have no doubt will be read with interest, as containing a plain business-like statement of the situation and prospects of the Company.

Greenwich Railway.—We have delayed our work for the purpose of noticing the meeting of shareholders, on the 29th ult. The report of the Committee, mentioned in our last as appointed to inquire into the Company's affairs, was read. Its substance was, that the concern was an exceedingly good one; that its returns, in its present imperfect state, were at least paying three per cent. on the whole capital; that the works were proved to have been constructed in a substantial manner, by the report of Mr. James Walker; that the new capital would complete the work and leave a balance, when the land was sold, of 75,000*l.* Much recrimination ensued. The Directors were wished to resign by the Committee. This was refused on their part, who repudiated the charges of negligence made against them by the Committee.

A motion for the Directors to receive the Committee's report and report thereon hereafter, was unanimously rejected. Afterwards it was moved, that the reports read be received, which was carried unanimously. It was afterwards moved that the names of ten out of the Committee (which, by-the-by, consisted of only nine) should be given to the Directors, out of which the three vacancies now existing should be filled up. Before the long rambling discussion was closed about this, we were obliged to leave. We rather expect it was ultimately carried.

Hull and Selby Railway.—The Directors of this Company have just contracted for the erection of a cast-iron bridge over the river Ouse, at Selby, (the most important work connected with the undertaking,) also for an iron bridge of 70 feet span over the Market Weighton Canal, for the embankment on each side of that canal; the only work of importance of this description on the line. They have also contracted for a thousand tons of iron rails, on very favourable terms; and preparations are making to advertise for tenders for two other parts of the works; viz., the forming the road between the river Derwent and the Market Weighton Canal, in length about ten miles, and quite level, and the line between Dairycoates (near Hull) and Hessle, about four miles. The embankment and other works are to be commenced forthwith, and every exertion will be used to complete the railway with the least possible delay.

Harwich Railway.—We scarcely know what to say about this railway. We feel the difficulty in which it is placed by the vacillating and uncertain conduct of the "Eastern Counties" management. We, however, think the present determination of that Company is so far favourable to the Harwich Railway, as it prevents any of their resources being employed beyond Colchester, which, we contend, ought in no case to be done until it is completed to that town. Indeed, it has long been our opinion that the Eastern Counties Railway (with another name) should never extend inland beyond Colchester, and with Harwich for its port, and a good management, it may then become one of the most profitable undertakings of its kind in the kingdom.

Jamaica Railway, from Kingston to Spanish Town.—The following copy of a letter has been handed to us from his Excellency Sir Lionel Smith, to John Ewart, Esq., enclosed by the latter to H. Playford, Esq., with, Mr. Ewart states, Sir Lionel's permission to publish it:—

"Sir,—I do myself the honour to acknowledge your letter of the 27th inst. (June), and I request you will acquaint the Provisional Committee of the Jamaica Railway Company, both in London and in this Colony, that it will afford me great pleasure to patronize and support, in whatever way my humble exertions

may prove useful, an undertaking so well calculated to encourage industry, and promote the best interests of Jamaica.

"I have the honour to be, Sir,

"Your most obedient Servant,

(Signed) "LIONEL SMITH."

Leicester and Swannington Railway.—At the annual meeting of the proprietors a dividend, after the rate of seven per cent. per annum, was ordered to be paid on the 1st of September.

Liverpool and Manchester Railway.—The increase of passengers during the half year ending the 30th of June last, over the corresponding half of 1836, was no less than 16,500.

Llanelly Railway and Dock.—A dividend of six per cent. per annum was, at the last meeting, declared, but we are happy to hear that the prospects are such as to render it highly probable that nine per cent. per annum will be the next dividend.

Lancaster and Preston Junction Railway.—Mr. Locke, the engineer, has commenced operations by staking out the line.

Midland Counties Railway.—The works of this undertaking are proceeding with considerable activity (400 men being employed) in three different places, on that part of the line which connects the towns of Nottingham and Derby with each other (fifteen miles): this will also form a part of line *from these towns and the north, to London.* This portion of the railway will be completed by the latter end of next year. The next part on which it is intended to proceed, is that from *Leicester to Rugby* (twenty miles), *so as to form a communication with London by means of the London and Birmingham Railway.* The contracts for this part of the line are advertised to be let on the 27th of October next; this part requiring a longer time for its completion than that between the Trent and Leicester. When the Midland Counties, and also the North Midland Railways are finished, there will be *a direct railway communication from Leeds and the West Riding of York, through Derby, Loughborough, and Leicester, to London.*

Maryport and Carlisle Railway.—We understand that since the passing of the Act the project is wearing a most healthy aspect, and shares have been most eagerly sought by those who have been at pains to investigate the traffic account.—*Carlisle Journal.*

Military employed on Railroads in France.—By the decision of the French Minister of War, all the Paris regiments have been authorised to furnish to the railway companies from Versailles soldiers to be employed on the works. The detachments thus employed are to be relieved by others every three months until the lines shall be complete. Preparations have already been made in the Park of St. Cloud for the portion of the railway which is to pass through it.—*Globe.*

National Loan Fund Life Assurance Society.—By an advertisement on our wrapper, we perceive that a company has started, on the novel principle of combining or amalgamating a Life Assurance Society with a Savings Bank. We are no encouragers of novelties, but we confess we like the principle of this Company. If assurance societies, loan societies, and savings banks, can exist separately, maintain their establishments separately, and yet be advantageous to the public, surely a society combining all three under one expense of management, is likely to be much more advantageous to the public and much more stable. We should like to see some competent person take this subject up, on which much might be said.

Newcastle and Carlisle Railway.—About 1,500 men are now, we believe, employed on this line, between Haltwhistle and Haydon-bridge, which leaves no doubt of its being finished before the end of the year, when the line between Redhugh and the Canal Basin at Carlisle (a distance of sixty miles) will be finished. The revenue is now, on the part completed, gradually increasing, and for the four weeks ending the 8th July, we are informed the receipts have been as follows:—Week ending 17th June, 895*l.* 6s. 11d.; ending 24th June, 1,004*l.* 12s. 11d.; ending 1st July, 1,085*l.* 15s. 3d.; ending 8th July, 1,144*l.* 6s. 8d.—*Newcastle Journal.*

Newcastle and Edinburgh Railway.—At a late meeting of gentlemen connected with the counties of Northumberland and Durham, and the town of Newcastle, it was resolved, that immediate steps be taken to carry into effect measures for the formation of a railway between Newcastle and Edinburgh, and Glasgow. —*Leeds Mercury.*

Northern and Eastern Railway.—There is some prospect of this railway not much longer remaining among the *statuos quos.* Vigorous measures are expected to be taken immediately for the prosecution of the undertaking. The Directors have very honourably given up their claim to 1,800*l.* during the time the works have been suspended. This is an exceedingly good hint to other directors, and particularly to those old ladies who merely get elected for the purpose of obtaining the salary.

Nottingham and Sheffield Railway.—A direct line of railway has been projected by Mr. W. D. Holmes, C.E., from Nottingham to Sheffield, of which we have received from a correspondent the following description, which arrived too late for our last Number. It is "only one *half of the distance* of that now being constructed by way of Derby and Rotherham; and as it is to be extended through the most populous manufacturing districts of the West Riding of Yorkshire, it has a paramount claim upon the attention of the public. Another part of this plan is to connect the port of Boston with the Midland counties, and to transmit, by a direct and descending line, coal, iron, lime, and other minerals, which abound in the midland counties to the eastern parts of the kingdom where

they are most wanted. This plan is calculated materially to benefit commerce by the safest and shortest conveyance of passengers and merchandise, and to afford the means of benefiting agriculture by a ready and cheap transit of lime and other manure. As far as regards the expense of the construction, this line possesses a decided superiority over most, if not all that have been formed, as it passes over a comparatively even surface, with a firm basis, and, where excavations or tunnels are needed, the strata are of a description that requires very little labour, expense, or loss of time, while materials for its formation of excellent quality, and at a very moderate cost, are to be found in its immediate vicinity."

Oxford and Tring Railway.—The London shareholders of this Company had a meeting on the 1st ult., for the purpose of considering the alleged extravagant expenditure of the money subscribed. Edward Conan, Esq., was in the chair, and the meeting was none of the most complimentary to the Directors. It was stated that 45,000*l.* had been expended; that the accounts were contradictory, confused, and unsatisfactory; that the Directors refused to give the explanations wanted, or to permit the accounts to be audited; and the Chairman wound up the complaints by declaring, "that he for one had a great distrust of the honour of the gentlemen composing the direction." Similar feelings of dissatisfaction pervade the shareholders of Manchester, and there seems both there and here a determination to have a thorough investigation. The following Resolutions were carried unanimously:—

"That the shareholders in the Cheltenham, Oxford, and Tring Railway Company, having been mainly induced to embark in that undertaking, by the high character and well-known integrity of the gentlemen composing the direction, consider that they are entitled to expect at their hands a full, candid, and detailed account of the expenditure of the funds entrusted to their management.

"That from the confused and unintelligible manner in which the various items of expenditure are set forth, it is difficult to point out which is the most objectionable; but in the absence of the desired details, this meeting is of opinion, that the gross expenditure has been enormous, and ought not to be approved by the shareholders without having been submitted to the investigation of a committee acting on their behalf.

"That this meeting fully approving of the steps taken by the Manchester shareholders to procure an investigation of the accounts, participating in the disappointment expressed by Messrs. Gasguoine and Railton, that the Directors should have thought proper to refuse any examination other than that of the 'unpaid bills,' this meeting being decidedly of opinion, that the shareholders are clearly entitled, previous to the dissolution of the Company, to a full and satisfactory examination of their own books of accounts.

"That the following gentlemen be appointed a committee on behalf of the London shareholders, to communicate to the Directors the foregoing Resolutions; and in the event of their still refusing to permit the desired investigation, that they be hereby empowered and requested to co-operate with the shareholders at Liverpool, Manchester, and other parts of the kingdom, in all measures that may be necessary for securing to them the exercise of their undoubted right:—Charles Martin, Esq., Edward Conan, Esq., G. A. Sharpe, Esq., and John Field, Esq."

Preston and Wyre Railway.—Nearly from Bourne Naze to Poulton, upwards of three miles out of eighteen of this line, are ready for the permanent rails, and eight will be completed by the spring. Mr. Stanton, the contractor, has begun operations at Weston, with much activity, the men working night and day. Near three hundred men and forty-five horses are employed, and the harbour will be ready to receive vessels of any burthen in the spring.

Proposed Railway to Lytham.—For some days past, Mr. Bushell, engineer, has been engaged in surveying the lands between this town and Lytham, with a view to report on the eligibility of forming a junction with the projected Wyre Railway.—*Preston Chronicle.*

Railroads on the Continent.—It may now be considered as certain that by the end of September the iron railroad will be opened on the one side to Ghent, and on the other to Tirlemont. It is also certain that by the end of the year it will be carried as far as Liege.—*Brussels Paper.*

Railroad from Paris to St. Germain.—On Sunday last the railroad from Paris to St. Germain may be said to have been opened in its full extent, a train of carriages, containing the Minister of Finance, the Duke de Cazes, several members of the Institute, and other persons of distinction having proceeded the whole length of the roads. The length of the railroad is 18,430 metres, or $4\frac{3}{4}$ leagues ($11\frac{1}{2}$ English miles), which the train passed over in thirty-five minutes, returning in twenty-nine minutes. The greatest rapidity with which the party went was at the rate of 14 leagues an hour. Only one pair of rails have yet been finished, and it appears that the company intend opening the railroad to the public without waiting for the second. In its course the St. Germain Railroad passes under two tunnels, and along two-thirds of the line it is raised on a viaduct of from fifteen to twenty feet high. It crosses the Seine twice, and passes over or under no less than fifteen roads. The rails are represented to be of unusual strength, those on the Liverpool Railroad weighing only thirteen kilogrammes, while those on the St. Germain weigh no less than thirty. The Paris tunnel is 550 feet in length, that of the Batignolles 960 feet. The whole of the works as far as they have yet gone, have occupied only eighteen months. The railroad to Versailles is, however,

expected to be the most profitable, the daily number of passengers being between 11,000 and 12,000. It has just been opened to the public.

A Suggestion.—We beg to submit to the Directors of those Companies, which have but little chance of complying with the new Standing Orders, whether it will not be prudent to call the shareholders together and divide what remains, rather than continue them on to increase the expenses further. Our attention has been directed to an Act passed about a century since, in which it is said to be distinctly provided, that if directors hold on with schemes beyond a certain time without progressing, they are liable to make good all deficiencies. We shall endeavour to procure this Act, and, if successful, shall not fail to lay the result of our inquiries before our readers.

Sheffield and Rotherham Railway.—On Wednesday, the second general meeting of the proprietors of the Rotherham Railway was held at the Town Hall, when a Report of the Directors was presented. The document stated that considerable actual progress had been made in the work. It then adverted to the difficulties that had been encountered, and at length overcome, in treating with the Duke of Norfolk for land on the line. The Directors expressed their satisfaction at the termini they had been able, though at great expense, to obtain at Rotherham, and especially at Sheffield, and also at the prospect of the work being creditably executed by the contractor. Reference was made to that part of the work (the heaviest on the line) which is at present in progress near Brightside, the labour going forward day and night. Other portions were likewise described as proceeding with such activity as to justify the Directors in anticipating that the line will be opened for the use of the public by this time next year, being the period within which the contractor is bound by heavy penalties to complete the works. The Report also set forth, that in pursuance of an agreement with the North Midland Railway Company, that Company had began to execute a branch to the Greasborough coal field and canal. It was at the same time stated that contracts had been made with Messrs. Stephenson and Co., of Newcastle, for three locomotive engines, and with Messrs. Baily, of Liverpool, for the whole of the iron rails, chains, &c. The cost of obtaining the Act of Parliament, including all the expences incident thereto, has been 11,622*l.* 2s. 11d. The other expenditure incurred during the year, consisting of compensation for land, engineering, surveying, &c., &c., amounts to 21,500*l.*—*Sheffield Mercury.*

Southampton Railway.—For the proceedings of this Company, we refer our readers to their Report in the present Number, which, though long, is interesting, and will amply repay any one interested for the trouble of reading it.

Thames Tunnel.—On the 25th of August another irruption of the water into this tunnel occurred. Happily it gave timely notice,

and the men were ordered out, so that no lives were lost. It is not exactly known what was the cause of the accident; but it is not unlikely to have been owing to the unsoundness of the ground in the bed of the river. Sacks of clay are now being let down to stop the aperture, and it is supposed it will take at least a fortnight to pump out the water and repair the accident. The men who work in this tunnel are not only exposed to the dangers of the waters above them, but to the perpetual accumulation of noxious vapours and inflammable airs within. Two or three explosions have already occurred. The accident is not by any means likely to mar the proceedings of the works.

Victoria Railway and Duke of Cornwall's Harbour.—This Company, which has obtained an Act of Parliament, we find has had no very pleasant exposée. It is stated meetings have been advertised to have been held, and votes to have been moved and seconded at them by nine Members of Parliament, not one of which were present, and all have disavowed any connexion with the Company. Of 19,000*l.* which ought to have been paid in two calls, only 235*l.* has actually been subscribed; and of 720*l.* due on the qualification shares alone of the Directors, it is stated not one shilling has been paid. In a Report of a meeting of the shareholders in the "Mining Journal," the chairman, Captain Gould, is reported to have stated to the shareholders, that he had received a communication from Mr. Rennie, saying the concern was "as good a speculation as could be." Mr. George Remnie, who is understood to be the Mr. Rennie alluded to, having been advertised as one of the consulting engineers, has publicly disavowed his ever having given any such communication whatever. A meeting of the shareholders is expected to be called to see what is to be done with the whole affair.

Venetian Railroad.—The projected iron railroad through the territory of Lombardy and Venice has been approved by the Government, for which purpose a Company has been formed at Trieste.—*Allgemeine Zeitung.*

York and North Midland Railway.—Yesterday week the half-yearly meeting of the shareholders was held at the office in St. Leonard's-place. G. Hudson, Esq., presided, and the Secretary (Mr. Baker) read a very satisfactory report, detailing the operations now in progress, and concluded by stating that it was the intention of the Directors to complete the line between the Leeds and Selby Railway with the utmost expedition, in order to make the undertaking productive to the shareholders.—*Leeds Mercury.*

FIRST REPORT FROM THE SELECT COMMITTEE ON THE DEPTFORD AND DOVER SUBSCRIPTION LIST.

(Continued from page 43.)

Mr. Lancaster, also, the accountant of the Company, obtained on the Tuesday (he believes), two signatures to the deed. He met, by chance, John Peter Houston, who is stated to be a very young man, keeping a small chemist's shop at Brixton, and told him the situation of the Company, and that they wanted signatures to the deed. He came and signed for 2,250*l.* Mr. Lancaster knows nothing of his pecuniary responsibility or his circumstances.

The other subscription he obtained was that of a Mr. Thomas Clarke, solicitor, of 5, Canonbury-row, Islington, for 5,000*l.* He had to call on Mr. Lancaster, at the Railway Office, on business; the deed was lying there, and Mr. Lancaster said, "Will you sign, and you will be entitled to shares, if you please." Mr. Clarke signed for a sum, chosen by himself.

Mr. Green was not less active than Mr. Smith in endeavonring without delay, immediately on his hearing of the increase in the estimate, to obtain signatures to the deed. He applied to different persons, he says, on account of their respectability.

He applied to Richard Ireland, a person connected with some of the Brazilian Mining Companies, and to his son. Richard Ireland, jun., who is one of the cashiers in Masterman's bank, both of whom reside in Canonbury, and were shareholders, and paid their deposits in the Gravesend Company, asking them to sign the deed, which they both did for 5,100*l.*

He called on Mr. Effingham Wilson, a bookseller at the Royal Exchange, and asked him to sign, which he did, at the Railway Office, for 10,200*l.* He, moreover, requested Mr. Effingham Wilson to allow his son, who is a bookseller and stationer in King William-street, to come and sign, which the son did for 4,500*l.*

He went to Mr. Hathaway, a newsvender, living under the Royal Exchange, an old friend of Mr. Green, and a subscriber to the Gravesend Company for 1,800*l.*, and asked him, as a favour, to sign the deed, which he immediately did for 10,800*l.*, paying no deposit, and Green fixing the amount.

Mr. Green applied also to Mr. George Price, Secretary to the Salisbury, Exeter, Plymouth and Falmouth Railway Company. "I applied to him," says Mr. Green, "as I did to others; I took to him the deed, and stated that I was pressed for subscriptions, and asked him to sign for 25,000*l.* He was a little startled at first, and said it was a large sum; but he very kindly did it." Mr. Green does not know anything of Mr. Price's pecuniary means.

At the Falmouth Railway Office, along with Price, Mr. Green applied also to Mr. William Andrews, solicitor to the Falmouth Railway Company, saying, that he wanted some more names to the deed. Mr. Andrews signed for 12,500*l.*, the sum being left to his pleasure.

The Committee have issued repeated summonses for the attendance of Mr. Price and Mr. Andrews, as witnesses, but they have not appeared to the summons.

Mr. Green took the deed to Mr. James John Brown, stationer, at 17, Old Broad-street, of the firm of Brown and Syrett, printers to the Company. He named to Mr. Brown the sum for which he should sign, which was for 10,250*l.*

Mr. Green procured also, though he did not witness, the signature of Samuel Collingwood, of Greenwich, surveyor, for 500*l.*

The preceding signatures were obtained by Mr. Green in the course, it is believed, of Monday the 13th of February.

The following signatures were procured by Mr. Green on the evening of the 13th, it should seem, or on the morning of the 14th, from members of his own family, he fixing the sums for which they all signed:—

Eliza Willans, his mother-in-law, signed for .	£4,500
Virginia Green, his daughter . . .	4,000
Julia Green, his daughter . . .	5,250
James Kennaby, his son-in-law . . .	5,000
Jane Green, his daughter . . .	5,250

The last signature, that of Jane Green, presents this peculiarity, that the name of the person who signed is not Green, but Kennaby, she being the wife of James Kennaby, the son-in-law of Mr. Green, who requested her to sign in her maiden name.

On the 14th, Green applied to Mr. James Wettenhall, stock-broker, in Copthall-court, and stating that he wanted some names, asked Mr. Wettenhall to sign the deed, which Mr. Wettenhall did for 10,250*l.*; Mr. Green indicating the sum to be signed for.

Green then went to the bank of Messrs. Spooner and Attwood, where he saw Mr. Twells, a partner in that bank, and one of the Directors of the Kent Railway Company, to whom he mentioned the difficulty there was about the deed, and asked Mr. Twells whether he had any objection to certain clerks in that bank (meaning James Parke and John Davies) signing the deed. Mr. Twells answered that he did not much like the thing; but having requested them to come in, and informed them that Mr. Green wished to have their signatures to the deed, and that they had better hear Mr. Green's own statement, he told them, after Mr. Green had explained his wishes, that he must leave them to do as they pleased. They then both signed the deed for 3,550*l.*, Green having settled the amount, as he believes, for which they signed.

(To be continued.)

PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum paid.	Closing Price of Shares in London Markets on									
					July.	August.								
					28.	1.	4.	8.	11.	15.	18.	22.	25.	29.
			£.	£.										
6,000		(3) Birmingham and Derby	.....	10	.....	.....	.....	.....	.....	1¼	.....	.....	1⅞	
9,500	.....	(3) Birmingham and Gloucester	.....	10	.....	.....	.....	.....	.....	1¼				
64,000	.....	(2) Eastern Counties	25	2	.....	.....	.....	.....	.....	.....	¼			
25,000	.....	(2) Great Western	100	45	.....	54	.....	52	.....	53	.....	55	54½	55
10,000	.....	(4) LondonandBrighton(Stephenson's)	100	25	1⅜	.....	1⅝	.....	1¾	.....	1	¾	¼	⅞
45,000	.....	(4) ——————— (Gibbs) ...	20	1	⅜	.....	.....	.....	.....	.....	.....	6s.	4s.	
16,000	.....	(3) ——————— (Rennie)....	50	3	1¼	1	.....	⅝	¾	.....	¾	⅜	¼	⅝
8,000	.....	(4) ——————— (Cundy)	100	3	.....	1	.....	.....	.....	.....	.....	.....	6s.	
20,000	3£ per c.	(2) London and Greenwich (ex div.).	20	20	13¾	13½	.....	14¼	.....	13⅛	13½	.....	13½	13½
25,000	.....	(2) London and Birmingham	100	90	124	131	130	130	131	132½	.....	139⅜	.....	139
20,000	.....	(2) London and Southampton	50	45	.....	21	20½	.....	.....	.....	.....	24½	.....	29½
16,000	.....	(2) Ditto, Ditto, New	25	1	13¾	.....	.....	.....	.....	.....	10	.....	10	10½
12,000	.....	(3) London and Croydon	50	20	.....	.....	.....	.....	.....	.....	14	.....	14	
10,000	.....	(2) Manchester and Leeds	100	10	.....	.....	.....	.....	.....	.....	.....	.....	.....	12
10,000	.....	(4) Manchester and Birmingham.....	50	5	4¾	4½	.....	.....	¼	4⅝				
15,000	.....	(2) North Midland	100	15	.....	.....	.....	.....	.....	.....	14⅞	15½		
24,000	.....	(4) South-Eastern Brighton, Lewes, and Newhaven.....	50	2	.....	.....	.....	¾	.....	⅜	⅝	½	⅝	½

THE

RAILWAY MAGAZINE;

AND

Annals of Science.

No. XX. OCTOBER, 1837. New Series.

Length, Cost, Revenue, Gradients, Tunnels, Curves, &c., &c., of Railways, Passed in the Session of 1837. By John Thompson, Esq.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

Harwich, and Birmingham, Bristol, and Thames Junction Railway Offices, 26, Austin Friars, August 25, 1837.

Dear Sir,—Many applications have been made to me by persons interested in railway undertakings, to furnish a statement of the different railways for which Acts have been obtained in the late session of Parliament, similar to that of last year, published in No. 9. of the "Railway Magazine." In compliance with their wishes I have prepared, from the Reports of the Committees of the House of Commons upon the respective Bills, the accompanying table, which I shall feel obliged by your giving a place to in the next number of the "Railway Magazine," if, at so short a notice, you can conveniently do so, preserving, if possible, the tabular form.

By a statement which you did me the favour to insert in your January number, it was shown, that notices were given of 118 intended applications to Parliament for Railway Bills in the late session; and, by a subsequent statement, it appeared that 79 of these Bills were actually introduced into the House of Commons; 42 of them only were passed, 34 having been either withdrawn, or lost at various stages in that House, and three in the House of Lords.

Of the 42 Bills passed, 14 only are for new lines; 5 for the extension of, or for the formation of branches to lines already authorized to be made; 10 for deviations and alterations of lines in progress; 6 for the amendment or enlarge-

ment of the powers of former Acts; 5 to enable companies to raise additional sums of money; 1 for the incorporation of an existing company; and 1 for extending the time for completing the undertaking.

The aggregate length of the 14 new lines and their branches is 471 miles, 2 chains, 12 yards, and the estimated cost of formation, 6,861,285*l.*, or 14,566*l.* per mile; the expenses of working and maintenance average 45 per cent. upon the gross revenue, which is calculated at 1,575,802*l.*, of which 923,078*l.* is expected to be derived from passengers, and 652,724*l.* from goods; the total amount of capital of the 14 companies is 8,090,500*l.*, and the estimated net profit upon the employment of this capital averages 10¼ per cent. 9 of these railways have no tunnels; the Bolton and Preston has one 690 yards in length; the Glasgow, Paisley, and Greenock, has 5 short ones, altogether 1,036 yards in length; the Brighton has 3 upon the main line 3,900 yards in length, and one of 875 yards upon its Lewes branch; the Manchester and Birmingham has 2 upon the main line 770 yards in length, and one of 210 yards upon its Macclesfield branch; and the Sheffield and Manchester has one 3 miles in length, to be ventilated by means of shafts. The gradients and curves are generally favourable. The most profitable of them, putting out of the question the Dundalk Western, which is a line intended to be worked by animal power, and cannot, therefore, properly be brought into comparison with the others—are the Sheffield and Manchester, and the Dublin and Kilkenny, the former showing a net profit of 18½ per cent., and the latter of 14¼ per cent. upon the capital employed. The best working line is the Dublin and Kilkenny. Of these new lines, 9 are in England, 3 in Ireland, and 2 in Scotland.

The 10 lines for which powers have been obtained to make deviations and alterations, will all of them be much improved. In the cases of three of them, the capital will be increased; in 2 it will be reduced; and in the remaining 5 no alteration in the capital will be made. Of the 5 lines to be extended, or from which branches are to be made, only one (the Slamannan) will require an increase of capital, although the additional cost will be very considerable.

I am, Dear Sir,

Your most obedient servant,

JOHN THOMPSON.

TABLE *of* RAILWAYS *for which Acts have been obtained during the Session of* 1837, *showing their respective Estimated Cost; the Number of Tunnels, and their Lengths; the Inclinations of the steepest Gradients, and the smallest Radii of Curves; the Estimated Revenue to be derived from Passengers and Goods; and the Profit per Cent. upon the Capital employed.*

Name of Railway.	Description.	Capital.	Estimated Cost.	Length of Main Line and Branches.	Cost per Mile.	Estimated Revenue from Passengers.	Estimated Revenue from Goods.	Annual Expenses.	Profit prCent. on Capital
Birmingham and Gloucester (A)	Extension of main line, and formation of branches to Worcester and Tewkesbury.	No additional capital.	. . . .	Extension line, 74 chains. Branches—Worcester, 3 miles, 77 chains; Tewkesbury, 2 miles, 22 chains.	. . .	4,054*l.*	1,570*l.*	⅓ of gross revenue.	
Bolton & Preston (B)	New line and branch.	380,000*l.*	349,500*l.*	Main line, 19 miles, 60 chains. Branch, 56 chains.	19,240*l.*	25,000*l.*	27,386*l.*	20,954*l.*	8½
Chester and Birkenhead (C)	New line.	250,000*l.*	250,000*l.*	Main line, 14 miles, 40 chains.	17,698*l.*	42,436*l.*	6,189*l.*	⅓ of gross revenue.	13
Chester & Crewe (D)	New line.	250,000*l.*	240,000*l.*	Main line, 20 miles, 52 chains.	11,622*l.*	26,098*l.*	24,908*l.*	½ of gross revenue.	13½
Cork and Passage (E)	New line.	200,000*l.*	180,000*l.*	Main line, 6 miles, 26 chains, 18 yds.	28,450*l.*	29,753*l.*	2,125*l.*	15,000*l.*	9½

(A) Gradients favourable, steepest 1 in 300; smallest radius of a curve 48 chains; no tunnel.
(B) One plane six miles in length, the inclination of which is 1 in 150. The other gradients are extremely favourable, none exceeding one in 442; With the exception of a very small portion of curvature near each terminus of a quarter-mile radius, there is no curve upon the line of less than one mile radius; one tunnel 690 yards.
(C) Gradients favourable, steepest 1 in 330; radius of smallest curve one mile; no tunnel.
(D) Gradients favourable, steepest 1 in 400; radius of smallest curve half-a mile; no tunnel.
(E) Gradients very favourable, the line being level, except at the termini, where it rises at each end at the rate of 1 in 80; curves very favourable, the smallest radius of any being one mile; no tunnel.

Name of Railway.	Description.	Capital.	Estimated Cost.	Length of Main Line and Branches.	Cost per Mile.	Estimated Revenue from Passengers.	Estimated Revenue from Goods.	Annual Expenses.	Profit prCent. on Capital
Dublin and Drogheda (F)	Amendments and alterations.	The capital will be reduced 52,000*l.*	. . . .	The main line will be shortened half a mile.					
Dublin and Kilkenny (G)	New line.	800,000*l.*	783,000*l.*	Main line, 73 miles, 44 chains.	10,651*l.*	149,379*l.*	47,997*l.*	40pr.cent.on grossrevenue	14
Dundalk Western (H)	New line.	100,000*l.*	96,000*l.*	Main line, 24 miles.	4,000*l.*	31,650*l.*	17,623*l.*	15,000*l.*	34
Durham Junction (I)	Extension to Houghton-le-Spring.	No additional capital.	11,357*l.*	Extension, 1 mile, 56 chains.	6,828*l.*	985*l.*	416*l.*	400*l.*	
Durham and Sunderland (K)	Deviation and branches to extensive coal-fields.	Estimated cost of branches to be raised by mortgage.	Cost of deviation will not exceed cost of original line; cost of branches, 45,843*l.*	Deviation of main line, 3 miles, 25 chains, 20 yards. Branches, 5 miles, 27 chains, 4 yards.					
Glasgow and Ayr (L)	New line and five branches.	625,000*l.*	623,289*l.*	Main line, 51 miles, 9 chains, 20 yds. Branches, 6 miles, 30 chains, 18 yds.	10,740*l.*	73,076*l.*	40,751*l.*	½ of gross revenue, or 37,942*l.*	12

(F) Steepest gradient 1 in 400; curves very favourable, smallest radius of any being 1 mile; no tunnel.
(G) More than half the line is on a level, and the steepest gradient is 1 in 500; curves very favourable, the smallest radius of any being 1 mile; no tunnel.
(H) Steepest gradient, exclusive of an inclined plane the particulars of which are not given, 1 in 104; smallest radius of a curve 484 yards; no tunnel. This railway is intended to be worked by animal power.
(I) Steepest gradient 1 in 139; smallest curve at the point of junction with the main line, the radius of which is 440 yards; no tunnel.
(K) There are five short inclined planes, the steepest of which is 1 in 31, and the flattest 1 in 250, all to be worked by stationary engines; smallest radius of a curve 198 yards; no tunnel.
(L) Gradients are extremely favourable, the steepest on the line to Ayr being 1 in 441, and on the line to Kilmarnock 1 in 600; curves extremely favourable, the smallest radius of any being 1 mile with the exception of those at the termini, which are less; no tunnel.

Name of Railway.	Description.	Capital.	Estimated Cost.	Length of Main Line and Branches.	Cost per Mile.	Estimated Revenue from Passengers.	Estimated Revenue from Goods.	Annual Expenses.	Profit prCent. on Capital
Glasgow, Paisley, and Greenock (M)	New line & branches.	400,000*l.*	393,000*l.*	Main line, 22 miles, 45 chains.	17,245*l.*	71,592*l.*	21,918*l.*	43,000*l.*	12½
Great North of England (Hurworth & York) (N)	Extension from the Tees to York, with branches to Durham and York.	No additional capital.	450,985*l.*	Extension 41 miles, 46 chains. Branches—Durham, 55 chs. York, 78 chains.	10,430*l.*	97,042*l.*	56,231*l.*		
Great North of England (Clarence and Hartlepool) (O)	New line and branch.	52,500*l.*	51,099*l.*	Main line, 7 miles, 69 chains. Branch, 1 mile, 6 chains.	5,717*l.*	600*l.*	12,487*l.*	5,627*l.*	1¼
Great Western (Paddington) (P)	Extension to Paddington.	. . . . .	250,000*l.*	Main line, 4 miles, 46 chains.	54,426*l.*	40,492*l.*	3,196*l.*	13,000*l.*	12
Great Western (Trowbridge) (Q)	Deviations and alterations.	15,000*l.* additional capital to be raised by mortgage.	15,000*l.*						
Kilmarnock and Troon (R)	Deviations and alterations.	40,000*l.* additional.	57,983*l.*	Deviation, 10 miles.	. . .	200*l.*	5,180*l.*	1,220*l.*	
Lancaster and Preston (S)	New line.	250,000*l.*	250,000*l.*	Main line, 20 miles, 30 chains.	12,269*l.*	35,828*l.*	7,826*l.*	20,000*l.*	9

(M) Gradients favourable, steepest being 1 in 360; curves favourable, smallest radius of any on the main line being 1 mile; at the stations there are smaller curves; there are five short archways or tunnels 1036 yards in length altogether.

(N) Gradients favourable, steepest on the extension being 1 in 394, on the branch to Durham 1 in 100, on the branch to York 1 in 523; curves favourable, smallest radius of any being 1 mile; no tunnel.

(O) Gradients favourable, steepest being 1 in 160, except a short inclined plane of 1 in 42½, to be worked by a stationary engine; smallest radius of a curve ½ a mile; no tunnel.

(P) Gradients very favourable, steepest being 4 feet in a mile, or 1 in 1320; curves very favourable, smallest radius of any being 2 miles; no tunnel.

(Q) Gradients favourable, steepest being 6 feet in a mile, or 1 in 880; smallest radius of a curve 5 chains, being near the entrance to the depot at Bath; no tunnel.

(R) Gradient 1 in 660 throughout; smallest radius of a curve 350 yards; no tunnel.

(S) Gradients very favourable, steepest being 1 in 500; curves favourable, smallest radius of any on the general line is one mile; no tunnel.

Name of Railway.	Description.	Capital.	Estimated Cost.	Length of Main Line and Branches.	Cost per Mile.	Estimated Revenue from Passengers.	Estimated Revenue from Goods.	Annual Expenses.	Profit prCent. on Capital
Dublin and Drogheda (F)	Amendments and alterations.	The capital will be reduced 52,000*l.*	. . . .	The main line will be shortened half a mile.					
Dublin and Kilkenny (G)	New line.	800,000*l.*	783,000*l.*	Main line, 73 miles, 44 chains.	10,651*l.*	149,379*l.*	47,997*l.*	40pr. cent. on grossrevenue	14
Dundalk Western (H)	New line.	100,000*l.*	96,000*l.*	Main line, 24 miles.	4,000*l.*	31,650*l.*	17,623*l.*	15,000*l.*	34
Durham Junction (I)	Extension to Houghton-le-Spring.	No additional capital.	11,357*l.*	Extension, 1 mile, 56 chains.	6,828*l.*	985*l.*	416*l.*	400*l.*	
Durham and Sunderland (K)	Deviation and branches to extensive coal-fields.	Estimated cost of branches to be raised by mortgage.	Cost of deviation will not exceed cost of original line; cost of branches, 45,843*l.*	Deviation of main line, 3 miles, 25 chains, 20 yards. Branches, 5 miles, 27 chains, 4 yards.					
Glasgow and Ayr (L)	New line and five branches.	625,000*l.*	623,289*l.*	Main line, 51 miles, 9 chains, 20 yds. Branches, 6 miles, 30 chains, 18 yds.	10,740*l.*	73,076*l.*	40,751*l.*	½ of gross revenue, or 37,942*l.*	12

(F) Steepest gradient 1 in 400; curves very favourable, smallest radius of any being 1 mile; no tunnel.
(G) More than half the line is on a level, and the steepest gradient is 1 in 500; curves very favourable, the smallest radius of any being 1 mile; no tunnel.
(H) Steepest gradient, exclusive of an inclined plane the particulars of which are not given, 1 in 104; smallest radius of a curve 484 yards; no tunnel. This railway is intended to be worked by animal power.
(I) Steepest gradient 1 in 139; smallest curve at the point of junction with the main line, the radius of which is 440 yards; no tunnel.
(K) There are five short inclined planes, the steepest of which is 1 in 31, and the flattest 1 in 250, all to be worked by stationary engines; smallest radius of a curve 198 yards; no tunnel.
(L) Gradients are extremely favourable, the steepest on the line to Ayr being 1 in 441, and on the line to Kilmarnock 1 in 600; curves extremely favourable, the smallest radius of any being 1 mile with the exception of those at the termini, which are less; no tunnel.

Name of Railway.	Description.	Capital.	Estimated Cost.	Length of Main Line and Branches.	Cost per Mile.	Estimated Revenue from Passengers.	Estimated Revenue from Goods.	Annual Expenses.	Profit prCent. on Capital
Glasgow, Paisley, and Greenock (M)	New line & branches.	400,000*l.*	393,000*l.*	Main line, 22 miles, 45 chains.	17,245*l.*	71,592*l.*	21,918*l.*	43,000*l.*	12½
Great North of England (Hurworth & York) (N)	Extension from the Tees to York, with branches to Durham and York.	No additional capital.	450,985*l.*	Extension 41 miles, 46 chains. Branches—Durham, 55 chs. York, 78 chains.	10,430*l.*	97,042*l.*	56,231*l.*		
Great North of England (Clarence and Hartlepool) (O)	New line and branch.	52,500*l.*	51,099*l.*	Main line, 7 miles, 69 chains. Branch, 1 mile, 6 chains.	5,717*l.*	600*l.*	12,487*l.*	5,627*l.*	14
Great Western (Paddington) (P)	Extension to Paddington.	. . . . .	250,000*l.*	Main line, 4 miles, 46 chains.	54,426*l.*	40,492*l.*	3,196*l.*	13,000*l.*	12
Great Western (Trowbridge) (Q)	Deviations and alterations.	15,000*l.* additional capital to be raised by mortgage.	15,000*l.*						
Kilmarnock and Troon (R)	Deviations and alterations.	40,000*l.* additional.	57,983*l.*	Deviation, 10 miles.	. . .	200*l.*	5,180*l.*	1,220*l.*	
Lancaster and Preston (S)	New line.	250,000*l.*	250,000*l.*	Main line, 20 miles, 30 chains.	12,269*l.*	35,828*l.*	7,826*l.*	20,000*l.*	9

(M) Gradients favourable, steepest being 1 in 360; curves favourable, smallest radius of any on the main line being 1 mile; at the stations there are smaller curves; there are five short archways or tunnels 1036 yards in length altogether.

(N) Gradients favourable, steepest on the extension being 1 in 394, on the branch to Durham 1 in 100, on the branch to York 1 in 523; curves favourable, smallest radius of any being 1 mile; no tunnel.

(O) Gradients favourable, steepest being 1 in 160, except a short inclined plane of 1 in 42½, to be worked by a stationary engine; smallest radius of a curve ½ a mile; no tunnel.

(P) Gradients very favourable, steepest being 4 feet in a mile, or 1 in 1320; curves very favourable, smallest radius of any being 2 miles; no tunnel.

(Q) Gradients favourable, steepest being 6 feet in a mile, or 1 in 880; smallest radius of a curve 5 chains, being near the entrance to the depot at Bath; no tunnel.

(R) Gradient 1 in 660 throughout; smallest radius of a curve 350 yards; no tunnel.

(S) Gradients very favourable, steepest being 1 in 500; curves favourable, smallest radius of any on the general line is one mile; no tunnel.

Name of Railway.	Description.	Capital.	Estimated Cost.	Length of Main Line and Branches.	Cost per Mile.	Estimated Revenue from Passengers.	Estimated Revenue from Goods.	Annual Expenses.	Profit prCent. on Capital
Dublin and Drogheda (F)	Amendments and alterations.	The capital will be reduced 52,000*l.*	. . . .	The main line will be shortened half a mile.					
Dublin and Kilkenny (G)	New line.	800,000*l.*	783,000*l.*	Main line, 73 miles, 44 chains.	10,651*l.*	149,379*l.*	47,997*l.*	40pr.cent.on grossrevenue	14
Dundalk Western (H)	New line.	100,000*l.*	96,000*l.*	Main line, 24 miles.	4,000*l.*	31,650*l.*	17,623*l.*	15,000*l.*	34
Durham Junction (I)	Extension to Houghton-le-Spring.	No additional capital.	11,357*l.*	Extension, 1 mile, 56 chains.	6,828*l.*	985*l.*	416*l.*	400*l.*	
Durham and Sunderland (K)	Deviation and branches to extensive coal-fields.	Estimated cost of branches to be raised by mortgage.	Cost of deviation will not exceed cost of original line; cost of branches, 45,843*l.*	Deviation of main line, 3 miles, 25 chains, 20 yards. Branches, 5 miles, 27 chains, 4 yards.					
Glasgow and Ayr (L)	New line and five branches.	625,000*l.*	623,289*l.*	Main line, 51 miles, 9 chains, 20 yds. Branches, 6 miles, 30 chains, 18 yds.	10,740*l.*	73,076*l.*	40,751*l.*	½ of gross revenue, or 37,942*l.*	12

(F) Steepest gradient 1 in 400; curves very favourable, smallest radius of any being 1 mile; no tunnel.
(G) More than half the line is on a level, and the steepest gradient is 1 in 500; curves very favourable, the smallest radius of any being 1 mile; no tunnel.
(H) Steepest gradient, exclusive of an inclined plane the particulars of which are not given, 1 in 104; smallest radius of a curve 484 yards; no tunnel. This railway is intended to be worked by animal power.
(I) Steepest gradient 1 in 139; smallest curve at the point of junction with the main line, the radius of which is 440 yards; no tunnel.
(K) There are five short inclined planes, the steepest of which is 1 in 31, and the flattest 1 in 250, all to be worked by stationary engines; smallest radius of a curve 198 yards; no tunnel.
(L) Gradients are extremely favourable, the steepest on the line to Ayr being 1 in 441, and on the line to Kilmarnock 1 in 600; curves extremely favourable, the smallest radius of any being 1 mile with the exception of those at the termini, which are less; no tunnel.

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Glasgow, Paisley, and Greenock (M)	New line & branches.	400,000*l.*	393,000*l.*	Main line, 22 miles, 45 chains.	17,245*l.*	71,592*l.*	21,918*l.*	43,000*l.*	12½
Great North of England (Hurworth & York) (N)	Extension from the Tees to York, with branches to Durham and York.	No additional capital.	450,985*l.*	Extension 41 miles, 46 chains. Branches—Durham, 55 chs. York, 78 chains.	10,430*l.*	97,042*l.*	56,231*l.*		
Great North of England (Clarence and Hartlepool) (O)	New line and branch.	52,500*l.*	51,099*l.*	Main line, 7 miles, 69 chains. Branch, 1 mile, 6 chains.	5,717*l.*	600*l.*	12,487*l.*	5,627*l.*	14
Great Western (Paddington) (P)	Extension to Paddington.	. . . . .	250,000*l.*	Main line, 4 miles, 46 chains.	54,426*l.*	40,492*l.*	3,196*l.*	13,000*l.*	12
Great Western (Trowbridge) (Q)	Deviations and alterations.	15,000*l.* additional capital to be raised by mortgage.	15,000*l.*						
Kilmarnock and Troon (R)	Deviations and alterations.	40,000*l.* additional.	57,983*l.*	Deviation, 10 miles.	. . .	200*l.*	5,180*l.*	1,220*l.*	
Lancaster and Preston (S)	New line.	250,000*l.*	250,000*l.*	Main line, 20 miles, 30 chains.	12,269*l.*	35,828*l.*	7,826*l.*	20,000*l.*	9

(M) Gradients favourable, steepest being 1 in 360; curves favourable, smallest radius of any on the main line being 1 mile; at the stations there are smaller curves; there are five short archways or tunnels 1036 yards in length altogether.

(N) Gradients favourable, steepest on the extension being 1 in 394, on the branch to Durham 1 in 100, on the branch to York 1 in 523; curves favourable, smallest radius of any being 1 mile; no tunnel.

(O) Gradients favourable, steepest being 1 in 160, except a short inclined plane of 1 in 42½, to be worked by a stationary engine; smallest radius of a curve ½ a mile; no tunnel.

(P) Gradients very favourable, steepest being 4 feet in a mile, or 1 in 1320; curves very favourable, smallest radius of any being 2 miles; no tunnel.

(Q) Gradients favourable, steepest being 6 feet in a mile, or 1 in 880; smallest radius of a curve 5 chains, being near the entrance to the depot at Bath; no tunnel.

(R) Gradient 1 in 660 throughout; smallest radius of a curve 350 yards; no tunnel.

(S) Gradients very favourable, steepest being 1 in 500; curves favourable, smallest radius of any on the general line is one mile; no tunnel.

Name of Railway.	Description.	Capital.	Estimated Cost.	Length of Main Line and Branches.	Cost per Mile.	Estimated Revenue from Passengers.	Estimated Revenue from Goods.	Annual Expenses.	Profit prCent. on Capital
London and Brighton (Rennie's) (T)	New line, with branches to Lewes, Newhaven, and Shoreham.	1,800,000*l.*	Main line, 897,073*l.* Branches, 302,833*l.*	Main line from its junction with the Croydon Railway, 41 miles, 51 chains. From the terminus at London Bridge, 50 miles, 62 chains. Lewes branch, 7 miles; Newhaven, 6 miles, 75 chains; Shoreham, 5 miles, 68 chains.	21,217*l.*	216,061*l.*	112,359*l.*	50 per cent. on the gross revenue.	9
London and Southampton (U)	Deviations, and to raise a further sum of money.	Additional capital, 400,000*l.*	The cost of the deviations will not materially exceed the cost of the original line.						
Manchester and Leeds (X)	Alterations and deviations.	No additional capital.							

(T) Gradients on the main line favourable, steepest being 1 in 264; curves favourable, smallest radius of any on the main line is one mile, except at the depot at Brighton where there is one with a radius three quarters of a mile, the curves where the Lewes and Shoreham branches join the main line have a radius of a quarter of a mile; main line three tunnels, one at Merstham 1320 yards, one at Balcomb 880 yards, one at Clayton 1700 yards, and one at Lewes Branch 875 yards.

(U) Gradients favourable, steepest 1 in 250; curves favourable, smallest radius of any one is three quarters of a mile; no tunnel on the amended line, that on the original line will be obviated.

(X) There are two inclined planes, the 1st, 1 in 165, 5 miles 35 chains in length; the 2d, 1 in 182, 6 miles 32 chains in length, with the exception of these, steepest gradient 1 in 330; curves favourable, smallest radius of any three quarters of a mile; five tunnels 3318 yards in length altogether.

Name of Railway.	Description.	Capital.	Estimated Cost.	Length of Main Line and Branches.	Cost per Mile.	Estimated Revenue from Passengers.	Estimated Revenue from Goods.	Annual Expenses.	Profit prCent. on Capital
Manchester, Cheshire, and Staffordshire, (Manchester and Birmingham) (Y)	New line, with branches to Crewe and Macclesfield.	2,100,000*l.*	1,565,391*l.*	Main line, 45 miles, 35 chains. Crewe branch, 15 miles, 68 chains. Macclesfield branch, 10 miles, 77 chains.	21,612*l.*	117,238*l.*	146,238*l.*	40 to 50 per cent. on gross revenue, say 131,788*l.*	6¼
Maryport and Carlisle (Z)	New line.	180,000*l.*	180,000*l.*	Main line, 28 miles, 1 chain.	6,425*l.*	15,545*l.*	14,817*l.*	10,121*l.*	11
North Midland (Leeds and Derby) (A)	Deviations and alterations, and formation of a branch at North Wingfield.	No additional capital.	The altered line will exceed the original line by 45,704*l.* Branch, 12,000*l.*	Altered line, 11 miles, 12 chains. Branch, 2 miles, 12 chains.	. . .	. . .	. . .	On the branch the annual expenses will amount to ⅓ of gross receipts.	
Preston and Wyre (B)	Alterations and amendments.	No additional capital.	The cost of the amended line will be less than the cost of the original line.						

(Y) There is one plane upon the Macclesfield branch one mile in length with an inclination of 1 in 150, and another of 1 in 264, with the exception of these, the gradients are favourable, the steepest being 1 in 331; curves favourable, smallest radius of any three quarters of a mile; two tunnels upon the main line 446 yards and 330 yards, and one upon the Macclesfield branch 210 yards in length.

(Z) Gradients favourable, steepest being 1 in 209; curves favourable, smallest radius of any on the general line half a mile; no tunnel.

(A) Gradients on the altered line are favourable, steepest being 1 in 330; on the branch there is a self-acting inclined plane; curves on the altered line are favourable, smallest radius being 1¼ mile, on the branch 15 chains; one tunnel on the altered line, the length of which is 320 yards.

(B) Gradients generally favourable; smallest radius of a curve 1 mile; no tunnel.

Name of Railway.	Description.	Capital.	Estimated Cost.	Length of Main Line and Branches.	Cost per Mile.	Estimated Revenue from Passengers.	Estimated Revenue from Goods.	Annual Expenses.	Profit prCent. on Capital
Sheffield and Manchester (C)	New line.	700,000*l.*	700,000*l.*	Main line, 40 miles, 12 chains.	17,434*l.*	88,819*l.*	170,700*l.*	50 per cent. on gross revenue.	18½
Slamannan (D)	Branch.	Additional capital, 29,000*l.*	28,433*l.*	Branch, 4 miles, 32 chains, 11 yards.	6,462*l.*	500*l.*	2,033*l.*	700*l.*	6
South-Eastern (London & Dover) (E)	Deviations and alterations.	No additional capital.	Cost will be increased 94,668*l.*	Main line will be increased in length 2 miles.	. . . .	. . . .	. . . .	The annual expenses will be diminished by the amendments.	
Taff Vale (Merthyr Tydvil) (F)	Deviations and branches.	No additional capital.	Branches, 30,000*l.*	Deviation, 3 miles, 8 chains. Branches, 4 miles, 40 chains.	. . . .	. . . .	1,197*l.*	Branches, 1,000*l.* to 1,200*l.*	
York and North Midland (G)	Alterations and amendments.	The capital will be reduced.	The amended line will cost less than the original line.		. .	.	.		

(C) Characteristic gradient 1 in 125, steepest 1 in 120; curves favourable, smallest radius of any three quarters of a mile; one tunnel 3 miles in length, 20 feet in height, and 16 in breadth.

(D) Steepest gradient 1 in 70½; smallest radius of a curve upwards of 30 chains; no tunnel.

(E) Gradients will be improved by the proposed deviation, steepest 1 in 264; curves favourable, smallest radius will be one mile; the two existing tunnels will be increased in length 1,440 yards.

(F) Gradients generally favourable, steepest being 1 in 246, but there are three short self-acting inclined planes on the branches of 1 in 10, 1 in 20, and 1 in 10 respectively; smallest radius of a curve 11 chains; no tunnel. This line is not intended for passengers or rapid conveyance.

(G) Gradients on the amended line peculiarly favourable; no tunnel.

BIRMINGHAM AND DERBY.—This Act is merely to rectify a mistake in the Act of last session for this railway.

BISHOP AUCKLAND AND WEARDALE.—This Act is merely to incorporate the subscribers to the undertaking as a Joint-stock Company, and to provide for the election of the officers of the Company, &c.

CLARENCE (DURHAM).—This Act is merely to enlarge and amend the powers and provisions of a former Act.

COMMERCIAL (LONDON AND BLACKWALL). No. 1.—This Act is merely to enlarge and amend the powers and provisions of a former Act.

LEICESTER AND SWANNINGTON.—This Act is to enable the Company to raise a further sum of money.

LIVERPOOL AND MANCHESTER.—This Act is to enlarge the powers and provisions of a former Act, and to raise a further sum of money.

LONDON AND BIRMINGHAM.—This Act is for the amendment of former Acts, and to enable the Company to raise a further sum of 1,000,000*l.*

LONDON AND GREENWICH. (No. 1.)—This Act is to enable the Company to raise an additional sum of 150,000*l.*

LONDON AND GREENWICH. (No. 2.)—This Act is to enable the Company to take additional tolls.

POLLOC AND GOVAN.—This Act is merely to continue the powers of two former Acts.

WHITBY AND PICKERING.—This Act is to enlarge and amend the powers and provisions of a former Act.

WISHAW AND COLTNESS.—This Act is merely for the purpose of extending the time for completing the undertaking.

Great North of England Railway from Newcastle-on-Tyne to York.

[This line of railway, of which our present number contains a map, obtained its Act for a part, that is from Newcastle to near Hurworth on the Tees, in the session of 1836, and for the remainder to York in the last session, that is 1837. It starts from the Newcastle and Carlisle Railway on the Tyne, and the lines to South Shields and Sunderland. It proceeds for some distance, nearly parallel to the turnpike road, which it crosses by a lofty viaduct near the Hermitage of Mr. Cookson. Skirting Durham on the east it meets the

Durham and Sunderland Railway, and at length crosses the projected South Durham line very nearly at its junction with the Clarence, and then the Clarence itself near Ricknall Mill. From this place it proceeds almost parallel to the turnpike-road, crosses the Stockton and Darlington Railway, and thence curving a little to the west, crosses the Tees near the New Spa Baths at Croft, and immediately afterwards the turnpike-road. On the west of the road it now continues to York, which it enters near Micklegate Bar, and joins the York and North Midland Railway, and the projected Northern and Eastern from London.

The whole length is about 75½ miles, which is near 5½ shorter than the turnpike-road. One million is the estimated capital. Throughout the whole line there is not a single tunnel. In general too, the earth-work is moderate, the gradients good, and the line one that will work well and economically.

Some time since we were called on by some gentlemen at Liverpool, who hold largely in the capital stock of the line, to give them our candid opinion of the project, more particularly that from the Tees to York, and as we took some pains to get at the facts, we think we cannot do better than lay the report we then made, with a trifling alteration or two, before our readers.—ED.]

GENTLEMEN,—You have imposed upon me no very easy task, that of giving an opinion of a line of railway from near Darlington to York. Like many others you seem to think the head of the editor of a railway periodical must be a complete portfolio of railway matters—an Encyclopedia of all that is known, or to be known. However, from the documents that I have at hand, and an attentive consideration of all the circumstances bearing on the subject, I will candidly give you my opinion of the undertaking.

It is almost impossible, I think, for any line to be projected under more favourable circumstances in regard to engineering advantages. Except a rise immediately south of the river Tees of under 13½ feet per mile, it has no gradient exceeding about 8¾ feet per mile. For all practical purposes, therefore, the line is scarcely inferior to a level, and full steam may be applied the whole way. So that in point of fact there will be no waste of locomotive power, nor any needless wear and tear from the overrunning of the trains, as may be seen by the following table of its gradients:—

Length of Gradients.		Feet per Mile.	
M.	Chain.	Rise.	Fall.
2	58	13 1/5	
4	15	.....	8 4/5
4	41	4 1/5	
5	62	.....	8 4/5
2	2 1/2	0	0
4	61	.....	1/8
5	28	.....	6 3/5
8	72	.....	1 3/5
2	14	.....	4 1/5
1	13	6 4/5	

Neither has it any objectionable curve. Indeed from Newcastle to York, a distance of seventy-five miles five furlongs,* the line is very nearly straight, if we except a slight bend just after it passes the (river) Tees and enters the county of York, and another on entering the city of York; both of which, however, are of considerable radius.

In its cuttings, embankments, and works, it appears to be equally fortunate. For miles together it is difficult, on the Parliamentary section, to distinguish the surface of the ground from the line of railway, so very kindly is the face of the country. "The Ouse embankment," says Mr. Wishaw in his "Analysis of Railways for 1837," "is the chief earth-work, and is nearly three miles long, and averages twelve feet high." In some places it is not four feet, in others fifteen or sixteen, and at one place, little better than a mere point, it is twenty-three. The other embankments, probably, do not average ten feet high. With regard to the cuttings, the heaviest is from the river Tees for about three miles, being for a short distance twenty-six feet, and averaging, perhaps, fourteen feet. Over the Tees there must be a bridge of about one hundred and twenty-five feet span and forty feet high, and over the Ouse, another of similar extent but not half the height, which are the only works of the kind I perceive. In respect of number of bridges, it appears by Wishaw's book, above referred to, that it has only sixty-one in the whole line and its branches, that is, under the rate of three to two miles, the length of the line and branches, being 44¼ miles. This is usually considered a small proportion, and is much less than on either of the Brighton lines, one of which, the "Direct," is accounted very economical in this matter, having only 109 in 72½ miles, including the branches.

Compared, therefore, with the generality of other lines, the Hurworth and York must be very easy of construction and inexpensive. This may account for the lowness of the capital, 450,000*l.*, or rather under 11,000*l.* per mile. I was at first struck with so low an amount, and thought it was one of those delusive estimates which have produced so baneful an effect on the public mind; for we must allow there is a wide difference between 11,000*l.* a mile and 40,000*l.* or 50,000*l.*, which some lines cost. However, if it

* This is 5⅜ miles less than by the turnpike-road.

be true, as I am informed it is, that the same engineer constructed, under the immediate direction of Mr. George Stevenson, the projector and principal engineer, the Stockton and Darlington, with its branches and appendages, 40 miles long, in the same neighbourhood, over more difficult ground, for 400,000*l.* or 10,000*l.* a mile, we cannot withhold our assent to the competence of the capital; especially as by the engineer's report good materials for the works are at hand and cheap. Indeed, such an instance as the Stockton and Darlington, if true, furnishes a case we cannot contest; it is fact, not argument or conjecture, against which there is no disputing. We have not heard his intentions, but we have no doubt the engineer will follow all the other great lines, and lay his rails on Kyanized wooden sleepers, instead of on stone blocks, by which he will save much expense, and add largely to the comfort of the travellers, as all who have been in America well know.

From all these circumstances, it certainly does appear, that the Hurworth and York line has few, if any, equals in an engineering point of view. The question, however, which most concerns you and the public is, how will it pay? Good engineering qualities are one thing, and certainly very desirable to most; good profits are another, and those which will be sure to satisfy all parties. We can put up with inconveniences in the former, but I never knew a case in which the latter were deficient that the concern proved agreeable or satisfactory.

To speak of the returns is much less easy than it is of the engineering qualities. One grand feature of the Great North of England line is, its running from end to end, that is from Newcastle to York, parallel to and nearly at the edge of the turnpike-road, and yet it is almost 5½ miles nearer. It thus embraces all the great towns, and consequently, if well managed, will take the whole of the traffic, direct and lateral, of the road. Another feature is, its crossing all the rivers and some five or more other railways made or passed—the Newcastle and Carlisle, the Stanhope and Tyne, the Durham and Sunderland, the Clarence, and the Stockton and Darlington—at right angles. These rivers and railways can, therefore, never be rivals to it, but in proportion to their traffic must become tributary streams of profit. The only rival which it can have, will be that which it professes to rival, the road. Again, in the south it forms a union with the York and North Midland, and through it and its connexions, (and with the Northern and Eastern, which there is little doubt will ere long be carried,) it is brought into

communication with the Capital, Birmingham, Liverpool, Manchester, &c., and almost every great commercial town south of York in England.

Running through so great a portion of the richly mineral county of Durham, and in direct communication with the ports of Newcastle, Shields, Sunderland, Hartlepool, and Stockton, it seems to me to be eminently calculated to confer upon, and consequently to receive, considerable benefits from the whole county. Neither should it be forgotten that this line forms a portion of 300 miles of railway, sanctioned by Parliament, between London and Edinburgh, and that, from its position, almost in a right line between the two capitals, it will, in all probability, become one of the grand arterial lines into which a number of others, yet unthought of, will ultimately flow, bringing with them, of course, each something to add to the general stock of its profit.

I do not know enough of the business carried on in the mineral districts of Swaledale, Nidderdale, &c., to be able to give an opinion of what may be expected from such sources; but the previous facts, coupled with that of the Great North of England, being, as I presume it must be, the main trunk leading from the capital to Edinburgh and the north, impress me with an opinion that it will be a line that must pay well. It seems, indeed, from the hilly nature of the country on each side, and the singularly easy level through which the line for so great a distance runs, as if nature herself had originally left this part of the country unencumbered with difficulties, for the purpose of uniting more closely the northern and southern parts of the country by our great modern improvement in transit, railways.

By looking into the facts of the traffic, as "proved before Parliament," I perceive my views are amply borne out. I am not in the habit of putting much confidence in these estimates and statements generally, being too well aware of the method in which they are commonly got up, to place great reliance on them. But here it does not appear that the parties who made out the traffic have been guilty of any of those amusing exaggerations, in the way of multiplication of gross returns, which ornament some of the prospectuses of railway companies. On the contrary, they seem in general to have been fonder of division. For example, in the item of coach parcels, they take exactly the amount which is now paid 1,870*l.*, taking credit for no increase whatever from increase of communication and intercourse. In the posting, they assume only one half; for the goods

transferred by wagon they take only a third of what now exists, that is, 6,397*l.* for 19,192*l.*; in coals they assume 40,000*l.* instead of 48,000*l.*, as at present. In the transport of cattle, sheep, and fish, on the contrary, they rather better than double the amount, making it 20,386*l.* instead of 9,833*l.* Their reasons for this I do not know; but it appears that they purpose to take cattle and sheep at the present costs, and to transport them as many miles an hour (12) as they now travel per day, thereby saving 11½ hours out of every 12, and all the waste and deterioration of driving. The fish, it is proposed to transport 12 miles an hour instead of 4, and at an expense of ½d. per ton per mile in place of from 1s. to 1s. 3d. These are the apparent causes; whether they are competent to produce the effects anticipated, I must leave to others to determine.

Coach passengers they propose to transport at the rate of 20, instead of 8, miles an hour, and to carry them at 2d. instead of 4d. per head per mile. With these advantages, they calculate on carrying quadruple the number, and receiving 94,132*l.* in place of 47,066*l.*, the sum now paid. Now there is no doubt, wherever good railways have been established, that the personal intercourse has been at least four times greater; and it may be laid down as a broad principle—resting on the soundest of all data, uniform past experience—that a saving of half the time, and one-third of the expense, will produce not less than four times the traffic, and, of course, double the revenue, provided there is no counterbalancing inconvenience. In this line the expense saved is not one-third, or 33 per cent., but one half, or 50 per cent., the time saved is not 50, but 60 per cent. Neither are these advantages met by any sets-off and drawbacks of dangerous planes or offensive tunnels. If, therefore, any inference is to be drawn from past experience, it is, that the passenger-traffic is under, and not overrated.

I have thus gone through the items in detail, to prevent the possibility of its being supposed that, in my review of that most important subject, the revenue, I take anything for granted or without investigation. Made up in the way I have shown, it appears the Company calculate on a revenue of 153,273*l.* per annum, from Darlington to York. Now Colonel Mudge, in his "Observations on Railways," page 21, assumes from the experience of the Liverpool and Manchester Railway, which has two inclined planes, and is by no means an economical working line, that the gross revenue is to the expenses as 1.6 to 1. On this principle the expenses would be 95,795*l.* and the profit 57,478*l.*, or

near 13 per cent. What the Directors compute it to be, I do not know, as I have not, to the best of my knowledge, ever seen their original prospectus; I should, however, say, if any dependence is to be placed on the data I have, there is no likelihood of the line in question paying less than 13 per cent., but, in all probability, much more.

Having candidly stated the results of my investigations with respect to the Great North of England Railway, I must beg leave to add, that I cannot conceive why the Directors, with a line every way so favourable for rapid motion, should limit the velocity to 20 miles an hour, while other companies, with far less advantages, are talking of 25 or 30. Let the Great Western be finished, and I am quite satisfied the Directors of that line will not sit down with 20 miles an hour. I have the honour to be, Gentlemen,

With great respect,

Your obedient humble servant,

JOHN HERAPATH.

Messrs. * * * * * Liverpool.

Railways as Investments. By A CONSTANT READER.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

MR. EDITOR,—In your valuable Magazine for July last, there appeared a paper "On Railways as an Investment." The title was singular, and the subject important; but the manner in which it was treated, was not calculated to secure the object the writer intended to accomplish. His design was obvious, but argument must be substituted for opinion, and facts must be employed to convince the prudent before they fix their capitals in new undertakings. Nor would it have been difficult to have furnished information suited to the subject. It is not enough to assert the money expended in railroads "does not go out of the country." This may not differ with any spendthrift, or debauchee. "Nor is it for landowners in general, or timber-merchants, or iron-masters," desirable to become shareholders in railways. The first of this class are too commonly money-borrowers, and the two last know how necessary an unfixt capital is, to obtain advantage from the fluctuation in markets. The parties to engage in railroad investments, are those who do not require all the money they possess; who can afford to live without the interest of the sum they employ in purchasing shares; and know how to add the interest withheld to their capital invested, till the railroad is in effectual operation. These are the parties from whom assistance is

to be sought, and not from tradesmen or professional gentlemen. Exceptions are to be found, but comparatively few. It is because those who ought not to have been shareholders have become such, that speculation has been prevalent, and in many instances heavy losses sustained. The case was similar when canals were first introduced, of which many proofs still remain, in Norfolk, in Surrey, and recently in the communication to Norwich, through the harbour at Lowestoft. Many and various topics demand consideration before a prudent person should fix his capital, besides what the writer mentions (page 25); of this our country has recently had abundant evidence. To prevent the recurrence of such events is the duty of every true patriot. He is not to listen to the statements of the engineer, or the calculations of the solicitor, or the persuasions of the *would-be* director, without examining the nature of the undertaking, its capabilities of success, and the permanency of the continuance. If the country through which the railroad passes be thinly inhabited, if it possess neither manufactures, coal, nor raw material, if the surface be unequal, and the expense for obtaining a level great, no wonder that those who have capital look upon schemes of such a character with *suspicion*. This occasioned the depreciation which at one time existed in the shares of the Leeds and Liverpool Canal, though they are now above five times their original value. There were, however, facts to induce the wealthy to look at the future, and who now, in their descendants, reap the advantage of their *forecast*. It is by the encouragement such persons give to railroads that their utility will be ascertained; and not by the puffings of sharebrokers, or the withholding of a number of shares, to be sold at the discretion of the directors. One lesson proprietors will learn, "to be careful whom they appoint to manage their affairs; and to insist upon an annual, if not a half-yearly, full statement of their proceedings." This will enable them to know the real value of their property, and be an effectual check against error. I trust "R. R." will pardon these remarks, which his production seemed to render necessary from your CONSTANT READER.

Taxation on Internal Communication. By R. R.

(Continued from page 176.)

(Sir John Hall, Bart.)

320. You have paid a good deal of attention to the management of the turnpike trusts in your neighbourhood?—I have paid a

good deal of attention to the management of the turnpike trusts in Berwickshire.

322. Looking at the probable extension of steam conveyance by land as well as by water, do you apprehend serious injury to the roads with which you are connected?—I cannot imagine their holding their ground. I do not believe they would be able to pay the interest of their debt, and to keep the roads up.

326. Are you aware that railway companies are incorporated as carriers, as well as farmers and owners of the road?—I have understood so.

327. Do you conceive the power they possess of running toll-free on their own road must be the means of deterring other carriers from competing with them, and that they have thus a virtual monopoly of the railroad?—Yes.

335. What remedy could you suggest for the purpose of putting the roads with which you are connected on a footing of equality with the other conveyances now in use?—We should be perfectly satisfied if the heavy duties on land travelling were taken off; in the event of that not being practicable, we think it would be better that there should be a somewhat similar duty on steam-carriage and steam-boat travelling.

346. Do you not anticipate that, were the taxation on travelling diminished, there would be a great increase of travelling among the community?—Undoubtedly.

347. And it is scarcely necessary to ask whether, in a commercial country like this, you conceive this would be one of the greatest advantages the public could receive?—I have no hesitation in saying, I believe it would.

(Mr. Richard Smith.)

350. You are the assessor of stage-coach duties?—Yes.

352. The taxation on stage-coaches is unequal at present, comparing animal as a motive power with steam, is it not?—Decidedly so; the taxation upon travelling by railroad is one-eighth of a penny per mile, the average rate of taxation on travelling by stage-coach is ¼d. per mile per passenger; the number of passengers charged is according to the license in the stage-coaches, and according to the number actually carried on the railroad; the *actual* rates upon stage-coaches are about ½d. for every three passengers; the increased rate (¼d.) arises from their not carrying the full number of passengers.

355. What would you suggest as the best means of equalizing the duties on the different modes of conveyance?—As a matter of principle, I should say that all taxation on internal communication is bad; but it being necessary to have a revenue (*from a bad tax?*) the only means of obtaining that fairly will be by equalizing the rates, and imposing taxes on those modes of communication upon which there are no taxes at present.

356. As far as railways are concerned, do you think any means

could be adopted of charging the railway companies upon the number their coaches are licensed to carry?—From all that I can understand of the nature of the traffic upon railways, it would be impossible to do that with any degree of fairness, owing to the vast numbers which are sometimes carried, and the small numbers which are carried at other times.

358. Then, how would you recommend that the duty should be equalized?—To place them on an equality, I think it would be necessary to charge the railway companies with ½d. for every passenger for every four miles, or fraction of four miles, instead of the present rate, which is ½d. for every four passengers per mile. I would then charge the stage-coach proprietor ½d. for every four sittings prepared in and upon his carriage, per mile, or fraction of a mile.

363. There is another competing steam-power, viz., that by water; have you ever considered any method of taxing that mode of conveyance?—I have considered that a tax might be levied upon the number of passengers conveyed, and that that rate might be similar to that proposed upon railway travelling, viz., ½d. per passenger for every four miles or fraction of four miles; that the distance should be calculated upon the land distance between the two places, except when the distance by water is the shorter of the two; and that the tax might easily be levied by stamping the tickets at present used for the collection of the fares. I have prepared what appear to me to be the necessary heads for a bill for a tax on the conveyance of passengers for hire by water, which I beg leave to hand in to the Committee.

[The witness hands in the "Proposed Heads," &c.]

364. Do you conceive that the tax you propose would be felt as a serious grievance by the public?—I should say not, except in the case in which all these taxes bear heavily on the public; that is to say, the long distances. The duty at present by stage-coach from here to Edinburgh is 8s. 4d. per passenger; the duty in this case would be 4s. 2d.

367. Have you formed any estimate of what such a tax might bring in to the revenue?—From the knowledge I have of several different places, I have considered that such a tax would yield at least from 150,000*l.* to 200,000*l.* a-year upon the steam-boats which are at present running.

368. Have you estimated the probable effect of the reduction you have spoken of in the stage-coach duties?—I should think it would amount to at least 200,000*l.*, but that the loss would be compensated by an increased quantity of travelling on other lines of road.

376. You are aware that compositions take place with railway companies, to enable them to convey passengers without paying the mileage duty?—Yes.

377. Are you aware upon what principle those compositions are

made?—The compositions were first allowed, I understand, for the purpose of facilitating the establishment of railways. The rule generally laid down has been, if a railway is not likely to pay, immediately to take a very small composition; to charge, where it can be ascertained at all, one-third of the amount of duty the second year, which would be payable as mileage the first year, two-thirds the next year, and after that the full amount of duty, if the railway appears likely to pay.*

(Sir Edward Lees.)

381. You are the Secretary of the post-office at Edinburgh?—I am.

402. Would not the Treasury gain in the post-office department what it might lose in certain cases in the department of stamps and taxes, by taking off the duty on carriages conveying the mail-bags?—Everything saved in the post-office must be a direct gain to

* From the returns given in by this witness, we extract the following account, showing the amount of duty collected from the different Railway Companies in England, for *the three years* ending Jan. 5, 1837:—

Mileage duty paid at the rate of ½d. per mile for every four passengers conveyed.	Total in three years.			Average per Annum.		
	£.	s.	d.	£.	s.	d.
Bodmin and Wadebridge	32	12	0	10	17	4
Clarence	123	16	0	41	5	4
Leeds and Selby	2,235	16	10	745	5	7
London and Greenwich (1 year)	451	5	11	451	5	11
Liverpool and Manchester	20,607	12	3	6,869	4	1
Stanhope and Tyne (1 year)	8	12	7	8	12	7
Whitby and Pickering (2 years)	151	6	10	75	13	5
	23,611	2	4	8,202	3	3

Paying Composition.	Total amount of composition paid in three years.			Amount of mileage duty which would have been paid if no composition had been entered into.		
	£.	s.	d.	£.	s.	d.
Bolton and Leigh	30	0	0	877	4	2
Canterbury and Whitstable	51	0	0	239	8	9
Hartleyburn and Brampton	6	0	0	23	5	0
Leicester and Swannington	60	0	0	257	11	6
Newcastle and Carlisle (2 years)	255	0	0	1,294	3	7
North Union (Wigan and Preston)	360	0	0	1,112	7	10
St. Helen's and Runcorn Gap	25	0	0	99	9	3
Stanhope and Tyne (1 year)	2	10	0	46	13	2
Stockton and Darlington	600	0	0	1,301	5	11
Stratford and Moreton	20	0	0	51	13	8
Warrington and Newton	110	0	0	424	11	5
	1,519	10	0	5,727	14	3

the Government. However the great gain to Government would be through other branches of the revenue, opening facilities of communication, allowing villages and towns through which the carriages were to pass to have the benefits of the transport of goods and parcels to the different persons concerned in the trade and commerce of the country.

408. Is not increased activity in the trades of saddlers and coachmakers the consequence of horses and carriages being untaxed in Ireland?—That is one of the branches of the revenue which I say the Government would also gain in.

409. Do you not conceive that if those taxes were abolished in England and Scotland, the same consequences would follow?—Yes.

(Mr. Wm. Clarke Wimberley.)

452. You live at Doncaster?—I do.

453. And you are connected with the stage-coaches running the Great North Road?—I am.

461. Is it your opinion that, taking the number of passengers and the number of miles travelled, the amount of land travelling is not so great as it used to be?—Certainly not; it is diminished excessively.

462. Do you conceive that the coach-masters have any thing to complain of on the score of unequal taxation?—Certainly, and they do complain of it.

465. Do you not think that all that the coach-proprietors could reasonably demand is, that as regards taxation they should be put on an equality with their competitors?—Yes, and that is all they desire.

466. Looking to the further increase of steam as a motive power by land as well as by water, do you contemplate still more serious consequences than have yet occurred to the coach-proprietors?—Certainly; they do contemplate almost the cessation of travelling, and therefore what they ask is merely a sort of reprieve, or power to gain a little before they are completely done up.

467. As the stage-coach duties have increased during the last three years, in conjunction with the great increase of steam both by land and water, on what ground do you base your fear that the result in future years will be different?—I do not think the amount of duties can be a fair criterion of the success of the coaching interest, because we find that persons will have coaches going, whether they gain or lose: there is very frequently that strange system in the coaching business; and besides, this would apply to the general coaching interest throughout the country, and my evidence bears on a particular line,—the line of road from London to Newcastle, parallel with the coast.

(Robert Philip, Esq.)

510. You are a proprietor of steam-boats, are you not?—Yes.

511. Engaged in conveying passengers from Edinburgh to London?—Yes; and from Edinburgh to Dundee as well.

512. You pay no tax upon your motive power employed in the conveyance of these passengers and goods, do you?—Not any direct tax, excepting the duty which is leviable upon the ships from the lights, and the duty which is payable on the materials of which these vessels are constructed.

514. Do you not consider that the coach-proprietors, being subjected to taxes, are treated with some degree of injustice, while other parties are allowed to carry passengers free of direct taxation?—That involves a question of policy as to whether steam power is to be put upon a level with the animal power of the kingdom. It is a matter of pure expediency and policy on the part of the Government.

515. Can you adduce any reason why steam-power should be exempted from a tax which other power is subjected to?—I think I can.

516. Will you state it?— Steam-power, or, I may say, the physical power which man is capable of employing by means of steam, makes that power more completely under the control of man than the animal-power of horses. The employment of steam-power has a tendency to increase the population of the country, while it diminishes the number of horses kept in it, and renders man less dependent upon animal-power than he otherwise would be.

517. Does not animal-power pay other taxes to Government, by the consumption of taxed commodities, from which steam-power is free?—When we speak of steam-power being free from taxation, I cannot think that it is altogether the case, because the number of hands that are employed in the construction of the steam-engine, and the preparing the fuel from the bowels of the earth for its application, as well as the number of men that are employed in directing and feeding the engine, all these persons are the constant subject of taxation to the Government; and while steam-power as such is not taxed, yet the employment of so many hands being constantly required in the construction and application of steam-power is virtually yielding to the Government a tax in their maintenance.

518. Are you aware that a proposition was brought forward some years ago, for imposing a tax upon steam-boats carrying passengers?—I believe it was contemplated by Lord Althorp at one time, but upon looking into the matter more minutely, it was found to be inexpedient.

522. Would not the middle and lower classes be benefited by any means which would cheapen land communication throughout the country?—They would certainly be benefited, and no doubt greatly benefited, by the reduction of the taxation upon land-carriage.

525. Are you enabled to carry more cheaply in consequence of being free from taxation?—Most undoubtedly.

526. Do you conceive that the coaches would be enabled to carry more cheaply if they were free from taxation?—Most assuredly they would.

527. Then your wish is not to secure a monopoly of the carrying trade by an unequal scheme of taxation, but to communicate to the public generally the advantage of cheap conveyance?—Yes; by abolishing all burthens upon internal communication, if possible.

533. Do you think that great objection would be made by the steam-boat proprietors in general to the imposition of any tax?—I think there would be a very considerable opposition to it among the steam-boat proprietors.

537. Have you any other observation to make to the Committee upon this subject?—Yes: I would beg to observe, that if steam-power is to be taxed on board of steam-vessels, I think, by parity of reasoning, that the same power ought to be taxed in all manufactories in the country; for a tax upon travelling should not be imposed because you travel merely by steam; for it must be remembered that other goods in the country are manufactured by steam. I think, therefore, that if a tax were to be imposed upon steam-power, a tax ought to be levied over all the horse-power in the kingdom by steam. And another observation is this:—If the tax were proposed to be levied upon steam-ships, either by the tonnage or by the horse-power, then I should consider that a tax upon sailing-vessels ought also to be imposed; because sailing-vessels employ another species of power, namely, the winds of heaven, in propelling them, and that is the cheapest of all the powers we have got; and if, therefore, more power is to be taxed in order to relieve animal-power, then the power of the wind ought to be taxed as well as the power of steam.

538. Then you think if steam-power in navigation is to be taxed, that all power ought to be taxed in travelling, whether by wind or steam?—Yes; because these are general principles, which I think would only be fair; for if legislation is to seize hold of one point, and not to apply that by a general principle throughout, it will be deemed unfair by some parties.

540. Is there not this difference between steam-power employed in travelling, and steam-power employed in manufactories,—that in travelling it is brought into competition with another power which is taxed, whereas, in manufactories, all the rival powers are equally untaxed with itself?—I conceive that formerly, when a horse-mill was in operation driving a certain quantity of machinery, that steam-power coming in competition with it has driven animal-power out of use, and this, I conceive, is upon the same principle.

541. Do you imagine that the steam-boat proprietors desire to secure to themselves, by an unequal rate of taxation, a monopoly

of the carrying trade?—By no means; I do not believe it: but there is one species of steam-power which does not come into competition with animal power at all, that is, where communication is had directly with the Continent; animal-power cannot come in competition there, but sailing-power comes in competition; and if mere steam-boats are to be taxed, then I say, in order to put them on a level with their sailing competitors, sailing vessels ought also to be taxed.

Mr. Yetts's Patent for an Improved Method of Calking.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

Great Yarmouth, September 5, 1837.

MR. EDITOR,—In the last number of your Magazine, an article was inserted by Doctor James Cadett, on the subject of calking ships, with reference to my patent, by which it appears evident that, owing to some very erroneous statements which had found their way into the public journals, that gentleman has been led completely into a mistake in regard to the principle of my invention, as it will be found in the following description, which I trust you will confer on me the favour to insert in your next number, that my application of India-rubber has nothing whatever to do with preventing the threads of oakum from working out of the seams.

Heavy straining at sea may cause a slight opening of a vessel's seams (more particularly at the butts), and the solidity of the oakum may thereby be disturbed; but nothing short of striking or straining upon the ground could occasion the threads of oakum to be forced from her seams—an evil (under such circumstances) that I believe no human means could possibly avert.

I am, Mr. Editor,

Your obedient, humble servant,

WILLIAM YETTS.

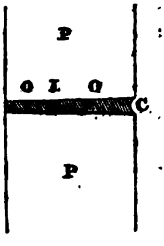
Mr. Yetts's Method of Calking Vessels by the Partial Application of Indian-rubber.

A thread of oakum (either white or brown, as occasion may require,) having been driven into the seams of the planks, butts, or scaffs, in the usual manner (by way of foundation), and without oil (which is injurious to caoutchouc) being used on the caulking iron; a stout filament or thread of caoutchouc, or Indian-rubber, of

about three-tenths of an inch thick, or of the suitable size or thickness, dependent on the size of the opening to be calked, is to be driven, with a flat-edged calking-iron, close up to the first-mentioned thread of oakum; after which, the remainder of the seam is to be filled up with the usual threads of oakum, driven up tight, in the usual manner. The form of the filament may be either square, round, oval, or any other shape; the only condition required being, that the filament should be of sufficient size, to be subjected to a tolerable degree of compression upon its surfaces, when it is introduced into the seam, so that it may afterwards exert its elastic or expansive pressure in a sufficient degree against the sides of the seam to prevent leakage in case of any slight opening of the seam, either by the working of the ship in bad weather, or the shrinkage of the planks, or the oozing of the pitch from the seams in hot climates.

In addition to this mode of calking the seams of planks, &c., where a vessel is required to be sheathed (or doubled) with wood, it is proposed to lay a filament of Indian-rubber (as described) along the concave or outer surface of the seams of the main bottom (which, as the Indian-rubber, will be subjected to compression by the application of the sheathing planks) it is evident that the filament will afford additional security against leakage.

In like manner, also, may the filament be used under a vessel's copper sheathing, as it will not only have the same effect to prevent the intrusion of water to the seams, but it will also be found useful in occasioning the copper to lay upon the bottom with a uniform surface.



Section of a vessel's seam, P P being the planks, I, Indian-rubber, O O, oakum, C concave surface of the seam when calked.

On Mr. Yetts's Method of Calking Ships. By JAMES CADETT, M.D.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

22, *Harley-street, September* 11, 1837.

MR. EDITOR,—Having received a very courteous communication from Mr. Yetts, enclosing me a description and

plan of his patent for calking vessels, I consider myself in justice bound to that gentleman, (and I hope you will allow me the opportunity, in consequence of my former letter to you on the subject,) to state, that I do now fully admit of the utility of his plan, and consider it a great and real improvement on the old method.

I remain, Mr. Editor,
Your very obedient servant,
JAMES CADETT, M.D.

On Dr. Lardner's Calculation for Duty of Steamers for long Voyages. By R. B. G.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

Liverpool, Sept. 16, 1837.

SIR,—At the request of several persons who were present at the Meeting of the British Association here, during the statement made by Dr. Lardner respecting long steaming voyages to India and America, I send you an abstract taken from the logs of the Atalanta and Berenice, which are new steamers just despatched by the East India Company to India, for insertion in your useful Magazine.

You may remember that the Learned Doctor stated that the Admiralty had intrusted him with the logs of their steamers to make any extracts he wished. From them he constructed a table showing the performance of several of them, which I now annex, to afford a comparison with those of the Atalanta and Berenice.

The two points which appeared to be requisite to form these abstracts were, the best description of data upon which any calculations could be grounded, and also the method of computing what the Learned Doctor termed a duty of the comparative performance of the vessels. The latter subject caused much discussion in the Section, and in the tables I have given the result deduced by Dr. Lardner, that suggested by Dr. Robinson the Chairman, and another which I proposed.

A Table as taken from the Logs of the Atalanta and Berenice.

ATALANTA.	Total coals consumed.		Average per hour.	Per hour per horse-power.	Distance run.	Time.	Rate.	Duty computed by			Remarks.
								Dr. Lardner.	Dr. Robinson.	R. B. G.	
	Tons.	Cwts.	Cwts. lbs.	lbs.	Miles.	Hours.	Miles.				
Falmouth to Teneriffe .	117	0	12·2	6·5	1487	193	7·7	2653·42	2668·9	2668·9	210 horse-power, 630 tons burthen—built by Messrs. Wigram & Green, Blackwall.
Teneriffe to Mayo . . .	63	11½	13·3	7·	895	95	9·4	3008·	2956	2956	
Mayo to Ferdinando Po	154	10	11·5	6·	2180	270	8·1	3023·97	2963·02	2963·11	
Ferdinando Po to Cape of Good Hope . . .	213	0	12·3	6·5	2373	346	6·8	2343·28	2339·59	2339·57	
BERENICE.											
Falmouth to Teneriffe, (remaining on board 182 tons 3 cwts.)	128	1	14	6·75	1572	175½	8·9	2953·02	2823·78	2823·58	230 horse-power, 680 tons burthen—built by Mr. Robt. Napier, Glasgow.
Teneriffe to Bonavista, (remaining 172 tons 17 cwts.)	85	8	16·25	6·5	952	105½	9·	3101·4	2563·96	2563·93	
Bonavista to Ferdinando Po (remaining 172 tons 17 cwts.)	157	3	11·67	* 4·75	2272	269	8·4	3961·44	3325·52	3325·23	

N.B. Dr. Lardner's method $\frac{2240}{\text{lbs. per horse-power per hour}} \times \text{rate.}$

Dr. Robinson's ditto $\frac{\text{Total Coal}}{\text{total horse-power}} = a$ then $\frac{\text{Total distance run.}}{a}$

R. B. G's ditto $\frac{\text{Total distance run} \times \text{total horse-power.}}{\text{Total Coals}}$

* During this trip they worked expansively, and sometimes consumed only 10 cwt. of coals per hour, and travelled from seven to eight knots per hour.

Table shown by Dr. Lardner.

	Coals per horse power per hour. lbs.	Distance per hour. Miles.	Duty.	
African	10·9	5·13	1045	
Blazer	10·3	6·9	1500	
Confiance	10·0	6·2	1389	
Firebrand	10·7	6·25	1308	
Medea	8·3	7·9	2105	Built in 1832.
Pluto	9·7	6·5	1501	
Tartarus	10·7	5·5	1150	
Dee	8·3	6·5	1754	
Flamer	10·7	6·0	1256	
Dolphin	12·0	9·75	1820	Post-office Packet.
Duchess of Sutherland	12·5	7·7	1380	Private ditto.

The Medea was most relied upon by the Learned Doctor as the best model to form an estimate of long voyages upon, which, by comparing with either the Atalanta or Berenice, or indeed almost any modern vessel, it will be seen how very inferior she is.

My object by these tables is to show that better and more recently constructed vessels than those selected by Dr. Lardner, have performed voyages of great length and difficulty, and that the consumption and want of stowage of coals are not so great as would appear to be necessary.

The interest which the importance of this subject has created, and a sincere wish that the present projects may be successful, is my only plea for intruding upon your columns.

I am, Sir, your most obedient servant,

R. B. G.

REPORTS.

LIVERPOOL AND MANCHESTER RAILWAY.—ELEVENTH HALF-YEARLY MEETING.

In their last Half-year's Report, the Directors had to notice that general depression in trade, which for several months had occasioned a serious diminution in the traffic by the railway. They regret to be obliged to state, that the distress which, at that time, had just overtaken the mercantile community, has since increased and extended, in a degree almost unprecedented; destroying con-

fidence, curtailing manufactures, diminishing exports, and assuming the fearful character of a national calamity.

It could not be expected that the railway, considered as a public carrying establishment, should escape the general pressure. Intimately connected with the trade and commerce of the country, the traffic by the railway, in the *merchandise department*, has diminished with the diminished trade of this great commercial and manufacturing district. In the travelling department the receipts have somewhat exceeded those of the corresponding period of 1836; but our judgment of the receipts in both departments, should be formed, not by simple comparison with the receipts of last year, but by an estimate of that *ratio of increase*, the anticipation of which was warranted by former experience, and which only the prevailing stagnation in all mercantile adventure could have prevented.

Since the meeting of proprietors in March last, the Grand Junction Railway has been opened, for the conveyance of passengers, between Liverpool and Manchester, and Birmingham. Proprietors are aware that the engines and carriages of the Grand Junction Company pass along the Liverpool and Manchester line, as far as the Warrington Junction. A considerable accession of revenue may be expected from this source. The last half-year's receipts, however, are not improved by any income from this quarter; the opening of the Grand Junction Railway not having taken place till the 4th of the present month.

The Act of Parliament for powers to raise additional capital for the re-laying of the road with stronger rails, and for the general completion of the works, has received the Royal assent. By this Act, the Company are empowered to hold their Annual General Meeting for choosing Directors, in January, in each year, instead of in March. By this alteration, shareholders will be saved the inconvenience of attending a formal meeting in March, so soon after the more important meeting in January. Proprietors, accordingly, will be so good as to recollect, that the choosing of five Directors, in the place of those which go out by rotation, will take place at the General Meeting in January next.

The re-laying of the road with stronger rails has been continued with little intermission through the last six months; the whole line will be completed in a few weeks from the present time.

The building of a handsome and commodious arrival station at Manchester, has been commenced; and the last suit of offices and package-rooms, at the Lime-street station, is now in progress. These works will be completed before the meeting of proprietors in January next.

In their last Report, the Directors informed the proprietors, that in the management of the railway, their primary object had been to provide that full satisfaction to the public, which affords, in its turn, the surest basis for the permanent prosperity of the railway.

In the half-year just closed, the coaching department has been conducted in a manner superior to what they had previously been able to accomplish. There have been more departures in the day, and the trips have been performed with greater expedition, and with more uniform punctuality; add to which, passengers at the Liverpool end are brought by the new tunnel, to the middle of the town, instead of being set down in Crown-street, a mile and a-half from the centre of business. The means employed to attain this end have been principally a larger and superior class of locomotive engines, and very complete machinery for working the new tunnel.

The Directors regret that these improved, but at the same time, more costly arrangements, should have been brought into operation in a season of commercial difficulty; that when the Company were prepared to meet an enlarged business, the aggregate traffic should have been curtailed; that the scale of operations and expenditure should have been enlarged, in expectation of an increased business; while, owing to the peculiar circumstances and pressure of the times, the receipts have been diminished. The Directors nevertheless feel confident that the unremitting efforts of the Company to satisfy the expectations of the public will ultimately conduce to the permanent prosperity of the concern.

The following is a Statement of Receipts and Disbursements for the Half-year ending 30th June, 1837.

Receipts.	£.	s.	d.
Coaching department	59,956	4	6
Merchandize ditto	42,698	13	4
Coal ditto	3,296	18	2
	105,951	16	0

Expenses.		£	s.	d.
Bad debt	account	221	18	0
Coach disbursement	ditto	10296	11	6
Carrying disbursement	ditto	9646	12	1
Coal disbursement	ditto	313	1	2
Cartage (Liverpool)	ditto	321	9	1
Ditto (Manchester)	ditto	3613	2	0
Charge for direction	ditto	366	9	0
Compensation (coaching)	ditto	59	9	6
Ditto (carrying)	ditto	201	0	3
Coach-office establishment	do.	840	7	10
Engineering department	ditto	125	0	0
Interest	ditto	6253	8	3
Locomotive power	ditto	22154	19	6
Law disbursement	ditto	150	0	0
Maintenance of way	ditto	4113	4	3
Office establishment	ditto	1002	2	8
Police	ditto	1158	17	8
Petty Disbursement	ditto	50	5	2

			£.	s.	d.
Rent	account .	494 19 7			
Repairs to walls and fences	do. . .	876 7 3			
Stationary engine disbursement	.	965 6 6			
Tunnel disbursement	ditto . .	476 17 3			
Tax and rate	ditto . .	2509 18 3			
Waggon disbursement	ditto . .	2861 7 2			
North tunnel	ditto . .	1116 19 6			
			70189	13	5
Nett profit for six months . . .			35762	2	7

Statement of Receipts and Expenditure on Capital Account, from the Commencement of the Undertaking to 30th June, 1837.

The Treasurer, Dr. to—

Amount of joint capital in shares and loans .	1,292,657	10	0
Amount of dividends not paid	1,141	6	2
Amount of reserved fund and interest . . .	4,262	4	8
Surplus in hand after payment of the thirteenth dividend in February, 1837	6,377	15	11
Nett profit for the half-year ending 30th June, 1837	35,762	2	7
	1,340,200	19	4

The Treasurer, Cr.

By amount of Expenditure on the construction of the way and the works, including the new station in Lime-street, &c.	1,326,536	10	6
By ditto of balance of book debts due to the Company	13,664	8	10
	1,340,200	19	4

By the foregoing statement of Disbursements, and a reference to previous reports, it will be perceived, that the gross receipts for the six months, ending 30th June, 1837, *fall short of* the corresponding receipts of 1836, by 3,405*l.*; whereas the receipts of the half-year, ending 30th June, 1836, *exceeded* those of 1835, by more than that amount.

While the receipts have been thus diminished, proprietors are aware that a half-yearly dividend must now be paid, on the first *Instalment of* 10*l. per Share* on the 7,968 new fifty pound shares, created in July last, as well as on 136½ new shares (issued in quarters) which the Directors were empowered to sell, to make up the aggregate capital authorized by the Act.

To the nett profit as per the foregoing statement	35,762	2	7
Must be added the surplus after paying the half-year's dividend in January last	6,377	15	11
Making a disposable nett balance of . .	42,139	18	6

The shares on which a dividend is to be declared, are—

	£.	£. s. d.
The old shares as heretofore, equalling	7,968¾	100 shares.
The 10*l.* instalment on 7,968 fifty pound shares, equalling	796⅘	100 shares.
And on the new shares sold by the Directors	136⅕	100 shares.
Equalling, in all . .	8,902⅕	100 shares.

The Directors recommend to the proprietors a dividend on this number of shares of 4*l.* 10s. per share, making 40,059*l.* 4s. 6d., which, deducted from the disposable fund above stated	42,139	18 6
	40,059	4 6
Will leave a balance of	2,080	14 0

to be carried to the credit of the next half-year's account.

CHARLES LAWRENCE, *Chairman.*

Liverpool, July 26, 1837.

GRAND JUNCTION RAILWAY.—REPORT OF THE DIRECTORS.

THE Fifth Annual General Meeting of the Proprietors was held in Liverpool, September 7th, 1837,—JOHN MOSS, Esq., in the chair:—

The Directors meet the Shareholders on the present occasion under circumstances of peculiar satisfaction. The expectations which were held out at the commencement of the undertaking, and which have been renewed at every succeeding Meeting with increased confidence, are now realized; and the road is opened for that most important branch of its traffic—the conveyance of passengers.

The time is gone by for expatiating on the general utility of railways; on the speed, safety, economy, and comfort which they afford; and on the mighty changes they are destined to effect in all the arrangements of society; but it has fallen to the lot of this Company to be the first to exhibit to the country the practical working of a railway nearly a hundred miles in length, and forming the main route through the heart of the kingdom to Scotland and Ireland, and to the populous manufacturing and commercial districts of the north. The opening of a railway of this character and extent may be said to be an event of national importance: and the results will be looked to with intense interest by the public at large, and especially by those who have embarked their property in enterprizes of a similar kind. The experience of the first two

months has been as satisfactory as the most sanguine could desire; most of the direct public conveyances have been superseded, and many of the collateral ones have been diverted upon the railway: private travelling on the line of country traversed by the railway has been annihilated; whilst, at the same time, the posting upon all the routes pointing towards it has been stimulated in an extraordinary degree. Liverpool and Manchester have been brought within a night's post of London,—an advantage in which not only the places bordering upon the railway have participated, but others lying considerably wide of, and beyond it; the extent of which accommodation will be best appreciated by the fact that no fewer than about 740 mail-bags are taken up and set down every day at the several stations on the railway. Much credit, indeed, is due to the Post-office authorities for the prompt and efficient manner in which they have adapted their system to the new order of things; and, though the Directors are of opinion that the remuneration is by no means adequate, either with reference to the service performed, or the great benefit derived by the public, they have felt it to be their duty to afford every facility, and to consider the profit to the Company in this case as a matter of secondary importance.

The gross receipts from the opening, on the 4th July, to the 2d September, have been as follows:—

	£.	s.	d.
For the week ending July 8th	3,224	15	7
,, ,, 15th	4,910	19	11
,, ,, 22d	5,452	10	7
,, ,, 29th	4,673	12	10
,, August 5th	4,887	4	0
,, ,, 12th	5,873	19	1
,, ,, 19th	6,304	1	8
,, ,, 26th	5,649	5	8
,, Sept. 2d	5,395	16	9
	£40,462	6	1

Of which receipts the following is an analysis:—

	PASSENGERS. 1st Class.	2d Class.	RECEIPTS. £. s. d.
1 Liverpool to Birmingham	5,706	2,840	7,893 9 6
2 Birmingham to Liverpool	6,542½	3,570	9,166 10 8
3 Stations on the line to Liverpool	4,870	3,300	3,535 1 9
4 Liverpool to stations on the line	4,441	3,320	3,199 10 0
5 Stations on the line to Birmingham	5,067	4,297½	2,191 0 6
6 Birmingham to stations on the line	5,748½	5,263	2,476 6 0

N.B. The traffic between these four points only and Manchester would be affected by the lines from Manchester to Stafford and Manchester to Crewe.

			£. s. d.
7 Manchester to Birmingham	2,588	978½	3,425 10 0
8 Birmingham to Manchester	2,567	1,241	3,535 15 6
9 Stations south of Crewe to Manchester	800½	674	895 15 6
10 Manchester to stations south of Crewe	640½	651½	825 14 6
11 Stations north of Crewe (inclusive) to Manchester	1,656½	1,440	721 13 6
12 Manchester to stations north of Crewe (inclusive)	1,637½	1,919½	803 7 6
13 From one station to another	6,621	15,840½	3,247 19 0
	48,888	45,341½	41,942 11 9
Parcels			2,396 1 4
Gentlemen's Carriages			1,483 6 0
Horses			520 7 0
Expresses			120 0 0
Total			£46,462 6 1

From the foregoing analysis are elicited two facts, highly important to the interests of the Company, namely, the large amount received in what is called road money, or short fares, a portion of the revenue which cannot easily be alienated; and the small receipts, whether considered positively or relatively, of the Manchester part of the traffic. This latter result, though it has disappointed the expectations of the Directors, may be looked upon as having a favourable bearing upon the permanent prosperity of the concern. It has not only shown how exaggerated were the estimates of the Manchester business, but it has added another to the many proofs of the fallaciousness of Parliamentary evidence; and, by removing the delusion which has so long existed on this subject, it may tend to limit the views of the subscribers to railways for which Acts have been lately obtained.

It would be premature in the Directors to offer a very decided opinion as to the future. If, on the one hand, the receipts have been swelled by novelty and a favourable season of the year, it must be remembered, on the other, that they have derived no aid from the carriage of merchandise and live stock;—three coaches, besides, are still running from Liverpool, and five from Manchester to Birmingham, or to London; these, however, are chiefly for the convenience of intermediate places, and cannot long survive the competition of the railway. But the traffic of the line will not be fully developed until the opening of the London and Birmingham Railway, when the increased facilities of intercourse with the

metropolis will give an impulse and a motive for travelling to which it is not easy to prescribe limits.

Of the current expenses no very accurate estimate can be made. The stock of engines, coaches, &c. being new, and of the best construction, the repairs have been light; and the line, moreover, has been exempt from any of those serious accidents which add so largely to this item. The road is, also, still in the hands of the contractors, by whom the Company are relieved for the first year from another costly item—the maintenance of way. Upon the whole, however, it may be safely asserted, that the expenses will be less, in proportion to the receipts, than upon a shorter line.

With reference to the general arrangements, the fares, hours of departure, stopping-places, &c., the Directors trust, from the few alterations which it has been found necessary to make, that they have been fortunate in meeting the wishes and convenience of the public. The journeys, making due allowance for the inexperience of all concerned, the distance, and the unfinished state of the stations, have been performed with much regularity. Many of the detentions have arisen from trivial causes, and some from a deficiency of locomotive engines, which has already been provided against by an order for a large additional supply. The gradients of the railway, to prove the unfitness of which for the purposes of a main line so much pains were taken before Parliament and elsewhere, have in no instance been found an impediment. The engines can surmount the Madeley summit, with a train of more than 200 passengers, and their luggage (a load far exceeding the average), without any material diminution of speed; nor is there any difficulty experienced in the same engine performing a trip to Birmingham and back again in the day.

The shareholders were apprised, at a former meeting, of the arrangement which has been concluded for the use of the Liverpool and Manchester Railway by this Company. With a single exception, the business has gone on harmoniously, and to the satisfaction of both parties. A difference, however, has unfortunately arisen on the subject of the use of the Liverpool and Manchester Railway, by the Grand Junction, on the Sunday, between the hours of ten o'clock in the morning and four o'clock in the afternoon, contrary to an express by-law of the Company. The arrangement between the Companies was concluded without any mention on the part of the Liverpool and Manchester Company of this by-law, although it has long been in existence. It is to be hoped that the Liverpool and Manchester Company must perceive that, although such a regulation may be expedient and practicable on a short line, it assumes a very different character if enforced to the stoppage of mails and passengers along an entire distance of 100 miles. The Directors, therefore, while they earnestly deprecate the charge of indifference to the observance of the Sabbath, or a desire to infringe the regulations of the Liverpool

and Manchester Company, feel that in a case like this the necessity of some arrangement appears to be clear and inevitable. In this conviction they will endeavour to effect a settlement of the question satisfactory to both parties, and consistent with the exigencies of the case. But they are compelled to state that the Secretary of the Post-office, in reply to an application made with a view to some change in the Sunday departures, has formally "declined being a party to an arrangement (for the suspension of any of the trains on that day) that will so vitally affect the public interests."

Allusion has already been made to rival lines of railway. A large portion of the time and attention of the Directors was occupied during the last session of Parliament, in endeavouring to protect the interests of the Grand Junction against the uncalled-for interference of competing lines. In their opposition to the South Union, they were completely successful; and, as may be gathered from the analysis of the receipts, the traffic which would be abstracted from the Grand Junction by the Manchester and Stafford (for which an Act was obtained), cannot be a very serious loss to this Company. In the case of the Birkenhead and Chester they were less fortunate. That Act was granted, Parliament having refused to regard the project, brought forward with the specious pretext of giving Chester an independent communication with Liverpool, as competing with the Grand Junction Railway. In order to combat this scheme the more effectually, the Directors caused surveys to be made for a line, to leave the Grand Junction at Moore, and crossing the Mersey at Fiddler's Ferry, to join the Liverpool and Manchester at Huyton; by which seven miles would be saved in distance, besides avoiding the Newton inclined plane, as well as the Sutton and Whiston inclines on the Liverpool and Manchester Railway. Plans and sections for this line are deposited, and the Directors are disposed, with the concurrence of the proprietors, to apply for an Act in the approaching session. The cost is estimated at 250,000*l.*, which may be raised either by loans, or by a mode perhaps more preferable—the creation of additional shares.

The Directors have to call the attention of the shareholders to another improvement of the line, which, though on a minor scale, may not be less important in its consequences. They allude to the effecting of a more convenient and direct communication between the London and Birmingham and Grand Junction, at Birmingham. From the best information which they can obtain, they are satisfied that the destination of a large majority of persons travelling upon the Railway is to parts beyond Birmingham; and to these, the annoyance and loss of time in the change of coaches and transferring of luggage will be a constant source of complaint. To such as are unacquainted with the localities, it may be necessary to state that the two railways, though coming from opposite points, enter Birmingham almost parallel to each other; the consequence of

which is, that the coaches, having arrived by the one line, must be turned singly upon a turn-plate, and remarshalled in a train, before they can depart on the other. It is to avoid this detention that the Directors propose to carry an embankment from the present temporary station at Vauxhall, to join the London and Birmingham about a mile from their own station. The length of this branch will be about three quarters of a mile, and the cost of making it is estimated at 20,000*l.* to 25,000*l.* The object is not so much the saving of distance as of time. It would reduce the stoppage at Birmingham to a few minutes, and would enable the train to proceed uninterruptedly for 200 miles, with merely a change of engine at Vauxhall, where a fresh one would be in readiness to start, whether the train was before or after its time. Overtures have been made by the Directors of the London and Birmingham Board to join in this arrangement, and to admit this Company to the use of their station, in Curzon-street, for such portion of their traffic as belonged exclusively to Birmingham. The former proposal was positively declined; and the latter, though acceded to, was coupled with conditions, which, in the Directors' opinion, rendered the acceptance of it incompatible with the free and independent management of their own line. Under these circumstances, the Directors recommend the proprietors to authorize them to take the necessary steps for the construction of the Branch Line at the expense of this Company. They are convinced that sooner or later the public will demand this accommodation; and under this impression they shall regret the expenditure of a large sum of money in erecting a complete passenger station in Curzon-street, which in a few years will be superseded. Plans and specifications, however, are now advertised; but it is a subject deserving of serious consideration whether the commencement of the works should not be postponed for the present. Meanwhile the station for merchandize may be proceeded with; and the communication with the London and Birmingham Line, at the termination in Curzon-street, completed.

A statement of accounts will be laid before the meeting, by which it will be seen that the capital expended upon the works, including the purchase of the Warrington and Newton Railway, and of engines, coaches, and waggons, up to the 30th June, is 1,469,811*l.* 4s. 5d.

There is still remaining 10*l.* uncalled, of which 5*l.* per share will be required in the present year; and the rest in the first half of the next, for the completion of the road, the stations, and for the purchase of additional stock.

The Directors cannot conclude their report without a special notice of the professional services of those who have been the most prominently engaged upon the undertaking from first to last. To Mr. Stephenson, whose connexion with the Company ceased very soon after the commencement of the works, belongs the merit of having pointed out the formidable engineering difficulties of a

portion of the line as originally laid out, and of substituting another, though of some sacrifice in point of distance, which the result has shown to be both practical and economical.

The execution of the works, with all the variety of detail belonging to it, has devolved wholly upon Mr. Locke, the engineer in chief, who has devoted himself to the discharge of his responsible duties, with an ability, zeal, and, above all, an untiring energy, which have fully justified the implicit confidence which has been reposed in him on all occasions; and it is a gratifying reflection, that he has earned for himself, in the service of this Company, a reputation which will confer upon him those solid advantages which are the sure reward of professional distinction.

In negotiating for the purchase of land, in the settlement of claims for compensation, and in the general legal business of the Company, the Directors have received the most efficient assistance from their law adviser, Mr. Swift; but his abilities have been more conspicuously displayed during the several Parliamentary campaigns in which he has been engaged on behalf of the railway; a branch of practice requiring much tact, judgment, and discretion. The duties of Treasurer and Secretary have been ably executed by Mr. Chorley; and the order and regularity of his office, and the correctness of the books and accounts, are highly creditable to his superintendence. New duties have also fallen upon him since the opening of the railway, which he has cheerfully and zealously performed.

Though much has been accomplished, much remains to be done, before the concern can be brought to that state of completeness and efficiency which can alone secure the interest of the proprietors and the favour of the public. The Directors do not despair of overcoming, in due time, every difficulty; but for the present they claim that indulgence and forbearance which it is only reasonable should be shown during the infancy of every undertaking.

Liverpool, Sept. 7, 1837. JOHN MOSS, *Chairman.*

Statement of Receipts and Expenditure, to June 30th, 1837.

			£.	s.	d.
Capital, 90*l.* called on 10,400 shares	936,000	0 0			
518 Warrington and Newton shares, at par of 100*l.*	51,800	0 0			
		987,800 0 0			
Less sums expended by the late Liverpool and Birmingham, and Birmingham and Liverpool Companies, previously to the formation of this Company, in their unsuccessful endeavour to obtain an Act of Incorporation		26,225 16 5			
			961,574	3	7
Loans	491,957	0 0			
Amount borrowed to replace loans —notice to repay which has given	45,000	0 0			
			536,957	0	0
Interest on Bank account and from Exchequer Bills			9,233	1	
Due to contractors—Balance of reserves			4,385	15	
			£1,512,150		

Expended.

	£.	s.	d.
Parliamentary expenses	22,757	10	4
Land and compensation	211,230	6	11
Law charges, conveyancing, stamps, &c., together with payments for advertising, travelling, and other expenses and disbursements connected with the law department and Parliamentary business	20,794	0	3
Contracts for works	748,698	5	3
Engineering and surveying expenses	23,823	18	3
General charges and office expenses, including advertising, printing, rent, Treasurer's and Clerks' salaries, &c.	4,551	5	10
Direction	3,134	5	0
Travelling	1,240	15	2
Stations	8,222	7	11
Locomotive engines and tenders	17,141	0	0
Building carriages and waggons	65,849	0	8
Rails, chairs, and keys	254,426	3	9
Sundry disbursements connected with coaching establishment	192	0	10
Purchase of Warrington and Newton Line, less surplus income	65,479	6	0
Interest on loans	22,270	18	3
Cash in bankers' hands	25,835	17	4
Arrears of calls, less amount of Warrington and Newton interest not yet called for	16,502	18	7
	£1,512,150	0	4

GREAT WESTERN RAILWAY.

THE Fourth Half-yearly General Meeting of the Great Western Railway Company was held at Bristol, August 31, 1837, ROBERT BRIGHT, Esq., in the Chair.

Since the last half-yearly meeting of the proprietors, the course they have so repeatedly approved of expediting the works for the early completion of portions of the railway, has been steadily pursued by the Directors; without, however, disregarding the ultimate and important object of the Company in the formation of the entire line between London and Bristol, within the shortest possible period.

The chief progress has naturally been made in the line between London and Maidenhead, which has always been stated to offer the greatest capability of rapid construction, combined with a large comparative return for the capital expended on it.

It will be in the recollection of the proprietors, that a Bill was only introduced in the last session for making the railway between Acton and Paddington, a distance of four miles, comprehending some heavy earth-work to be executed, as well as the construction of the London station of the Company. A very unexpected delay in obtaining that Bill, under circumstances which the Directors could not control, materially retarded the commencement of some of the works, which could not be safely commenced

without the sanction of Parliament; but they have pleasure in stating that, although the Royal Assent was only given on the 3d of July, the contract works between Paddington and Maidenhead are in such a state of forwardness as to ensure their completion early in October. The time necessary for laying the permanent rails in a manner quite satisfactory to the engineer, in addition to circumstances previously alluded to, may probably induce the Directors to defer the opening of the railway somewhat beyond the period first contemplated; but they feel so strongly the vital importance of attention to this point, as well as of making every preparatory arrangement for the complicated and extensive business of the line as perfect as possible, that they have resolved fully to attain those objects, before they permit any traffic to pass on the railway, even if this should involve a delay in the opening until the month of November.

Between Bristol and Bath, every exertion has been made on the part of your Directors to expedite the completion of the line, which the peculiar character of the works would admit of, and since our last report, not only a real, but a very evident progress has been made in them.

The bridge across the Avon at Neotham Dam, which had been much delayed, is now proceeding with spirit.

The entrance, and a considerable portion of the Brislington Tunnel, is completed to the full dimensions; and the opportunity thus afforded of ascertaining the effect of the increased height and breadth which have been adopted in the tunnels and other works of the Great Western Railway, has proved most satisfactory.

The embankment across the Keynsham Hams is completed; and the rate of progress at the next embankment, that at Saltford, has gradually increased during the last few months, and at present the work is advancing with great rapidity.

These constitute the heaviest works upon this portion of the line. Considerable delay has occurred in obtaining possession of the property at the entrance to Bath, which has necessarily retarded the commencement of the works at this point. These impediments have, within a few days, been entirely removed, and immediate steps will be taken to commence operations.

During the last session of Parliament a Bill has been obtained authorising such a deviation of the line as enables the Company to avoid the intended tunnels at Sonning and Purley, thereby leaving the railway without a single tunnel from London to Corsham, a distance of ninety-six miles; and, although the necessity of procuring the sanction of Parliament to these improvements has occasioned some postponement of the works between Reading and Chippenham, yet, as the operations in the neighbourhood of the latter place are proceeding with activity, it will not materially affect the period of their final completion; it being fully expected that the line to Twyford (within four miles of Reading) will be

completed in June next, to the town of Reading itself in the following autumn; and, at about the same time, a further distance of fifteen miles to Dudcot, where it passes within ten miles of Oxford.

The several shafts at the Box Tunnel are nearly finished, and the contracts for a considerable portion of the tunnel itself advertised. To the assertions, so confidently promulgated, that serious difficulties had arisen from the water found in the strata through which it passes, it may be briefly replied, that the quantity hitherto met with has been frequently insufficient for the ordinary purposes of the masonry.

In acknowledgment of the zealous and indefatigable attention of Lord Wharncliffe, as Chairman of the Committee on the Act of Incorporation, in the House of Lords, the viaduct over the Brent Valley has, by his Lordship's permission, been named the Wharncliffe Viaduct.

Two vacancies in your direction, occasioned by the retirement of Mr. Wildes from the London, and Mr. Roch from the Bristol Committee, have been filled up, in accordance with your Act, by the election of Mr. Charles Russell, and Mr. Frederick Ricketts; the former, from his late situation as Chairman of the Committee on your Bills, &c., in the House of Commons, peculiarly acquainted with the interests of our undertaking; and the latter, one of its earliest promoters, and Chairman of the Bristol and Exeter Railway Company. Mr. Russell resides in London, and Mr. Ricketts in Bristol.

Whilst there can be no doubt that the new Standing Orders of the House of Commons, as relating to the conditions under which future Railway Bills are to be introduced, must be highly beneficial to existing Companies, it is a source of great gratification to your Directors to report to you, that, although your own Deviation and Extension Bills were obtained in the most advantageous form, every Bill introduced into Parliament during the late session, the operation of which could have been injurious to the Great Western, has failed. Thus released from the interference of their projected rivals, your great ancillary lines, the Cheltenham Union and the Bristol and Exeter, will soon be carried on under the most favourable circumstances, possessing themselves exclusively of most important districts, and securing to themselves, and to your Company, an intercommunication which will be of the greatest value. The early formation of the whole line to Exeter, through which the entire south-western communication with the metropolis will be poured into your trains at the common terminus, is looked to by your Directors with the greatest interest.

In more particularly adverting to the progress of the works, it may be stated, that 3,000 tons of iron rails, and a sufficient quantity of timber for the construction of the permanent railway

between London and Maidenhead, and between Bristol and Bath, have been taken on contract at prices advantageous to the Company's interest, and that a supply of the requisite number of engines, carriages, and trucks, for present purposes, has been provided for the most part by contracts, made on public tender. The Directors, feeling most anxious to introduce a system of strict economy in this department, have resolved immediately to form an establishment for the construction and repair of common carriages, waggons, and trucks, in a manner which they believe will lead to a considerable saving of expense.

The verdicts given in various cases recently submitted to the decision of a jury, have afforded just ground of satisfaction to the Directors; to which it may be added, that the only two injunctions obtained against the Company were, upon argument, dismissed with costs against the parties.

The space allotted for the depot in London, for goods, will, for the present, be employed as a temporary station for passengers until the permanent buildings can be erected, and the several stations between London and Maidenhead have been determined on with a view to the public convenience of the towns and places contiguous to the line, arranged on such a system as to attract the utmost amount of traffic to the Railway.

An enactment in the Bill, however, precludes the Directors from constructing any station or depot within three miles of Eton College without the consent of the Provost and Fellows of that Establishment, which, it is feared, will deprive the public of that accommodation to which they would otherwise be justly entitled at the hands of the Company. The trains will, of course, convey any passengers who may be desirous of travelling to or from the neighbourhood of Slough, and the Directors can only regret that they are not at liberty to provide the ordinary conveniences of a station for persons waiting there to be received on the railway.

Arrangements are in progress for the conveyance of the mails, as well as with the coach-proprietors, post-masters, &c., for providing means in connexion with the railroad, for the continuation of journeys by coaches and posting beyond Maidenhead, to all places on the same route; and it is confidently believed that these, together with the extensive and increasing traffic demonstrable on the lines already opened, will, ere long, realize the most favourable anticipations of the success of your Company.

The accounts to the 30th of June are appended to this Report; and the Directors, having fully considered the propriety of submitting to the Company the Clause, No. 239, in their Act, giving a discretionary power to the proprietors of raising money by mortgage in anticipation of their capital, think it right to acquaint you that they propose to recommend the exercise of that power, as soon as 1,250,000*l.* shall have been received, with a view to limit

or defer the future calls on the proprietors to such extent, and in such manner, as may hereafter be determined.

ROBERT BRIGHT, *Chairman.*

Statement of Receipts and Payments to the 30th of June, 1837.

Amount received on account of capital, to June 30, 1837. .				1,052,970 0 0
Ditto	on account of interest on investments, &c. .			6,546 6 8
Ditto	for registration fees, &c.			510 2 6
				£1,060,026 9 2
Expenses before the Act, to October 24, 1835, as per statement		£88,710 10 11		
Payments to December 31, 1835 . . .		4,322 1 5		
Ditto to June 30, 1836		92,512 9 6		
Ditto to December 31, 1836 . . .		258,470 13 4		

Payments from the 1st of January to the 30th of June, 1837.

Land and compensation . .	77,790 3 6		
Contracts for works . . .	211,932 19 9		
Freehold premises in Princes-street	5,090 16 6		
Engineering, surveyors, &c. .	10,157 12 9		
Advertisements, printing, &c.	768 4 8		
Travelling expenses . . .	292 2 0		
Land valuers purchasing land	2,314 5 6		
Law charges, conveyancing, and costs of title . . .	1,467 19 9		
Parliamentary expenses . .	3,391 5 6		
Office expenses, directions, salaries, postages, &c. . .	3,294 13 10		
		316,500 3 9	
			760,515 18 11
			£299,510 10 3

ROBERT BRIGHT, *Chairman.*

General Abstract of Expenditure, from the passing of the Act to 30th June, 1837.—*Half-yearly Statements.*

Rendered to the proprietors, to	31 Dec. 1835.	to 30 June, 1836.	to 31 Dec. 1836.	to 30 June, 1837.	TOTAL.
	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
Land and compensation .	2,440 10 0	61,922 10 10	136,910 11 0	77,790 3 6	279,063 15 4
Contracts for works . . .	" " "	15,354 12 4	88,556 11 6	211,932 19 9	315,844 3 7
Freehold premises in Princes-street	" " "	" " "	10,103 10 0	5,090 16 6	15,194 6 6
Engineering, surveyors, &c.	" " "	10,769 17 8	11,628 17 2	10,157 12 9	32,556 7 7
Printing and advertisements	103 16 6	295 11 7	380 7 5	768 4 8	1,548 0 2
Travelling expenses . .	108 8 2	242 2 5	373 2 10	292 2 0	1,015 15 5
Land valuers purchasing Land	" " "	" " "	729 4 0	2,314 5 6	3,043 9 6
Law charges, conveyancing, and cost of title .	" " "	44 11 0	3,865 13 3	1,467 19 9	5,378 4 0
Parliamentary expenses .	" " "	" " "	3,039 10 10	3,391 5 6	6,430 16 4
Office expenses, direction, salaries, postages, &c.	1,669 6 9	3,883 3 8	2,883 5 4	3,294 13 10	11,730 9 7
	4,322 1 5	92,512 9 6	258,470 13 4	316,500 3 9	
					£671,805 8 0

GREENWICH RAILWAY.

Report of James Walker, Esq., Civil Engineer, on the Works of the London and Greenwich Railway, made the 25th of August, 1837.

Mr. Yates (Deputy Chairman of the London and Greenwich Railway) having called upon me and informed me that a Committee of Inquiry of the Proprietors were, with the concurrence of the Directors, desirous that I should survey and report on the work, I attended a Meeting at the Railway Office on the same day (the 15th of August), when Mr. Yates and several members of the Committee were present; and I was then instructed to furnish a statement of my opinion of the present condition of the works, in reference to their construction, state of repairs, and security, and whether the design and execution of the works are calculated to answer the purposes intended, and also to point out the nature of any defects I might discover in any of the above respects, and the manner and expense of rectifying them.

Having, since the above, surveyed the works of the railway with Mr. Landmann and his assistant, Mr. Pinhorn, and also with Mr. Whishaw, an uninterested engineer, who has paid particular attention to this railway from its commencement and during the progress of the work, for his publication on this and other railways, I have now briefly to report my opinion of the principal parts separately, from which my general opinion, as above requested, will be deduced.

Piers.—The brick piers, which support the arches, are the most expensive and important feature of the work. These carry the Railway for its whole length, and are founded at various depths, from four to twenty-three feet, under the surface, as the nature of the ground varied. For about a quarter of a mile, between the quarter and half mile from the London or west end, the parapet shows a line irregular in direction, and to the extent at one point of nearly six inches below the proper level, which is only to be accounted for by a settlement of the ground, or of the concrete foundation, at three-quarters of a mile from the west end; also a few of the piers appear to have sunk, though not so much as the above, but the principal sinking has been in about twenty of the piers near the common sewer, called Earl Sewer, to the extent, in the middle, of fourteen inches. The former of these is, I think, reasonably accounted for by the very rapid way in which the work was built and loaded, and the latter by the great depth to which the Earl Sewer works was obliged to be carried; but I do not think this cause sufficient to account for the settlement of so many piers had they been well founded. The piers that have settled have generally a leaning towards the sewer—a few of them to the extent of four inches in the height. The arches now form a

preventive to the further leaning over, and Mr. Landmann assures me that for fourteen months the settlement of these piers has not increased. The state of the cemented string over the piers, which exhibits a defect at only two of the piers close to the sewer, corroborates Mr. L.'s statement, and neither in these nor in the piers near the upper end, already referred to, nor in any other of about seven hundred to eight hundred piers along the whole length of the line, including the arcade, although founded at various depths, and on different soils, as has been named, have I, or either of the two assistants who accompanied me, been able to discover the smallest crack or fracture in a single brick. This is very creditable and satisfactory. The bricks are sound, the mortar excellent, the workmanship not the best, but respectable; and, on the whole, I cannot discover any reason for at all doubting the security and permanency of the piers, which I consider on the whole a good and substantial work.

ARCHES.—The materials of the arches are the same as of the piers, but from the nature of the work, particularly the soffit, or under part of the arch, more care is required to make the work look well, by removing the superfluous mortar, and pointing after the centres are struck. This care not having been taken, the work looks rough. Where the mortar is deficient in the joints, some filling up is requisite: this should be done, not for appearance only, but also for use: the expense would be small. For a considerable length towards the middle of the line, the arches have been begun before the centres for them were placed, and the curve is very imperfectly preserved: this is another eye-sore, and on the whole the arches appear to have been done with less care and greater hurry than the piers. Although the work is generally sound, and notwithstanding the great wear that came upon them so soon after they were turned, there is, with the exception I shall presently notice, no appearance of failure; but, on the contrary, the experience that has been had gives reason for confidence in the general design of carrying a railway upon arches.

It appears that a few of the arches, not exceeding four in number, after being turned were obliged to be taken down. I have been particular in my inquiries as to these, and my conclusion is, that it was confined to arches from which the temporary support was improperly removed too soon, or before they were abutted by other arches, and therefore these form a [no?] criterion for any general opinion. The exception to which I have above referred, is a bulging out of the face of the spandril walls of some of the arches, and in some cases a slight separation in the bricks of the arch itself, caused by the action of the trains tending to press out laterally the material upon which the blocks are bedded, when that material is of a soft nature: this pressure is communicated to the side wall, which in some cases has yielded to it, and in other cases a separation or fracture in the arch is visible. Mr. Land-

mann informs me that the above is entirely confined to the arches, which, to save time and expence, he was urged to fill over with an inferior material; that this was only for a mile in length, at the upper end, and that where concrete is used there is no apparent tendency to bulge or separate. My survey confirms this, with the exception of about two spandrils only, but I think it would be well not to confine to the mile the means Mr. L. is properly taking to prevent the evil by iron-tie bars extending across the width of the arch, and built into the spandril walls on each side.

I did not think proper to have openings made for examining the concrete, but in two places at the upper end, which I found open for placing the bars, it was not good.

Drainage.—In the upper mile and half, the rain which falls upon the line is carried by a small drain to the end of each pier; and, with the exception of the arcade, where, from the length of the arches, the water does not run off, there is very little leakage indeed through the arches. In the eastern half the water is conveyed by a brick surface-drain to the large piers, and thence through a vertical drain in the body of the pier to the bottom, where it is discharged at the surface of the ground through an opening in the pier. There are modifications of this plan in different piers, which show a want of decision as to which is the best, but generally it has not answered so well as the plan of drainage at each pier. The rain gets down by the side of the blocks, under the level of the surface-drain; and when this is so, it is extremely difficult, by any covering or cementing of the arch, to prevent a moisture through the brickwork. The defect appears, more or less, in most of the arches for two miles in length. In some cases, after a very heavy rain, when I took the opportunity to examine it, the water was dropping through the arches.

This is an imperfection; but the leakage is not generally such as to cause danger; on the contrary, I think that time will close most of them. It would be wrong, however, to trust entirely to this, for fear of the frost injuring the bricks where the worst leakage is. Means should also be taken to clear the foundations of the piers, and the space generally under and at the side of the arches, of rain water, by a culvert having openings into the side ditches.

There is as yet no provision of this kind—a proof of the stability of the piers, and that Mr. Landmann was not afraid of testing them; but the appearance must be bad in winter, even now it is by no means creditable.

Bridges.—The viaducts, or bridges, under the line are numerous, and, with one exception, are built of brick of various spans, and some of very great obliquity and difficulty. I have never seen brick-work applied more boldly, or, so far as present appearances go, with greater success, for I scarcely noticed the smallest fracture, or failure of any kind, in any one bridge upon

the line. The arches of the bridges have been pointed, which much improves their appearance: the workmanship is, on the whole, very creditable. The bridge over Bermondsey-street is cast iron, very oblique and flat, and is entitled to the same character as the other bridges.

Stone-work.—The stone-work is throughout well and carefully done, and with good materials. I did not notice a bad joint, or a fractured stone.

Cement Coping.—The parapet walls are coped with bricks built with cement, which is covered over with cement plastering, to resemble stone coping. The cement covering is fractured and out of repair for a great part of the line. That this defect is generally caused by moisture and frost, or inferior cement, and not by sinking, is evident from the cement string (of which Mr. Landmann assures me scarcely any part has been done since the first) being, with very little exception, perfect, even where the coping is the worst.

Blocks.—The blocks, for carrying the rails, are partly of granite and partly of Bramley fall—the two very best kinds of stone, but some of the granite is of a very *coarse* quality, which ought to have been and probably would have been rejected but for the great difficulty which Mr. Landmann states there was in obtaining granite of any kind within the time fixed for the opening.

Chairs.—The bottoms of the first cast-iron chairs have, like those of most other railways, been thin for the work. Several have been broken and replaced by new.

Rails, &c.—The iron rails in the western half of the line are of good quality, and have suffered very little by the wear. From near the mile-and-a-half mark there is an evident change for the worse in the manufacture, or welding of the iron, and considerable defects already appear in many of them. The weight of rails, 50 lbs. per yard, I consider sufficient for a passengers' line, and that the form of the rail is good. The pins that connect the chairs with the blocks are too small, so that, for a great proportion of the line, they are loose, and hence, in a great degree, the rattling noise and shaking as the carriages pass over them; but, with so heavy a body passing, with great velocity over hard surfaces, it is difficult, perhaps impossible, to entirely prevent movement. The general construction of this railway, as respects the blocks, the chairs, and rails, is nearly the same as that of the other great lines of railway at present in use, in which an inconvenience has been felt by the materials being too hard and unyielding, and engineers are now exerting themselves to find a plan which shall possess a degree of softness and elasticity, and at the same time be durable.

The Great Western use Kyanised timber only; the Manchester and Bolton Company are using timber only; and the Dublin and Kingstown Company are taking up the stone blocks, and mean to

substitute timber, by which they calculate upon a great saving in the cost of engines working the line. My opinion is, that the arches of the Greenwich Railway render it peculiarly adapted to the use of timber, because it may be so laid as to be less liable to decay than in solid embankment, or cutting, and because, any apprehension of injury to the arches, from the shake of the engines, would be thus much lessened; so, also, the wear of the engines and rails, and the noise and discomfort to passengers, arising partly from the hardness of the substructure and the hollow arches' close parapets; and, to bring the present rails into use, the continuous bearing of the rail upon the timber must be dispensed with, but the length of bearing may be lessened at a small expense by intermediate supports upon the timber. The subject is very deserving of the Company's early consideration. The cost would be 2,000*l.* to 2,500*l.* per mile.

Having thus stated, in detail, my opinion of the different parts of the railway, I think the fair conclusion to be drawn is, that, although the works are not perfect (and I know no work of the kind that is), and, although there are defects of the nature, and to the extent I have stated, yet, as respects the *essentials*, they are, in design and execution, calculated to answer the purpose which they were intended to secure. The work is not yet finished, and it was probably Mr. Landmann's intention to do much of what I stated, but the desires of the Directors may have induced him to do some things hurriedly, and, therefore, not in the best manner.

The expense of the principal improvement suggested by me is stated; but to estimate the various minor alterations and repairs would have required much more detail of examination than the time limited for my survey and report has enabled me to make.

Great George Street, Js. WALKER.
25th August, 1837.

P. S.—*26th August.*—Much rain having fallen this morning and forenoon, I thought right to visit the works. The necessity for the culvert I recommended, to take off the drainage into the side ditches, was apparent. The water was standing in pools round some of the foundations. I observed, also, that very little of the rain that fell upon the Railway was discharged through the drains in the piers, which I can only account for, supposing that the concrete and rubbish were absorbing it, and that the water did not get freely to the drains. The dropping through the arcade had increased, indeed I could find no proper drains for discharging the water I found standing in considerable quantity. Evidently there is a want of proper drainage in this place, which is probably to be accounted for by the extreme hurry in which the arcade, and the railway over it, was done. A great part of the evil would be remedied by giving the gravel of the way a slope towards the sides, their receiving the water in surface-gutters, and conveying it through the parapets.—J. W.

LONDON AND BIRMINGHAM RAILWAY.

THE Eighth Half-yearly General Meeting was held at Birmingham, on the 18th August, 1837, GEORGE CARR GLYN, Esq. in the chair.

The Directors on the present occasion of submitting their half-yearly report, have the satisfaction to announce, that the expectation they held out in their last report of a partial opening of the line in the course of the present summer, to the extent of twenty-one miles out of London, has now been fully realized. Early in the month of July, the engineer having reported that the works of the twenty-four and a half miles, between the Company's station, at Euston-square, in London, and Boxmoor, were in a fit state for use, the Directors decided that this portion of the railway should be opened to the public, on the 20th of that month. The trains commenced running accordingly on that day, and although the traffic has hitherto been merely derived from excursions of pleasure and curiosity, and from the journeys of the comparatively few individuals who reside in the immediate vicinity of the line, and although the departures of the trains, (in consequence of the progress of the works connected with the entire completion, and finishing off, of this portion of the railway,) are at present confined to three from each end, the number of passengers has already exceeded anticipation, and proved fully equal to the means for their conveyance.

On the 16th instant, being twenty-eight days from the first opening, 39,855 persons had been conveyed by the railway, being an average of 1,423 per day, for which the daily receipts average 159*l.*; during the last week the daily average of numbers has advanced to 1,807, and of receipts to 189*l.*

The Directors are assured by the engineer that the works which at present interfere with mid-day trains will be entirely completed, and that the whole of this part of the railway will be in excellent travelling order in the course of a month, by which time the stationary engine for the incline of the extension line will be in readiness for work, and an ample supply of locomotive engines at their command. Full effect will then be given to provisional arrangements, which have been already entered into with the principal coach proprietors, for bringing the passengers by their respective coaches upon the railway, as fast as it is in a state of readiness to receive them, which arrangements, and others calculated to bring an immediate and active traffic upon the railway, all the parties concerned appear most anxious to carry on with spirit, whenever the Directors feel satisfied that they are in a situation to perform punctually and efficiently, what the Company will then have to undertake.

The Directors cannot but notice the great advantage arising from the gradual opening of successive portions of the railway, appar-

tunity being thus afforded for organizing the arrangements required in the carrying department, and for progressively adapting them with the benefit derived from experience on a small scale, to more extended operations, whilst the road is becoming gradually and safely consolidated, and an important revenue is afforded by a limited number of passengers' trains.

The advance made towards the entire completion of all the works of the London and Birmingham Railway, and the near approach of the time at which the whole line will be opened to the public, appear to the Directors to require on their part, a communication to the proprietors of the most exact information which it is now in their power to obtain, as to the ultimate cost of the whole undertaking, the periods at which each portion of it may be reasonably expected to be opened for business, and the probable traffic. They have, in consequence, required from the engineer carefully revised estimates, of the cost of all the works in his department which are still unexecuted, and such a statement of the probable cost of those remaining works, of their entire sufficiency for the purposes of the traffic of all descriptions, to be anticipated on opening the whole line, and of the exact periods at which in all probability, each successive portion cannot now fail to be executed and completed, as he may be willing should go forth to the proprietors with the full sanction of his name and professional character.

The details will be annexed to the report, and the Directors cannot but remark with pleasure upon the assurance they have from Mr. Stephenson, at this advanced period of the works, that not only will a few weeks see the railway at the London end opened from Boxmoor to Tring, (a further advance of seven miles,) but that in the course of December next it will extend in perfect working order for business, sixteen miles farther, to Denbigh Hall at the crossing of the Holyhead-road, and at the Birmingham end as far as Rugby, making the whole length of railway which will be entirely completed, and which the Directors, therefore, hope to have opened to the public on the first of January next, seventy-seven miles. They have thus reasonable ground to hope that at this early period the entire line of railway communication between London, Birmingham, and the principal places in Lancashire, will be open to the public, with the exception only of an interval of thirty-five miles of excellent turnpike road between Rugby and Denbigh Hall. The engineer states that the proprietors may calculate with perfect confidence on the entire completion of the whole line, and of the works connected with it, in the course of the autumn of 1838.

The proprietors will see by the annexed revised estimates that the expectation of the entire completion of the railway and stations in efficient working order from end to end, and of the ample carrying establishment now contracted for, within the capital of 4,500,000*l.*, is confirmed and strengthened by the further means of

calculation afforded by the nearer approach of all the works to their termination. As far as relates to the cost of stations, engines, carriages, waggons, and indeed every item of future expenditure, excepting the unexecuted works in the engineering department, there is scarcely any opening for error or question, and the Directors think that the confident manner in which Mr. Stephenson has expressed his conviction of the sufficiency in all respects of his present revised estimates (confirmed by the circumstance that works in the hands of the Company have been let, and executed by sub-contractors considerably below the engineer's estimate), affords every security and assurance of accuracy that can be obtained on this subject. It should also be mentioned that no credit whatsoever is taken for a considerable extent of unoccupied land in possession of the Company for re-sale, as opportunities offer, and that the engineer's estimate for the carrying department includes a much larger extent of stock than will be required in the first instance, if at all. The Directors, therefore, do not hesitate to express their confident expectation that the proprietors may calculate upon having the railway completed, and in full operation within the present capital of 4,500,000*l.*, sanctioned by Parliament; and that if there should eventually prove to be any further excess in the engineering department, or if the extent of the future traffic should render expedient any extension of the works at present contemplated, the additional capital cannot be required until a large revenue has rendered it easy of attainment, and placed the proprietors in a situation to judge of the propriety of such farther outlay.

As the undertaking approached completion the probable amount of traffic to be expected became a point of great interest. In order to obtain as near an approximation to the truth as the circumstances of the case admit, a Sub-committee was appointed to examine into the subject. The result of their investigations may be stated as follows:

	Per Week. £.
That the gross receipt from passengers now travelling by coaches on the roads parallel immediately contiguous to the line of the railway, without assuming any increase, amounts at railway prices to	6,789
That the gross receipts from persons now posting on the same roads amount to	729
That the gross receipts from parcels now carried by coaches on the same roads amount to	1,571
That the gross receipts from goods now conveyed by waggons and canals on the lines between London and Birmingham, not including iron, timber, cattle, minerals, or other goods, which pay low tonnage, amount to	8,120
That the total gross receipts from the foregoing sources, assuming no increase, amount per week to	17,209
That the total annual receipts amount to	894,868

The data from which these results are obtained will be found in the report to the Board by the Sub-committee appointed to investigate the subject; copies of which document may be had by the proprietors, on application to the Secretaries.

The Directors congratulate the proprietors upon the completion and opening for traffic of the Grand Junction Railway between the Liverpool and Manchester line and Vauxhall near Birmingham, and upon the commencement of the works of the Midland Counties and North Midland Railways, connecting the London and Birmingham line with Yorkshire and the Midland Counties; all which lines form great tributary streams, the full value of which to the main trunk can scarcely be over estimated. The Birmingham and Gloucester, and the Derby and Birmingham Railway Companies also appear to contemplate the use of the entrance into Birmingham and the stations of the London and Birmingham Railway. The Directors have the pleasure of communicating the entire success of the opposition announced in their last report to the attempts to establish injurious rival lines, uncalled for by any public necessity. The judicious regulations now adopted by Parliament relative to all new lines of railway, afford ample grounds of security against the recurrence of projects of a similar description.

The Directors have to announce that the Act authorizing the Company to raise an additional million, and for other purposes, received the Royal assent on the 30th June, and that in pursuance of the resolution of the Special General Meeting of the same date an additional capital of 625,000*l.* has been created, under the powers of the Act, in 25,000 shares of 25*l.* each, which have been offered to the proprietors of 100*l.* shares, in the proportion of a 25*l.* share for each 100*l.* share. It is proposed that the new shares of 25*l.* each, which form an integral part of the capital stock of the Company, shall be entitled to the same rate of dividend as the original shares of 100*l.* each, without distinction as to the time of the payments of the calls which shall have been made respectively when a dividend is declared.

By the statements of accounts now to be laid before the proprietors, it will appear that

	£.	s.	d.
The receipts to the 30th of June, were	3,181,069	15	8
The disbursements	3,102,272	8	5
And the balance of cash in the Company's hands at that date	78,797	7	3

The proprietors in referring to the account of capital, will observe, that there remains of the 4,500,000*l.* a sum of 1,329,282*l.* 17s. 3d. applicable to the further expenditure of the Company, which, in the annexed estimate is stated at 1,313,698*l.*

Birmingham, August 18, 1837.

General Account of Receipts and Disbursements, to the 30th June, 1837.—[A]

1837.	RECEIPTS.	£.	s.	d.	£.	s.	d.
June 30.							
	Calls	2,085,448	5	11			
	In advance on shares	25,995	2	0			
					2,111,443	7	11
	Loans				1,045,717	2	9
	Miscellaneous,						
	Penalties	1,505	0	0			
	Land resold and rents	1,352	10	8			
					2,857	10	8
	Interest, viz.,						
	Exchequer bills and banker's balances	18,788	0	9			
	Calls in arrear	2,263	13	7			
					21,051	14	4
					3,181,069	15	8

	DISBURSEMENTS.						
	Payments for obtaining Act of Incorporation	72,868	18	10			
	Land and compensation	601,010	3	1			
	Conveyancing	6,328	3	4			
	Works	2,269,329	1	8			
	Engines and carriages	29,747	4	4			
	Engineering	61,171	11	0			
	Law charges	5,360	2	2			
	Advertising and printing	2,820	5	8			
	Direction	8,691	2	6			
	Office charges, salaries to Secretaries, &c.	16,801	6	5			
	Sundries, travelling charges, &c.	6,963	1	8			
	Interest on debentures	16,617	5	9			
	Stamps	4,564	2	0			
					3,102,272	8	5
	Balance at the disposal of the Company				£ 78,797	7	3

Dr.	*Capital Stock.*			
1837, June 30.		£.	s.	d.
To Calls, 85*l.* per share on	£2,500,000	2,125,000	0	0
Nil on 25*l.* shares	625,000			
Capital in shares	3,125,000			
Loans (as per Abst.) in part of	1,375,000	1,045,717	2	9
	4,500,000			
		3,170,717	2	9

1837. June 30.	*Cr.* £.	s.	d.	£.	s.	d.
By railway works and stations	2,269,329	1	8			
Less penalties received . .	1,505	0	0			
				2,267,824	1	8
" Locomotive engines and carriages				29,747	4	4
" Land and compensation . .	601,010	3	1			
Less land re-sold and rents	1,352	10	8			
				599,657	12	5
" Miscellaneous charges, included in general disbursements				185,568	13	7
" Calls on shares, balance of account				13,556	12	1
" Cash				74,362	18	8
				£3,170,717	2	9

Dr. *Income.* *Cr.*

1837.	£.	s.	d.	1837.	£.	s.	d.
June 30. To Interest.				June 30. By interest on			
On Exchequer bills and Banker's balances . .	18,788	0	9	loans	16,617	5	9
On calls in arrear	2,263	13	7	" Cash . .	4,434	8	7
	21,051	14	4		21,051	14	4

Dr. *Cash.* *Cr.*

1837.	£.	s.	d.	1837.	£.	s.	d.
June 30. To capital stock, balance of account.....	74,362	18	8	June 30. By bankers. London division	41,533	4	4
To income ditto	4,434	8	7	Birmingham division ...	37,264	2	11
	78,797	7	3		78,797	7	3

R. CREED, C. R. MOORSOM, } *Secretaries of the Board.*

Estimate of Funds required to complete the Railway.—[B]

1. Land and compensation		£10,500
2. Works for the roads and stations, according to the estimate of the engineer: viz. road	£576,451	
Stations	266,365	
Permanent way materials, viz. blocks, sleepers, rails, and appendages	192,931	
		1,035,747

	£.	£.
3. Engines and carriages of all descriptions: viz.		
Locomotive engines and tenders	90,215	
Carriages	98,000	
Waggons and trucks	37,336	
Tarpaulins	1,500	
		227,051
4. General disbursements: viz.		
Law charges, including conveyancing	15,000	
Engineering	17,000	
Advertising and printing	600	
Direction	2,400	
Office charges	3,400	
Travelling charges and sundries	2,000	
		40,400
Total		£1,313,698

Engineer's Estimate of the Periods at which different Portions of the Line will be completed.

	Miles.	
From London to Boxmoor	24½	open.
" Boxmoor to Tring	7½	" Oct. 1837.
	32	
" Tring to Denbigh Hall (at the crossing of the Holyhead road)	16	" Jan., 1838.
" Birmingham to Rugby	29	
	77	
" Denbigh Hall to Blisworth	13	" May, 1838.
	90	
" Blisworth to Rugby	22½	" Aut. of 1838.
Total	112½ miles.	

BRISTOL AND EXETER RAILWAY.

SECOND Half-yearly Meeting, held at the Merchants' Hall, in the city of Bristol, on Thursday, the 31st of August, 1837, FREDERICK RICKETTS, Esq., in the chair.

In again submitting to the proprietors a concise but correct account of the Company's position, it is satisfactory to the Directors, after the lapse of several months of aggravated commercial difficulty bearing with peculiar pressure on every undertaking dependent on the application of surplus capital, to be enabled to state that, with the exception of such a retarded payment of the last instalment as is necessarily consequent on the period, they have not a single fact to communicate which can otherwise than strengthen that entire confidence in the ultimate distinguished

success of the Bristol and Exeter Railway, hitherto entertained by all who are acquainted with its cheapness, its facilities, its security, and its resources.

The particular facts establishing these advantages have been so fully demonstrated in their two former reports that the Directors refrain from repeating them; merely remarking on the additional value they derive from the defeat and abandonment, during the last session of Parliament, of every competing line between London and the Western Counties, and a moral certainty, arising both from physical impediments and the new requirements of the Legislature, that the introduction of any other is effectually precluded.

Since the last report, two additional contracts, extending to the high road to Bridgwater in the village of Lympsham, have been entered into on terms advantageous to the Company, arising from the easy nature of the ground.

The greater portion of the land is purchased on the 11 miles comprised in the two first contracts; and the contractor is availing himself of the favourable state of the weather to expedite the progress of the works.

Aware, however, of the large amount of capital at present employed on the numerous and extensive railroads in progress throughout the kingdom, and desirous of giving the greatest effect to the available means of the Company, by not operating on too large a surface at a time, the Directors—though fully determined to complete the line to Exeter—have resolved to finish and open such portions of it, commencing with Bristol, as will enable them to secure an actual remuneration on the capital expended on its progress to Weston and Uphill in the first instance, Bridgwater in the second, and Taunton in the third, so that investment and return may, in a good degree, keep pace with each other. They purpose, therefore, to limit the scope of this report chiefly to an exposition of such circumstances as will best enable the proprietors to form a correct opinion of the required outlay and ascertainable proceeds on these portions of their expenditure.

The estimates of their engineer, which have been hitherto so satisfactorily borne out by the contracts entered into for upwards of two-thirds of the distance to Bridgwater, and by the actual cost of land already purchased, warrant the Directors in assuming that the cost of opening the line to that port, including the stations, locomotive engines, and every other expense, will, at the outside, not exceed thirty-five pounds per share.

In stating the dividend to be reasonably anticipated from this expenditure, they are so fully sensible of the extent of prejudice they have to encounter, arising less from the misrepresentations of the interested than from the inconsiderate assumptions of a few who are unacquained with the facts of the question, and the credence yielded by the many to assertions of which they have never examined the proof, that the Directors would feel the declaration of truth itself to be unavailing unless supported by that

species and amount of evidence which they well know must remain unshaken by the severest scrutiny.

They annex, therefore, as an appendix, an abstract, corrected to the present time, of the traffic, proved before the Parliamentary Committee, under the investigation of adverse counsel, and illustrated by such references as can leave little room for doubt in minds accessible to the influence of testimony. To those who, dazzled by the celebrity which our great manufacturing towns have obtained from the magnitude and productions, rather than the travelling wants and habits of their population, conclude that these must of necessity create an extent of intercourse for which it will be vain to seek a parallel in the other districts of the kingdom, it will appear remarkable that the coaches at this time daily running betwixt London, Bristol, and Exeter,* considerably exceed the entire number plying between London and Birmingham, Liverpool, and Manchester, before the opening of the Grand Junction Railroad. Yet such is the incontrovertible fact, as will be seen by any one who takes the trouble to refer to the Appendix; and it is on this plain ground, together with the acknowledged cheapness which natural facilities give to the construction of the Bristol and Exeter Line, that the Directors feel justified in holding out to the shareholders the expectation of a dividend of 14 per cent. on the outlay before-mentioned, to Bridgwater, being about 1 per cent. more than the profit originally estimated on the entire line. To this it may be added, that it is the peculiar advantage of this line to open up new sources of profit in its progress, at such short successive distances as can rarely be presented by any similar undertaking. The completion of less than ten miles will enable the Company, at an ample profit not included in the present or any former estimate, to bring the products of a vast coal-field into the city of Bristol, at a charge of 1s. per ton. 12 additional miles, which bring the line close to the mouth of the Ax, and the natural harbour at Uphill, will establish a line of communication between the whole of the south of Ireland (including, of course, the southern coast of Wales), and Bristol, and London, of which the most sanguine can scarcely calculate the advantages: and 11 miles more, by carrying the line to Bridgwater, will necessarily render it the medium of intercourse between the western counties, and London and the north.

* Before the opening of the Liverpool and Manchester Railroad, there were but 22 coaches travelling between those towns. (See Mr. Booth's evidence before the House of Commons' Committee.) * * * Before the opening of the Grand Junction Railway there were but 16 coaches travelling daily between Birmingham and Manchester, and Birmingham and Liverpool, inclusive of all reaching those places from London or the west, viz., the Brilliant, Star, Emerald, Tartar, Erin-go-bragh, Bangup, Mail (evening), Courier, Surprize, Mail (morning), Sun, Royal Express, Red Rover, Reindeer, Bee-Hive, Estafette, two others parallel with Birmingham, but to the same destination, and 4 to intermediate places,—altogether 22 coaches. The Bristol and Exeter road, also inclusive of those to and from London, has 25 coaches daily the whole distance, and 7 to intermediate places—altogether 32 coaches. (See Appendix to this Report.)

Although, as the subjoined accounts will show, the outlay on the works is becoming heavy, the Directors expect that the balance in hand, aided by the instalment now in course of receipt, will prevent the necessity, for some months, of a further call on the shareholders; and, under the desire that all possible economy should be exercised, the Directors have earnestly applied themselves to the business of retrenchment, by the reduction of several branches of expenditure, including the relinquishment of a moiety of the compensation so liberally voted for their own services at the first general meeting.

Carefully weighing, therefore, every consideration, whether of a public or a private nature, which relates to this undertaking, the Directors feel its vigorous prosecution to be their highest duty, and, with a stedfast determination to fulfil it, cheerfully appeal to the confidence and support of all who are interested in its completion. Signed, on behalf of the Board,

August 31, 1837. FREDERICK RICKETTS, *Chairman.*

Statement of Receipts and Expenditure, 30th June, 1837.

RECEIPTS.	£.	s.	d.
Deposit of 2*l.* 10*s.* per share on 14,988 shares ..	37,470	0	0
Reserved for landowners .. 12			
15,000			
First call of 2*l.* 10*s.* per share on 13,978 shares ..	34,945	0	0
Reserved, as above 12			
In arrear 1,010			
15,000			
Second call of 5*l.* per share on 4,670 shares ..	23,350	0	0
Reserved, as above 12			
In arrear 10,318			
15,000			
Interest received from bankers and shareholders ..	1,401	15	11
Registration and transfer fees	53	17	6
	£97,220	13	5

EXPENDITURE.	£.	s.	d.
Parliamentary expenses, including Parliamentary agents and fees, solicitors' bills and fees to counsel, witnesses, canvassing, taking road-traffic, hire of committee-rooms, and all other law charges and disbursements, up to the time when the Act of Parliament for constructing this line received the Royal assent . .	18,592	1	10
Engineering, including surveys of the whole line, plans and sections, maps, professional evidence in Parliament, and all other expenses and disbursements in this department, up to the time when the Act received the Royal assent	6,957	1	5
Travelling expenses of Directors and others, before and up to the time of obtaining the Act, and country agency employed in relation to the line generally	1,739	2	10
Printing, advertising, stationery, book-binding, and various incidental expenses in Bristol and London, from the first projection of the undertaking to this time	1,770	15	6
Expenses connected with ascertaining and setting out the line since the passing of the Act	1,719	3	3
Purchase of machinery, implements, utensils, tools, maps, plans, &c., for use on the line, and at the engineer's office . .	1,847	3	10

Cost of the engineer's office, furniture and disbursements		£379	12 6
Expenses at the head office in Bristol, consisting of salaries to secretary, book-keepers, and other clerks, office furniture, rent, travelling expenses, postage, carriage of parcels, &c.		2,301	9 9
Salaries in the engineering and surveying department, and draftsmen's salaries		5,787	0 2
Purchase of land, surveying, and valuing, and compensation for damages		5,354	15 0
Law charges and disbursements since the Act was obtained		831	8 4
Direction from 19th May, 1836, to 30th June, 1837		1,890	0 0
Payments to contractors, and expenses relating to their contracts		1,277	4 7
Balance in the hands of the bankers	47,671 7 5		
Balance in the hands of the secretary	92 7 0		
		47,763	14 5
		£97,220	13 5

Since the period to which the above account is made up, viz., the 30th of June, the Directors have made various additional payments for purchase of land, compensation for damages, wages on the line, and advances to the contractor, amounting to the sum of 10,265*l.* 15s. 1d., by which means the said balance of 47,671*l.* 7s. 5d., stated to be in the bankers' hands on the 30th of June last, is reduced to the sum of 37,405*l.* 12s. 4d.

		£47,671	7 5
Land and compensation	£7,837 16 3		
Contractor	1,595 17 4		
Wages, &c., on the line	812 10 0		
Other payments	19 11 6		
		10,265	15 1
		£37,405	12 4

APPENDIX.

	£.	s.	d.
Passengers.—The following table exhibits an annual aggregate number of miles travelled between Bristol and Bridgwater of 4,708,184, which being doubled, according to Parliamentary rule, and calculated at 2d. per mile, will yield a revenue for Passengers of	78,469	14	8
The revenue is here estimated by doubling the passengers now travelling by coaches, &c., and calculating them at 2d. a mile, but on the Manchester and Liverpool, Stockton and Darlington, Newcastle and Carlisle, and Grand Junction Railways, the travelling has been trebled, and the average charge is above 2½d. a-mile.			
Coach Parcels and Packages.—Calculated on 18,096 journeys per annum, at 2s. 6d. to 10s. per coach per journey, according to the distance	6,119	8	8
By the evidence of persons in the booking department of coaches, 18,358*l.* 6s. was proved to be a moderate estimate for parcels on the whole line. One-third of this sum is taken for the distance between Bristol and Bridgwater.			
Merchandize.—The goods and merchandize now conveyed by stage-waggons, calculated at 4d. per ton per mile	6,026	10	0
Weight of goods estimated at 15 cwt. per horse on the number in draught. At present the goods are conveyed at 1s. 3d. per ton per mile.			

	£.	s.	d.
The goods now conveyed by carriers' and other carts, between places on the line of railway between Bristol and Bridgwater, and calculated at 3d. per ton per mile	1,054	0	0
Only one-fifth of the quantity observed is assumed to travel on the railway an average of 10 miles.			
The goods now sea-borne between Bristol and Bridgwater, and Gloucester and Bridgwater . .	6,353	6	8
The goods now sea-borne between London and Bridgwater	1,133	6	8
This revenue is estimated from the Custom-house returns, and the testimony of various merchants and traders, that the goods are of a description to be chiefly supplied from Bristol by a railway, in preference to the present defective and circuitous navigation.			
Cattle.—16,000 beasts per annum to the market at Bristol, reckoned on an average 25 miles by the railway, at 3d. per head per mile	5,000	0	0
87,000 sheep per annum, the same distance, at ½ per head per mile	4,531	5	0
In these items the numbers and the distances travelled (in most instances from places westward of Bridgwater), were proved before the House of Commons by the clerk of the Cattle-market, and several experienced dealers in cattle.			
15,000 beasts to the London markets from Devonshire and the neighbourhood of Taunton, reckoned the 34 miles from Bridgwater to Bristol, at 3d. per head per mile	6,375	0	0
9,750 sheep to London markets as above, reckoned 34 miles, at ½ per head per mile	690	12	6
By the Parliamentary evidence and salesmens' returns, and from subsequent inquiry and observation of this branch of traffic, it is proved that 20,000 beasts, and 13,000 sheep, are annually driven to London from Devon and Somerset, but principally from the neighbourhood of Taunton. Three-fourths of these numbers are estimated to be taken on a railway from Bridgwater to Bristol.			
26,451 calves, lambs, and pigs, conveyed to Bristol and to the Bath and London markets, from various parishes in the county of Somerset, which would be within an easy distance from a railway between Bridgwater and Bristol	1,754	12	5
10,108 tons of cheese, cider, butter, and other articles, from the same parishes to the same markets	3,569	5	6
These items were proved by several extensive farmers before the Committee on the Bill, and the revenue is calculated for the distances the stock and produce would be taken on the railway to reach the present markets supplied therewith.			
	121,077	2	1
Deduct one-third for expenses . . .	40,359	0	8
Annual net revenue between Bristol and Bridgwater (equal to 14 per cent. on 35*l.* per share)	80,718	1	5

Estimate of Traffic between Bristol and Bridgwater.

PASSENGERS.

NOTE.—By a report of the London and Southampton Railway, received since the meeting to which this report was made, it is assumed that only one-half of the passengers by the London mails and coaches, numbered from 4 to 11 inclusive, will travel by the Bristol and Exeter Railway; and that the rest, being for short distances, will take the Southampton Line. Without disputing the extent to which this claim may eventually be substantiated, it should be observed that the entire reduction it could possibly effect would not exceed 7,897*l.* 1s. 4d., the subtraction of which would still leave a nett profit of 13 per cent. on the required outlay to Bridgwater.

	Places.	Names of Coaches.	Weekly Journeys.	No. of Passengers.	Places where Passengers will join the Railway.	Distcs. to be travelled.	Aggregate No. Miles weekly by Railway.
1	London and Bridgwater	Swiftsure	6	54	Bristol or Bridgwater	34	1836
2	" Taunton and Barnstaple ...	North Devon	12	108	Ditto	34	3672
3	" Exeter	Bath and Exeter Mail	14	70	Ditto	34	2380
4	" Ditto	Penzance, Falmouth, and Exeter do.	14	70	Ditto	34	2380
5	" Ditto	Exeter, *via* Yeovil ditto	14	70	Ditto	34	2380
6	" Ditto	Devonport and Exeter ditto	14	70	Ditto	34	2380
7	" Ditto	Traveller	14	126	Ditto	34	4284
8	" Ditto	Telegraph	12	108	Ditto	34	3672
9	" Ditto	Herald	12	108	Ditto	34	3672
10	" Ditto	Subscription	14	126	Ditto	34	4284
11	" Ditto	Defiance	14	126	Ditto	34	4284
12	Bristol and Bridgwater	Self-Defence	12	108	Ditto	34	3672
13	" Ditto, and Minehead	Speculator	6	54	Ditto	34	1836
14	" and Taunton	John o'Groat	6	54	Ditto	34	1836

15	Bristol and Exeter	Mail	14	70	Bristol or Bridgwater	34	2380
16	" Ditto	Exquisite	12	108	Ditto	34	3672
17	" Ditto	Times	14	126	Ditto	34	4284
18	" Ditto	Beehive	12	108	Ditto	34	3672
19	" Ditto	Tam o'Shanter	6	54	Ditto	34	1836
20	" Ditto	Retaliator	6	54	Ditto	34	1836
21	Bath and Exeter	White Hart Fast Coach	12	108	Ditto	34	3672
22	" Ditto	York House Day Coach	12	108	Ditto	34	3672
23	" Ditto	Lion Day Coach	12	108	Ditto	34	3672
24	" and Taunton, Tiverton, and Barnstaple	York House Coach	12	108	Ditto	34	3672
25	" and Lyme	Perseverance	6	54	Ditto	34	1836
26	Bristol and Weston	Magnet	12	84	Bristol or Weston	20	1680
27 28 29	" Ditto	Sovereign, 2 coaches, and Cuckoo*	24	168	Ditto	20	3360
30 31	Bristol and Clevedon	Bee and Nettle†	24	168	Bristol or Yatton	10	1680
32	Wrington	Coach from Talbot	6	42	Ditto	10	420
					348 × 52wks. = 18,096 journeys a-yr.		83,912
	Posting‡ and private carriages, and one-third of the gigs, cars, and caravans, taken by observation, conveying 586 persons various distances weekly, equal to one-third of the number, travelling 34 miles						6,630
	Annual number of miles travelled, 4,708,184.						
							90,542

* As these three coaches do not run in winter, they are calculated as two coaches for the year.

† There are sometimes more than two coaches, but only two are calculated, as in the winter one ceases travelling.

‡ The posting was omitted in this appendix when read with the report on the 31st August. The posting is calculated at three persons to each pair of horses, and one third of the gigs and cars observed is calculated at three persons for every two vehicles.

SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

BRITISH SCIENTIFIC ASSOCIATION.—SEVENTH ANNUAL MEETING.

THIS body met at Liverpool Sept. 11, for the purpose of bringing before them the labours of the members within the last year, and also of any other persons, having made improvements or discoveries, who may choose to submit them to the Association. How far these migratory meetings will forward the real and solid interests of science it is not for us to say; experience will be the best test. It is, however, from all that we have yet seen, our opinion, that such meetings are eminently useful in bringing into friendly collision the various cultivators of science, by which the asperities of feeling, so frequently engendered by public writings, are rubbed down into the smooth and grateful surface of friendship and goodwill. We also think they are not less useful in bringing together once a-year an immense quantity of floating knowledge; that is, detached portions of knowledge on various subjects which individuals have acquired by observation and experience, but have not, from modesty or other circumstances, communicated to the world. No man who has not mixed in the great multitude can tell how large is the quantity of information, or what, in the language of astronomy, may be called unreduced observation, which actually exists on almost every subject, unknown to scientific and other writers, and which, but for the communication of intellect, if we may use the term, at such meetings, might never be known to them.

What the Association has most to fear is, that these meetings may ultimately degenerate into mere congregations for the public bandying of compliments and display of particular individuals. If such things be sedulously avoided; if coterie principles, partial preference, and exclusion be shunned; and if a liberal encouragement to all parties be given, we think the Association, with the ample funds it has annually at its disposal, may do vast and mighty good, if not in extending the abstract sciences, at least in advancing the others, by instituting such experiments, and causing such observations to be made, as no single individual could do or procure to be done.

It would hardly be right for us to conceal, that we have noticed a little of that tendency to personal display, both at Bristol and at Liverpool, we allude to; but it has been so infinitely overbalanced by generous feelings and liberality, so completely outshone by innumerable other good qualities in all that we have come in contact with, that it is, at present, like those minute spots in the sun, which become visible to the most powerful instruments only, and

when detected, serve rather to give interest than to disfigure the body they belong to.

As at Bristol, so at Liverpool, the hospitality and magnificence of the town has been most generously displayed. Every exertion which could be has been made to welcome and entertain the members of the Association. The next meeting is to be held in August, 1838, at Newcastle, and upwards of 3,000*l.* has been this year voted for the purposes of experimental research, the results of which are then to be produced and laid before the members.

We shall here give a sketch of the principal matters brought before the Association, not confining ourselves to any order of time, or of place, but giving the preference to those which are more intimately connected with the peculiar objects of the present work; that is, matters of mechanical interest.

MECHANICS.

Duty of Cornish Engines.—Mr. Henwood, who has made a great number of experiments on the performance of the Cornish engines, stated, that taken for long periods together, he could never find their daily duty exceed more than 86 or 87 millions of tons raised one foot high with a bushel of coals. The statement made at the last meeting, of 127 millions, he disbelieved, and thought it must have arisen from some fallacy in the experiments, as, for instance, their being continued through a short interval of time, in which a considerable quantity of heat having been communicated to the whole apparatus beforehand by fuel not taken into the account, and this heat having been partly expended in the course of the experiments, thereby contributing to produce the effect attributed to the fuel, supplied in the interval of the recorded time occupied. He stated that no good account of these great duties had ever been verified. In speaking of the comparative merit of the engines, he gave, as the result of his experience, a preference to the single expansive working engines over the double inexpansive; and exhibited diagrams, showing the pressure and saving of the steam by single stroke engines working expansively. At a future meeting, Mr. Taylor stated, that in the experiments referred to by Mr. Henwood, the times of experiment, which gave the high duties of 125 and 127 tons, were too short to be relied on for averages, but insisted on it, and produced the testimony of others, that they were fairly made under the circumstances. A long discussion followed, in which Dr. Lardner, Mr. Ilam, and Mr. Webster, took part, which ended in the subject being thought of sufficient importance to merit particular recommendation to the Association for further inquiry.

Topography of America.—Professor Henry, of New Jersey, America, exhibited a large map of the canals and railways already constructed in America. In the course of his observations he

stated, that the Mississipi contained with its branches no less than 10,000 miles of navigable waters; that there were now constructed 1,500 miles of railway, 2,000 of canals, and there were 3,000 of railways now in progress. In answer to a question put to him, he said that he had sailed by a steamer from New York to Albany, 150 miles, in nine hours, that is, at the rate of $16\frac{2}{3}$ miles an hour. This, however, is done by boats built on purpose, extremely light and well adapted for rivers and swift sailing, and at a great expense of fuel. Wood is generally used, and Professor Henry stated to us that though it be so cheap there, it costs to produce this velocity in wood as much as 50*l.* sterling for fuel for one such trip. There also seems to be a very different construction in their steamers; the paddle-wheels are very large, and the machinery above deck, instead of beneath it, as with us. Professor Henry's statement, which was then doubted, was subsequently confirmed by others. In our journey home we too met with a gentleman who informed us that the distance between Liverpool and Dublin, 150 miles, was constantly steamed in eleven and sometimes in ten hours. Professor Henry's observations were marked with perspicuity and modesty, and gave great satisfaction to the audience.

Engine Lathe for Busts and Models.—This is effected by fixing the marble to be cut in a frame of almost universal motion, and which is capable of bringing it, in every needful position, in contact with the cutter in the lathe. Mr. Hawkins, the inventor, showed a specimen of a marble bust, about six inches long, executed in this way by the tool, and without any other assistance, which displayed a most beautiful surface. Busts, &c., may be enlarged or diminished by this instrument with great fidelity and accuracy, and minute precision.

Waves in shallow Water, and Form of Vessels of least Resistance.—Mr. Russell detailed his experiments, made in conjunction with Mr. Robinson, at the request of the Association, on the above subject. He said, that, in a channel four feet deep, the wave raised by the prow of the vessel frequently preceded it by a mile and a quarter, and, in shallow streams, that the height of the wave, before it broke, was double the depth of the water beneath. This wave flowed at the rate of about eight miles an hour; so that, if a vessel went slower, it experienced great resistance from it, having, as it were, a constant tendency to ascend a hill, and its prow being considerably immersed in the wave. On the contrary, when it went a little faster than eight miles an hour, it rode as it were on the top of the wave, its prow being out of it. He found that the deeper the water the more this wave disappeared, and, consequently, that rectangular channels were better, both for saving the banks and facilitating the progress of vessels, by offering less resistance than those the section of whose beds was triangular, or any other figure departing from a rectangle. When there is a wave before, there must necessarily be currents backward by the sides of the vessels,

and Mr. Russell mentioned some curious results, namely, that, in steam-vessels, he has observed, that, at 4 miles an hour, the engines made 22 strokes a minute; at 6, 35; but, at 5½, it would require 60 strokes a minute; and 70 strokes a minute would give no increase of speed, nay, by increasing the number of strokes, the vessel actually decreased in velocity. With respect to the figure of the vessel, Mr. R. contended that the greatest transverse diameter at the water line should be rather behind midships. And, on the Editor of this Magazine putting some questions to him as to the aft figure of the vessel—stating that nautical men had assured him they found a tapering after-part by far the best for swift motions—he said, that was the result of his experiments. He found, that the after-part should taper off, but that there were other considerations mixed up with it, into which he could not then enter. Mr. Russell, in the course of his remarks, observed, that he had found that the anterior wave was partly composed of a translation of mere form and of substance. This exactly confirms our opinion expressed at Bristol. Mr. R. then stated, that he conceived the wave was a mere translation of form. We expressed our opinion that a repetition of his experiments would show that there was substance, as well as form, translated, which we were certain if he found, he would have the candour to acknowledge. This Mr. Russell has done in a manner that does him high credit. The whole of his statements were distinguished by clearness and deep thought, and were much approved by the section.

Tidal Waves, and Ebbing and Flowing of the Sea.—Mr. Russell proposed to make the ebbing and flowing of the sea more serviceable, and to reach to a greater extent up rivers, by making the sides or banks of rivers more perpendicular. By this means he says the tides are accelerated, and their effects reach to a much greater distance up the rivers. In rivers there are phenomena, well known to sailors under the name of bores, which are a certain breaking of the tidal wave like a surge. They arise from the bed of the rivers being on a level, or lower than the mid-tide. To avoid this, he proposes deepening the bed to such an extent up as may prevent the bore from forming until beyond the point desired. Curves and bends in rivers are considered to retard the flowing of the tide. The waters on the inner side, when the beds are of equal depth, gain in progression by having a shorter distance to travel. Mr. Russell proposes to obviate this by deepening the bed from the inner to the outer bank as much as is needful to accelerate the velocity of the tidal wave, and keep it travelling equally up the course of the river. The form of the bed should be that of a parabola convex upwards, with its axis coinciding with a vertical line from the inner bank.

Sea Walls.—Mr. Russell applied his experimental knowledge on waves to the preservation of sea walls. The purport of his observations was, that he would make them of a parabolic form,

convex upwards, the parapet being in the axis produced, which he said would reduce the action of the waves to a minimum.

Teeth of Cogged Wheels.—Mr. Willis proposed a plan of making the teeth of cogged wheels work on each other without slipping. His proposal was, to have the circle, from which the cycloidal arc was to be determined, not greater in diameter than the radius of the least wheel in the system to be driven, and to form all the teeth by the rolling of this wheel alone on the internal and external circumference of each wheel. This plan was very well received by the section.

Safety Railway.—Mr. Currie proposed his plan for a safety railway. An account of it will be found in our nineteenth number.

Railway Iron.—Mr. Mushet proposed a plan to improve the texture of iron, which was to "puddle" the pig-iron; then, instead of "running it fine," to "ferment" it with adding a small portion of fresh ore.

Form of Iron Rails for Railways.—Mr. Fairbairn gave a description of a rail for railways, which he described as of much greater strength than others. It was of the usual form—that is, an edge at the top and a foot at the bottom, the latter being six times wider than the former. This is on the same plan, but we are not sure if it be the same proportions, as the rail used by Mr. Brunell on the Great Western Railway. Mr. F. also went into some details of the relative strengths of rails of different forms; and to a question put by Mr. Herapath said, he had not found the theorems of Emerson, Barlow, &c. accurately confirmed. He kindly promised to send us the results of his experiments, which we should be glad to see, as the matter is one of great interest.

Ventilation of Tunnels.—A method of ventilating tunnels was proposed by a Mr. West, which consisted in stopping up the shafts, and let them ventilate themselves. Mr. Herapath put some questions to Mr. West, which elicited from him an acknowledgment of its inefficacy.

Resistance of Railway Trains.—Dr. Lardner exhibited some new investigations on the resistance of railway trains. The principal new element introduced was that of the gyration of the wheels, which seems to have been neglected by Pambour and others. Dr. L. gave the data and results of some experiments to which he had applied his theorems; and, what is very singular, found the resistance of the train, abstracting the excess of resistance of the engine, to be eight pounds and a half per ton, which he still thought was a little too much, coinciding very nearly with eight pounds, which Mr. Herapath afterwards said he had deduced from some experiments of his own, and used in his calculations. We expected to be able to give Dr. Lardner's theorems, but have not been furnished with them. Mr. Vignolles observed, that Wood

had taken into account the rotation of the wheels; on which it was remarked, that Wood's theorems were never used. Dr. Lardner then made some observations on the practical unimportance of atmospheric resistance in his experiments, which we believe was misunderstood to mean a general neglect of the atmosphere; whereas, from what he afterwards said to us, he meant that his experiments were made at a velocity of only nine or ten miles an hour, and with heavy trains, exposing so little surface as to render the resistance unimportant. Dr. Robinson and Mr. Vignolles decidedly expressed their dissent from neglecting the effect of the air, and Mr. Herapath stated in some experiments he had made, that to a load of thirty tons the air at a velocity of thirty-two miles an hour, that at which he travelled, added an apparent load of twenty-one tons more, and that trains which in a non-resisting air would move at a rate of sixty miles an hour, were by the air's resistance reduced to about forty. Mr. Roberts, of Manchester, made several pertinent observations, and so did Mr. Hardman Earle. Mr. R. said that he once made a top which would spin for thirty-seven minutes, but when gilded, only seventeen minutes—a practical hint for making pendulums. Dr. L. concluded with expressing a wish that the Association would direct some experiments to be made on this very important and interesting subject, which was loudly re-echoed by the section.

Hot and Cold Blast Iron.—At the last meeting at Bristol, the sum of 60*l.* was voted towards deciding by experiment the relative merits of the hot and cold blast, and Mr. Fairbairn and Mr. Hodgkinson appointed to carry the experiments into effect. An elaborate report on this subject was now read, in which the results of a variety of experiments were detailed, and the mean of all was in favour of the cold blast. The iron made from the cold blast was almost in every instance superior, both in strength and tenacity, to that made by the hot blast. In some cases the ratios were very nearly that of equality; in others they amounted to thirty or forty per cent. difference. One curious fact has been elicited, which excited a good deal of interest. It was, that if a bar of iron be transversely strained by any weight, it assumes a permanent set or bend, which it does not appear afterwards is ever restored. The least weight whose effects were observed, was one of twenty-eight pounds, on a bar four feet and a half long, and one inch diameter, supported at both ends; but as the weight was increased, the permanent set increased, and the elasticity of the iron, though it restored a good deal of the deflection when taken off, never recovered this permanent set. It was also observed, that iron made from the hot blast is more flexible than from the cold; that in the fractures, the iron grain, or fibres, were finer in the former case than in the latter; that the Scotch iron was stronger than the Welsh. All the experiments were made from remelted iron. The room was crowded with iron-masters, who took great interest in

the discussion, and appeared much alive to their own interests, and jealous of rivalry.

Safety of Ships.—Mr. Lang exhibited a method of preventing, by a series of false keels and coverings over the bottom of a ship, a method of securing her in a great measure in case of striking. His method was by having the false keels to slide one over the other, so that when one is struck, by giving way it may prevent that destruction which probably would follow from a fracture, if the bottom had been one solid piece. The method has already been tried, and in the cases where the vessel has struck, has been found efficient.

Steam Navigation with America.—Dr. Lardner having on Monday commenced his observations on this subject, concluded them to-day. He took his data from eleven Government steam-vessels. Excluding two of them, he found that 9·96 pounds of coal were consumed per horse power per hour, which propelled them at the rate of 6·32 miles per hour. From this he calculated the mean distance which a ton of coals per horse power would propel a vessel, to be 1446⅔ miles. The two other cases gave the consumption per horse power per hour, 12·25 pounds, the rate 8·725 miles, and the distance due to a ton of coals 1,595 miles. If they meant to steam to New York, they must therefore take two tons and one-third of coal per horse power, unless they meant to sail as well as steam, whereas they usually took but one and a quarter. The load of coals, therefore, would be enormous, and would make the project barely practicable. Under these circumstances he thought there was but little prospect of opening, with any chance of success, a steam communication with America. He observed, that the average time of passage out was 35 days 17 hours, and home 19 days 6 hours, and that the advantage gained by any steamer would be so trifling, as to be not worth the great extra expense. In reply to these observations, Mr. Rotch, of London, observed, that Dr. Lardner had taken all his data from Government vessels, notoriously the worst supplied with machinery, and the veriest "old sea tubs" afloat, instead of from the latest and most improved specimens of engines and vessels, and therefore that the Doctor's data and conclusions were both wrong. Mr. Guppy also, of Bristol, produced cases and authorities which showed that infinitely greater exploits had actually been performed by steam-vessels, and were daily, than Dr. L.'s data showed. Mr. Guppy said, the Atalanta used seven pounds of coal per horse power per hour, and the rate was 9·4 miles an hour; that another vessel, whose name we did not hear, consumed six pounds, and worked 8·1 miles per hour. These facts were taken from the "Nautical Magazine." Dr. Robinson directed Mr. Vignolles how to reduce these numbers to Dr. Lardner's duty, that is, the distance a ton of coals per horse power would propel a vessel. He made it 1755 miles. There was, no doubt, some mistake in the process,

as Mr. Herapath calculated some of Dr. Lardner's numbers, and found them right, and by the same means the duty of the Atalanta and the other, which he found to be 3008 and 3024 miles. The latter vessel Mr. Guppy stated to have sailed 2180 miles, and to have consumed 154 tons of coals, and then to have had left 175 tons. Though no one doubted the fidelity of Dr. Lardner's statements, it was considered the Government vessels were not fair samples of what is actually done. The discussion was managed with great pleasantness; and Messrs. Rotch and Guppy particularly kept the section in almost incessant laughter by their humorous observations. In our return to town we met with a gentleman who has frequently crossed by steam between Dublin and Liverpool, which by the route taken is little, if any, short of 150 miles, but statute miles. He says it is almost invariably done in 11, but often under 10 hours, that is, at the rate of 15 miles, or near 13 knots an hour. He quite confirmed the statement of the inferiority of the Government steamers.

Safety Lamp.—A model of a lamp, by Mr. Leethead, was exhibited, in which a large ball or reservoir at the bottom was to contain a quantity of compressed oxygen gas, and the upper part was to be a cylinder, with a hole for circular plate of glass, through which the light came. This lamp was efficient so long only as the oxygen lasted, which, when exhausted, must be renewed.

Telegraphs.—Dr. Clanny brought forward the model of a telegraph, the principle of which was the dividing of the circle by an arm into twenty-four equal parts, each position of the arm denoted by a letter. By this means the words were to be spelt. Dr. Lardner observed, that we should soon know the result of Mr. Wheatstone's electric telegraph, and that if it succeeded we should have a communication almost instantaneous by night or by day. Col. Gold made several objections to visual and sound telegraphs, and recommended electrical. Lieut. Watson, manager of the Liverpool telegraph, commenced a paper on the subject of telegraphs, but was interrupted in consequence of his being unable to lay his plan before the section, because of his intention to patent it. We have been at the Liverpool office, and were exceedingly pleased with the system and efficiency of his plans. A young gentleman, we believe a son of Mr. Watson, displayed to us and other gentlemen, the whole process, with a clearness and urbanity that reflect great credit on him. We have been favoured with some extracts from their books, which it is our intention, at some future opportunity, to publish. In the mean while we wish Mr. Watson every success in the prosecution and success of the new plan for which he is taking out a patent.

Fires, and Collision of Steam and other Vessels.—Mr. Williams proposed a plan which, he said, was already extensively in use, to prevent the disastrous consequences of fires and collisions of vessels. His plan is, to divide the vessel into four compartments

by iron bulk-heads, water tight. If a vessel gets one stove in, it does not sink her; and if a fire happens, the water can easily be turned in on it. Formerly it had been supposed that these stiff bulk-heads would prevent the working of the vessel, but experience proved otherwise. Mr. W. detailed some experiments he had made, showing the efficacy of his plan. He let the water into the first, it sank the prow 6, and raised the stern 2, inches; he then let it into the two first, and it sank the prow 12, and raised the stern 10, inches. He also observed, that the bulk-heads would operate to prevent the rushing of air to feed the flame.

Inflexible Suspension Bridge.—A description and drawings of a bridge, by Mr. Curtis, which had the above title, was exhibited. There did not appear to us to be any thing new in it; and from the description given, some doubted its capability.

Thrust of Arches.—Dr. Lardner read a paper from Professor Moseley, on the above subject; but without going into the mathematical details we could not do it justice, or then make it intelligible to many of our readers.

At the close of the labours of section G on Friday, Dr. Robinson announced that it is intended to establish a course of study in the new University of Durham, for the instruction of students intended for the profession of civil and mining engineers; that the lectures to such students are proposed to be given in eight successive months of each year, and that the students will, from time to time, be examined as to their proficiency, and receive certificates of competency or honorary distinctions, if judged worthy of them.

The mathematical, physical, &c., parts in our following numbers.

SUMS GRANTED BY THE ASSOCIATION FOR SCIENTIFIC PURPOSES.

Mathematics and Physics.—Reducing observations of the stars, 500*l.*; discussing the tidal observations at Bristol, 75*l.*; hourly observations in meteorology, 50*l.*; to the meteorological Committee, 100*l.*; to repair Whewell's anemometer, 10*l.*; to construct a new one, 40*l.*; extending the Astronomical Society's catalogue, 500*l.*; observation on waves, 100*l.*; the effects of gases on Brewster's solar spectrum, 100*l.*; making a rock-salt lens, 80*l.*; total, 1,555*l.*

Chemistry.—Experiments on atmospheric air, 20*l.*; table of chemical constants, 30*l.*; effects of fresh and salt water on cast and wrought iron, 20*l.*; effect of heat of 212° on organic and inorganic bodies, 10*l.*; total, 80*l.*

Geology.—To determine relative level of land and sea, 272*l.*; publishing "Agassiz's Fossil Ichthyology," 105*l.*; observations on peat mosses, 50*l.*; experiments on mud and silt in rivers, 20*l.*; total, 447*l.*

Natural History.—For observations on growth of plants under glasses, 50*l.*; preserving vegetable and animal substances, 25*l.*; total, 75*l.*

Anatomy and Medicine.—For observations on the venous and absorbent systems, 50*l.*; on the effects of poisons on animals, 25*l.*; analysis of animal secretions, 25*l.*; motions and sounds of the heart, 50*l.*; pathology of the brain, 25*l.*; lung diseases, 25*l.*; total, 200*l.*

Statistics.—For inquiries into the state of education, more particularly in large towns, 150*l.*; condition of the working classes, 100*l.*; total, 250*l.*

Mechanics.—For determining the relative strength of iron made by the hot and cold blast, and extending the inquiry to wrought iron, 100*l.*; printing Taylor's report on the duty of Cornish engines, 50*l.*; duty of a bushel of coals in pumping engines not in Cornwall, 100*l.*; railway constants, 50*l.*; duty of a ton of coals in horse power in steam-vessels, 100*l.*; if extended to America an additional 50*l.*; total, 450*l.* Grand total granted, 3,057*l.*

Nautical Almanac, and its Superintendent.—In the "United Service Gazette," of the 23d ult., we perceive a letter from Mr. Woolhouse, late head computer to the "Nautical Almanac," in which he charges the superintendent with making some strange errors, which he there points out. We do not like to give an opinion on the subject, until we see what Mr. Stratford can say to it; but if true it is rather a serious item in the competence of the worthy superintendent, Mr. Stratford, to manage our "Nautical Almanac," to the accuracy of which so many hundred thousand lives, and so many millions of property are annually intrusted to plough the "vasty deep."

Artificial Production of Thunder, Lightning, and Rain.—An experiment is contemplated to be tried in America to produce these phænomena almost at pleasure. It is well known that vapour exists in much greater abundance near the earth's surface than higher up, and that if this vapour could be elevated in ample quantities to a sufficient height, the superior cold would condense it into clouds, which, from the very process of evaporation and condensation, would become electrical. Hence may proceed those grand phenomena of nature. The method obviously pointed out is, to produce a powerful current from the surface upwards, at the time the atmosphere is otherwise still, which may be accomplished by a great heat rarifying the substrata. This is indeed the very steps nature follows; and it was lately stated to us, before several gentlemen, by a distinguished philosopher, that it has actually been done, though accidentally, in America. A large quantity of wood or turf was by some means set on fire, and after burning a considerable time, a deep cloud formed above, and the phenomena of thunder, &c. followed. In corroboration of this, it has been remarked by several that heavy rain, and not unfrequently thunder and lightning, follows great battles.

RAILWAY NOTICES.

Birmingham, Bristol, and Thames Junction Railway.—A Meeting of the Proprietors of this Company took place at the City of London Tavern on the 6th of last month, at which a most satisfactory report was made by the Directors, and a Resolution was unanimously passed authorizing them to renew their application to Parliament, for an extension of the line to Knightsbridge-green, in the next session. We are glad of this, because we think it will prove a great convenience to a large mass of the western metropolitan population, and because we believe the spot chosen for the terminus to be a good one. That the extension will add greatly to the value of the line there can be no question. The works are proceeding satisfactorily. Messrs. Cubitt have got the contract for the construction of the gallery and bridge at the Paddington Canal, which insures the due execution of this the most important and interesting work on the whole line. We could wish some of the larger undertakings were managed in the same systematic and business-like manner the affairs of this Company are.

Birmingham Railway.—This line will be ready to Tring by the 12th instant, but it is not quite certain whether it will be open to the public until towards the end of the month. It will be a great boon to the public all the way; the impositions on the road and at Birmingham are enormous.

Brighton Railways.—We hear that Mr. Stephenson's friends seriously intend to bring this subject again before Parliament next session.

Bolton and Preston Railway.—On application, a certificate was lately granted by the magistrates to enable the Company to take, *nolens volens*, land needful for the line.

Belgian and French Railroads.—*Brussels, Sept.* 17.—The receipts of the iron railroad fully justify the expectations that were formed of it. The receipts from a certain period, when only one section of the railroad, that from Mechlin to Brussels, was completed, being ascertained, it was calculated that when two sections were opened the receipts would be doubled, and when three sections were in use, tripled. This might have been thought rather a sanguine expectation, but it has been realized. The receipts for eight months on the first section were 241,451f. 10c. Triple this sum, 724,355f. 10c., was assumed as the probable receipt on three sections during an equal period of time; the real receipt in the first eight months of this year has been 742,888f. 24c., that is to say, 18,533f. 14c. above the estimate. This may be considered as highly satisfactory; for the third section, that to Termonde, is of far less importance than those of Brussels and Antwerp. Three new sections will be opened in the month of September, and we

shall then see the product of six sections. Sept. 18.—We are informed that the commissioners assembled at Arras to consider the best direction to be given to the iron railroads have nearly agreed on the following bases:—The communications between France and Belgium to be by a principal line from Paris to Lisle, by way of Amiens, Arras, and Douai, with a branch from Douai to Valenciennes and Cambrai, and from Lisle to Belgium. The communications between France and England on the one hand, and between England and Belgium on the other, to be by a line which, proceeding from Amiens, passing by Abbeville, Estaples, Boulogne, Calais, Watten, St. Omer, Aire, and Merville, with a branch from Watten to Dunkirk, would join the principal line at Lisle.—*Brussels Papers.*

Birmingham and Derby Junction Railway.—A Half-yearly General Meeting of the proprietors was held at Birmingham on the 31st August—Henry Smith, Esq. in the Chair.

"It appears that the important contract at Tamworth had been let to an experienced contractor—the whole of the land required having been purchased: the two contracts next in importance, viz., the viaduct over the river Anker, and the bridges over the Derwent and the canal at Derby, had also been let, and the works commenced. Upon the remaining part of the line, the greater part of the land had been purchased. The application for an amended Act, to enable the Company to make a line from Tamworth to Rugby, had, from the severe opposition it had to encounter in Parliament, been thrown out. The Directors had, therefore, deemed it proper to commence without delay the Stonebridge branch, as a line to London, from which great advantages might be anticipated. Within less than twelve months from the opening of the London and Birmingham line, the works of the Birmingham and Derby line, including the Stonebridge branch, might be completed. The report proceeds to enter into details of the advantages contemplated by the Directors, and observes, that to facilitate the transfer of shares, arrangements have been made with Mr. H. Patteson, secretary of the North Midland Railway Company, for transfers being made in London.

"From the accounts it appeared, that the receipts of the Company, up to the 30th June, were 58,178*l.* 13s. 3d., and the disbursements, up to that date, 32,337*l.* 11s. 1d., there then remaining unpaid on the second call, 5590*l.*, which amount was, however, gradually diminishing, from the additional registration of shares."

Greenwich Railway.—Since our last Number, it appears that our anticipations were true, relative to the re-modelling the Direction, by the admission of three members of the Committee of Shareholders (who had been appointed to examine into all matters connected with the affairs of the Company), and, also, one of the shareholders. It seems that measures are now in progress for the immediate completion of the railway, and the public appear to

participate in the feeling, as the old shares have recently risen considerably. The new shares that are now in course of issue will bear interest at five per cent. before the old shares receive any dividend; and, when the old receive more than five per cent., the whole will receive equal dividends, whether five or ten per cent.

We insert Mr. James Walker's report as to the structure and stability of the railway and its arches. We understand the new Directors, as now constituted, hold one-fifteenth of the whole shares. This is putting their shoulder to the wheel right well.

Great Western Railway.—This great line there is every probability will be opened to Maidenhead by the middle of November. It is expected to be a pattern of easy and quiet running, as the engineer will lay his rails on wooden sleepers, Kyanized, instead of on stone blocks. He calculates to use 400 loads of timber per mile, and has fourteen tanks for preparing it between London and Maidenhead, each containing 9,000 cubic feet. We have long contended that all rail-roads must come to use wooden sleepers, and, of course, Kyanized; and we are not a little flattered to find our opinion corroborated by such engineers as Vignolles, Walker, Brunel, Locke, &c.

A trivial repetition of what took place some months since at Hanwell has occurred near the same place. The substratum of clay has spewed up a little on each side, from the weight of the gravel embankment, which has sunk a trifle perpendicularly. The whole consequences will be the expense of some extra loads of gravel to the contractor. Report, as usual, has mightily magnified this; but we must remember the report arose near the Asylum.

Eastern Counties Railway.—We are sorry to see the perpetual public squabbles of this Companny. In the "Times" there lately appeared a long correspondence between the worthy Secretary of the Company and Messrs. Lawford, solicitors to Mr. Labouchere, arising out of some direct reflections in their report. It seems the Company entered into an agreement with Mr. L., similar to that with Lord Petre, which they now refuse to ratify, because, says the Secretary, "neither in *honour*, nor in *justice* could fulfilment have been demanded" from the parties who made it. Good heavens! is it possible that men, who "originated entirely," say Messrs. Lawford, "such agreements," should proclaim before the wide world that they "will not fulfil,"—that they are not bound in HONOUR, nor in JUSTICE to fulfil—the acts and deeds which they themselves proposed and executed!!! What must the shareholders think of this code of honour and justice? Will they entrust their affairs and pay their money into hands which thus publicly announce such principles? We shall see—the present call will tell us. We fear, the reported giving away of some of their shares in London and Liverpool, with 2s. 6d. per share besides, to take them, is rather

a poorish symptom of answering the call.* But, it is said, the proprietary are to be forced to pay, if they decline to do it voluntarily. Would the Directors risk such measures? Will they permit us to ask them, whether either of their officers holds to the tune of 1,300 shares, or 32,500*l.*, and, if so, whether the calls have been duly paid up? If not against their code of *honour* and *justice*, we should feel thankful with an answer.

Our attention has been called to a few items in the accounts. For example, 38,072*l.* were expended, exclusive of 1,500*l.* to the Directors, to the time of obtaining the Bill, though, we believe, they were not more than three or four days in Parliament! This is very nearly the amount which it cost the Southampton Line, that stood so severe a contest in the House, and nearly half what it cost the Great Western, which throughout two sessions sustained the most expensive and determined opposition any one line ever experienced, the very evidence of which, in the last session in the House of Lords alone, occupied 1,400 folio pages. Does not this argue great liberality in the Eastern Counties somewhere? We wonder how much was paid for the previous concern, and to whom; for, at the beginning of the present undertaking, we were assured 100*l.* would cover the whole. Again, we perceive, per report, for the "salaries of Secretary's department, 1,163*l.* 13s. 6d.; printing and advertisements, 937*l.* 15s. 9d.; account books, &c., 442*l.* 5s. 7d.; letters and parcels, 99*l.* 17s. 8d.; office rent, furniture, and expenses, 732*l.* 14s. 9d.," making a total of 3,376*l.* 7s. 3d., for ONE YEAR'S expense of that which we suppose comes entirely under the Secretary's management. Add to this, 1,435*l.* 13s. 9d. for the Direction, and 1,500*l.* for the engineer's salary, and we have 6,312*l.* 1s. for what may be called the expenses of management from July 4th, 1836, to July 4th, 1837. Now, the "engineering and works are 9,101*l.* 1s. 3d." Take 1,500*l.* out of it for the engineer's salary, it leaves 7,601*l.* 1s. 3d. for the cost of the works, for which 6,312*l.* extra were expended in the mere management, as far as we understand it. If wrong, let us be corrected: if not, it is something for the shareholders to look at.

We beg to inform "S." we have not room for the "Letter in the 'Times,' of Sept. 23d, p. 3, signed 'Aristides,'" but we, nevertheless, fully concur in the justice of its observations, and think it well worth the attention of the Eastern Counties' Proprietary.

We have just seen something intended for a reply, by one "Civis." Is this the Scotch for "J. C. Robertson, Secretary?" "Civis" says he is "a large shareholder;" but the cunning fellow does not tell us how many hundred shares he holds, and how many single ones he has paid on. Had the Directors not better at once close the concern?

* We have been offered 5s. per share, and the expenses of transfer paid, to take them.

Improvements in the Port of Hamburgh.—The general system of improvements for this important port, as proposed by Mr. Vignolles, have been adopted by the Hamburgh Senate, and an immediate commencement will be made by constructing the new steam-boat harbour and landing quays. The next step will be the formation of docks, and in order to fully explain to the mercantile community of Hamburgh the nature of the work, a beautiful model, on a large scale, and embracing the whole extent of improvements, is now constructing in Hamburgh, under the immediate eye of M. Hubbé, the engineer of the Hamburgh Government, who is appointed to carry the plan into effect. The model will also show the mode in which the railway for Hanover will cross the Elbe and communicate with the new docks. Such improvements are essential to the commercial prosperity of Hamburgh, which is seriously threatened by the advantages Antwerp will derive from the chain of railways to the Rhine, and by the railroads contemplated by Prussia, from the Rhine into the interior, whereby the colonial produce and manufactured goods consumed by Germany, will be likely to be entered at the port of Antwerp, in preference to Hamburgh, should this city remain without a similar railway communication into Prussia and Saxony.

Manchester and Leeds Railway.—The Directors of this Company appear to be making a good use of their time. By their report, just published, it seems that within four months, and since they have been in possession of the powers conferred by their Act, they have let to first-rate contractors about twelve miles of this line, extending from Manchester to Rochdale, and they have also purchased the land for nearly the whole of that distance, upon satisfactory terms. The most energetic exertions are making by all parties to urge forward this great undertaking; from one thousand to two thousand men are already employed on the line. The Directors, by waiting until this summer before they commenced active operations, have well consulted the permanent interests of the shareholders. It is an extraordinary fact, that although the present season cannot be considered as a dry one, yet the chief lines of canal to the east coast have been stopped for want of water, and land carriage has been obliged to be substituted for about one-third of the distance, at an increased expense of fifty per cent. The tract of country to be traversed by this railway comprises within it a greater amount of wealth, and a larger population, than any other provincial district of the same extent in the kingdom; besides having Manchester at one end and Leeds at the other, it will have the important manufacturing towns of Oldham, Heywood, Middleton, Rochdale, Littleborough, Todmorden, Hebden Bridge, Mythomoyd, Sowerby Bridge, Halifax, Bradford, Huddersfield, Mirfield, Dewsbury, and Wakefield, and their respective dependencies lying between, with an aggregate population of upwards of a million and a half—being equal to one-ninth of the

total population of all England, though only one thirty-eighth part of the area. It will, moreover, open a direct communication between the two seas. The contractors are under heavy penalties to finish the line to Rochdale (11¼ miles) in May 1839, and from it a considerable income will be derived. The prospects of remuneration to the shareholders are therefore most cheering, and quite justify the very favourable opinion with which the public regards this important railway. We regret the report came too late for publication the present month.

The Midland Railway to Edinburgh and Glasgow.—This project is steadily advancing in public opinion, which is partly attributable to the indefatigable and judicious exertions of Mr. Stephen Reed, the projector of the line, and Mr. Richardson, the engineer, but more especially to the intrinsic merits of the line itself.—*Newcastle Journal.*

Mammalia.—The remains of Mammalia have been found on the plains of Cheshire. In the progress of cutting for the Grand Junction Railway, two grinders of the elephant were discovered in a bed of gravel replete with marine shells.—*Times.*

National Loan Fund Life Assurance Society.—We are glad to hear that the principles of this Society begin to be thoroughly appreciated by the public. We have received an interesting article on the subject, which came too late for the present number.

Neapolitan Railroad.—The King of Naples has given M. A. G. Bayard de la Vingtrie his Royal sanction for the construction of a railroad from Naples to Nocera, with a side branch to Castellamare, with the additional privilege of extending the line to Salerno and Avellino, and forming several side branches to other places, on condition of the works being begun within the space of five years. The railroad is to commence in the market-place of Naples, to proceed towards the plain of Portici, by the harbour of Granatello, and thence, between the shore and Resina, to Torre del Greco and Torre dell' Annunziata. At the latter place it will branch off in two directions—one along the seashore to Castellamare, the other through the gates of Pompeii to Nocera, leaving Angri on one side, but passing through Pagani. The length of the whole road will be about 24 *miglie*. A calculation, based upon the present number of passengers and goods, and a much lower price than that now usually paid, is said to leave a profit of nine per cent to the Company.

Northern and Eastern Railway.—The Directors have given orders to begin the construction of the first and most profitable part of this line, that is, from Kingsland turnpike to Broxbourne, immediately. It is calculated that this part, which is very easy of construction, may be executed within twelve months after obtaining possession of the land, and will pay a clear profit of "22 per cent." We can only say we are glad to see this alacrity after so

long a pause, and we trust it will not cease until they reach Cambridge.

North Union Railway.—The works on this line are at present making rapid progress at the Wigan End. The erection of two iron bridges, one over Walgate and the other over Chapel, are now in progress, and they are expected to be an ornament to that town. —*Preston Chronicle.*

Paris and St. Germain Railway.—This line does not seem to please well. Its cost of construction is said to be immense, its terminus inconvenient, and chance of paying well but little.

Railroad in Holland.—Amsterdam, Sept. 7.—The King, by his decision of the 4th of this month, has confirmed the statutes of the Dutch Iron Railroad Company, and consequently that Company may be considered as constituted. Our fellow-citizens know that the work of preparing the ground is already proceeding with activity, and from the great number of workmen employed, we may expect that important work will be speedily carried into effect.—*Globe.*

Russian Railroad.—At a late Meeting of the Proprietors of the Zarsko Selo Railroad, the following Resolutions were come to:—1. By a majority of 164 out of 186 votes, that the Directors be empowered to contract a loan of 1½ millions rubles for completing and carrying the railway from the Fontanka Canal within the city to the terminus within the Park of Pawlowsk. 2. By a majority of 122, that the Company carry on the traffic under their management: only 32 voted for leasing the same. 3. That the railroad be continued to Pschora—unanimously.

River Dee and Chester Harbour.—We have seen an elaborate and interesting report on the improvement of this river and harbour by Sir John Rennie, which we have been anxious to give our readers the benefit of, but the British Association and the Railway reports put it entirely out of our power, at least for the present.

Railways in Germany.—It appears certain that the Prussian Government have resolved upon promoting a system of railway lines to connect Prussia Proper with its various dependencies, but more especially with the Rhine Provinces. To effect this object the kingdom of Hanover will be traversed from east to west, and this main line will connect on the borders of Saxony with the Leipsic and Dresden Railway, and will intersect the proposed Hamburgh and Hanover Railway between the cities of Hamburgh and Brunswick. At the latter city will terminate the railway from Hartzburgh and the celebrated Hartz mountains. The railway from Magdeburg to Leipsic is so far organized that the line has been traced on the ground and the working drawings made. Some of the German engineers are now in England, and attended the meeting of the British Association in Liverpool, and have examined our principal railways. Mr. Vignolles, C. E., who has lately returned from a tour through Germany, is the engineer consulted

on most of these lines, and is now giving the orders for the engines, &c. required for the Brunswick and Hartzburgh Railway.

Thames Tunnel.—A Court of Directors of the Thames Tunnel Company was held on Thursday, when Mr. Brunel laid before the meeting a detailed report of the late irruption, and of closing the aperture in the bed of the river, and of the successfully clearing of all the water out of the tunnel. The shield has been approached, and all found in good order. The quantity of mud which has run into the tunnel from the bed of the river is much less than was expected. The clearing out of the shield will be immediately commenced, and the works will then be resumed.—*Mining Journal.*

York and North Midland Railway.—We are glad to learn the progress which the works connected with this Company are making. At their meeting on Thursday week the Directors entered into a contract for stone blocks, &c.; they also gave instructions to the engineer to prepare a further part of the line as far as the Leeds and Selby Railway line; to furnish them with plans and specifications of a bridge over the river wharf at Ulleskelf, and to advertise for contracts for the same. It is the intention of the Directors immediately to enter into a negotiation with the different landowners, on the line, and to purchase as soon as possible the whole of the land required between York and the Leeds and Selby Railway.—*Leeds Intelligencer.*

Iron Steam Boats.—An iron steam boat, called the Sirius, was launched the 26th ult. from Messrs. Fairbairn's, at the Isle of Dogs, the longest yet made of iron. She measures about 164 feet in the keel, and 176 on deck. Her beam is 17 feet. She is intended to be worked by two high-pressure engines of 35 horse-power each, with 24 inch cylinders, of 3½ feet stroke, and three boilers with copper tubes worked expansively; and to ply on the Rhone. The iron planks of which she is made are about 7 feet long, 14 inches wide, and a quarter of an inch thick, and her ribs are of double angle iron with diagonal stays. Her mould is handsome, but rather narrow; and when she has her machinery and water, it is calculated she will not draw above two feet of water. She is, besides, divided into four compartments by three iron water tight bulkheads; so that if a fracture should happen in any one part she will still float safely.

PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

NAMES OF RAILWAYS.	No. of Shares.	Share.	Paid.	Prices sold at.			Dividend per Cent.
				Highest.	Lowest.	Last Price.	
		£.	£.				
(3) Birmingham and Derby	6,000	...	15	9¼	8¼	8¾	
(3) *Birmingham and Gloucester*	9,500	100	10	1½	1½	1½	
(2) Birmingham, Bristol, and Thames Junction	7,500	20	3				
(2) Bristol and Exeter	15,000	100	10	4	4	4	
(2) Cheltenham and Great Western	7,500	100	7½				
(3) Commercial, Blackwall	12,000	50	2				
(3) Dublin and Kilkenny	8,000	100	2½				
(2) Eastern Counties	60,000	25	2	½	2s 6d*	†	
Edinburgh and Dunbar	.....	...	2				
Edinburgh and Glasgow (old)	13,000	50	2	1½	1½	1½	
Ditto, ditto (new)	.....	...	4				
(3) Edinburgh, Leith, and Newhaven	5,000	20	3				
(3) Great North of England	10,000	100	7				
(2) Great Western	25,000	100	55	66½	53½	65	
(1) *Grand Junction*	10,919	100	90	186	183	186	
(2) Hull and Selby	8,000	50	5				
(2) Llanelly Railway and Dock Company	2,000	100	35	...	...	...	6
(1) *Liverpool and Manchester*	4,000	100	100	201	199	201	9
Liverpool and Manchester, ¼ shares	.....	...	25	47¾	47½	47½	
Do., ¼ *shares*	.....	...	20	57½	49½	57½	
(1) *Leicester and Swannington*	1,500	50	...	77	77	77	6
(3) London and Brighton	36,000	50	5	1⅞	⅛	1⅛	
Do. Rennie's	.....	...	...				
(4) Do. and Blackwall	12,000	50	3	9s.	7s.	½	
(2) Do. and Birmingham	25,000	100	90	146	139	145	
Do. ½ Shares	.....	...	5	20½	19	20½	
Do. Bonds, 4 per Cent. 1843	.....	...	...				
(2) Do. and Greenwich	20,000	20	20	15¾	13	15¾	3
(2) Do. and Southampton	20,000	50	45	30	29	29	
Do. do. New	.....	...	1	11½	10	10¾	
(2) Do. and Croydon, Trunk	7,000	20	20	16	15	16	
Do. Scrip	7,000	14	2				
(3) Do. Grand Junction	12,000	50	5				
(3) Manchester and Birmingham	30,000	50	5	4¼	3¼	3¼	
(2) Do. and Leeds	10,000	100	10	11	10½	10½	
(2) *Midland Counties*	26,000	150	10	5½	5½	5½	
(3) Northern and Eastern	12,000	100	8	3	¼	3	
(2) North Midland	15,000	100	15	15	13	12¾	
North Union	.....	...	100				
Do. New shares	.....	...	10	22¼	14¾	22¼	
(4) South Durham	3,000	50	2½				
(2) South-Eastern and Dover	28,000	50	7	4	3	4	
South Midland	....	50	1				
(4) South-Western	40,000	50	1	¼	¼	¼	
(1) *St. Helens, Runcorn Gap*	.....	...	100	25½	25½	25½	
(3) Thames Haven	9,000	50	2½				
(3) York and North Midland	6,000	50	3				

* Less than nothing. † Ditto.

*** Those in Italics are Liverpool prices to the 23d of September: the others London to the 27th.

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Report of the Statement and Calculations respecting the Motion of Trains on Railways, made before the Mechanical Section of the British Association in Liverpool, September, 1837, by Dionysius Lardner, LL.D., F.R.S., &c., &c.

In the observations which Dr. Lardner addressed to the Mechanical Section of the British Association at Liverpool, he stated his object to be, to direct the attention of practical men to the necessity of taking into account, in their calculations, the effect of the inertia of the wheels in all experiments made with a view to determine railway constants, where the motion of the trains under observation is not uniform: he stated that although it was, or ought to be, well understood, that the moment of inertia of the wheels forms an element in such calculations, yet in by far the greater number of cases this effect has been omitted. It is probable that the most satisfactory methods of determining the railway constants will be derived from uniform motion, in which case the moments of inertia of the wheels will not be taken into account. But if accelerated or retarded motion be used at all, proper formulæ should be previously established, by which exact results may be obtained, and such formulæ must include the moments of inertia of the wheels.

When a train is moved upon a straight and level railway at an uniform speed, the resistances which the moving power has to encounter are—1st, the friction of the several axles; 2dly, the friction of the tires of the wheels upon the rails; 3dly, the friction of the machinery of the engine; and

4thly, the resistance of the atmosphere. Let us for the present put out of view the friction of the machinery of the engine, and the atmospheric resistance, and only consider the friction of the axles, and the friction of the wheels on the rails. It has been satisfactorily established by the experiments of Coulomb, Ximenes, Vince, and others, and still more recently by a very extensive series of experiments, conducted under the orders of the French Government, by Morin, that the resistance which arises from these modes of friction are in the ratio of the pressures on the rubbing or rolling surfaces, and are independent of the velocity of the motion. Dr. Lardner stated, that the results of his own observations on railways, were in accordance with this law.

If the intensity of the tractive power, after deducting the effects of the resistance of machinery and of the air, be equal to this resistance, it will be capable of moving the train at a uniform speed, the amount of that speed depending on the rate at which the tractive power can be produced.

If, however, the intensity or energy of the tractive power be greater than this resistance, then the speed of the train will be accelerated, and two other causes of resistance will be produced in addition to those abovementioned, viz.—1st, by the inertia of the whole mass of the load moving parallel to the railway; and 2dly, by the inertia of rotation of the wheels, each particle of which revolves with a different velocity, and all with accelerated motion. These complicated effects, produced by the moving power, must be carefully analyzed if correct formulæ are required.

Let t express the resistance opposed to the tractive power, by the unit of weight placed on a carriage moving at a uniform velocity.

Let M express the gross mass of the load, and g the accelerating force of gravity.

Hence Mg will be the gross weight of the load; and Mgt will express the actual resistance which the load will offer to the tractive power when moving at any uniform speed.

Now let t' express a tractive force greater than t, which would move the unit of load with a uniformly accelerated motion; and V express in feet per second the velocity of the load; the time T being expressed in seconds.

When the load is put in accelerated motion, by the tractive force t', the effect produced will be the progressive motion of the whole mass M, and at the same time the

rotatory motion of the wheels. The effective impelling force will be

$$Mg(t'-t),$$

which in the time dT will exert an impulse expressed by

$$Mg(t'-t)\,dT.$$

Now by applying the principle of D'Alembert, we shall obtain the relation between this and the actual moving force impressed upon the load. The progressive velocity imparted to the load in the time dT will be dV, and the moving force consequent on such velocity will be $M\,dV$. But at the same time that this progressive motion is received by the gross load, including the wheels themselves, a rotatory motion is also imparted to the wheels. Let dm express an elementary particle of the mass of the wheels at the distance z from their centre of motion, and let the angular velocity imparted to the wheel in the time dT be $d\omega$. The actual velocity then imparted to the particle dm in the time dT will be $z\,d\omega$, and the moving force given to it will of course be

$$z\,d\omega\,dm.$$

Now these moving forces must, by the principle of D'Alembert, be in equilibrium with the other moving force $M\,dV$ and the impelling force. Hence we obtain the following condition, where r expresses the radius of the wheel

$$Mg(t'-t)r\,dT = Mr\,dV + d\omega\,\Sigma(z^2\,dm);$$

multiplying both members by r, and replacing $r\,d\omega$ by its equivalent dV the condition becomes

$$Mg(t'-t)r^2\,dT = Mr^2\,dV + dV\cdot\Sigma(z^2\,dm);$$

or

$$g\{t'-t\}\,dT = \left\{1+\frac{\Sigma(z^2\,dm)}{Mr^2}\right\}dV \quad . \quad . \quad . \quad . \quad [1]$$

This being integrated, and the initial velocity being expressed by V', we shall have

$$\left\{1+\frac{\Sigma(z^2\,dm)}{Mr^2}\right\}(V-V') = g(t'-t)\,T \quad . \quad . \quad . \quad . \quad [2]$$

Also by eliminating T from [1], by the condition $V\,dT = dS$, (S being the space moved over in feet) we obtain

$$g(t'-t)\,dS = \left\{1+\frac{\Sigma(z^2\,dm)}{Mr^2}\right\}V\,dV,$$

which being integrated gives

$$\left\{1+\frac{\Sigma(z^2dm)}{Mr^2}\right\}(V^2-V'^2)=2g(t'-t)S \quad . \quad . \quad . \quad [3]$$

Hence eliminating V by [2] and [3], we find

$$g(t'-t)T^2+2\left\{1+\frac{\Sigma(z^2dm)}{Mr^2}\right\}V'T=2\left(1+\frac{\Sigma(z^2dm)}{Mr^2}\right\}S \; . \; [4]$$

when S is the space through which the tractive force has acted during the time T.

It is evident, that $\Sigma(z^2dm)$ expresses the moment of inertia of the wheel round the centre of motion, or rather the sum of the moments of inertia of all wheels. As the matter composing the wheels is distributed uniformly round their centres, if the excess of matter at the sum be considered as compensating for the excess of matter at the nave and in the axle, we shall obtain an approximate value for the moment of inertia, by considering the wheel as a circular disk of uniform thickness. The wheels of railroad waggons do not, like those of other carriages, turn on their axles, but form one solid piece with the axle, which turns with them. The axle therefore must be regarded as part of the revolving mass, and assists in the compensation for the excess of matter in the tire of the wheel. Treating then the wheel as a flat circular disk, let its thickness be u, and the density of its material k, the mass of an annulus of the breadth dz at the distance z from the centre will then be expressed by

$$2z\pi ukdz=dm;$$

hence

$$z^2dm=2z^3\pi ukdz.$$

This being integrated between the limits $z=o$ and $z=r$, will give

$$\Sigma(z^2dm)=\frac{\Sigma r^4uk\pi}{2};$$

but since $r^2\pi$ is the area of the disk of the wheel, it is evident that $\Sigma r^2\pi uk$ is the mass of the wheels, or rather the sum of the masses of all the wheels. Let $m=$ this mass, and we shall have the moment of inertia of all the wheels expressed by $\frac{mr^2}{2}$. Hence

$$\frac{\Sigma(z^2dm}{Mr^2}=\frac{m}{2M}$$

where $\frac{m}{M}$ expresses the ratio of the weight of the wheels to the gross weight of the load, including the wheels themselves.

If the preceding formulæ do not give a sufficient approximation to the moments of inertia of the wheels, their value must be determined in every particular case by experiments, which may always be done with facility.

In the equations [2], [3], [4], V' expresses the velocity when the train commences to move over the space S, and V the final velocity. In practice there is some certain speed which must be attained by the train, and which, when attained, is continued uniformly. When the train starts from a place of rest, there is a distance through which it must move to acquire this speed; and in like manner, when about to stop, there is a certain distance from its place of rest, at which the action of the moving power must be entirely suspended. To ascertain these distances respectively, let V express the uniform velocity which must be given to the train, and let t express the uniform force of traction with which this velocity is maintained. Let t' express the excessive force of traction, applied in the first instance to impart the velocity V. To find the space S, through which it is necessary for this force t' to act, let $V' = O$ in [3], and we have

$$S' = \frac{a\,V}{2g(t'-t)} \quad \ldots\ldots\ldots\ldots \quad [5]$$

where for brevity we put $1 + \frac{m}{2M} = a$. S' is then the space in feet, at the end of which the velocity V will be acquired by the train, by the action of the impelling force t', and at that point the intensity of the impelling power must be reduced to t if it be desired that the velocity V should be continued uniform. The time T', necessary to impart to the train the velocity V, will be found from [2], by putting $V' = O$, and we have for T',

$$T' = \frac{a\,V}{g(t'-t)} \quad \ldots\ldots\ldots\ldots \quad [6]$$

The time T' is here expressed in seconds.

To find the place when the action of the moving power should be suspended, in order to make the train to stop at a given point, let S'' be the distance between the points where the action of the moving power is suspended, and the point where the train will come to a state of rest. In [3] let

$V = O$, and $t' = O$, and for S substitute S''; then t will express the retarding force of friction, V' will express the uniform velocity which the friction will destroy. We shall have then

$$S'' = \frac{a V'^2}{2gt} \quad \ldots \ldots \ldots \ldots \ldots \quad [7]$$

and in like manner from equation [2] we have

$$T'' = \frac{aV'}{gt} \quad \ldots \ldots \ldots \ldots \ldots \quad [8]$$

when T'' is the time necessary to stop the train. The distance S'' is the shortest space in which a train can stop with a velocity V', without the assistance of the brakes; and T'' is the time in seconds which it takes to stop.

When a train performs a journey of any length, subject to intermediate stoppages, time is lost at each stoppage by the necessity of suspending the action of the moving power, and letting the train stop gradually, and upon starting again, getting up the regular velocity gradually; this loss of time may be calculated from the above formula. The difference between the time T'', and the time in which the space S'' should be moved over with a uniform velocity, gives the time lost in bringing up the train to a place of rest. The time lost in bringing up the train to its regular velocity will be found by taking the difference between the time T', and the time of moving over the space S' with the regular velocity. The total loss of time, then, in bringing the train to a state of rest, and restoring it to its former velocity, will be

$$\frac{aV}{2g}\left\{\frac{1}{t} + \frac{1}{t'-t}\right\} \quad \ldots \ldots \ldots \ldots \quad (9)$$

V, as before, still expressing the regular velocity of the train.

If n be the number of stoppages in a journey, the total time lost will then be

$$\frac{naV}{2g}\left\{\frac{1}{t} + \frac{1}{t'-t}\right\} \quad \ldots \ldots \ldots \ldots \quad [10]$$

Besides the loss of time in stoppage, it is necessary to inquire whether any moving power is lost. The power which would be expended in moving over the spaces S' and S'', if no stoppages took place, would be

$$t(S' + S'');$$

but if a stoppage takes place, no moving power is expended over the space S'', and the moving power expended over the space S is t' S'. The loss of the moving power then by the stoppage (if any) would be

$$S' t - (S' + S'') t,$$

or

$$S' (t - t) - s' t$$

by substituting in this for S' and S'', their values in [5] and [7], we find the whole = 0. Consequently no moving power is lost by stoppages. By the same reasoning it is apparent that the excess of moving power, expended in moving the train, is restored at the end of the journey.

On the Motion of Trains Ascending in Acclivities.

The acclivities on railroads are generally inclined planes, and we shall, therefore, assume every part of the ascent to be of the same inclination to an horizontal plane. Let this angle of inclination be ϵ.

Let ρ be the angle of elevation of an inclined plane, on which the gravity of a train downwards is exactly equal to the resistance opposed by the friction of the carriages and the road to its downward motion. This is called the angle of repose. The tractive force necessary to balance the resistance arising from friction on an inclined plane, will be less than the force t for the level, in the same ratio as the pressure is less; hence this resistance on the inclined plane, whose elevation is ϵ will be $t \cos \epsilon$ and on the plane of repose will be $t \cos \rho$.

The force necessary to balance gravity on the inclined plane, whose elevation is ϵ, will be $\sin \epsilon$, and on the plane of repose will be $\sin \rho$. Hence we have

$$\therefore \quad t \cos \rho = \sin \rho \quad \therefore t = \tan$$

Let F be the accelerating force produced by the tractive force t' in ascending a plane; then gt' will be the actual accelerating effect of t'; this is opposed by the retarding effect 1st, of friction which is $g\, t \cos \epsilon = g \tan \rho \cos \epsilon$; 2d, of gravity which is $g \sin \epsilon$. $\therefore$

$$F = (t' - \tan \rho \cos \epsilon - \sin \epsilon)\, g$$

$$\therefore \quad F = \left\{ t' - \frac{\sin (\rho + \epsilon)}{\cos \rho} \right\} g$$

but ρ is so small that without any sensible error we may take $\cos \rho = 1$. Hence,

$$F = g \left\{ t' - \sin (\rho + \epsilon) \right\} \quad . \quad . \quad . \quad . \quad (11)$$

Hence, equations (2) (3) (4) for an ascending plane will become

$$g \left\{ t' - \sin (\rho + \epsilon) \right\} T = a (V - V') \quad . \quad . \quad (12)$$

$$a (V^2 - V'^2) = 2 g \left\{ t' - \sin (\rho + \epsilon \right\} S \quad . \quad (13)$$

$$g \left\{ t' - \sin (\rho + \epsilon) \right\} T^2 + 2 a V' T = 2 a S \quad . \quad (14)$$

There is a certain tractive force which is necessary to keep a load in motion at an uniform speed in ascending a plane. This will be found by putting $F = o$ and solving (11) for t'; hence

$$t' = \sin (\rho + \epsilon)$$

If a train start upon an ascending plane there is a certain space (S') and time (T') necessary to give it any proposed velocity (V) with a given tractive force (t'); these may be found by putting $V' = O$ in (13) and (12) and solving for S and T; hence we find

$$S' = \frac{a V^2}{2 g \left\{ t' - \sin (\rho + \epsilon) \right\}} \quad (15) \qquad T' = \frac{a V}{g \left\{ t' - \sin (\rho + \epsilon) \right\}} \quad (16)$$

Also if a train be stopped in ascending a plane there is a certain space (S'') and a certain time (T'') after the tractive power has been suspended before it comes to a state of rest. These may be found by putting $V = o$ and $t' = o$ in (13) and (12) and solving for S and T, hence we find

$$S'' = \frac{a V'^2}{2 g \sin (\rho + \epsilon)} \quad (17) \quad T'' = \frac{a V'}{g \sin (\rho + \epsilon)} \quad . \quad (18)$$

In (15) (16) (17) (18). V and V' express the uniform speed at which the train is required to be moved on the road when in regular motion.

It may be shown, as in the case of level planes, that the time lost in stopping the train and recovering its speed is expressed in seconds by

$$\frac{a V}{2 g} \left\{ \frac{1}{\sin (\rho + \epsilon)} + \frac{1}{t' + \sin (\rho + \epsilon)} \right\} \quad . \quad (19)$$

It will follow also in like manner that no power is lost by

the stoppage. In all the preceding cases we put out of the question the effect of brakes. If brakes be used, the loss of moving power will be equal to the resistance which they produce.

On the Motion of Trains descending Inclined Planes.

The formulæ (11) (12) 13) (14) will be applied to the motion in descending inclined planes, by changing the sign of ϵ; hence for descending we obtain,

$$F = g\left\{ t' - \sin(\rho - \epsilon) \right\} \quad . \quad . \quad . \quad . \quad . \quad . \quad (20)$$

$$g\left\{ t' - \sin(\rho - \epsilon) \right\} T = a(V - V') \quad . \quad . \quad . \quad (21)$$

$$a(V^2 - V'^2) = 2g\left\{ t' - \sin(\rho - \epsilon) \right\} S \quad . \quad . \quad (22)$$

$$g\left\{ t' - \sin(\rho - \epsilon) \right\} T^2 + 2aV'T = 2aS. \quad (23)$$

There are three classes of inclined planes which differ in particulars, of so much practical importance that we shall consider them separately. These are characterized by

$$\epsilon > \rho, \qquad \epsilon = \rho, \quad \text{and} \quad \epsilon < \rho$$

First Case $\epsilon > \rho$.

On planes of such elevation, the gravity of the train being greater than its friction, it will even, without any impelling power, descend with an uniformly accelerated motion. The accelerating force with which it will descend will be found by putting $t' = O$ in (20) which gives

$$F = -g \sin(\rho - \epsilon) = g \sin(\epsilon - \rho) \quad . \quad . \quad . \quad (24)$$

Inclined planes of this degree of acclivity require the use of the brake when they are of such a length that a train would acquire undue velocity in descending them. To enable an engineer to determine the circumstances which would attend the failure of the brakes, it may be convenient to give the formulæ by which the time of descent, the speed acquired, and the length and acclivity of the plane are related. These will be obtained by introducing the condition $t' = O$ into the formulæ (21) (22) (23) whence we obtain

$$g \sin(\epsilon - \rho)\, T = a(V - V') \quad . \quad . \quad . \quad . \quad (25)$$

$$a(V^2 - V'^2) = 2g \sin(\epsilon - \rho)\, S. \quad . \quad . \quad . \quad (26)$$

$$g \sin(\epsilon - \rho)\, T^2 + 2aV'T = 2aS \quad . \quad . \quad (27)$$

Second Case $\epsilon = \rho$.

In this case the elevation of the plane is equal to the angle

of repose. The component of the weight of the train in the direction of the plane, is exactly equal to the friction, and there is, therefore, no force resisting its descent, while, on the other hand, there being no excess of gravity down the plane, there is no accelerating force in that direction. No tractive power is, therefore, necessary. When the train has once received any uniform speed, it will retain it until it arrive at the termination of the plane. Since, however, in practice, the resistance is never strictly uniform, a slight action of the moving power will be used to obliterate the effects of these inequalities; its amount may, however, be disregarded.

Third Case $\epsilon < \rho$.

The angle of elevation of the plane is, in this case, less than the angle of repose. The effect of gravity being less than that of the friction of the train, it cannot move without the operation of the tractive power, and the motion of the train will be influenced in the same manner as on a level plane, on which the friction would be lessened by the amount of the gravity down the plane.

To find the tractive force t' necessary to sustain a uniform velocity in the descent, we have only to find the value of t' in (20) when $F = o$ which gives

$$t' = \sin(\rho - \epsilon).$$

If t' express the force of traction necessary to obtain a uniform velocity on an ascending plane, whose elevation is ϵ, and t'' the force of traction necessary to maintain a uniform velocity on a descending plane, whose elevation is ϵ, we shall have for the values of these several forces,

$$t = \sin \rho$$
$$t' = \sin(\rho + \epsilon)$$
$$t'' = \sin(\rho - \epsilon).$$

The value of t'' will be positive, so long as the elevation of the plane is less than the angle of repose, showing that within that limit the power which maintains the velocity uniform must be a *tractive power*—but when the angle of elevation becomes greater than the angle of repose, then t'' becomes negative and expresses a retarding force, being, in fact, the power which the brakes must exert in order to prevent acceleration. When the angle of elevation is equal to the angle of repose $t'' = O$ in the descent as has been already shown.

If the values of t' and t'' be added and subtracted, supposing $\epsilon < \rho$ we obtain

$$t' + t'' = \sin(\rho + \epsilon) + \sin(\rho - \epsilon) = 2 \sin \rho \cos \epsilon$$
$$t' - t'' = \sin(\rho + \epsilon) - \sin(\rho - \epsilon) = 2 \sin \epsilon \cos \rho$$

But we shall show hereafter, that for all inclines which can occur on railroads, we may take $\cos \rho = 1$ and $\cos \epsilon = 1$. Hence,

$$t' + t'' = 2 \sin \rho \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (28)$$
$$t' - t'' = 2 \sin \epsilon \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (29)$$

But if $\epsilon > \rho$ let t'' be taken to express the amount of force checking the descent so as to keep the velocity of the descending motion uniform, and prevent acceleration, we must then take $t'' = \sin(\epsilon - \rho)$ and we shall obtain by the same reasoning

$$t' + t'' = 2 \sin \epsilon \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (30)$$
$$t - t'' = 2 \sin \rho \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (31)$$

The formulæ (28) and (31) offer convenient methods for determining the amount of friction by means of a dynamometer,—if such an instrument can be found applicable to railways. From numerous experiments which Dr. Lardner has made, he is inclined to think that it will not be found practicable to determine the friction of trains by such an instrument. But if it be so, it will be convenient to adopt a method which will render the result independent of any errors of levelling. In fact, in applying this instrument, it would not be enough to know the general inclination of the line over which the carriages are drawn, but the actual inclination of every part of the surface of the rails should be determined—a thing which is all but impracticable. By the formulæ (28) and (31), however, the friction may be obtained independently of the gradient. If the inclination of the rails be less than the angle of repose, let the dynamometer be applied to opposite ends of the waggon, so as to draw it in contrary directions on the rails. Its indications will give values for t' and t''. A mean of these being taken from several observations, and the sum of these mean values being added altogether, twice the friction will be obtained.

If the angle of inclination be greater than the angle of repose, then the dynamometer being applied to the higher end of the waggon, it should be drawn upwards at a slow uniform rate, and the mean indication of the dynamometer observed. This will be a value of t'. — Let now the carriage be allowed to descend at a slow uniform speed, the dynamometer

being used only to check its tendency to accelerated motion. The mean indication of the dynamometer will, in this case, be a value of t''; and the difference between t' and t'' will be twice the friction.

Dr. Lardner has attempted numerous experimental inquiries in this way, but he has not yet found any dynamometer practically applicable to the purpose.

Of the Effect of Brakes.

As there is a limit beyond which a train cannot be permitted with safety to acquire speed in descending an inclined plane, it is important that means should be provided by which the further acceleration of the trains may be prevented, this is effected by means of brakes.

A brake is a block of wood attached to the end of a lever, and placed near the tire of the wheel, so that when necessary it may be pressed against the tire, producing thereby a friction proportioned to the intensity of pressure, and retarding the train with a corresponding force.

Brakes are useful even on a level or ascending plane, when, from the occurrence of an accidental impediment, it becomes necessary to stop the train within as short a distance as possible.

In such a case the impelling power of the engine is suspended and at the same time the brakes are applied.

It is important, therefore, to consider the circumstances on which the effective performance of the brakes depend, and their effects in different cases in which they are brought into action.

Let b be the ratio of the total pressure by the brakes on the wheels to the weight of the load.

Let f be the ratio of the friction of the brake to its pressure, this ratio for brakes of the same kind of wood is constant, but with different woods it is different.

Then $f\,b\,g$ will be the whole retarding force of the brakes.

If a train moving on a level plane with the velocity V be required to be suddenly stopped, and the impelling power being suspended and the brakes applied, the distance S, within which it can be brought to rest, and the time T may be found by substituting $-f\,b$ for t' in (3) and (2) putting $V=0$ and finding the corresponding values of S and T; hence

$$S=\frac{a\,V'^2}{2\,(f\,b+t)\,g} \quad \ldots\ldots \quad (32)$$

$$T = \frac{a\,V'}{(fb + t)\,g} = \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (33)$$

If the train be moving on an inclined plane these formulæ will be obtained in the same manner, from (13) and (12).

$$S = \frac{a\,V'^2}{2\left\{fb + sin\,(\rho + \epsilon)\right\}g} \quad . \quad . \quad . \quad . \quad . \quad . \quad (34)$$

$$T = \frac{a\,V'}{\left\{fb + sin\,(\rho + \epsilon)\right\}g} \quad . \quad . \quad . \quad . \quad . \quad . \quad (35)$$

But it is when trains descend inclined planes of greater elevation than the angle of repose that brakes become chiefly useful. On such planes the descending motion of the train is always accelerated, and since it is generally necessary to sustain its ordinary speed until the moment it begins its descent, the brakes must be almost instantly called into action to prevent acceleration.

The force of the brakes in descending will be found by substituting $-fb$ for t' in (20) which gives—

$$F = g\left\{-fb - sin\,(\rho - \epsilon)\right\} = g\left\{sin\,(\epsilon - \rho) - fb\right\}$$

If $\epsilon = \rho$ the whole retarding force of the brake is effective, and the time in which the train can be stopped may be found from (22) and (21)

$$S = \frac{a\,V'^2}{2fb\,g} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (36)$$

$$T = \frac{a\,V'}{fb\,g} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (37)$$

If $\epsilon < \rho$ the distance and time of stopping the train will be found in the same manner to be—

$$S = \frac{a\,V'^2}{2\left\{fb + sin\,(\rho - \epsilon)\right\}g} \quad . \quad . \quad . \quad . \quad (38)$$

$$T = \frac{a\,V'}{\left\{fb\ \ sin + (\rho - \epsilon)\right\}g} \quad . \quad . \quad . \quad . \quad (39)$$

In the first two cases the motion down the planes when the impelling force has been suspended cannot be accelerated, and in the latter, in fact, must be retarded, independently of the brakes, therefore the effect of the brakes is more immediate; in other words, the values of S and T will be small if the brakes be at all effective; but when $\epsilon > \rho$ the motion down the plane will be accelerated, and the use of the brakes is indispensable, even when it is not desired to stop the train.

In this case the speed down the plane when the brakes are in operation and the impelling power suspended will be accelerated, when

$$sin\ (\epsilon - \rho) > fb$$

It will be uniform when

$$sin\ (\epsilon - \rho) = fb$$

and retarded when

$$sin\ (\epsilon - \rho) < fb$$

If $sin\ (\epsilon - \rho) > fb$ an acceleration will take place in spite of the brakes, and the velocity acquired in the descent, and the time of descent will be obtained by substituting $-fb$ for t' in the equations (22) (23) which thus become

$$a\ (V^2 - V'^2) = 2\ g\ [sin\ (\epsilon - \rho) - fb]\ S \quad . \quad (40)$$

$$g\ [sin\ (\epsilon - \rho) - fb]\ T^2 + 2\ a\ V'\ T = 2\ a\ S \quad (41)$$

The pressure on the brakes necessary to obtain an uniform velocity in the descent will be given by

$$b = \frac{f}{sin\ (\epsilon - \rho)} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (42)$$

To find the distance and time in which it is possible to stop the descending train by the brakes, when $sin\ (\epsilon - \rho) < fb$ we have only to substitute in (22) and (21) as before, and solve for S and T by which we find

$$S = \frac{a\ V'^2}{2\left\{fb - sin\ (\epsilon - \rho)\right\} g} \quad . \quad . \quad . \quad . \quad (43)$$

$$T = \frac{a\ V'}{\left\{fb - sin\ (\epsilon - \rho)\right\} g} \quad . \quad . \quad . \quad . \quad (44)$$

It sometimes happens that the brakes fail to act in descending planes and the train runs amain, the speed it will acquire on its arrival at the foot of the plane in such a case may be determined by substituting in (40) for V' the velocity of the train at the moment of failure of the brakes, and putting $fb = O$. The corresponding value of V will be the final velocity of the train, S being taken to express the length of the plane between the point where the brake fails, and the point where the velocity V is acquired.

It sometimes happens that the brakes act with such effect as to stop the revolution of the wheels, and to convert the waggon into a sledge; this will happen when the friction between the brake and the tire of the wheel is greater than the friction which would be produced between the wheel and the rail by a sliding motion of the one upon the other.

To determine the conditions under which this will happen,

let p be the part of the weight of the waggon which rests on the wheel on which the brake acts. Let f' be the ratio of friction to pressure between wrought iron and wrought iron, the condition which will limit the ordinary action of the brake will be

$$fb < f'p$$

If it be desired to determine the friction by the motion of carriages down an inclined plane more steep than the angle of repose, the formulæ (25), (26), and (27) ought to be the basis of the investigation. In these, the train is supposed to have a certain initial velocity V' at the commencement of the descent. If, however, it move from a state of rest, and continue descending a uniform and straight inclined plane, the formulæ (25), (26), and (27) will be rendered applicable by putting $V' = O$. In that case if the final *velocity* and the *time* be observed, and the moments of inertia of the wheels ascertained, the formula (25) will give the angle of repose, or, what is the same thing, the friction. If the *space* moved over, and the final *velocity* be observed, the formula (26) will give the friction. And finally, if the *space* moved over be accurately measured, and the *time* of the descent be accurately noted, the formula (27) will give the friction. In all cases, however, it will be apparent that it is necessary to have previously determined with the last degree of precision, the inertia of the wheels, and the value of the gradient. The formula best adapted for practical purposes is (27), inasmuch as the only matter of immediate observation during the experiment would be the *time* of a descent, which, if the plane were very long, might be observed with sufficient precision. It is, however, in practice subject to this objection, that the gradient is never perfectly uniform, without which uniformity the formula (27) cannot strictly represent the phenomena.

After having, however, devoted much consideration to this subject, Dr. Lardner is inclined to think that the steam-engine itself will be found to be the best dynamometer, and that practical methods may be adapted, which will afford mean values for the railway constants with greater precision than any of the more refined methods suggested by the mathematical formulæ, which have been given in the preceding pages; meanwhile, these formulæ will not be without their use as means of verification, and as affording grounds for exact reasoning according as the construction of railways and carriages upon them, approaches more nearly to mathematical perfection.

Dr. Lardner would suggest then the following practical method for determining the mean amount of friction. Let an engine be loaded with as heavy a train as it is capable of drawing at a very slow and uniform speed, having its steam valve fully open, and no steam blowing off at the safety-valve. Let care also be taken that the diameter of the steam-pipe from the boiler to the cylinder shall bear a considerable ratio to the diameters of the cylinders. Under such circumstances we may, without sensible error, consider the pressure of the steam in the boiler and the cylinders to be the same; and if no steam blow off from the safety-valve the indication of the lever will be a true measure of the pressure of the steam upon the pistons of the cylinders. This pressure is transmitted to the cranks, the mean leverage of which being known, the amount of force transmitted to the point where the driving-wheels rest upon the rails is a matter of easy calculation. This will evidently constitute the gross amount of the tractive force exerted by the engine; and this force may be considered as expended in moving the train and the engine; and will be the tractive force sought.

In the same manner the tractive force necessary to move the engine itself unloaded may be determined; and this being subtracted from the former, will leave a remainder which will be the tractive force necessary to move the train.

In practising this method of course the gradient must be observed, and the effect of gravity taken into account.

The following example of the practical application of this method was given by Dr. Lardner.

An engine weighing 10 tons 2 cwt. with 14-inch cylinder, and 16-inch stroke; wheels 4½ feet diameter, steam 50 lbs pressure in the boiler, was attached to fifty waggons loaded with merchandize. The gross weight including the waggons 223 tons 6 cwt. The weight of the tender was 7 tons, and the gross weight of the train including the engine, 240 tons 8 cwt. With this load, the engine carried the train from Liverpool to Manchester; the velocity varied, but was never less than nine miles an hour. Now it is known that a part of the line from Liverpool to Manchester ascends at the rate of 8 feet a mile; and up this, the engine moved the train at a uniform rate. The friction may be then calculated as follows:—

Pressure of steam per square inch on pistons . .	50 lbs.
Number of square inches in piston	153·93
Total pressure on each piston	7696·5 lbs.
Mean leverage of the two pistons	1·69 ft.

Leverage of driving-wheels	4·5 ft.
Force on pistons reduced to circumference of wheels	2890·5 lbs.
Gravity of gross load ascending 8 feet per mile .	814·5 "
Remainder representing the gross resistance from friction and the atmosphere	2076·0 "
Ditto per ton of the gross load	8·65 "

Thus it appears by the result of this experiment that the mean values of the total resistance arising from the friction of the engine and train, and the atmospheric resistance at nine miles an hour, did not much exceed 8½ lbs. per ton. Now if the friction of the engine itself be taken according to the estimate commonly given (and which is probably not far from the truth) at 15lbs per ton of its own weight; its total resistance from friction would be 150lbs. This would leave the total resistance of the train, independent of the engine, 1926lbs., which divided among 230lbs. will be at the rate of 8·37lbs. per ton.

Dr. Lardner has contended that the actual amount of the friction of the train of waggons, as at present constructed, does not exceed about 7½ lbs. per ton. If this estimate be correct, it would appear that the resistance produced by the atmosphere in the preceding experiment was little more than ¾lb. per ton.

It was objected by Mr. Earle to this experiment that the pressure of steam in the boiler was greater than that ascribed to it by Dr. Lardner, because, although the safety-valve only indicated 50lbs., yet, as the steam was blowing off, its real pressure in the boiler must have been greater than that indicated by the valve.

To this Dr. Lardner replied: 1st, that according to his recollection the steam was not blowing off on that part of the railway; and 2dly, that if the resistance produced by the friction of the train were sensibly greater than that which is given in the above calculation, it would have exceeded even the theoretical amount of the adhesion of the wheels upon the rails, supposing both to be perfectly clean and dry. That in fact the resistance to the driving power of the engine calculated above amounts to 0·120 of the total weight of the engine; and that, if the rails and wheels were perfectly dry and clean, the total adhesion would be nearly 0·139 of the weight of the engine. Thus the actual resistance above calculated comes to within 0·019 of the highest amount of the adhesion under the most favourable possible circumstances. But it was recorded in

writing by Mr. Earle himself at the time of the experiment, that the rails were very wet, and that the wheels did not slip even at the slowest speed except at starting, the rails being at that place soiled and greasy with the slime and dirt, to which they are always exposed at the stations. Dr. Lardner, therefore, contended that to suppose with Mr. Earle, that the resistance of the train exceeded the above amount, would be equivalent to supposing that the adhesion of the wheels with the wet rails was greater than the most perfect adhesion which can be produced between wrought iron and wrought iron, under the most favourable circumstances. But, Dr. Lardner contended that Mr. Earle was still more in error, in estimating the friction alone at 9lbs., as in this case the atmospheric resistance was included in the result.

It was remarked by Mr. Herapath, that experiments made by himself gave precisely the same result, for the resistance from friction as that obtained in the above calculation by Dr. Lardner.

Dr. Lardner stated finally that he did not wish undue, or indeed any importance to be attached to the particular experiment which formed the basis of the above calculations, and that he only gave it to illustrate the method by which he would recommend the mean practical amount of friction to be determined.

Taxation on Internal Communication. By R. R.*

After the extracts already given from the evidence taken by the House of Commons' Committee,† we proceed to the Report of the Committee itself. This document first notices the fact, "that a great inequality exists between the rates of taxation imposed on the different modes of internal communication,"—*animal* power being in comparison with *steam* power heavily taxed, and it then enumerates the various taxes (eight in number) which are levied on land travelling when animal power is used. The amount of the duty thus collected (*exclusive* of the assessed taxes on carriages and horses kept for private use), is about 820,000*l.* per annum, of which the post-horse duty, and the mileage duty on stage-coaches, furnish upwards of 86 per cent., or 734,782*l.* The taxation on land travelling by *steam* power

* We earnestly recommend this very able article to the attention of our Legislators.—Ed.

† See "Railway Magazine" for Sept. and Oct. pp. 171 and 256.

consists of a duty of *one halfpenny per mile* on every *four* passengers, (or ⅛th of a penny per passenger) actually conveyed, whereas the stage-coaches are charged on the number the coach is licensed to carry, whether it be full or empty. The railway companies have also been allowed to compound for their taxes, at a rate which the Committee consider "very low and perfectly illusory, and not consistent either with justice or expediency."

From the valuable evidence given by Sir Edw. Lees, Secretary to the Post-office, at Edinburgh, it is shown that great public benefit could accrue from the establishment of *mail-cars* for the conveyance of the post upon the cross-roads of Scotland and upon many in England, similar to those now in use in Ireland, "thereby increasing the revenue, and opening up districts now altogether destitute of public conveyance." . . . . "*The grand obstacle, however, to the establishment of these cars is the heavy taxation on travelling, which utterly deters individuals from engaging in such speculations; while in Ireland, where the roads are decidedly inferior, but where none of these taxes exist, cheap and expeditious public conveyances are every where to be found.*"

It was a bright thought of the Stamp-office to charge the *mail-coaches* with duties which must be repaid by the Post-office department in their contracts for carrying the mails, with the additional loss of the poundage allowed to the distributors of stamps! "Whereas," say the Committee, "were the mails to run free of duty, a premium would, in many instances, be offered for the privilege of carrying them."

The Committee next advert to the duty on carriages kept to let for hire,* of which, "under all circumstances," they earnestly recommend the abolition, with the anticipation that the revenue would gain more than an equivalent in the additional amount of horse-duty that would then be produced.

All the post and coach-makers agree that, "whilst loaded with a heavy taxation," they are utterly unable to compete with untaxed steam-power, the use of which is every day extending both on sea and land. The Committee estimate that, on the average, for every passenger conveyed, the railway proprietors (qu. *the public?*) pay *one-eighth of a*

* 5*l.* 5*s.* per annum on carriages with four wheels, and 3*l.* 10*s.* on carriages with two wheels.

penny per mile of duty, the stage-coach proprietors fully *one-fourth*, and the post-masters *three-fourths* of a penny, while the conveyance of passengers by *water* is entirely free from duty. This great disproportion the Committee consider should be put an end to, both in fairness to the coach-proprietors, and also, "with a view to the maintenance of the public roads, the use of which can never under any circumstances be dispensed with."

The remainder of the report we shall give in the words of the Committee:—

"*If it shall be necessary that a sum somewhat equivalent in amount to what is now raised should still continue to be levied on travelling*, there does not seem to be any fairer mode of doing so than that suggested in the evidence of Mr. Smith, of the Stamp and Tax-office.

"Mr. Smith suggests, that the proprietors of *railways* should be charged with a halfpenny of duty per passenger, for every four miles or fraction of four miles (the present rate); *that a similar amount of duty should be levied on steam-boats*, the number of passengers being ascertained, in both instances, by a system of stamped tickets, as more fully detailed in his evidence; and the distance in the case of steam-boats being ascertained by the land distance, except when the distance by water is shorter. This would necessarily apply to canals, as well as to rivers or arms of the sea, *and whether the motive power was steam or animal;* that *stage-coach* proprietors should be charged one halfpenny per mile for every four sittings prepared in or about their coach.

"This would still leave the advantage in favour of steam-power, of being charged only on the passengers actually conveyed. While stage-coaches would be charged on all they are licensed to carry; an inequality, however, which it does not seem very easy to obviate. Mr. Smith further suggests the reduction of the post-horse duty by one halfpenny per mile per horse, which, from the increased travelling that would arise, he thinks would not materially diminish the revenue.

"*On the whole, however, considering the objections which would undoubtedly arise to the imposition of a tax on a mode of communication now so extensively in use, and the immense advantage to every class of the inhabitants of a commercial country of cheap and expeditious travelling, your Committee earnestly recommend the abolition of all*

taxes on public conveyances, and on carriages generally, at the earliest period consistent with a due regard to the financial arrangements of the country. It appears to your Committee, that though the diminution of revenue in consequence of the adoption of such a course might appear considerable, it would in a great measure be compensated by the increased consumption of taxable commodities. While the inequality now so justly complained of would be removed, and a great accession afforded to the prosperity and comfort of the population."

The conclusion of this report is by far the best part of it, and, saving the reservation as to "the financial arrangements of the country," we consider it fraught with wisdom and sound policy. No subject really more important to the interests of the country, whether moral, commercial, or financial, can be pressed upon the attention of the Government, than *the removal of all taxes on internal communication.* A great deal more is implied in a change of this kind than meets the eye of a mere financier, and if it is looked at merely as a question of finance, no proper estimate will be formed of its importance. We cannot conceive of any mode of raising a revenue much more objectionable than one which checks the intercourse of families, the free communication of knowledge, and the personal agency of all engaged in business, in every class of the community but the highest. At the same time can there be a doubt, that, if so great a relief were effected, as to set entirely free from all direct taxation, every mode of intercommunication used by sixteen millions of people, the result would be, as the Committee intimate, a large *increase* instead of deficiency in the public revenue, by the increased consumption of taxable commodities? The experiment (if it can be called such) may be too bold for underlings in office, who can look only at one side of the question (the temporary loss to the revenue), but its very boldness and simplicity must recommend it to any minister, who is fitted to control the finances of this great empire.

What the Committee say as to the inequality of the present rates of taxation on the coach and railway proprietors, (or rather on the public through them), is very just; but it is idle to think that any equalization of the duty, will enable animal to compete with steam-power, when employed on parallel lines of great intercourse. If the coach proprietors, for instance, of Liverpool and Manchester, were exempt from taxation, and the railway were to pay double its pre-

sent rate of duty, not another coach could be maintained on the turnpike road between those towns. For a time, perhaps, the profits of the railway would be diminished by the amount of the tax, but ultimately the loss would fall on the public, and the coach proprietors would gain nothing. All that they ask, however, or that could in fairness be allowed, is to be placed on the same footing as railway proprietors in respect to taxation, and their own testimony sufficiently proves that this would not enable them to maintain their ground against competing railways.* Concurring, therefore, most fully in the recommendation of the Committee, to relieve animal power from taxation in every way, which would vastly increase the travelling collateral to railways and allow the coach proprietors to transfer their stock to new lines of road without loss, we still feel that nothing short of the *entire abolition of taxation on travelling*, will effect those great national benefits which perfect liberty of personal communication throughout the country would produce.

The English are proverbially a *locomotive* people, and thousands of those who throng the cities and watering-places of the Continent, where travelling is comparatively cheap, would become better acquainted with their own country, and spend their money at home, were travelling in England more economical. Perhaps this view of the case has not yet occurred to the Chancellor of the Exchequer, and we request his consideration of it. Let him be assured, that of all "practical reforms," no one would more tend to give popularity to a Government, and solid satisfaction to the people, than such an addition to the comforts, both of the poor and the rich, as the abolition of all taxes on travelling would confer.

Nothing apparently can be worse policy than to impose an additional tax on the use of *steam-power*, whether by land or water. Mr. Philp's arguments on this point are sound and unanswerable. (See Evidence, queries 510 to 541.) To enforce a tax on passengers by steam-vessels will, we trust, always be found impracticable, as Lord Althorp found it, when he was injudicious enough to make the attempt. And no reason can be offered why the proprietors of a *railway*, made at their own cost, should be burthened (or their trade limited) by a tax, which the owners of *steam-vessels* are not called on to pay; or why the public should not be allowed to travel untaxed by land as well as by water.

* See the evidence of Mr. Horne (Queries 9—12), Mr. Gray (66, 67), and Mr. Fagg (241).

The Committee we think should have taken the evidence of some railway proprietors or directors, which could hardly have failed to strengthen the case so well put by Mr. Philp, on behalf of the proprietors of steam-vessels.

It is lamentable to see with what avidity the Government officials fasten upon any new mode of raising revenue, let the ultimate consequences be what they may. Whatever may be the success of a few railways, it is not likely that any great number of them will return more than a fair interest upon their cost; some of them perhaps not even that; and when by the enterprise of individuals and the outlay of so much capital, a road is constructed which offers the greatest mechanical advantages for travelling, why should the Government step in, to restrict the public benefit and injure those who have thus invested their property by ill-judged taxation? The loss which thus arises to the nation, it is almost impossible to calculate. Our legislators have not yet understood the fable of the goose and the golden eggs. If they will have the wisdom to leave unfettered the main springs of social prosperity, (of which free personal communication is perhaps the chief,) they may safely rely upon an increased capability of supporting taxation in other ways. But if they aim a blow at the root, all the branches must suffer with it, and their anticipations of a productive revenue will be disappointed. If our legislators would give half the time to the consideration of the *principles* of taxation, which they spend in fruitless (because indiscriminate) efforts to get it reduced, we should see a vast deal more of good done, and less dissatisfaction among the people with the remaining taxes. Now a little reflection will convince us that there can be no taxes more impolitic or pernicious, than those which in any way restrict free communication between man and man, and the free interchange of the manufactures and products of different districts of the country. The great agent of civilization is the principle of *association* and free intercourse. In a savage country the population is thinly scattered over a wide track of land, and every man, therefore, depends upon himself. The principle of civilization is, that one man shall help another, and by the division of employment, the labour of each shall be exerted in the most productive mode. Just in proportion, therefore, as a people advance in civilization we see them associating more and more, the natural obstacles to communication overcome, new roads opened, bridges constructed, new methods of conveyance invented, and in short every thing done to annihilate

the difficulties which time and space interpose to free communication and mutual co-operation. It is easy to carry forward this view to its legitimate results, in the increasing wealth and intelligence of a people. We see universally that, *cæteris paribus*, the more a man mingles with his fellows the more his intellect is sharpened and his faculties exercised. Thus the inhabitants of towns invariably are superior in taste, intelligence, and skill to the rural population, and whatever may be the evils incidental to this state of society, it is a state which the progress of the nation in wealth and civilization necessitates. If the Government, therefore, would have the people educated and trained to a knowledge of their own rights and duties, let them do every thing to promote the collision of mind with mind, and give all the facilities in their power to that spirit of enterprize and improvement which marks the present age. They will thus lay strong and deep the foundations of national prosperity, and earn the best reward of a statesman's labours,—the gratitude of an intelligent and happy people. In the meantime we would suggest to the proprietors of railways and steam-vessels, as well as to the coach and post-masters, to petition the Legislature for the removal of all taxes on public conveyances, and strenuously to resist any alteration of the law by which the right of *locomotion* would be further circumscribed.

October 10, 1837. R. R.

On Railways as Investments. By R. R.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—A correspondent in your last number, under the title of "A Constant Reader," has referred to a short paper of mine on the above subject, (which you were pleased to insert in your July number,) in a way which leads me to think he has not properly attended to the drift of that article. My object was, not to recommend railways indiscriminately as advantageous modes of investment, but to throw out a few general observations in favour of such undertakings of the kind as are "*well planned and prudently conducted*," and to obviate some of the objections which are loosely urged against this mode of employing the national capital. It is for your readers to judge whether the views suggested were

just or not; but, so far as I can see, "A Constant Reader" neither adds anything to them or controverts any position which I adduced. If he will refer again to the article, he will see that all my arguments (or if he pleases so to term them, "opinions") go to the same point as his own; and that my "facts" are certainly not more scanty than those which he adduces, though he alleges (what I did *not* profess) that "it would not have been difficult to have furnished information suited to the subject." I can assure him that I shall be very thankful for all the information of this kind that he will have the kindness to furnish, though it cannot, I think, supersede the use of general *á priori* argument upon the subject. The single fact which your correspondent notices, of the depreciated value at one time of the Leeds and Liverpool Canal shares, which are now above five times their original value, tallies exactly with the instances I brought forward of two railway undertakings; and *his* inference is justly the echo of mine, viz. that these are "facts to induce the *wealthy* to look at the *future*, and in their descendants (at least) reap the advantage of their *forecast*." I had no intention to urge "tradesmen or professional gentlemen" to become speculators in railways, but I had to notice it as a *fact*, that commercial men generally, and *not* men "who do not require all the money they possess," *are* the parties to whom the public is indebted for these great national improvements. I regret that it should be so, and my design was to stimulate those who have surplus *incomes* and are *not* engaged in commerce, to give more consideration to the subject of railways, and to render support to them ("when there is a reasonable prospect of a profitable return for the outlay required,") at a period when assistance is most wanted, and before the *advantages* of the investment are lost by the *general demand* for it. It would be easy, certainly, to cite many additional instances of the undue depreciation of undertakings which have ultimately proved successful, but facts of this kind are lost upon those who cannot beforehand appreciate the circumstances which *ensure* the profitable issue of an undertaking. What these are in the case of a *railway*, have often been stated in your work, and may be briefly summed up in two points: *first*, a good working line, as to levels, curves, &c., and *secondly*, a *proven* traffic proportionate to the utmost outlay that can be required. Where these two essentials for *perfect* success can be found combined, or where the marked predominance of one of them renders the other *pro tanto* less important, it seems inevitable that a railway, which cannot fail to mo no-

police the travelling, and to obtain a great share of the general traffic, must fully succeed. I need not, however, enlarge further on this point, as the railway (the Grand Junction) to which in my former communication I referred as likely to prove a decisive experiment on the subject, has, since its opening, confirmed my anticipations, and shown that the advantages and profit of railways have not been overrated. How long it will take to imbue our more cautious capitalists with this opinion, remains to be seen; but as there are some who *will* always see things their own way, no matter how the *facts* may be against them, they must be left to indulge their own belief, and to enjoy the fruits of their superior *caution*, if they do not regret, when it is too late, their lack of "speculation" and seasonable boldness.

I am, yours, &c.,

Oct. 5, 1837. R. R.

Computations of Earth-work. By Wm. Dodd, Esq.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

Let ABCD be a vertical section of any cutting, AB being the bottom, a given quantity. Call the sine and cosine which the slopes make with AB, m and n respectively; then by trigonometry and the properties of the figure we have the area of the section ABCD $= mn$. BC. AD + (BC + AD). $\frac{m\ AB}{2n}$ a general expression for all excavations when the slopes make equal angles with the bottom. Where the bottom AB is 30, and the rise 2 feet in every 3 (as is the case with the London and Southampton Railway) the formula simply becomes $\frac{6}{13} \times BC \times AD + (BC + AD) \times \frac{30}{\sqrt{13}}$ or $\frac{6}{13}$. BC. AD + (BC + AD) × 8·3205. In words, the sum of six thirteenths of the product of the slopes, and 8·3205 times their sum is equal to the area of the section ABCD.

On the Salt Monopoly of India. By A. B.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

London, October 17, 1837.

Sir,—As the time of Members is much occupied during the session of Parliament, the present appears better calcu-

lated for directing their attention to subjects which require deliberate consideration. I am, therefore, desirous of submitting through your valuable and influential journal for the ensuing month, a few observations upon a subject which involves the welfare and interest of the unrepresented millions of British India.

The state of that vast mass of our fellow-subjects is very imperfectly understood in this country; the burdens by which they are oppressed, and the grievances they endure, become only now and then partially known, and thus never excite that abiding interest which things more obvious create.

By the press things which concern them are little noticed, and so few advocates do they find in the great assembly of the nation, that scarcely a voice is raised in their behalf, even upon questions most seriously affecting their welfare.

On the present occasion I would beg leave to notice one subject only: "THE SALT MONOPOLY."

In 1832 a Select Committee of the House of Commons was appointed to inquire into the state of the salt trade in British India, and so strong and conclusive was the evidence furnished on that occasion, of the evils arising from the Indian monopoly, that the Committee, in their report, strongly recommended the progressive importation of salt from this country. The East India Company, however, entrenching themselves behind "*The Charter Act*" refused to comply with this recommendation, and in 1836 another Select Committee was appointed for the purpose of renewed inquiry. The result was as before, yet nothing has been done towards carrying into effect the terms of the report, a copy of which I will subjoin. As there can be no doubt of its being brought again before the House, in the approaching session, I will, with your permission, throw together a few facts bearing upon the question. I first proceed to show that although salt is an article of little consideration in the expenditure of a family in this country, it is not so with the poor Indian. The Board of Directors of the East India Company themselves say in a letter, dated 11th July, 1831, "That to a great part of the people, it (salt) constitutes THEIR ONLY LUXURY." Mr. Colebrook, one of their servants, observes, "Salt is eagerly desired by the Indian; his vegetable diet requires it; but the most numerous class cannot afford to season their food with it. Observe the peasant's meal; a few pinches of salt on a leaf, stands by his plate of rice; a few grains at a time deceive his palate while he swallows several mouthfuls of most insipid food." Another

authority, Mr. Mills says, "It is higher than the poorer classes can afford to pay for it."

Mr. Crawford's evidence before the Committee assures us, "There is no country in the world in which salt is higher priced than it is in Bengal, in reference to its absolute price, and still more so in reference to the capacity of the people who are the consumers of it." The force of the last observation will be appreciated when it is considered that it takes (according to the same authority) two months of a labourer's wages, one sixth part of his earnings, to pay for the salt necessary to season the insipid food of his family. This statement is corroborated by Mr. Beecher, an intelligent public officer of the Company's Government.

The high price of salt throughout India, says another of the Company's servants, "is not only the occasion of much distressing privation to the inhabitants, but it has led to great adulteration, the salt retailed being often a mixture of earth and other impurities."

Mr. Crawford computes the population subject to the salt monopoly at 132,945,908, nearly 133 million persons, so scantily supplied, as not only to use very impure salt, but to have recourse to the ashes of burnt vegetables or the impure lees of saltpetre, as condiment to their food.

Rammohun Roy, a very intelligent and highly-educated Brahmin, who gave evidence before the Committee, declared "that the adulteration of salt is carried on to an enormous extent, by mixing it with *one-third*, or even *one-half* of *earth*, until, instead of being like salt, it more resembles the earth of which it is composed."

Mr. Mill says, "much salt of a very bad and unwholesome quality, made from the refuse of saltpetre and other salts, is manufactured and used in the province of Behar."

Another writer says, "we feel justified in considering the all but exclusion of British salt, one of the most degrading and mischievous instances of the domination of the Government manufacture monopoly . . . . that we have had to record."

Besides the distressing privations entailed upon the inhabitants of India by this monstrous state of things, it has led to such an extensive system of smuggling, that the expense of defending the integrity of the monopoly, has materially affected the net revenue derived from this source. We find by the official reports that, notwithstanding the sales have increased, the net revenue, or sum paid into the

Treasury, after deducting the manufacturing, fiscal, and other charges, has considerably diminished.

The following paragraph, taken from an official letter from the Board of Customs, dated 30th August, 1834, will exhibit the result from 1829 to 1834:

		Maunds.		Rupees.
1829—30	Quantity of Salt sold ...	45,00,000	Net Revenue	1,22,97,814
1830—31	.....	42,00,000	.....	1,28,45,401
1831—32	.....	46,04,000	.....	1,28,92,796
1832—33	.....	47,00,500	.....	1,07,10,050
1833—34	.....	47,01,000	.....	1,02,00,000

It might be inferred that as the greatest quantity sold produced the least net revenue, the price must have been considerably lowered; not so, and herein lies the gist of our argument to prove the evils of the monopoly. We find by the report of the affairs of the East India Company, printed by order of the House of Commons, that in

		Maunds.		Rupees.
1818	There was cleared from the Golahs	46,41,102	Sale price being...	341
1827	.....	51;12,709	.....	415

or taking four years,

1818 to 21	Average	47,12,475	Average price	3404
1824 to 27	.....	49,03,228	.....	392

Thus showing the increasing demand among the people, notwithstanding the price went on increasing, and consequently that the poor natives are not so well supplied, although, according to Rammohun Roy, they are ready to surrender every thing else in order to preserve a small portion of this article, which has by long habit become a necessary of life.

Mr. Crawford gives the following, as the charges upon the gross and net revenue:

1832—3	On the gross revenue...	22 per cent.	On the net revenue	28 per cent.
1833—4	upwards of	21		27 .....
1834—5	.....	25		33 .....

The permanent charge of the existing system is 176,000*l.* per annum. The quantity of salt that passed the Company's sale:

1833—4 It will be seen was 47,01,000 maunds, or 172,090 tons.

We have amply demonstrated the insufficiency of the supply to the wants of the people, and there can be no doubt that if a cheaper and more wholesome article were

procurable, the consumption would be much greater, as the effect of the monopoly is truly stated to be to keep the produce stationary, while it is admitted that the population and wealth of the country are increasing. It has been estimated at 220,000 tons, but whether 170,000 or 220,000 tons would find a sale, or what portion would be furnished by this country, it imports not to the argument when discussing the expediency of allowing a free importation, although this question has been raised as an objection against the proposed modification.

If the salt manufacturers of this country can furnish a purer and better salt than that now used, at a cheaper rate, and still pay a duty per ton, equivalent to the revenue derived by the East India Company in their twofold capacity of manufacturers and territorial governors, there can be no sufficient reason for the continuance of this close and odious monopoly. It matters not in what way the requisite sum finds its way into the Company's treasury, their object being the maintenance of a certain revenue.

Enough has been said to show how severely the salt monopoly presses upon the inhabitants of India, although proofs innumerable might be adduced to show its evil tendency, whether viewed in reference to its moral or political relations, proofs equally abundant could be adduced, that great benefits would result from a free trade in this essential article, not only to the vast mass of consumers at present so ill supplied, but to the mercantile and shipping interests of this country.

The reply of Mr. Alex. Reid to question 301 of the minutes of evidence was, "There is one remarkable circumstance I may state, in reference to the cost of Government salt in Bengal, that the contract price with the Molunghees for the mere labour of producing the salt, is the total price at which the salt now going from Liverpool by the Alice will be delivered at Calcutta." Therefore, suppose we could send the whole the Company require, they would save all the expences except the mere wages paid to the Molungees.

This is a subject wanting of better advocacy than I can offer, and I do hope, Sir, the aid of your powerful pen * will be given to a cause which is that of humanity and justice.

Yours, A. B.

* Our readers will, we are sure, agree with us that this subject cannot be in better hands. The facts here stated are certainly most extraordinary, we might say astounding; and claim the attention of every man, who has the heart and deserves the name of Englishman.—Ed.

Great Western Railway.

[As the Directors of this great undertaking have announced their expectation of opening the line as far as Maidenhead in the month of December, our readers, and particularly those who may be shareholders, will be gratified to learn from the following report, which has been furnished to us by a friend, the general state and character of the works. The information is given as the result of a recent personal inspection of the line. The greater part of the report will be found of permanent interest, as describing the particular nature of the earthwork and the character of the gradients, curves, bridges, &c. We sincerely trust the Directors will be enabled to carry their wishes into effect, so that in the beginning of the year we may announce the opening of the line to Maidenhead.]

FIRST SECTION.—LONDON TO MAIDENHEAD (22¼ miles).

At the Paddington terminus, the necessary excavations and erections are proceeding with great rapidity. A road is to be carried upon arches to join the bridge on the east side of the depot over the Paddington Canal, and beneath some of these arches already constructed, temporary offices will be made for the use of the Company when the line is opened. The engine-house and carriage-sheds are commenced, and will be connected with the temporary station of the Company. The Westbourne-road is carried over a series of seven arches, under which the railway leaves the depot, very obliquely. The lines for passengers will run through three of the arches, and those for goods through the other three. The centre arch will have no rails through it, being funnel-shaped to give the required obliquity.

Leaving the terminus at Black Lion-lane a cutting commences of about a mile in length, and an average depth of nine feet. Near the terminus, and for a very short distance, it is about fifteen feet, which is the greatest depth. This cutting which is finished, is in clay, and is being ballasted. It is crossed by three bridges, carrying roads over the railway.

Another cutting of more than a mile in length, and averaging ten feet in depth, carries the line through Wormwood Scrubs. This cutting is also finished. At 2¼ miles from Paddington, the line of the Thames Junction Railway crosses the Great Western, and a little further on, the road from the Canal Bridge is to be carried over the cutting on a bridge of two arches, nearly completed.

The line next crosses Old Oak Common by an embankment of half a mile in length, and about twelve feet average depth, going over two occupation bridges. This embankment is finished, quite solid, and the slopes growing green.

We next enter the deepest cutting on this portion of the line, extending for about half a mile through Acton parish, near Friars'-place, where it is deepest (about twenty-eight feet) a bridge is built over the railway for the public road. Nearer Old Oak Common there is a private communication bridge across this cutting, of wide span, elliptical, and very neat. This is the only cutting on the whole line which is not quite finished, owing to the necessity of retaining a temporary road over it, until the traffic can be conveniently sent over the Friars'-place bridge. It will be completed in ten days from this time.

After a short level (of twelve chains) a cutting of two and a quarter miles commences, through which the line is carried on to Ealing. It averages about fourteen feet in depth, chiefly in gravel and sand-stone. The work here is all but completed, a small quantity of gravel having been left for ballasting the road, which is now in progress. This cutting is crossed by six bridges, of which four are finished and the others rapidly advancing.

At a distance of six and a quarter miles from London, an embankment commences, three quarters of a mile long, which is now completed up to the east end of the "Wharncliffe viaduct" at Hanwell. Its average depth is about fifteen feet, but near the viaduct it is about thirty feet. The road to Greenford is carried through it under a bridge which is finished.

On the east side of the Wharncliffe viaduct, the piers are rising to carry five land arches, which will connect the viaduct with the embankment. The viaduct itself is substantially finished, and constitutes the finest work upon the line. Its entire length, including the wing-wall arches, is 900 feet, and the heights of the rails above the level of the valley is seventy and a half feet. The main arches, eight in number, are nearly semi-elliptical, with a rise of seventeen and a half feet, and seventy feet in the span. The piers at the springing of the arch are ten and a half feet thick, growing wider to their base. The dimensions of the viaduct give it a very imposing effect from the Uxbridge-road, which runs nearly parallel to it for some distance on the south. From the west end of the viaduct the embankment is continued to the point where the Uxbridge-road and Windmill Lane cross

each other at right angles, and the railway is carried over the junction by a bridge of very peculiar construction, formed of cast-iron girders. From this point the line passes on to Norwood upon an embankment of nearly a mile in length, and varying from twenty to ten feet in height, until the natural level is again attained. This embankment is quite finished, as well as a bridge and covered way under it, and the slopes are growing green.

From Norwood to Southall-green, considerable progress is made in driving piles and laying the balks and sleepers for the permanent rails. The wood is all Kyanized, and the mode of construction adopted, whilst it secures the great point of a continuous bearing for the rails, is calculated to give great stability and evenness to the road.

From Southall-green, very slight cutting and embankment carries on the line for about half a mile into Hayes parish, where the embankment becomes deeper, and for about a mile and a half averages ten feet. In the course of it occur an occupation bridge, two skew-bridges (with cast-iron beams) over the Paddington and Grand Junction Canals (thirty and a half feet span on the square), and another over Yedding or Bull's-bridge Brook, Cranford and Cranford-park lie a little to the south of the line here. Near the bridge over the Grand Junction Canal (at ten and a quarter miles) tanks are prepared for Kyanizing the sleepers, &c., on a very extensive scale. There are others at Paddington, Wormwood-Scrubbs, Hanwell, West Drayton, Slough, and Maidenhead.

From the Grand Junction Canal, for a distance of two and a half miles, through Hayes, Harlington, and Hillingdon parishes, the earthwork is very light, consisting of cuttings and embankments of four to six feet in depth, and a portion of it level. The whole of this may be said to be finished, as are three bridges carrying roads over the railway, and another bridge for the road to Hillingdon is proceeding rapidly.

In Hillingdon parish, for about a quarter of a mile, where the railway closely approaches the Grand Junction Canal, the line passes through some brickfields, of which possession was obtained more recently than the other land, and an embankment of six feet high is the only remaining work to be done for a length of about 150 yards.

At West Drayton (twelve and seven-eighth miles from London) the railway is carried over the road to Uxbridge on a bridge of fine proportions, and very well executed in white brick. From hence an embankment of rather more

than three-fourths of a mile in length, and averaging about fifteen feet in height, carries the line by a two-arched bridge over two streams at Thorney-road, and by another bridge over the river Colne. These bridges are of brick, thirty-five feet span, the arches semi-elliptic with a rise of eight and a half feet. There are three other bridges in this embankment also finished. The embankment is ballasted and well consolidated, and the slopes are growing green.

Soon after entering Iver parish, the line passes through a cutting of more than a mile in length, and averaging ten feet in depth. On this part of the line, the workmen are very busy laying the permanent rails, and it is expected that an experimental trial of the line with a locomotive engine will be made here early in December.

The embankment from the fifteenth to the sixteenth mile, through Langley Marsh parish, averaging about eight feet in depth, is completed and ballasted. From its termination to the Slough-road (at eighteen miles from London) the earthwork is extremely light, chiefly shallow cutting. The line in this part is crossed over by five bridges, which, with the earthwork and ballasting are now all completed. On emerging from the cutting at about sixteen and a half miles, a fine view of Windsor Castle is obtained. At the eighteenth mile, the line passes a little to the north of Slough, within five minutes' walk of the Crown Inn.

From Slough to the crossing of the western-road at Maidenhead, a distance of four and a quarter miles, the earthwork consists of cutting and embankment in nearly equal proportions, and is quite completed. The cutting varies from ten to five feet, the embankment from fifteen to eight, except as it approaches the London-road at Maidenhead, where it increases to about thirty feet in height. The embankment generally is well consolidated, and the sides overgrown. There are thirteen bridges crossing over or under the railway in this portion of it, all being finished.

In Hitcham parish, about a mile from Maidenhead, considerable progress is made in laying the sleepers for the permanent rails, and the work is proceeding with as much speed as is consistent with the care and nicety required in the adjustment of the bearings.

The skew-bridge over the London-road is a very fine structure, and displays excellent workmanship and ingenuity of design. It crosses the road at an angle of 45°, the span on the skew being forty-six and a half feet, and on the square thirty-two feet. The clear headway is twenty-four

feet. The railway itself will be at an angle of 60° to the road. All the coaches, &c. to Maidenhead now run under this bridge, and the progress of the works at this point excites great interest among the passers-by. Leaving the turnpike-road, the embankment passes upon another bridge over the Taplow-road, and grows deeper as it approaches the Thames, its maximum being about thirty-five feet. It will shortly be completed up to the land arches on the east side of the river.

It is understood that the Company will not open the line beyond the London-road until the bridge over the Thames and its approaches on both sides are completed. The station, therefore, at Maidenhead will be adjacent to the turnpike-road bridge, on the premises at present occupied by the Company for workshops, &c. The other stations between London and Maidenhead, besides that at Paddington, will be at Ealing Haven, Hanwell, Southall Green, West Drayton, and Langley Marsh. The trains will also stop at Slough to put down and take up passengers, although the Company are prohibited from making a depôt within three miles of Eton College, without the consent of the Provost and Fellows! An excellent specimen of legislative wisdom in the nineteenth century. How those who come after us will laugh at us!

Bridges.—Besides the viaduct at Hanwell there are, between Paddington and Maidenhead, twelve culverts and covered ways through embankments, and fifty-eight bridges passing over or under the line, which are mostly completed, including eight over streams and canals. The few which remain to be finished are all road or occupation bridges passing over the railway. They are all constructed of white brick of thirty feet span and seventeen and a half feet headway where they pass over the railway, and about sixteen feet and upwards in span and height where the railway passes over them. The arches are mostly semi-elliptical.

It may be observed here that, although the construction of many bridges adds greatly to the cost of a line, the numerous roads for which they are required are the best evidence of the degree in which travelling takes place in the district through which the railway runs, and of course the more numerous they are, the greater are the facilities of communication with the railway from various and distant points.

Gradients.—The gradients of this section of the line will be best shown by the following table. They will be found to be unequalled by any other twenty-three miles of

railway at present constructed in the kingdom; and a proportionate economy in the working-power required will be the consequence:—

Planes.	Gradients per mile.		Inclination.	Length of each Plane.		Locality.
From London.	*Feet.*	*Inches.*		*Ms.*	*Chns.*	
Rise . . .	3	0	1 in 1760	2	28	Paddington, Kensington, Hammersmith.
Rise . . .	4	4½	1 in 1204	4	52	Acton, Ealing, Hanwell.
Rise . . .	4	0	1 in 1320	2	60	Hanwell, Hayes.
Level . .	. . . . .		. . . . .	0	40	Hayes.
Fall . . .	3	0	1 in 1760	2	48	Hayes, Harlington, West Drayton, &c.
Fall . . .	4	0	1 in 1320	0	40	Hillingdon.
Level . .	. . . . .		. . . . .	1	72	Iver, Langley Marsh.
Fall . . .	2	8	1 in 1985	0	30	Langley Marsh.
Fall . . .	4	0	1 in 1320	1	40	
Fall . . .	2	0	1 in 2640	0	20	Upton.
Rise . . .	2	0	1 in 2640	1	40	Upton, Stoke Poges, Farnham.
Rise . . .	2	6	1 in 2112	1	0	Farnham Royal, Burnham.
Rise . . .	4	0	1 in 1320	0	20	Burnham.
Rise . . .	2	8	1 in 1985	0	30	
Rise . . .	4	0	1 in 1320	2	20	Hitcham, Taplow.

London to Maidenhead (Thames. Bridge), 22 miles 60 chains, or 22¾ miles.

CURVES.—The curves on this portion of the line are generally of very long radius, say from five to seven miles. The three sharpest are above two miles radius, except that in the depot at Paddington, which is of 100 chains, or 1¼ mile. The bearing of the curves is chiefly southward of a strait line drawn from London to Maidenhead, which places coincide in latitude.

Northern and Eastern Railway.

THIS line of railway, of which the present number contains a map, was originally projected by that compound of all oddities, Nicolas Wilcox Cundy, C. E. One of his stage-coach surveys planned and levelled the whole distance to York, almost as quick as a bird could fly over it. In the year 1835, a company was formed and surveys made to carry it out, under Mr. Walker, Cundy having given up to him. But when the time came for applying to Parliament,

the Committee thought the undertaking too large for one concern, and went in for a Bill to Cambridge only, which was obtained in 1836. A variety of circumstances have concurred to prevent the line from being prosecuted until the present time; but the vigour with which it is now taken up augurs as if lost time is to be recovered.

It is at present intended to commence near Kingsland turnpike, and to complete the line to Broxbourne before going farther. For about the first two miles there is something to do; but for ten or eleven miles after the ground is remarkably favourable. Indeed, it appears from the section on the map, almost as if an English hen and chickens could scratch the ground level and ready for the rails in a few months. We, therefore, presume there can be little doubt of its being opened to Broxbourne in twelve months as contemplated. When this portion is finished the other to Cambridge will be proceeded with. But it seems the Directors think it better to concentrate their whole efforts on that part of the line first which promises to pay the best, a very prudent measure.

From Kingsland the line runs parallel to the road, and between that and the Lea to Hoddesdon. It afterwards takes the course of the Stort to beyond Bishop Stortford, and then keeps parallel to the road all the way to Cambridge. We have not seen the last section of this railway, but we believe there are no engineering difficulties all the way, and that the gradients are very easy. The part that is now about to be made is unusually favourable, and, from opening a communication with the towns of Ware and Hertford, it will no doubt add much to its revenue. The part now intended to be made is about fourteen miles; to Cambridge, we believe, it is fifty-three or fifty-four.—EDITOR.

REPORTS.

LONDON AND CROYDON RAILWAY.—EXTRACTS.

THE Fourth Half-yearly General Meeting was held on the 5th of September, 1837.

With regard to the general affairs of the Company, your Directors have to report, that the proposals for raising the sum of 98,000*l.*, by a creation of new shares, were circulated immediately after the special meeting of the proprietors, held on the 29th June last. They have also the satisfaction to state, that the whole number of shares was subscribed by the actual proprietors and their nominees, and that the deposit of 2*l.* per share has been paid up.

In anticipation of this result, your Directors took immediate steps for giving the requisite notices to the landed proprietors, along the remainder of the line, viz., from the end of the contract, No. 2, at New Cross, for a length of nearly five miles, to the terminus of the short contract entered into at Croydon Common. For this purpose the final surveys of this portion of the line have been perfected, and the whole of the remaining notices to the landed proprietors have been served.

As soon as the preparations for obtaining possession can be duly advanced, proceedings for which will be carried on without delay, the specifications of the remainder of the works will be called for, with a view of putting them under contract with as little delay as circumstances will permit.

Your Directors have also to report, that the notices which under the provisions of the Company's Acts it was expedient to give to the owners and occupiers of properties at the station in Tooley-street, have been given accordingly; the compensation for several of the interests have been already paid; all the remainder, except one, have been agreed for, the proprietor in that instance having consented to postpone the valuation.

Your Directors have also inserted the necessary advertisements for the supply of two locomotive engines, and for half the quantity required of longitudinal wooden rails, and cross sleepers. They have also entered into a contract for fencing the remainder of the line.

With regard to the works in progress, your Directors have to report, that as the present season has been remarkably favourable for the prosecution of public works, they have impressed upon the contractors the policy of proceeding with the greatest activity; the contracts in hand have proceeded, if not with all the despatch which could be desired, without interruption; the piers of the viaduct from the junction with the Greenwich Railway towards the Grand Surrey Canal Bridge are completed; several of the arches have been turned, and the remainder are in progress; the piers of the bridge over the Grand Surrey Canal are finished; the stone courses at the springing of the arches have been laid; the centerings are placed for the side arches, and those for the main arch are on the ground ready to be placed; the bridge at Cold Blow Farm is also in a very forward state; and your Directors are assured that the brick-work upon this important portion of the line will be finished before the close of the present season.

The embankment of the New Cross contract is advanced altogether 570 yards, and as the contractor, in consequence of discussions with the Board, is now applying a considerable increased force, your Directors are inclined to think, that notwithstanding the diminishing number of working hours in the day, the weekly progress of the embankment will be increased.

The quantities excavated from the commencement in February,

to 26th August last, are 152,253 cubic yards; of which 55,309 have been thrown into embankment, and 96,944 yards into spoil.

The contract on Croydon Common is also in progress.

Your Directors add, as in former reports, a statement of the moneys, &c., in hand as follows, viz.—

	£.	s.	d.
1. Exchequer bills, exclusive of those deposited in the names of vendors and the Company, awaiting the completion of conveyances of land	14,678	6	2
2. Loan on security	1,200	0	0
3. Cash at the bankers', 4th September	10,050	2	1
Total cash and available securities in hand	25,928	8	3

Added to this there are the following arrears of calls due upon the original shares, viz.—

	£.	s.	d.
Upon the fourth call, 2*l.* per share on 330 shares	660	0	0
Last call, 5*l.* per share on 1704 shares	8520	0	0
Total outstanding calls due upon shares	9180	0	0

Although they are anxious to adapt the payment of these calls as much as possible to the convenience of proprietors, consistently with the policy so generally understood and enforced by themselves, of prosecuting the undertaking with all practicable despatch, your Directors are nevertheless bound to proceed (as soon as with reference to the Company's interests they shall think expedient) to give a final notice to proprietors of shares upon which calls are still outstanding; should further proceedings (which is scarcely probable) be required, a special general meeting will be duly convened, in order to declare the forfeiture of the shares, in conformity with the Act of Parliament.

JOHN MOXON, *Chairman.*

Dr. *Receipts.*

	£.	s.	d.
Balance in cash, 31st January, 1837	2470	9	7
Interest on exchequer bills	450	18	4
Call (3d) on 999 shares	2997	0	0
Do. (4th) on 6470 do.	12,940	0	0
Do. (5th) on 4846 do.	24,230	0	0
Interest on calls	128	2	7
Deposit on 6258 new shares	12,516	0	0
Fees on certificates and transfers	11	10	0
Stamps for transfers	23	0	0

In anticipation of this result, your Directors took immediate steps for giving the requisite notices to the landed proprietors, along the remainder of the line, viz., from the end of the contract, No. 2, at New Cross, for a length of nearly five miles, to the terminus of the short contract entered into at Croydon Common. For this purpose the final surveys of this portion of the line have been perfected, and the whole of the remaining notices to the landed proprietors have been served.

As soon as the preparations for obtaining possession can be duly advanced, proceedings for which will be carried on without delay, the specifications of the remainder of the works will be called for, with a view of putting them under contract with as little delay as circumstances will permit.

Your Directors have also to report, that the notices which under the provisions of the Company's Acts it was expedient to give to the owners and occupiers of properties at the station in Tooley-street, have been given accordingly; the compensation for several of the interests have been already paid; all the remainder, except one, have been agreed for, the proprietor in that instance having consented to postpone the valuation.

Your Directors have also inserted the necessary advertisements for the supply of two locomotive engines, and for half the quantity required of longitudinal wooden rails, and cross sleepers. They have also entered into a contract for fencing the remainder of the line.

With regard to the works in progress, your Directors have to report, that as the present season has been remarkably favourable for the prosecution of public works, they have impressed upon the contractors the policy of proceeding with the greatest activity; the contracts in hand have proceeded, if not with all the despatch which could be desired, without interruption; the piers of the viaduct from the junction with the Greenwich Railway towards the Grand Surrey Canal Bridge are completed; several of the arches have been turned, and the remainder are in progress; the piers of the bridge over the Grand Surrey Canal are finished; the stone courses at the springing of the arches have been laid; the centerings are placed for the side arches, and those for the main arch are on the ground ready to be placed; the bridge at Cold Blow Farm is also in a very forward state; and your Directors are assured that the brick-work upon this important portion of the line will be finished before the close of the present season.

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Fees on certificates and transfers	11	10	0
Stamps for transfers	23	0	0

	£.	s.	d.
Tonnage on canal	84	9	8
Rents	237	10	0
Barges sold	27	0	0
	£56,116	0	2

Transfer stamps in hand 37*l*.

Cr.	*Expenditure.*					
Exchequer bills bought			14,681	5	10	
Ditto sold			12,534	4	1	
						*2147 1 9
Engineering						1880 0 0
Surveying						471 9 0
Law						705 9 7
Land						5881 5 0
Houses						2733 0 0
Compensation						846 9 6
Works . . Sherwood's			9937	19	7	
Hoof			4645	11	10	
Colson			4814	0	10	
Sundries			2086	5	0	
Horses, carts, &c.			395	5	6	
Rails (410 tons)			6392	5	7	
						28,271 8 4
Salaries						255 0 0
Stationery and printing						34 15 6
Advertisements						50 17 11
Rates						63 3 1
Stamps for new shares						35 0 0
Petty cash						23 15 8
Balance in cash, 31st July, 1837						12,717 4 10
						56,116 0 2

† Exchequer bills in hand, as per account, 31st January, 1837	14,331	4	5
Add balance as above *	2147	1	9
	16,478	6	2

London, 31*st July*, 1837. R. S. YOUNG, *Secretary*.

† Of these 1800*l*. are deposited to abide the completion of contracts.

MANCHESTER AND LEEDS RAILWAY COMPANY.

THE second half-yearly meeting of the proprietors of the Manchester and Leeds Railway, was held under their Act of Incorporation, at the York Hotel, King-street, Manchester, on Thursday, September 14, 1837; James Wood, Esq., Chairman of the Directors, in the Chair.

When the Directors of the Manchester and Leeds Railway Company had last the pleasure of meeting the subscribers, their amended Bill was before Parliament, and it was not until the 5th of May that the Bill received the Royal Assent. The Directors have, therefore, been in possession of the requisite powers for making the railway about four months, during which period they have been actively engaged in purchasing land, and entering into contracts for the execution of the works. Their attention has been more particularly called to that part of the line between Manchester and Rochdale, and they have much pleasure in stating their success in having purchased nearly all the land between these two points at moderate prices, without being compelled to summon a jury, except in the case of the church lands, near Manchester, with the favourable result of which no doubt the shareholders are already acquainted.

Four contracts, embracing a distance of eleven miles and a quarter, have been let to experienced and responsible contractors. Three of these contracts include the distance from Junction-street, in Manchester, to the town of Rochdale, and the fourth includes parts of the tunnel at the summit ridge. These contracts are in the most active operation.

The contract for the viaduct from Junction-street to the station at Lees-street, a distance of seven hundred and thirty yards, will be let during the present month. The whole of the works between Manchester and Rochdale will then be contracted for, and in progress. The contractors are under heavy penalties to complete the works in May, 1839, during which month the Directors have every reason to believe they shall be enabled to open the line to Rochdale, and from which a considerable income to the Company will be derived. Some portions of the line beyond Rochdale are in a state of forwardness for letting, and will shortly be advertised.

The Directors take the liberty of stating that, within twelve months after they have been in possession of the powers of their Act, they anticipate that the entire line will be one active scene of operations. They are further stimulated to carry forward with the utmost vigour this great undertaking by the pressing demands of the public, arising from the insufficiency of the existing modes of conveyance, both by land and water; the canal being at the present time stopped for want of water, and land carriage being obliged to be substituted for about one-third of the distance, at an increased expense of 50 per cent. This fact proves one of the most

important claims of the Company for their Bill before Parliament, viz. the inadequacy of the present conveyances for the requirements of commerce.

The Directors have to congratulate the shareholders on the daily proofs they experience of the ultimate benefits to be derived both to the public and themselves on the opening of this great commercial railway, the importance of which will not be surpassed by any railway in the kingdom, whether it be considered in reference to the transit of goods to the western or the eastern coasts, or that of passengers; the whole line presenting one of the most densely populated districts in the kingdom.

The Directors cannot refrain from expressing to the shareholders the very great benefits which have resulted to the Company from their having induced one of their own body to devote a great portion of his time and energies almost exclusively to the undertaking. The important duties performed by this gentleman have been, in the opinion of the Board, more advantageously discharged under the present arrangements than they could have been in any other way; the entire control and responsibility of the Board of Directors being preserved, while its powers being concentrated, are brought into action with the greatest effect.

The Finance Committee in Account with the Shareholders, December 31, 1836, *to June* 30, 1837.

1836.	*Dr.*			£.	s.	d.
Dec. 31.—To total Receipts up to this time	£66091	8	1			
Less total Payments up to this time	33997	6	4			
1837. Difference, being the balance in hand 31st Dec. 1836				32094	1	9
June 30.—To amount received on account of first call				10	0	0
To amount received on account of second call				48250	0	0
To amount of calls paid in advance .				5800	0	0
To amount received for interest on payments of second call, after 15th June				8	4	3
To interest allowed by bankers . .				538	12	2
				£86,700	18	2
To balance brought down				69,707	8	11½
being in banker's hands	£69,696	16	0			
in secretary's hands . .	10	12	11½			
	£69,707	8	11½			

Cr.

June 30, 1837.		£.	s.	d.
By amounts paid for	Engineering and Surveying	4,912	7	11
" "	Solicitors on account of their bills	3,204	15	1
" "	Counsel and Parliamentary agents	1,488	17	1
" "	obtaining assents	291	19	8
" "	Witnesses	313	1	9
" "	Travelling Expenses, Stationary, Advertising, and Sundries	1,037	6	11
" "	Land and Compensation	2,141	7	10
" "	Stamps	26	5	9
" "	on account of Works	960	16	0
" "	Remuneration to Directors	2,400	0	0
" "	Secretary's salary and office expenses	176	13	10½
By banker's commission and postages		39	17	4
June 30th. By balance		69,707	8	11½
		£86,700	18	2

SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

BRITISH SCIENTIFIC ASSOCIATION.—SEVENTH ANNUAL MEETING.

MECHANICS.

Printing for the Blind.—Mr. Taylor, Manager of the Glasgow Blind Asylum, read a report on the history and progress of printing for the blind, prepared at the request of the Association. The report gave great satisfaction, but we could not make out whether Mr. T. advocated arbitrary characters, or the common Roman letters. He said that the letters should be raised about one-fortieth or one thirty-fifth of an inch above the surface of the paper; that copies of the Testament might be printed for about 1*l.* 10s. each; and that a blind person could read by his fingers at about half the rate of a seeing person. A long discussion arose on the respective merits of the plans of Mr. Taylor, Mr. Lucas, of Bristol, and Mr. Alston, of Glasgow, in which Dr. Lant Carpenter and other gentlemen took part. Dr. Carpenter came over to the opinion that the blind must be taught by the same characters as those they

mixed with; that is, as we understood him, the common Roman alphabet in capitals. On the justice of this we presume there cannot be two opinions. If arbitrary characters were to be used there would be no end to systems; they would introduce the confusion of Babel.

Focal Length of Spectacles.—Mr. Hawkins exhibited an ingenious instrument for measuring the breadth and focal length of eyes. He asserted the curious fact that the breadth between the eyes was from $2\frac{1}{8}$ to $2\frac{7}{8}$ inches in England, while in Germany it was from $2\frac{1}{8}$ to $3\frac{1}{4}$ inches. The eyes of many had one focus for vertical, and another for horizontal lines; and it was rare that the foci of the two eyes of any one individual were of the same length. Dr. Lardner said that Professor Airy had found that his eyes were not a sphere, but a spheroid, which affected his distinct vision in the way Mr. Hawkins described. To correct it, he had the glasses of his spectacles ground to a corresponding spheroid, which succeeded. Dr. L. said that some people's eyes were different at different times of the day. He, for instance, saw very differently before and after dinner—an observation that excited peals of laughter. He did not mean that he saw double, but that the process of digestion had considerable influence on his vision.

Artificial Horizon.—After expatiating on the impossibility of using the common artificial horizon at sea, and the difficulties of sometimes seeing the natural horizon, Mr. Ettrick described some inventions of his own. One of which was by means of a hemispherical horizon, the convex side being uppermost. His object was to make the incident ray always fall on the vertical point of the hemisphere, but how he effected it we could not understand. His principal machine, however, was a glass mirror, resting on the points of three or four cranked pendulums, the points of suspension being at the angles. If these cranked pendulums were perfectly equal and similar, and so placed that the planes of each were parallel, their vibrations would be the same by any motion of the vessel, and the mirror resting on the points would continue in the same horizontal plane; and therefore would be parallel to the horizon. Mr. Ettrick proposed to lessen the vibrations of the pendulums by immersing them in water, or some fluid. In theory this contrivance is correct, but we doubt it will ever hold in practice.

Treffos Pump for supplying a continual Stream.—A paper, on an apparatus for effecting this, by Mr. Williams, was read. The principle was to have a reservoir tank or receiver communicating with the pipe from the well. This tank was to be larger than the cylinder of the pump in which the lifting-box is, and its bottom on a level with that of the cylinder, its top being higher. With the cylinder it communicated by a pipe from its bottom to that of the cylinder. There was also a valve opening upwards in the reservoir from the pipe in communication with the well. Some discussion

afterwards arose by Mr. Addams, Mr. Knight, Mr. Evans, Mr. Webster, the Secretary, &c., the result of which was that the pump was not likely to effect more than the common pumps of the same dimensions; the author thought it would double it.

Railway Balance Lock.—Dr. Lardner read, for Mr. Remington, who was absent, a method of raising railway trains from one level to another. The principle, as far as we could understand it, seemed to be, to raise the line of rails with the train on it, by rollers working diagonally in grooves in the side walls of the locks, the mass being drawn up by a fixed engine. This method, if practicable, will cause the loss of considerable time in pulling up and setting the trains in motion, besides, in our opinion, an immense expense of power.

MATHEMATICAL AND PHYSICAL.

Calculus of Principal Relations.—Sir William Hamilton gave new applications of this calculus, of which he is the inventor. In the course of some observations he stated that the object of this calculus was to integrate, by differentiation and elimination, all such differential equations only as the calculus of variations led to, which could in all cases be done, "if the form of one principal function were known." The reader will find a very brief sketch of it in the two last vols. of the Association.

Geometrical Series.—Mr. Blackburn gave some interesting cases of geometrical series, which when multiplied together gave other simple summable series.

Algebraic Equations.—It is pretty well known that Abel, a Swedish mathematician, failing to resolve algebraic equations of the fifth degree, considered that he had succeeded in demonstrating the impossibility of it in any finite function of the co-efficients. Sir William Hamilton now stated that he conceived Abel to be right, and that, consequently, Mr. Jerrard's process of solving these and higher equations referred to at the last meeting of the Association fails, though it effects "the reduction of a general equation of the fifth degree to a trinomial form."

Turner's Theorems for odd Numbers.—If the series of odd numbers be divided into groups of one, two, three, &c., the sums of them will be the cubes of the number of terms in each of these groupes: as

1	3 5	7 9 11	13 15 17 19	21 23 25 27 29
Sum 1	Sum $8 = 2^3$	Sum $27 = 3^3$	Sum $64 = 4^3$	Sum $125 = 5^3$

Also N^m = the sum of all the odd numbers, whose two extremes are $N^m - (N-1)$ and $N^m + (N-1)$

As for instance, $3^5 = 3^4 - 2 + 3^4 + 3^4 + 2 = 243$. These

theorems were detailed by Sir William Hamilton. Professor Stevelly added, that if weights were taken corresponding to any portion of the series of natural numbers 1, 2, 3, 4, and their respective cubes, by occasionally using some of the weights in one scale and some in the other, we might weigh anything not exceeding a weight equal to the sum of all the weights. As for instance 1, 2, 3, and their cubes 1, 8, 27, will weigh anything up to 42, the sum of all.

Parallax of the Stars.—Professor Robinson discussed a number of the Greenwich observations, by which it appeared that the question of parallax is still undecided and open to future observation.

Atmosphere of the Moon.—Mr. Holden recounted several phenomena which he thought tended to establish the existence of seas and an atmosphere in the moon.

Lunar Tables.—Mr. Lubbock read his report for the construction of new Empirical Lunar Tables. The object of it was to recommend to the Association the reduction of all the observed places of the moon, made at Greenwich, for the last eighty-eight years, about 9,000, together with those made at Cambridge, so as to compare some good lunar tables, as Damoiscau's or Burckhardt's, with them. By this means the errors of the tables and any new equations may be discovered. Of course it was approved.

Greenwich Circle and Constant of Lunar Nutation.—According to Dr. Robinson, of Armagh, this circle is gradually undergoing a change of figure. The Constant of Lunar Nutation he found by several thousand observations to be 9″·234 differing as Mr. Baily observed from that, 9″·2347, of Busch, of Berlin, only by 0″·0007.

Lateral Discharge of Electricity.—When a Leyden jar is discharged a slight shock may generally be taken from it afterwards. This is called *redundant electricity*. Professor Henry has studied this part of electricity with great care. He observed that the quantity of redundant electricity may be increased by increasing the thickness of the glass or the size of the knob of the jar; but the apparatus producing the greatest effect is a long, fine, straight, insulated copper wire, parallel to the horizon, with a small knob at each end. Sparks thrown on this from a globe of a foot diameter will illumine the whole wire, though 100 feet long, and rays fly off on all sides, perpendicular to the axis of the wire. If the wire be bent like a U sparks will fly off from the outsides only; and if it be bent into three parallel pieces the middle part will be neutral, and the two outward ones throw off irradiations as before. The coruscations Professor Henry ascribes to electric momentum—for he says, if the electricity be gradually induced on the wire they will not appear—the latter phenomenon to mutual induction. Such is the effect of the momentum in the production of lateral electricity, that he said a pistol of Volta could be fired by the

lateral discharge from any part of a wire, though one end of it was immersed in a deep well of water, provided the upper end terminated in a ball, and the spark was thrown on it from the one foot globe. Several other curious facts were mentioned; and Mr. S. Harris stated, that he thought the pressure of the atmosphere played a more important part in these matters than was generally imagined. In proof of it he said, glass rods and other non-conducting substances were excellent conductors in vacuo. This, if true, would lead to the inference that electric conductibility depends on the joint properties of the body and the atmosphere.

Aurora Borealis.—Mr. Snow Harris related the unusual fact of this phenomenon having appeared during last summer, and indeed every month for the last year, in the south of England. Mr. Stevelly mentioned that a friend of his said, he could predict the appearance of the aurora on the evening of any night it would appear from some black clouds which preceded it about sunset.

Instrument to measure the Electricity of the Atmosphere.—Lieut. Morrison exhibited a pretty little instrument, which he thought would determine the atmospheric electricity; but a reply to a question put by Mr. Addams, that it was not effected by a common machine, led the section to consider that the indications were due to some other cause than the one assigned.

Velocity of Electric Light.—Mr. Ettrick read a paper on an apparatus he proposed for determining the velocity of electric light. He said, by a rough experiment he had made, it appeared that it was about 118,000 miles per second; the sun's light moves at the rate of 195,000.

Electro-Magnetism.—M. de la Rive related some experiments, in which it appeared from the indications of a metallic thermometer, that the intensity of the galvanic currents was increased by increasing the metallic surfaces in contact with the liquid, while the power of decomposition was weakened and even annihilated. When the annihilation is reached the intensity of the current is the greatest, and does not afterwards increase by any increase of surface. When platina, gold, silver, palladium, &c. wires are used to transmit the currents, the collection of gas is at first abundant, but afterwards diminishes and then ceases. At this time the wires are covered with a very fine powder of their own metal, not oxides. Dr. Andrews stated, that if one end of the transmitting wire be fine and the other a large surface, that gas will appear at the small, but not at the large end. Mr. M'Gauley exhibited some interesting experiments, but nothing material, or new, or towards furthering his locomotion, appeared.

Cheap Magnets.—Mr. Cunningham, of Cork, proposed to make magnets of cast-iron, cast in the horse-shoe form, which he suggested should be raised to a red heat and cooled slowly. He stated that, he had made some magnets of cast-iron stronger than any he had ever

met with made of steel. This statement, without numerical values, was considered too vague, and Mr. Christie, Mr. Holden, Mr. Peacock, Mr. Snow Harris, and Professor Henry, all gave their opinion in favour of steel; and some stated it should be tempered blue.

Report on the Variations of Intensity of the Magnetic Force in different Parts of the Earth.—Major Sabine made his report on this subject, which contains in a condensed form all that has been done by philosophers of all nations to the present time.

Tides.—Mr. Lubbock entered into a long explanation of the labours that had been undertaken under his superintendence, at the request of the Association, to reduce the phenomena of the tides to calculation. Upwards of 13,300 observations had been discussed, and the result was, a conviction in Mr. Lubbock's mind that Bonrouille's theory was much more exact and complete than has generally been supposed. The exact time of high-water, however, still fluctuates round the calculated times a trifle. Mr. L. mentioned a very curious circumstance, namely, that by a comparison of observations made by John Wallingford, an Abbot of St. Alban's, in the thirteenth century, with observations of the present day, it appeared that the times of high-water then and now differed as much as between two and three hours.

Light for Light-houses.—Captain Denham addressed the section on a proposed improvement for coloured light in light-houses. Instead of a plain screen before the parabolic mirror, he proposed to put a cylindrical glass or muff of the same colour round the light. If the muff was of the same thickness and material as the screen, it was the opinion of Brewster, Faraday, and Peacock that no difference would exist.

Cataract of the Eye.—Sir David Brewster stated some optical experiments which led him to consider the means of curing that distressing complaint, the cataract. It has been tried and with success. The principle is to puncture the eye when there is an excess of the aqueous fluid, and to inject distilled water when there is a deficiency. Sir David afterwards addressed the section on what he thought was a new property of light, but the phenomenon in Mr. Whewell's opinion, did not appear to warrant the term new.

The Diamond.—Sir D. Brewster mentioned a case in which he had observed the curious phenomenon of a diamond lens of less than the 5th inch diameter, possessing layers of different refractive powers, hardness, and specific gravity. He considered this an argument in favour of the diamond being a vegetable substance.

Dispersion of Light.—Professor Powell read a communication, by which it seemed that oil of cassia presented an anomaly to the mathematical theory of Sir Wm. Hamilton; but a memoir by Mr. Kelland appears to show a perfect concord.

Registering Anemometers.—Mr. Whewell and Mr. Osler, of Bir-

mingham, detailed the effects of two anemometers severally invented by these gentlemen. Mr. Whewell's anemometer consists of a wheel, like the common ventilators, attached perpendicularly to the short end of a vane, which always makes it face the wind. This wheel revolves faster as the wind is stronger, and for every 10,000 revolutions a pencil connected with it by a train of toothed wheels and screws, descends vertically one-twentieth of an inch, tracing its vertical and horizontal courses on the circumference of a cylinder whose axis is the axis of the vane. The vertical course measures the total force or the velocity of the wind, and the horizontal the changes. This instrument evidently gives, as Mr. Whewell observes, the whole or integral force and directions of the wind between the two times of observation. Mr. Osler's instrument carries a pinion, working in a rack, sliding backwards and forwards at the lower end of the rod, or rather tube, supporting the vane as the vane turns round. To the rack is attached a pencil, which marks on a card, having the cardinal points the direction of the wind. By means of clock-work this cardinal card progresses one inch every hour. The force is ascertained by a plate a foot square, at right angles to the vane, "supported by two light bars running on friction rollers, and communicating with a spiral spring." The effect on the spring is transmitted by a light wire down the tube, to a pencil which registers the force on a paper below. Mr. Osler likewise described a rain-guage, consisting of a balance, with a bucket at one end, which discharged itself when full, and registered its work. The anemometer is good, but we have our doubts of the rain-guage.

Internal Temperature of the Earth.—Mr. Henwood stated that he had examined the temperatures of various mines in Cornwall, and that he invariably found the temperature of granite was 13°·9 colder than slate of the same depth; but that as the depth increased, granite cooled slower than the slate. These facts were determined by the temperature of springs, issuing from the granite and slate. After Mr. Henwood had finished, a gentleman entered from Penzance, stating that he had made experiments in different Cornish mines, which would prove the very contrary to what Mr. Henwood had detailed. Professor Phillips presented the report of the Meteorological Committee. From some experiments recorded in this, it appeared that the temperature, after a certain depth, sunk about 1° Fahrenheit for every sixteen yards. For the late French experiments on this subject, see *Railway Magazine*, No. XVII., p. 48.

Aerial Currents.—A paper, by Mr. W. R. Birt, was read, in which he attempted to explain the physical cause of the various winds, on the hypothesis of the heated air, in the intertropical climes flowing over towards the poles, combined with the rotation of the earth. No doubt can be entertained that the sun has the principal influence in causing the winds, but that influence extends

all over the globe, and is much disturbed in any regular laws by clouds, rain, &c.; most certainly it is not confined to intertropical regions.

MISCELLANEOUS INTELLIGENCE.

Vaccination.—M. Perdrau has addressed documents to the Academy of Sciences, claiming to have first proved, in the beginning of 1836, the regeneration of vaccination, with a female of the commune of Passy through accidental inoculation from pustules on the udder of a cow. With respect to vaccination we think it right to state, that in the spring of the year 1832, we had four children out of five that had been vaccinated seized with the small-pox naturally. The only two that had been inoculated for the small-pox escaped. All the vaccinations had been made by professional men at different periods and from different subjects. Our opinion, therefore, is, that vaccination is not a preventive to the small-pox, and from the violence with which the child that first took it was attacked we much doubt its powers as a meliorative. In fact, we are so thoroughly convinced from this and other circumstances which have fallen under our observation of its inefficacy, as never to permit it again with our family. If we cannot inoculate we would prefer the chance of the small-pox.—Ed.

Shooting Stars.—In the night of the 10th to the 11th of August last, M. Arago's eldest son and a friend counted, in the garden of the observatory, 107 of these bodies between 11¼ and 12¼ hours. Also from 12 hours 37 minutes to 3 hours 26 minutes the beginning of twilight of the same night, M.M. Bouvard and Laugur observed 184. The motions of the greatest number were directed towards Taurus, as they ought from the motion of the earth.

Preservation of Vegetables.—If in a compost of potter's clay and cow-dung, rather liquid, vegetables, plants, &c., be completely dipped, and then packed with straw in a vessel air-tight, they may be carried from one end of the globe to the other perfectly fresh and safe. An experiment of this kind was lately tried on some trees which were thus transported from Europe to the Isle of France, and instead of dry and sapless wood they arrived in leaf and blossom. They were of course put in the hold of the ship.

Shower of Stones from a Meteor.—In the night of December 11th, 1836, perfectly clear, and wind S. W., a most brilliant meteor was seen, apparently above the village of Macao, Brazil. Its size appeared equal to that of a balloon, in which people ascend. It followed a direction from north to south, and was seen by the people of Cearn, 60 leagues off. Nearly as soon as seen, it suddenly burst like thunder, and dispersed, over a radius of more than 10 leagues, an immense quantity of stones, some of them weighing from one to eighty pounds. A few broke through houses, and others buried themselves many feet deep in the sand. Some oxen were wounded

or killed, but no human life was lost. One of these aerolites is now undergoing a chemical analysis by M. Berthier.

Statistics—Proportion of Males to Females born.—A very interesting memoir on this subject has been presented to the Academy of Science, by M. Girou. Among a variety of other matter he says, that eldest sons have generally more females born to them than younger sons have; that conceptions made about the beginnings of Carnival or Lent produce relatively more girls than at other times of the year, which he attributes to the debilitating effects of idleness, intemperance, or incontinence which then prevail. He also confirms the facts previously received, namely, that the proportion of births is decidedly greater in country places, where health and temperance reign, than in cities and large towns.

Artificial Rubies are capable of being made in considerable quantities by a very simple process, which has been adopted by M. Gaudin. They have been analysed and found to consist of ninety-seven parts of alumine, one of oxide of chromate, and two of silex and chalk. He has recomposed these elements, which has all the properties and the same form and cleavage as natural rubies.

Resistance of Boats on Rivers.—Experiments have been made in France, similar to those made by M'Neil, Russell, &c. in England, and with the same results. It was found that a tensile force of from 200 to 400 kilogrammes, which it took to mount the wave generated by the boat, sank to 100 as soon as it was mounted, and the boat went 16,000 metres an hour. In these experiments it was found advantageous to put the horses into a gallop as soon as possible after they started, by which they attained the required velocity before the wave had time to form, and with less expense of power.

Nuisance of Locomotive Chimneys.—Some plan must ere long be adopted to prevent the nuisance arising from the steam and small particles of coke issuing from locomotive chimneys. Outside travelling is all but impossible. Even when the trains go under any archway if the wind is blowing obliquely, the steam mixed with coke issues in at the windows by reflection from the sides of the archways in a very offensive degree. Why not turn the chimneys to point backwards under the carriages? A series of thin tin plates running under the bottoms of the carriages and overlapping each other would prevent it ascending, until the train was passed. Any difficulty in the draught in getting up the fire, could easily be obviated, and when the train is in rapid motion, probably the vacuum created behind by the velocity of the train, would aid rather than injure the draught. We throw out the hint to set others going, and shall rejoice if it has an effect.

New Railway Power.—A proposition has been made, which has received a favourable consideration, for working an intended railway 300 miles in length, in the State of Virginia, in the United States. There are a series of waterfalls in the immediate vicinity

of the whole length of the line, from which it is proposed to cut numerous canals to obtain a head of water for working the water-wheels to be applied, similar to fixed engines for moving the railway carriages.—*Athæneum.*

English Inventions.—It is no less singular than true, that inventions made in England are often in operation in Russia, Germany, Prussia, &c. before they are here. Immediately the slightest hint is given of any invention, information is conveyed, how we hardly know, to the ever-wakeful agents of those countries. Introductions to the inventor are procured, and under the plea of foreign curiosity to see all the varieties of the country, the whole particulars of it are obtained, which, perhaps, before another sun has arisen are rapidly winging their way to one or more of the above nations, to be turned to useful account.

Condensing-Engine.—Mr. John Barton, the inventor of the improved metallic piston, has now just completed a new condensing-engine, boilers, &c., by which one-half the space may be saved, one-third in weight of engine and fuel, and above one-third in expense. The construction of the engine is such that it will be almost impossible for any vessel in which it is adopted to be lost at sea; the engines and boilers are in their formation completely novel, and not less ingenious; and they are not only particularly strong, but peculiarly adapted to obviate the possibility of explosion.—*Weekly Dispatch.*

PRIZES PROPOSED BY THE ACADEMY OF SCIENCES IN PARIS.

Grand Mathematical Prize for 1838.—The solution of the problem as to the resistance of water, which has been twice unsuccessfully given out before, is again proposed for 1838, and the time for receiving the answers is limited to July 1st, 1838.

Grand Mathematical Prize for 1839.—To determine the perturbations of the elliptic motion, by series of periodical quantities different from circular functions, so that by aid of the existing numerical tables we may compute by these series the place of a planet for any given epoch. If the analysis can be made applicable to the moon so much the better, but it is not insisted on as a condition. The communications must be sent to the Secretary of the Academy before May 1st, 1839. No mention is made of the amount of either of these prizes; but we presume each is not less than 3,000 francs.

Astronomical Prize.—Laland's medal of 635 francs, to all persons, except the members of the Institute, who shall have made within the year the most interesting observation, or who shall have written the most useful memoir for the progress of astronomy.

Prize extraordinary on the Application of Steam to Navigation.—6,000 francs, or 250*l.*, for the best work or memoir on the most advantageous employment of steam to the sailing of vessels, and on

the mechanical system, "installation," stowage, and arming, which ought to be preferred for this sort of vessels. The memoir to be sent before May 1st, 1838.

Montyon's Mechanical Prize, 500 *francs*, for the best invention or improvement of instruments useful in agriculture, Mechanical arts, or sciences. To be sent as before, prior to May 1st, 1838.

Montyon's Statistical Prize, 530 *francs*.—This prize is confined to works, whether in manuscript or print, if they have come to the knowledge of the Academy, the most useful relative to the statistics of France. This must also reach before May 1st, 1838.

INSTITUTION OF CIVIL ENGINEERS.

We have before us minutes of the proceedings of the above body for 1837, and we cannot but express our admiration of the number and interest of the subjects that have been brought before them, and our approbation of the lucid and able manner in which they have generally been treated. It is our intention to gratify our readers with extracts from these "Minutes" in our future numbers. The Council have given out the following subjects for communications and premiums for the session of 1838, which commences the 9th of January:—

1. The nature and properties of steam, considered with reference to its application as a moving power for machinery.

2. The warming and ventilation of public buildings and apartments, with an account of the methods which have been employed most successfully for ensuring a healthy state of the atmosphere.

3. An account and drawings of the original construction and present state of the Plymouth breakwater.

4. The ratio from actual experiment of the velocity, load, and power of locomotive engines on railways. 1st, Upon levels; 2d, upon inclined planes.

5. Drawings, description, and account of the principles of Huddart's rope machinery at Limehouse.

6. Sewerage of Westminster.

7. Drawings and description of the shield of the Thames tunnel, with an accurate account of the method by which it is advanced and worked.

☞ Out of nineteen sittings in 1837, we perceive the President, James Walker, Esq., presided sixteen times. We recommend this example to other presidents, who have so much more time on their hands, and so much less excuse for non-attendance.

REVIEW OF BOOKS.

Vicat on Cements and Mortars, 8*vo*. John Weale, 59, High Holborn.

Capt. Smith has rendered a great service to the country in the translation of Vicat, both in rendering him intelligible, and in the

many useful observations he has added. It is hardly credible how much such a subject has been neglected in England, distinguished as it is for its works. In the early part of this year some interesting discussions took place relative to cements, in the Institution of Civil Engineers, and there evidently wants only some stimulus to set the genius of our engineers to work. We can hardly imagine a better than the book before us. M. Vicat has certainly the merit of reducing the chaos of mortars and cements to something like system and science, and the book possesses a mass of useful information, not merely to the engineer and builder, but to the man of science.

Simms's Treatise on Levelling. John Weale, 59, High Holborn.

This is a very useful little book for the practical man, and is distinguished by many sound and useful observations. The author would, however, have done better if he had made it a more independent work, and not so much resting on his other treatise. It contains rules for the computation of earthwork, making roads, &c., taken from the best sources, which cannot fail to be valuable.

RAILWAY NOTICES.

American Railways.—By a map, lately published by Poussin, of the American railroads, it appears there is now constructed and in the course of construction, one continued length of railway, with a few steam-boat interruptions, from Portland, New England, lat. 44° to Pensacola, West Florida, Gulph of Mexico, lat. 30½°, the total length of which cannot be less than from 1,300 to 1,400 miles, besides numberless branches sprouting out from it of 100, 200, 300, &c., miles each. Added to this are many long lines scattered over the country, chiefly from inland places to their immense rivers and lakes. So that if the Americans go on thus much longer, the whole face of the country will be covered with a trellis-work of railways.

Anti Dry-Rot Sleepers.—In our last we mentioned several eminent engineers who are now using Kyanized sleepers and continuous bearers. By accident we omitted the names of the two Messrs. Stephenson, and also of Mr. Giles, whom we well remember to have heard soundly rated in the House for doing what all are now coming into.

Amsterdam, Oct. 4.—The king has confirmed the Statutes of the Dutch Iron Railroad Company. A proposal to prolong the railroad to Rotterdam, by way of Leyden and the Hague, was unanimously agreed to.

Brighton Railway.—Something like business appears to be going on with this line. The engineers, Sir John Rennie and Mr. Rastrick, have nearly completed their permanent levels, and the line

is poled out to a very considerable extent. The working plans and estimates are in a state of great forwardness. A report is shortly expected, embracing in detail the whole of their operations since the passing of the Act, and the means as well as the expence of accomplishing the undertaking. It is understood that this report, before it is presented to the public, will be submitted to Mr. Locke, the engineer of the Grand Junction Railway.

The shareholders in the Western line, viz.: Stephenson's and Mills', as also those in Gibbs', and the South-Eastern Brighton lines, have to a very considerable extent joined the incorporated Company by an exchange of their shares, and although on the shares of the two Western lines, an additional payment beyond the original deposit has been required, to meet the expense incurred before the amalgamation of the various Companies, that payment has to a very large extent been made by the shareholders. We are informed that nearly one-half the new shares in the incorporated Company has been taken up.

We shall look with anxiety for the engineer's report, and hope to be able to present our readers with a copy of it in our next number.

Birmingham Railway.—This great line was opened to the public as far as Tring, thirty-one and three-quarter miles from town, on Monday, the 16th ult. An experimental trip was made under the direction of the London Secretary, Mr. Creed, on the previous Saturday with a large party. The distance was run in one hour and seven minutes, about twenty-eight and a half miles an hour. Tring is at the summit, and the whole distance is consequently up hill, at the average rise of about ten feet per mile. The speed, therefore, attained would be about forty miles an hour on a level. It seems that the times of reaching the station had been calculated and fixed theoretically; and what is very gratifying, we understand the practical performances corresponded with them exceedingly near. About the beginning of the year the line will be ready to Denbigh Hall, but it is likely not to be opened until completed to Wolverton, about fifty-one miles from town, which will probably be in March. When the line is once fairly opened great care will be taken to insure punctuality and prevent delays. The time-keepers at the stations will be regulated by London time, and under lock; a good chronometer will be furnished to each train; an engine at each station will always be ready, and despatched to meet any train not arriving within a quarter of an hour of its time. We presume, therefore, we shall be under no apprehensions of a night's lodging in the carriages from a restive or broken down steam-horse.

"*The General Steam Navigation Company*," a Brussels paper, *L'Emancipation*, says, "intend to place two of their best boats on the station from London to Ostend. The consequence will be that, as soon as the railroad is finished, travellers will be able to

to from Brussels to London in sixteen hours at an expense of thirty francs."

Continental Line of Railroad.—The great conception relative to the establishment of a great continental line of railroad across North Germany is in progress of execution. The line of railroad in Belgium extends to the frontiers of France and Prussia, from Ghent to Aix-la-Chapelle. France is hesitating; but Prussia is opening fifty German miles of railroad, which will afterwards be extended to her capital. The Company of railroads of the Rhine and the Weser have obtained the concession, and are setting to work upon it. Doubts and obstacles disappear. It was said, indeed, that in Germany the expense of railroads would be enormous, and the profits small; and the expense of 233,000 thalers per mile expended on the Belgian railroad was cited, with the trifling profit of 13 per cent. But these are easily answered. In Belgium they counted only on 70,000 passengers, yet they were obliged to make a second line to accommodate the increased number. In North Germany, too, the country is much flatter, and the cost per German mile will not exceed one-half of the expence in Belgium.—*Augsburg Gazette.*

Eastern Counties Railway.—We are sorry to hear that some of the Directors of this Company imagine our observations emanate from hostility towards them. Once for all, we beg seriously to declare we have no such feeling. Several members of the Direction we know, and for them individually, we have great esteem. But somehow or other such funny things do come from the Board that we, naturally inclined to be merry, cannot but laugh. For instance, take the document just issued about the traffic to Chelmsford, and we ask who can read it with a grave countenance? A gross revenue of 339,431*l.* per annum, for twenty-eight miles of railway to the little country town of Chelmsford, with a population of 5435 of all sorts, while the gross annual revenue of the Grand Junction (see No. xx. R. M. p. 273) with Liverpool and Manchester at one end, and Birmingham having a population—and such a manufacturing population too—of 146,986 at the other, only produces a gross annual revenue of 278,773*l.* for 97½ miles; that is, 60,658*l.* per annum less for a line, three-and-half times longer than the Chelmsford!!!!!!! We appeal to the Eastern Counties Directors themselves, whether Munchausen, if a railway man, could beat this case of traffic.

With their permission and the aid of old Cocker we will shew from the receipts of the Grand Junction, and of the Liverpool and Manchester railways, what the maximum limit of their traffic might be, was Chelmsford, instead of a mere country town, a busy manufacturing place like Birmingham. The Grand Junction is as nearly as possible three-and-half times the length of the Chelmsford; its annual revenue, therefore, other things alike,

ought to be three-and-half times greater. But when a line is made between two towns, it is, *ceteris paribus*, the population of the less town which determines the amount of traffic upon it. Now, Birmingham is twenty-seven times the population of Chelmsford; consequently, the Grand Junction gross returns should be 27 × 3 = 81 times, say 80 those of the Chelmsford Railway. But the annual returns of the Grand Junction are 46,462*l.* × 6 = 378,772*l.* (see No. xx. p. 273 R. M.); 1/80th of this is 3,484*l.* (not 339,431*l.*), a little more than enough to pay the Secretary's department, without allowing anything for wear, tear, locomotion, &c. If this be supposed an unfavourable comparison, let us take the Liverpool and Manchester Railway itself, say nothing of the cost, and attend only to the gross revenue and population. Liverpool is the less populous of the two towns, being 165,175, or more than thirty times that of Chelmsford. The Liverpool line is also three miles longer, but let this go to the advantage of the Chelmsford. By our last number, p. 269, the annual receipts are 105,951*l.* × 2 = 211,902*l.*, one thirtieth of which is 7,063*l.* for the gross annual receipts of the Chelmsford line, which would just about pay the expenses of last year's management, and leave perhaps enough to find grease for the wheels, with 0000 for the shareholders, and an annual expense besides on them of thousands for locomotive power, maintenance of the way, &c. Should this be, in the opinion of the Directors, not a fair deduction we call on them to point out where; they shall have the use of our pages to do it. We earnestly beseech them to publish no more such silly statements; they cannot think how much it injures them. To assert that a railway to the little insignificant town of Chelmsford will produce receipts 127,000*l.* per annum, or 65 per cent. more than is done on that prince and father of railways, the Liverpool and Manchester, appears such an outrage on probability and common sense, that we fear people afterwards will not believe anything from them that *may* be reasonable.

Since writing the above we have received the following, published we suppose "officially," in the *Norwich Chronicle*. Our correspondent calls it "a bait to catch the 'Eastern flats;'"—"*Eastern Counties Railway*.—The works of this railway are going on in the neighbourhood of Old Ford and Bow, and a bridge is nearly finished over the river Lea, of one semi-elliptic arch, the span of which is seventy feet, near which is also building another bridge or viaduct of five arches, each thirty feet span. A number of men are also employed at Maryland Point." So that after receiving "113,321*l.*" with only 2,638*l.* left, by the same document, above their expenses and liabilities, they have TWO BRIDGES in progress, and some "men employed at Maryland Point."

Calcutta and Saugur Railway.—This Company, we hear, is paying back the money they have in hand to the shareholders, and of course, may be considered as dissolved.

Grand Collier Docks.—This important undertaking, for which an Act was obtained in August last, we are informed, is meeting with that encouragement from the public, which cannot fail to insure its success. The crowded and dangerous state of the river loudly calls for a speedy and efficient remedy, and which can only be effected by the removal of the colliers out of the stream, thus restoring a free and uninterrupted navigation, and enabling the port of London to vie and compete in commerce and facilities with our great maritime ports. We would call the attention of the public to the printed report of the Collier Dock Company of September last, to show that the business of the coal-trade may be conducted in dock, with greater advantages to all parties than it is at present, both as regards despatch and economy, and that a handsome profit will be realized to the proprietors of this undertaking. It has our good wishes for its success.

German Railroads.—In consequence of one of those stupid under calculations which have done so much mischief in this country, the railway spirit in Germany has sunk considerably. The line from Dresden to Leipzic was estimated to cost 1,500,000 dollars, but it is now found it will cost near 4,500,000. This unpardonable, or we suppose wilful, error has stagnated the whole; and it is doubtful whether time itself will obliterate the mischief done.

Greenwich Railway.—We are glad to perceive that the Directors are in earnest in their efforts to complete the railway to Greenwich. We understand the contractor is very speedily to be employed on three points at once, so that in all probability the whole will be completed in the spring. A new arrangement of some consequence seems to be in contemplation by the Directors regarding the facilities for conveying passengers from Deptford to Greenwich at a very trifling cost. Should the Croydon railway be opened at midsummer, the Greenwich railway would no doubt be in full operation by the autumn.

Great Western Railway.—We refer our readers to a very interesting report of the first section (namely, to Maidenhead) of this railway, in our present number. It appears this part, 22¼ miles, will not be opened until December (we should rather think the beginning of the year), to the great annoyance of the Directors, who, with the engineer, secretary, &c., have made almost superhuman efforts to keep to the time first mentioned. It is scarcely credible the anxiety that is manifested for the opening of this great line. Two things contribute to this—the increase of gage, and its anticipated effect on railway velocity. The French railways are almost at a stand-still, in expectation of the result. A slight subsiding has, as mentioned in our last, been manifest in the

embankment at Hanwell, owing to the wetness of the subsoil. We are, however, assured it is inconsiderable, and will no doubt be effectually stopped by a culvert about to be made, to drain the ground.

Great Central Irish Railway.—A line, or rather lines of railway, have been projected from Dublin, to Athlone, to Longford, and to Kells, which are ultimately intended to be carried out to Galway, Sligo, and Enniskillen. The total distance now projected is 132 miles, and capital 1,175,000*l.* The engineer estimates that 8,500*l.* per mile will be ample to defray the cost of construction. It seems to have met with the approbation of Mr. Vignoles, one of the Government engineers, and we presume will therefore be carried out. The main line passes through Chapelzod, Palmerstown, Lucan, Celbridge, Kilcock, Mullingar, to Athlone. Near Augher it branches off to Summerhill, Dangan, Trim, and Kells. Not far from Killucan a branch leaves for Longford. It has no tunnels, the earthwork is light, and the gradients favourable. By this line it will be 80 miles from Dublin to Athlone, 45 to Kells, and 74 to Longford.

Grand Junction Railway.—It is intended to throw a bridge over the Mersey, at Fidlers' Ferry, which would shorten the distance to Birmingham about seven miles, and avoid three inclined planes. A new embankment was also proposed to be raised at the Birmingham station, which would cost about 20,000*l.*, and be highly advantageous.

Grand Connexion Railway.—The Committee have 11,234*l.* in hand, and there is a strong party in favour of a renewed application to Parliament.

Great North of England Railway.—The contract for the bridge over the river Tees, at Croft, which has been advertised in our pages, has been taken by Messrs. Dees and Co., of Newcastle, who will forthwith proceed in the execution of it. The part from Croft to York is expected to be completed in two years.

London and Southampton Railway.—The works at the London end of this railway are fast approaching towards completion. The embankment across Battersea fields is brought to within a short distance of the terminus, near Vauxhall, and the buildings for the depot are commenced.

There is no doubt that the line will be opened to Woking Common (23 miles) on the 1st of May, in accordance with the hopes which were held out to the proprietors at the late general meeting.

Leith and Edinburgh Railway.—This Railway is begun, and some progress made in the cutting and embanking.—*Edinburgh Courant.*

Mayence and Frankfort.—It is stated, the Grand Duke of Hesse had granted permission to construct a railroad from Mayence to Frankfort, passing by Cassel, on the right bank of the Maine.

Some progress is also making with a like project from Amsterdam to Arnheim.

Manchester and Sheffield Railway.—The Directors of this line have suspended operations until the spring. At that time it is hoped the works will be resumed with spirit, and prosecuted with vigour. We shall be glad to see this line completed, as we believe it to be one that will command an immense traffic, and, of course, proportional returns.

Mammalia.—The remains of Mammalia have been found on the plains of Cheshire. In the progress of cutting for the Grand Junction Railway, two grinders of the elephant were discovered in a bed of gravel replete with marine shells.—*Mining Journal.*

North Union Railway.—The works on this line are at present making rapid progress at the Wigan end. The erection of two iron bridges, one over Walgate and the other over Chapel, are now in progress, and they are expected to be an ornament to that town. —*Preston Chronicle.*

North Midland Railway.—Operations have commenced a little way beyond Heath Common, near Wakefield, where a considerable number of workmen are employed.—*Birmingham Herald.*

Oxford and Tring Railway.—In our 19th number we noticed the appointment of a Committee to inquire into the alleged extravagant expenditure, "45,000*l.*," of the Directors of this absurd project. It seems, to an application of the Committee for an inspection of the books, Mr. Pearson Thompson, Chairman of the Directors, has replied by a threat of some "judicial inquiry." Mr. Thompson is quite right. What have the shareholders to do with how the money has been spent? it is enough for them to have paid it. Mr. T. should reply in the language of Elizabeth, "We are surprised and displeased that ye, who are only brute folk, should presume to meddle with our affairs, which are above your comprehension." Make another call, Mr. Thompson, and tell them if they don't pay, you will seize their goods and chattels, and throw their impudent bodies into jail; that is the way to silence them.

Prussian and Belgian Railway Junction.—It has been related to us as a curious fact, that the junction of the railways of these two nations is actually in a tunnel near Louvain, on the borders of the two countries. This looks droll. It is rather a darkish communion. We wonder whether the two nations are afraid, or ashamed to look each other in the face, that they meet in a hole, or is it the best place, do they think, to play their "tricks upon travellers?" Have they a station there, too?

Railway Brake or Regulator.—We have seen the model of a railway brake, for which a patent has been taken out. The principle is the application of brakes by means of a series of continuous rods from one end of the train to the other, connected by joints between the carriages, so as to yield to curves, inequalities of the road, &c. When running down hill, the rod presses against the

tender, and the strap brakes rub against every alternate pair of wheels. By this means the patentee expects to have the train more under command, and to stop or check its velocity more speedily, and without the repercussions we now experience. He calculates, also, on other advantages we cannot now describe.

Railroads in Belgium.—The line by which the Belgians propose to connect their western boundary looking on the sea, with their eastern bordering on Germany, is already so far advanced as to be opened from Tirlemont to Ghent on the 29th of September. When the whole line is completed, the journey by steam-packet and railway, between London and Brussels, will be effected in sixteen hours.

Railway over Morecombe Bay.—Great interest has been excited by Mr. Stephenson's survey of the country between Lancaster and Whitehaven, with the view to the formation of a line of railway. We understand the project of the embankment of Morecombe Bay is viewed with much interest by a great many influential gentlemen in the metropolis.—*Preston Pilot.*

Brussels, Oct. 21.—Mr. Simons lately visited all the works preparatory for laying down a railroad from Ghent to Bruges; the operation of levelling is finished as far as Beerren, two leagues from Bruges. Mr. S. seems to be sure that the section from Ghent to Bruges may be opened in the month of May, next year, and that from Bruges to Ostend, in the month of June following.—*Sun.*

Russian Railroad.—Five wersts of the Zarsko-Selo Railway were opened Oct. 7. Twelve journeys were made a-day, and 16,213 passengers carried in 5 days, increasing every day. The receipts of the 5 days were 21,255 rubles.

American Railway Expresses.—The rapidity with which the Government express was carried with the President's message to all the chief cities in the Union deserves a record. That to Philadelphia and New York is unparalleled, perhaps, in the history of the world. The express left Washington at twelve o'clock on Tuesday and reached Philadelphia (145 miles) at six, and New York (242 miles) at three minutes before eleven, thus performing the whole distance in ten hours and fifty-seven minutes! Seventy-four miles of railroad between Baltimore and Wilmington were travelled in one hour and fifty-five minutes.—*American Paper.*

The cost of the Railroad to be constructed from Strasburg to Basle is estimated at twenty-five millions of francs. The subscription in the two cities already amount to nearly sixty millions of francs.—*Morning Post.*

South-Eastern Railway.—The obstacles which existed in the commencement of the works having now been removed by the completion of the purchase of the land in the vicinity of Dover, the Directors have given instructions for the immediate commencement of the works connected with the Shakspeare Tunnel.

at Dover, for which contracts were entered into some months ago, as noticed in our Magazine.

We observe by notices published in the Dover papers, that the Directors intend, in the next session of Parliament, to avail themselves of the option given to this Company under the provisions of the London and Brighton Railway Act, to make the South-Eastern an integral line from Croydon to Dover, by taking that part of the Brighton line which lies between Croydon and the point of divergence into Kent. This will not only be a saving of a considerable amount in the cost of the line, but will reduce the tunnel from 2¼ miles in length to but 1,320 yards. Independent of its own traffic the South-Eastern line will have the additional traffic to Brighton over twelve miles of its line.

Llanelly Railway.—The works towards the completion of the main line and branches are, we find, proceeding rapidly, contracts for the whole having been entered into, and most of the land purchased on very favourable terms. The *excess* of coal brought down only two miles of the road first made, on comparing the first six months of the present with a like period of the last year, amounts to nearly 30,000 tons; and there cannot be a doubt but on the completion of the Railway up to the Anthracite, or Stone Coal district, that an immense traffic will be created, inasmuch as the successul experiments, recently made, indicate the use of that coal for purposes to which it has, until lately, been thought inapplicable.

Preston and Wyre Railway and Harbour Company.—The half-yearly General Meeting of this Company took place on Wednesday, the 25th; the Report, which was read, containing a statement of the progress of the works and affairs of the Company, gave great satisfaction.

Standing Orders.—It is to be hoped the Commons will not lose a moment in altering their Standing Orders relative to railway bills. If they make these orders to conform to the Lords' it would answer every purpose, and Companies *bonâ fide* got up could not object to them. If not, all public improvements in railways must be considered as ended. Some imagined that the "ten per cent." clause would operate in favour of lines that have their Bills, by enabling them to get in their calls. Experience has shown them the folly of this. Their calls have been answered worse than ever. It is well known that lines *per se* between two towns will rarely pay well; it is from other lines joining them, from the streams of traffic brought in from more distant sources, the profit part is to come. Parties who have calculated on these, seeing them now cut off, naturally enough stop the supplies, and would rather forfeit what they have paid, than, under such circumstances, advance more. Thus it is that many really good lines which have their Acts are standing still; their half-finished works are every where

presenting their disfigured heads; and nothing but one scene of discord between the managers and the unjustly alarmed proprietary reigns throughout the land. Take, for example, the Croydon Railway, who ever thought a line to Croydon would pay if it was to stop there? It is quite evident the shareholders did not, or in the midst of the railway fever they would never have so neglected it. But the moment there was a chance of extension to Dover and Brighton, in come the calls and the works proceed. Yet, would it be believed, the Directors of this very line, in their last report, laud that Standing Order, which, had it existed one session before, would have sent their own Bill, plans, &c., to wrap up half-pounds of butter and farthing rushlights in some petty chandler shops. We are the friends of railways generally, because we are convinced of their utility and benefit, but we cannot help suspecting the soundness of the heads that can approve measures so unwise as the last Standing Orders of the Commons are.

Sunderland and Durham Railway.—The half-yearly meeting of proprietors was held Oct. 3, Thomas Pemberton, Esq., in the Chair. It appeared that the line will terminate at Shincliffe, near Durham, in which vicinity a new colliery is sinking. The branch to Whitwell Grange colliery was nearly completed. In some parts the line was being widened and a double rail laid down in the place of a single one. The revenue was exceedingly promising. In the passenger department it had risen five-fold in the short space of a few months. The total cost from the commencement to the completion of the undertaking, was estimated at 180,000*l.* To enable the Directors to complete the works, it was resolved, that they be empowered to raise the additional sum of 24,000*l.*—*Tyne Mercury.*

Wonderful Discovery.—A letter from Rouen mentions that, on digging in the Basin, de St. Valero for the foundation of a draw-bridge, a kind of buried forest has been discovered, about 100 feet below the level of the soil. Vines were likewise found, and the bones of wild oxen, together with the horns of stags. Such was the state of preservation in which these subterranean trees were found that in many instances the nuts were still hanging to the bushes.—*Journal des Debats.* [Query, were the boys found picking and eating them too?]

Chester and Birkenhead Railway.—At the first general meeting of the proprietors of this undertaking, held at Liverpool, on the 29th ult., it was unanimously resolved to carry the Act into effect, and Directors were appointed to proceed with the work. The cost of the railway, it was stated, would not exceed 250,000*l.*; this sum includes the procuring of the Act, with the land, roads, bridges, stations, and offices.—*Birmingham Advertiser.*

PRICES OF RAILWAY SHARES.

These finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

NAMES OF RAILWAYS.	No of Shares.	Share.	Paid.	Prices sold at.			Dividend per Cent.
				Highest.	Lowest.	Last Price.	
		£.	£.				
(3) Birmingham and Derby	6,000	...	15	6¼	6	6¼	
(3) Birmingham and Gloucester	9,500	100	12½	4½	4	4½	
(2) Birmingham, Bristol, and Thames Junction	7,500	20	3				
(2) Bristol and Exeter	10,000	100	10	2¾	2¾	2¾	
(2) Cheltenham and Great Western	7,500	100	7½	6¾	1	1	
(3) Commercial, Blackwall	12,000	50	2	1¼	1¼	1¼	
(3) Dublin and Kilkenny	8,000	100	2½				
(2) Eastern Counties	60,000	25	3	¼	¼	¼	
Edinburgh and Dunbar	...	...	2				
Edinburgh and Glasgow (old)	13,000	50	2				
Ditto, ditto (new)	....	...	4				
(3) Edinburgh, Leith, and Newhaven	5,000	20	3				
(3) Great North of England	10,000	100	7				
(2) Great Western	25,000	100	55	65¼	63½	64¼	
(1) Grand Junction	10,919	100	90	180	180	180	
(2) Hull and Selby	8,000	50	5	5	5	5	
(2) Llanelly Railway and Dock Company	2,000	100	35	...	...	...	6
(1) *Liverpool and Manchester*	5,100	100	100	199	197	197	9
Liverpool and Manchester, ½ *shares*	....	...	25	47½	46½	46½	
Do., ¼ *shares*	....	...	20	57	56½	57	
(1) *Leicester and Swannington*	1,500	50	...	...	...	...	8
(3) London and Brighton	36,000	50	5	1¼	1	1¼	
Do. Rennie's	....	...	...	1½	3s 6d	4s.	
(4) Do. and Blackwall	12,000	50	3	9s.	4s 6d	9s.	
(2) Do. and Birmingham	25,000	100	90	146	139	140	
Do. ½ Shares	....	...	5	20¾	19½	19¾	
Do. Bonds, 4 per Cent. 1843							
(2) Do. and Greenwich	20,000	20	20	15½	13½	14	3
(2) Do. and Southampton	20,000	50	45	28½	26	26½	
Do. do. New	16,000	25	3	10½	8¾	10¼	
(2) Do. and Croydon, Trunk	7,000	20	20	17	16	16	
Do. Scrip	7,000	14	2	5½	5	5½	
(3) Do. Grand Junction	12,000	50	5				
(3) Manchester and Birmingham	10,000	50	5	3¼	2½	2¾	
(2) Do. and Leeds	30,000	100	10	10	8½	9	
(2) *Midland Counties*	26,000	100	10				
(3) Northern and Eastern	12,000	100	8	3½	2½	2¾	
(2) North Midland	15,000	100	15	12¾	12	12	
North Union	....	...	100	69	69	69	
Do. New shares	....	...	10	26½	25½	25½	
(2) Preston and Wyre	2,000	50	28				
(2) South-Eastern and Dover	28,000	50	7	3½	3	3	
South Midland	....	50	1				
(1) *St. Helens, Runcorn Gap*	....	...	100	25½	25½	25½	
(1) Stockton and Darlington	1,000	100	100				
(3) Thames Haven	9,000	50	2½				
(3) York and North Midland	6,000	50	3				

*** Those in Roman letters are London prices; the Italics Liverpool. The former are to the 27th ult. inclusive; and the latter to the 24th.

THE

RAILWAY MAGAZINE;

AND

Annals of Science.

No. XXII. DECEMBER, 1837. New Series.

Inflexible Suspension Truss for Bridges and Viaducts.

By Mr. Hacket.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

Sir,—I beg to submit to your notice the result of a few experiments on the construction of a truss, one form of which, adapted for extensive roofing, you were kind enough to insert in the Nineteenth Number of your valuable Magazine. On the present occasion I think the following experiments will prove the possibility of constructing a similar truss for railway bridges and viaducts, where the span is great, and the elevation very limited, as for instance, only about three feet rise in 120 feet span. It will also prove useful to railways passing over marshy or swampy ground, where foundations are generally bad, or difficult to obtain. In these cases a viaduct may be formed by my trusses resting upon brick piers, or piled platform piers of timber, comparatively at a moderate expense.

Trusting that my endeavours may be useful, I have the honour to be, Sir, Yours, &c.,

James Hacket.

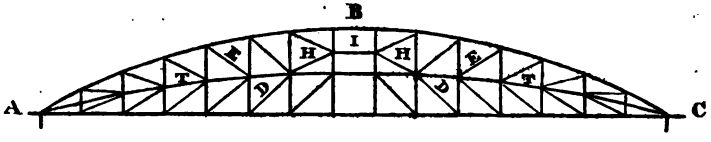
For the purpose of ascertaining the combination of struts, ties, &c., which would give the greatest strength, I commenced a series of experiments on the above truss in various states.

The model I used had its horizontal or tie-beam of pine, 4 feet in length, by a section of $\frac{61}{100}$ horizontal, and $\frac{31}{100}$ of an inch vertical. The curved principal had the same section as the tie-beam, and was part of a circle 4 feet radius, rising in the middle $6\frac{1}{2}$ inches in the clear, and sustained in this position by 14 inferior tie-pieces perpendicular to the horizontal tie-beam, their transverse section was $\frac{61}{100}$ by $\frac{19}{100}$ of an inch. The vertical section of the braces T was $\frac{15}{100}$ by $\frac{31}{100}$ of an inch horizontal, and the struts C and D were nearly of the same

dimensions. The principal A B C was bent to the curve, and secured to the tie-beam A C at the points of contact with it, by a screw at each end. The inferior tie-pieces were united to the principal and tie-beam by tenons, mortices, and keys. The braces T had short tenons on each end to fit the mortices in the inferior tie-pieces. The struts E and D were fitted tight in their positions. This model was supported at each end under the extremity of the curved principal. Previous to the experiments, I strained a silk thread firmly along the base of the model. The vertical inferior ties were marked by this line at the base, in order to obtain the effect by measurement from a scale of 100 parts to an inch. The braces and struts were removed, or added, as the experiment required. A weight of 33lbs. avoirdupois, was suspended alternately upon each inferior tie-piece. The figures on each line denote so many hundred parts of an inch. The symbol — signifies the number of parts the tie-beam became depressed by the load under the horizontal line at the base, and + signifies the number of parts it arose above that line. This mark = indicates that the inferior tie-beam, under which it is placed, is loaded, and the figures with their symbols denote its effect upon the whole line of the base.

In the first experiment the braces T, the struts E and D, with the centre framing were omitted, leaving the model with only the curved principal, tie-beam, and the inferior vertical tie-pieces for the first trial.

Elevation of the Model.



FIRST EXPERIMENT.

$-\overline{17}-29-30-27-17-8$	$+9$	$+17+24+23+21+14+8$
$-21-\overline{42}-49-43-33-16$	$+13$	$+30+39+39+33+26+13$
$-28-49-\overline{65}-64-52-30$	$+10$	$+37+46+50+43+32+17$
$-21-46-68-\overline{78}-69-43$	$+8$	$+42+59+63+55+42+21$
$-16-39-55-71-\overline{76}-59$	-10	$+36+53+62+56+42+21$
$-8-17-31-43-56-\overline{59}$	-29	$+8+29+46+47+37+20$
$+9+11+11+6-10-28$	$-\overline{42}$	$-28-10\times 6+10+11+10$

In this experiment the curved principal A B C shows a tendency to depress under the load, forcing its curvature to the other side of the truss, where it swells, raising the tie-beam above its original level, in the same ratio as the loaded part is depressed beneath the horizontal line. When loaded on the centre exactly, the circumference of the curved principal is forced towards each side, swelling from the central part between to each extremity of the curved principal A B C, and raising the tie-beam A C up proportionably towards each end as depressed in the centre.

SECOND EXPERIMENT.

With the Braces T, Curved Principal, &c.

—	$\bar{6}$	—10	— 8	— 4	— 2	— 0	+ 3	+ 8	+ 7	+ 5	+ 4	+ 3	+ 1
—12	—$\bar{21}$	—21	—17	—11	— 3	+ 4	+12	+14	+13	+12	+ 9	+ 7	
—13	—24	—$\bar{26}$	—25	—23	—11	+ 4	+20	+23	+21	+20	+13	+ 7	
—10	—23	—32	—$\bar{39}$	—32	—17	+ 6	+21	+27	+27	+26	+20	+ 9	
— 9	—16	—26	—37	—$\bar{40}$	—33	— 9	+17	+26	+29	+27	+20	+10	
— 3	— 9	—13	—23	—32	—$\bar{36}$	—21	+ 6	+17	+22	+26	+30	+11	
+ 4	+ 9	+ 8	+ 0	— 8	—20	—$\bar{28}$	—21	— 8	— 2	+ 9	+11	+17	

By adding the braces T to the above, the effect of the loading was reduced to one-third on the first inferior tie-piece, and to two-thirds on the centre of the truss, making the advantage near the extremities double that of the centre, and of course strengthening the intermediate places in proportion to their distance.

THIRD EXPERIMENT.

Framing H I H added.

— $\bar{7}$ — $\bar{17}$ — $\bar{23}$ — $\bar{22}$ — $\bar{17}$ — $\bar{19}$ — $\bar{14}$

The framing H I H in the centre was next introduced, and the load placed in succession at each inferior tie-piece. On the centre it reduced the effect of the loading to one-half that of the preceding experiment; gradually diminishing its effects to each end of the truss. I observed the elevated and depressed curves of the tie-beam to become more gradual and less sudden.

FOURTH EXPERIMENT.

Struts D added.

$\bar{7}-7-7-2+2+3+1+1+2+6+3+2+0$

$9-\bar{14}-13-7+0+4+6+7+7+6+5+4+3$

$9-14-\bar{17}-13-3+6+6+8+8+7+7+4+2$

$3-10-15-\bar{15}-8+1+4+6+8+6+6+4+2$

$2-3-7-8-\bar{10}-6-3+2+3+4+3+3+1$

$0-1-1-3-4-\bar{7}-4+2+1+2+2+1+0$

$0+0+0+1-2-3-\bar{5}-3-2-1+0+0+0$

The struts D were next added to the model, omitting the struts E only. Their utility was apparent in resisting at the opposite side the rise of the tie-beam above the horizontal level, as described in the first experiment. When the loading rested on the centre, these struts D reduced the effect to nearly one-third of the third experiment.

FIFTH EXPERIMENT.

Struts E added.

$\bar{2}$ No apparent alteration on this line.

$2-\bar{6}-3-2-2-0+0+0+1+3+2+1+1$

$1-4-\bar{7}-6-4-3-1+0+2+3+3+2+2$

$0-2-3-\bar{9}-7-7-2-1+2+5+4+3+3$

$3-2-0-8-\bar{12}-11-7-3-0+7+8+7+4$

$6-6-4-2-11-\bar{15}-14-9-2+3+7+7+5$

$+5+8+7+3-4-10-\bar{13}-10-3+4+8+8+6$

The struts D were removed from the model, and the struts E were introduced. The result shows that these struts resist the effect of the loading as it advances on each side of the truss, and they also strengthen it in the parts where the struts D could not; affording the greater advantage at the sides and the least at the centre.

SIXTH EXPERIMENT.

The Truss Complete.

$-\bar{2}-\bar{2}-\bar{3}-\bar{3}-\bar{3}-\bar{3}-\bar{3}$ not affecting this side.

The struts E were replaced, and all the parts of the model were then in their positions as shown in the figure. The load was placed in succession at each inferior tie-piece, and the result shows but a very slight depression at each place under the load.

It will be observed, that the inferior tie-beams in this model are vertical, and not radiating as in the roofing truss. In the latter truss the loading rests upon the curved principal: but the present truss has to sustain alternate loads upon various parts of its tie-beam. The pressure on this beam being perpendicular, the vertical ties and screw bolts support it more directly than the radiating pieces could do—the latter having a different function to perform in the roofing truss. The scantling of the principal timbers are not half the strength required by proportion for such a model. The curved principal also has a disadvantage in point of stiffness, by being bent to the curve, and will consequently give more readily under a load, than if it was a made beam, such as described for the roofing truss. There is an advantage gained by its pliability under a load on any spot, as it proves beyond a doubt the efficacy of the struts, and the other modification introduced to make it inflexible. The experimental load used on a spot at each time is more than nine times the weight of the largest proportional load. In the transit of a train over a bridge of this kind, it is certain the load on one part tends to counterbalance the weight of the loading upon the other parts of the truss. Therefore an immense load on any particular spot is the most severe test to prove the inflexibility of a truss. I have to remark that the model, during these experiments, rested upon the parts, under the termination of the curved principal; but in reality the place of bearing would extend to under the first vertical tie-piece at each end, which of course would add considerably to the power of the truss. The braces T form a central line through the truss, to which all the unequal effects of loading are transferred by the struts C and D, the one counterbalancing the effect of the other. It also serves to strengthen the truss, as the second experiment shows. The struts E, from their position, check the first displacement of the curved principal; and I have to remark here, that as the load was advanced from the springing to the centre, these struts were quite tight under the loaded side of the truss; but at the opposite side they became loose; and when the model was loaded at the centre, the struts C were of no

particular use to support that part. The struts D were introduced, in the first instance, to prevent the tie-beam from rising by the swell of the principal above the horizontal line, and to act in concert with the struts E, to preserve the curved principal from being depressed by the load on the tie-beam. The struts D also support the central part of the truss. I have remarked, that when the centre was loaded, all these struts D were quite firm; and whilst the load was on either side of the truss, the struts D at the opposite side were tight, and those at the loaded side were quite loose: but when all the struts were placed in the model, they were all equally tight under a load on any part of the truss. It must appear by the introduction of these struts, combined with the arrangement of the braces and tie-pieces, evident that they render it equally strong to support loading on any part. All the parts, indeed, contained in this truss act in unison to strengthen each other's position, performing their several distinct functions so effectually, that the omission or removal of any part would render the truss incomplete, demonstrating, of course, that there is nothing superfluous used in its construction, but that all the parts combined together are needful to render the whole completely adequate for the purpose intended.

In reference to the description given of my roofing truss, I have mentioned that my experiments were not then ready for publication. I have now partially completed them, and the result proves that the figure of that truss is the best form to support equal loading, when laid upon the circular principal, as in roofs; and that on the removal of an unequal load from any particular spot, it resumed its former figure much more readily and completely than if the inferior tie-pieces were vertical. I tried an experiment upon two models, of the same dimensions as the truss, described for my inflexible suspension-bridge, the inferior tie-beams of one being vertical, those of the other radiating as in the roofing truss. The load was thirty-three pounds laid upon the parts of the curved principal over each tie-piece in succession. The effect produced on the models was as follows, depressing the tie-beams under the horizontal line, so many hundred parts of an inch as are figured. The truss was formed of its tie-beam, curved principal, and radiating tie-pieces only.

1st	2d	3d	4th	5th	6th	Centre
17	42	56	59	54	40	32

The other model with only its tie-beam, curved principal, and vertical inferior tie-pieces.

1st	2d	3d	4th	5th	6th	and centre
17	43	65	78	76	59	42

The result proves the radiating ties to possess considerable advantage over the vertical ties in point of strength, where the loading rests upon the curved principal as in roofs. The braces T and the central framing were added to the model of the roofing truss, and it supported considerable loads, unequally placed on it, without deranging its figure. It also retained its form perfectly, under enormous equal loading. J. H.

Observations on the late Discussion relative to the Atlantic Steam Navigation, and Duty of Coal. By the EDITOR.

IN No. 20 we gave the substance of an interesting discussion that took place at the meeting of the British Scientific Association at Liverpool, relative to that most important subject, the practicability of navigating by steam the Atlantic. The principal disputants were Dr. Lardner and Mr. Guppy, an enterprising merchant of Bristol, who holds a share in some of the steam-ships intended to cross the Atlantic.

As there has been very considerable misrepresentation in some of the periodicals of what was said, especially by Dr. Lardner, we have applied to him for the particulars, and the following is the substance of the correspondence:—

"That in this particular inquiry he has based no reasoning or calculation on the performance of any Government steamer, save the *Medea;* that he still believes her to be as efficient a vessel, considering *both fuel and rate,* as any that float; which was confirmed by Mr. Laing, the builder of her, who, when asked in the section G whether he could *now* build a better, said he could not;* that the Dundee and Perth, *fuel and rate both considered,* are not superior to her; that all other vessels, of which he has seen performances accurately reported, are inferior; that he does not admit the logs of the Atalanta and Berenice, afford data

* We well recollect this. We have since spoken with a gentleman who commanded two steamers, and knows the Medea well; he is of the same opinion.—ED.

sufficient to determine their actual performance; that in this matter he has nothing to do with river steamers, they having no bearing on the question; that he has never seen or known any one who has seen the logs of a SEA-GOING *American Steamer* worked with coals, and not wood, so kept as to indicate her actual performance, as the logs of the Medea do hers."

In some prints it has been stated that Dr. Lardner denied the *possibility* of fifteen knots an hour on any occasion in any steamer. This must be a mistake. We understood he denied that any *sea-going steamer*, in the present state of steam navigation, had attained, or could attain an *average speed*, taking all weathers, of fifteen knots an hour. We believe he admits that the Dundee and Perth have averaged a speed of ten knots, but that the increased expense of fuel has been in a greater ratio than the increased speed, as compared with the Medea.

Now, when we consider the immense labour and pains that Dr. Lardner has bestowed on this subject, together with the ample means of *information* that he has had at his disposal, one cannot imagine that a man of his great scientific skill and ability, would over and over iterate his confidence in the efficiency of the Medea on light and frivolous grounds. Besides, what has Mr. Laing, her builder said, "that after so much additional experience, he could not build a better?" Yet we have facts brought before us (see our number 20, p. 266), by gentlemen of high respectability, of performances full 50, and in one case near 100, per cent. greater. Dr. Lardner, however, declares that the logs of these vessels, the Atalanta and Berenice, "do not afford data sufficient to determine their actual performance," as steamers. If our memory, too, be correct, we have heard that these logs had been offered to him, and were rejected because of their incompleteness.

These, it must be owned, are material points, which can only be settled by answers to the following questions:— Was any register kept of the actual pressure of the steam, that is, of the steam-guages and barometers, in the Atalanta and Berenice? Was it over or under, on an average, that at which the powers of the engines are estimated? It is obvious that if it was under, and the vessels were rather of the character of sailers than steamers, they could not be fairly compared with one whose chief character was that of a steamer, or with what might be expected of one in an ordinary average steam voyage.

Neither can it be quite fair to compare a single voyage—made, perhaps, under favourable circumstances—with an average performance in all weathers. Take, for example, the case of an homeward voyage, which, owing to the aid of the westerly winds, Dr. Lardner said, averages about 19¼ days; would it be right to compare the performance in this voyage with that in the average outward voyage, which, combating the same winds, occupies 35¼ days, or even with the average of the two, 27½ days?

Another question then arises, Were the voyages of the Atalanta and Berenice such average voyages as might be expected to arise from the mean of all weathers, or picked and favourable voyages? If they were the latter, any inference drawn from a comparison would not be just.

Again, with respect to river and sea-going steamers, no man, after the testimony given at Liverpool, can doubt that American river-steamers may average 15 or 16 miles, or 13 or 14 knots an hour; but how is it done—at an extravagant expense of fuel, and under circumstances which admit of no comparison with the case before us? The American steamers are fitted up for voyages of 100, 150, 200, &c., miles only, and are filled with machinery. If they have space for fuel a little more than sufficient for the voyage, that is all they require. But would this do for vessels which have to contend with the difficulties of the ocean for 3,000 or 4,000 miles? In short voyages the proportion of power in the engines is often that of one horse to two tons of "measured capacity;" but in long voyages it seems the proportion is sometimes reduced as low as that of one horse to four tons. Supposing now, the speeds of the two vessels to be equal, which is obviously impossible—for the swifter must always be that with the higher power—then a vessel to go a voyage of 3,000 miles must evidently require space for $\frac{3000}{150} \times \frac{2}{4} = 10$ times the quantity of coal, that one fitted for a voyage of only 150 miles would, all circumstances of wind and weather being the same. Can such a space be devoted for fuel, is then the question? Dr. Lardner maintained the contrary.

We have ventured to put the above questions for the purpose of eliciting the whole of the circumstances, which, if known, we think would reconcile the now apparently hostile statements. In the mean while we beg to throw out a few observations relative to the duty of coals, which appear to us wonderfully to reduce the mound of discord.

In a very able article in number 131, p. 131, of the "Edinburgh Review," on "Atlantic Steam Navigation," "the *locomotive* duty of the fuel," is called "the distance over which *a ton of coals per-horse power* is capable of propelling a vessel." Now, with regard to the same vessel, or to different vessels, whose respective proportions of horse-power to tonnage (the total weights of the vessels' rigging, &c., being also as their tonnage) are the same, this would probably be the case; but it appears to me, where the ratios of horse-power to tonnage are not the same, this rule would not lead to correct results. For example, if one vessel of 800 tons had engines of 200 horse-power, and another of the same tonnage had engines of 400 horse-power, it is quite evident that the hourly consumption of coal per horse-power might be less and the rate greater in the latter than in the former vessel, and yet the effective duty of a given weight of coals—that is, the distance over which it would carry the vessel—might be precisely the same. Thus the Medea is 807 tons burden, and 220 horse-power (Ed. Rev. p. 132), while the Atalanta is 630 tons, and 210 horse-power (Rail. Mag. No. 20, p. 265), and the Berenice 680 tons, and 230 horse power, and, as one might expect, the rates of the two latter are greater, and their hourly expenditure of coals per horse-power less than in the Medea.

We, therefore, beg to submit to Dr. Lardner, and the other gentlemen, whether it would not be better to define the locomotive duty of the fuel, "that distance over which a unit of coals would propel the same, or any given multiple of (say five or ten times) the same unit of tonnage.

This tonnage must evidently be the gross weight of ship, cargo, and all, estimated, as Dr. Lardner hereafter observes, by the actual quantity of water displaced. But if the weight of the vessel's rigging, &c., be proportional to the measured capacities for tonnage, the latter may be used for the gross masses in comparisons of duty, without sensible errors, as we have done.

There may be other considerations to be taken into account to make it mathematically exact; but still it may not be a bad approximation. On this principle we should have the following simple rule for finding the duty of a unit of coals.

As the total coals consumed is to the tonnage of the vessel, so is the total miles run to the miles which unity of coals will propel unity of weight.

Calculating in this way, for the Atalanta, from the data, p. 266, of R. B. G., we shall have 548·07 total coals consumed, to 630 tonnage, as 6,935 total miles run, is to 7,972 duty. And in the Berenice, 570·6 coals, is to 680 tonnage, as 4,796 miles to 8,800 duty; or, if we reject the last voyage as being differently worked, that is, partly expansively, it will be as 213·45 coals is to 680 tonnage, so is 2,524 miles to 8,041 duty, nearly the same as the Atalanta.

In the Medea we have neither the total miles nor the coals consumed, but we have the hourly consumption per horse-power, the number of horse-power, the tonnage, and the miles run per hour. From these data we can easily get at the same thing, though probably not quite so accurately, as the numbers may not be given sufficiently near. Thus as 88 × 220 coals, in lbs. consumed in an hour, is to 807 × 2240 tonnage in lbs., so is 7·9 miles to 7,821 duty.

This duty is about two per cent. instead of fifty, different from the Atalanta, and little more from the Berenice.

We offer the above solution of the difficulty with some diffidence to the gentlemen concerned, but if allowed to be true, it at once reconciles the difference between Mr. Guppy and Dr. Lardner's cases. It may also raise, in Mr. Rotch's estimation—which would be no little consolation to the captain and crew of the Medea, and may even make her engines work all the better—this fine frigate from "an old tub" to a good and efficient steamer.

After writing the above, we sent it, very nearly as it stands, to Dr. Lardner, to ask whether the substance of what passed, and of a former correspondence with him thereon, was a fair representation, and received from him the following reply, which, as containing matters of importance to the great question before us, and with which we could not be acquainted, we lay before our readers.

In a matter of such serious importance it would be wrong in us to hazard a premature opinion. We have briefly stated the leading points of discussion to draw attention to them: at the same time we feel it right to add, that we have spoken with several practical and experienced men since, who, one and all, feel a perfect confidence in the practicability of navigating the Atlantic by steam, under all circumstances. Shortly, however, we shall have it put to the test, and most happy shall we be if the experiment prove successful.

DR. LARDNER TO THE EDITOR.

My dear Sir,—I think the statement you have drawn out appears to be very fair. You have rightly stated, that in consequence of no record being kept of the state of the steam guages and barometers, there is no evidence that the engines were working at full power, and if they were not, the apparent duty of the fuel might be magnified to any extent, according to the discretion of the engineer. If the steam, for example, were wire-drawn by partially keeping the throttle-valve closed, each stroke of the engine might not consume half the proper quantity of steam, and the engine would be working at proportionably less power; or if the valves were arranged as they might have been in these vessels, so as to cut off the steam at half stroke or less, even though the throttle-valve should be fully opened, the engines would still be working under their power, and would have the further advantage of working expansively.

I know that the engines of the Berenice had valves capable of being adapted for expansive action, and that in fact the steam might be cut off at any required part of the stroke, and I believe that the engines of the Atalanta were constructed in the same way.

It is admitted in the log of the Berenice, that in one at least of her long runs the steam was thus cut off. This run must of course be rejected, as affording no comparison with the Government vessels, which were worked at full power, nor indeed any safe or certain grounds whatever for reasoning. It ought to be remembered, that in all cases like those now considered, where sails co-operate with steam, the share which each of those propelling powers have in moving the vessel must be strictly attended to. If under such circumstances the engines be worked considerably or at all under their power, either by wire-drawing the steam or working it expansively, the share which the steam has in propelling the vessel will be proportionally diminished; and through whatever distance she may be carried, a greater proportion of that will be due to the wind, and a less to the steam. If the locomotive duty of the fuel be calculated in such cases, by merely estimating the actual quantity consumed in a given distance, or the distance through which the vessel is moved during the consumption of a given weight of coals, it would be evident that a most fallacious inference would be made, and in proportion as the engines would be worked

below their power, in the same proportion would the apparent locomotive duty of the fuel be increased.

In the performances of the Government vessels, on which I have based my calculations, the engines have always been working at their full power, and when the weather permitted, sails co-operated with steam. You will see, therefore, that to justify any comparison of the performance of these with other vessels, it is most essential that it should be distinctly shown that the other vessels were working in the same manner with the full power of the machinery.

But I further object to a comparison of the performances of the Atalanta and Berenice with those of the Government steamers, reported by me, on other grounds. The distances from which I deduced their locomotive duty were *direct distances* from port to port, without allowing for the casual departures of the vessels from the true course. The distances, on the other hand, from which the reported duty of the Atalanta and Berenice are deduced, are those *given by their logs*, and must be considered as including every variation of their course. Such distances, if the log were correctly kept, must evidently be greater than the direct distances from port to port, and therefore would give a greater locomotive duty.

I further object altogether to a *single voyage* of the Atalanta and Berenice being taken as representing a true average of all vicissitudes of weather. On the contrary, I am informed that these particular voyages from Teneriffe to the Cape, were unusually favourable, and such as ought to give an average result greatly above that which would be obtained if all vicissitudes of weather were encountered.

I further maintain that there is internal evidence that the logs of these packets were not accurately kept. As a proof of this, I will refer to the discrepancies in the distances given by the logs. The distance between Falmouth and Teneriffe, given hy the Atalanta, is 1,487 miles, by the Berenice 1,572 miles, giving a difference of 85 miles.

It may be concluded that such discrepancies arose from the casual departures of the vessels from their direct courses. I believe, however, that for steamers working under such favourable circumstances as these, this would be considered rather a large allowance for such an effect; but what will be said to the log of the Atalanta, which gives us the distance run by the vessel between Teneriffe and Mayo 895 miles, while the length of an arch of a great circle of the earth joining these places is 905 miles! Has the

magic power of steam actually arrived at that point, that it can really shorten the shortest distance between two places on the earth's surface? I leave it to others to consider how far we would be justified in founding upon such data inferences affecting the interests of commerce and navigation.

After all, these questions will speedily be set at rest. I have commenced those inquiries suggested by me at the British Association, and for which I succeeded in getting a committee appointed, and a grant made. I shall take care that if the performances of steam-vessels belonging to private companies shall not be satisfactorily and accurately reported in juxta-position with those of Government vessels, the fault shall not rest with the committee.

I remain, dear Sir, yours very truly,

DION. LARDNER.

P. S.—From the suggestion in the latter part of your remarks, I am inclined to think that the real question which I had to discuss at Bristol, and in the "Edinburgh Review," has escaped your notice. The question was not which was the most efficient vessel, all things considered, but what vessel would go farthest, with the least consumption of fuel, without any regard to tonnage. It was maintained, with some truth and fairness, that if a regular intercourse could be maintained with New York, by steamers, the question of the value of tonnage would be of comparatively little importance. I will explain my meaning thus: Let the true tonnage of a vessel be T, that is, let T be the actual gross weight which the propelling power has to transport; let D be the distance between the places of intercommunication; and let C be the quantity of fuel consumed in making the passage. There can be no doubt that the efficiency of the vessel would be expressed by $\frac{T \times D}{C}$; but it might happen that the mechanical and nautical conditions, which would render this a maximum, could not be fulfilled in a voyage of 3,000 miles, under the peculiar circumstances of the outward voyage. If such were the case, the vessel whose efficiency would be greatest could not be used. The question which I had to investigate was, under what circumstances would $\frac{D}{C}$ be a maximum—no matter what might be the value for T; and you will see that when the ratio of the power to the tonnage is the same,

$\frac{D}{C}$ becomes identical with my definition of locomotive duty.

I agree with you, however, that it will be convenient and advantageous to investigate the actual efficiency of vessels in regard to the tonnage, distance, and fuel; and, for that purpose, the formula $\frac{T \times D}{C}$ may be adopted; but take care not to ascribe to T the tonnage by builders' measurement, as this would be a great error; let T signify the tonnage by displacement, or the weight of the water displaced by the vessel.

D. L.

On the application of the Hot Blast in the manufacture of Iron. By BETA.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—The discussions which took place at the recent meeting of the British Scientific Association at Liverpool, on the subject of smelting iron by means of the hot blast, seem fairly to have brought the subject before the public as a scientific question. The iron trade of this country is a matter of such great national importance, that the philosophical investigation of this question is as legitimate an object of inquiry as any which the Association could select; and I am happy to find they have decided that further investigations shall be undertaken. On that portion of the labours of their members which is before the public, I would, however, beg leave to offer a few remarks.

And first, for the information of the uninitiated in this matter, let me briefly state what is meant by "hot blast." In the furnaces employed in the smelting of iron, the combustion of the fuel is maintained by forcing into the furnace an immense quantity of atmospheric air, by means of blowing machines. On the old plan this air passes into the furnaces at a low temperature; that is to say, at the ordinary temperature of the air. The principle of the hot blast, invented by Mr. Neilson, consists in making the air pass through a heated chamber, usually a tortuous iron pipe, which raises the temperature of the air to about 600° Fahrenheit before it enters the furnace. This is the whole of the invention; but the effect which is produced is undoubtedly important. It is well known that air will not support

combustion until it attains the temperature of about 1000° of Fahrenheit; but it might be supposed that but little difference could arise in the quantity of fuel consumed in heating the air, whether this were done in the furnace or out of it. But it appears to be placed beyond a doubt, that a great saving occurs by heating it before it enters the furnace, although with different qualities of coal considerable differences occur in this respect. The prodigious quantity of air which is forced into the furnace, might indeed lead us to suppose that a very slight alteration of the heat of the air would make a considerable difference in the time required for smelting the iron. It has been estimated that each ton of pig iron which is run from the furnace, has had about *fifteen tons weight of air* expended in its formation; and therefore we need not be surprised, that when this quantity of air is highly heated before it enters the furnace, a considerably less period of time would be required for the smelting of the ore. This may in some degree account for the reduced quantity of fuel consumed; but it will not wholly do so, for the time is not reduced as much as the consumption of coal. The saving in fuel is stated to be from one-third to two-thirds of the former quantity employed, according to circumstances; while the time is reduced from one-fourth to one-half of that required by the cold blast.

But the great question to be decided respecting the hot blast, is, how it affects the quality of the iron. For this purpose let us examine Dr. Thomson's analyses of the hot and the cold blast iron, which he exhibited at the late Liverpool meeting. The average of five different specimens of hot blast iron, and six specimens of cold blast, were compared; from which the conclusion is drawn that the hot blast iron is much the purer of the two. But these averages do not by any means appear to be satisfactory. To be accurate, I imagine, they ought to be specimens of the same ore, the same flux, and the same coal, worked by the two different methods. But this is not the method adopted by Dr. Thomson in taking the averages. For the cold blast average he has analysed three specimens of Muirkirk iron, one of Carron, one of Clyde, and one of iron pyrites; and for the hot blast average he has taken three samples of Clyde, and two of Carron iron. As every iron differs in its composition, the effect of these comparisons is to render abortive any conclusion as to the purity of the iron; and it is therefore not at all surprising that Dr. Thomson should have elicited the remark from some of the iron-masters who were

present, That notwithstanding his analysis showed the hot blast iron to be the purer of the two, they always found more waste in refining the hot blast iron, than that which is made by the cold blast.

The fact is, that iron smelted by the hot blast is always more highly carbonized than that by the cold blast; hence arises, in part, the waste on refining. Dr. Thomson's analysis does not show this to be the case, and I cannot but think there is some error in his experiment, for the state of carbonization is a matter about which it is impossible for a practised eye to be deceived. The reason of the hot blast iron being more brittle than the other, still remains, however, to be accounted for, and at present it appears to be hid in mystery. In the absence of all information on the subject, if a theoretical conjecture might be hazarded, I should say that it probably arises from the extraneous oxides which exist in the ore or the coal, or which are added as a flux in the furnace—namely, the lime, alumina, and silica. These may probably be reduced to their pure metallic state, by the greater intensity of heat by the hot blast, and therefore the base of these oxides, namely, calcium, aluminum, and silicium, or some of them, may become mixed with the iron, and in some manner alter its quality. If these substances really exist, *in their metallic state*, in the iron, they must be in extremely minute quantities; but it is no new thing in the chemical composition of iron, to find these minute differences make a great alteration in the quality of the iron. Perhaps the greatest differences which can exist between two kinds of iron are those known as the cold short and the red short qualities. This great variation of quality arises from an extremely small quantity of phosphorus in the former of these kinds of iron, which does not exist in the latter; but from whence it is derived, and in what state it exists, is completely unknown.

As such minute variations in the constituents of iron, cause such great differences in its quality, it is essentially necessary, if the theory of the hot blast is to be explained by chemical analysis, that the inquiry be conducted in the most accurate manner. The comparison of different irons will, I apprehend, prove nothing; for scarcely any two mines yield exactly the same quality of iron or of coal, a fact which is known to every mineralogist in the kingdom. And the best practical proof that this is the case, is, that the manufacturers of the most approved qualities of iron in the country, annually purchase large quantities of minerals from other

mine owners, in order to improve the quality of their manufacture by mixture with other minerals, not better perhaps in quality, but possessing different properties from their own.

The elucidation of this subject requires all the refinements of modern science; but it is not, I apprehend, beyond the reach of our present knowledge if properly applied.

Yours obediently,

November 18, 1837. BETA.

On the Comparative Power of Locomotive Engines.

By S. JONES, ESQ.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—The application of steam to the translation of marine vessels and locomotive carriages, has given a powerful impetus to the minds of those who are directly concerned either as manufacturers or as proprietors of the steam-engine, as well as to that of the scientific engineer. But in the construction of high-pressure engines for the traction of locomotive carriages, it has been found that the great velocity of the piston in the cylinder, requisite to generate the desired speed of the train on railways, is detrimental in the derangement and wear of the machinery. To obviate these, some few engineers have of late increased the diameters of the cylinder and crank wheels, and consequently have diminished the velocity of the piston; but this change should evidently be such as not to weaken the power of the engine. And, as I am not aware that any author has investigated the theory for the requisite change so as to preserve the same power (at least none has come under my inspection as Teacher of the Mathematical Department of Engineering), I have thought the subject worthy of attention. And as your valuable publication is extensively circulated, not only among those directly concerned in the railway department, but also, in this town at least, among those young engineers engaged in the offices of the different foundries, it occurred to me that by laying the result of my deductions before you, my time would not have been altogether uselessly employed. I shall only add, that my chief aim has been simplicity and perspicuity; thus—

Let D = the diameter of the cylinder
L = the length of the stroke
V = the velocity of the piston
R = the radius of the wheel of the engine A.

Also d = the diameter of the cylinder
l = the length of the stroke
v = the velocity of the piston
r = the radius of the wheel of the engine B.

Now the expansive force of the steam is proportional to its density, and the density being reciprocally as the space occupied, it follows, that the pressure on the surface of the boiler, and consequently, when there is a superabundance of steam and a free communication between the boiler and cylinder, the pressure on the piston will be nearly as the density of the steam in the boiler. Let us suppose this density to be the same in both of the engines, and to produce a pressure of n pounds per square inch, then—

$\cdot 7854\ D^2 n$ = the moving force on *A's* piston;
and $\cdot 7854\ d^2 n$ = the moving force on *B's* piston;

also, since the length of the crank in each engine is equal to half the length of the stroke, we have, when there is an equilibrium on the axle of each engine,

$\cdot 7854\ D^2 n L$ is proportional to $2R \times$ power of *A*;
also,
$\cdot 7854\ d^2 n l$ is proportional to $2r \times$ power of *B*;
therefore,

the power of *A* : the power of *B* :: $\frac{\cdot 7854\ D^2 n L}{2R}$: $\frac{\cdot 7854\ d^2 n l}{2r}$ :: $\frac{D^2 L}{R}$: $\frac{d^2 l}{r}$.

This proportion gives the relative powers of the engines when they move with the same speed, as may be shown; thus—

As V : 1″ :: L : $\frac{L}{V}$ seconds = the time of one stroke of the engine *A*, in which time the engine itself would have moved over a space on the rails equal to $3{\cdot}1416 \times R$; therefore, as the spaces described are as the times of describing them, we have—

As $\frac{L}{V}$: $3{\cdot}1416 \times R$ :: 1 hour : $3{\cdot}1416 \times \frac{V R}{L}$ = the speed with which *A* travels per hour.

Similarly,

$3{\cdot}1416 \times \frac{v r}{l}$ = the speed with which *B* travels per

hour. Therefore, when the engines travel with the same speed, we have—

$$\frac{VR}{L} = \frac{vr}{l}; \quad . \quad . \quad . \quad (1)$$

Hence, multiplying the power of each engine by its equal speed, we have—

The power of A : the power of B :: $\frac{D^2L}{R} \times \frac{VR}{L}$: $\frac{d^2l}{r} \times \frac{vr}{l}$ :: $D^2V : d^2v$; therefore, substituting the load for the power, we have—

$$\frac{A\text{'s load}}{D^2} : \frac{B\text{'s load}}{d^2} :: V : v;$$

but from *equa.* (1)

$$V : v :: \frac{r}{l} : \frac{R}{L};$$

consequently,

$$\frac{A\text{'s load}}{D^2} : \frac{B\text{'s load}}{d^2} :: \frac{r}{l} : \frac{R}{L};$$

multiplying the extremes and means. A's load $\times \frac{R}{D^2L}$ $= B$'s load $\times \frac{r}{d^2l}$; changing this equation into a proportion,

A's load : B's load :: $\frac{D^2L}{R}$: $\frac{d^2l}{r}$, the same as before.

Corollory 1.—The power of an engine, or the load it will draw, is proportionate to the capacity of the cylinder traversed by the piston, divided by the radius of the crank wheel.

Cor. 2.—The power of an engine is proportional to the area of the piston multiplied by the velocity it traverses the cylinder, if the radius of the crank wheel be invariable.

Cor. 3.—The power of an engine is unchanged, by increasing or diminishing the length of the stroke and radius of the crank wheel in the same proportion.

Cor. 4.—The power of an engine is unchanged by increasing or diminishing the area of the piston and the radius of the crank wheel proportionally.

Cor. 5.—By increasing the diameter of the cylinder and that of the crank wheel proportionally, the velocity of the piston is diminished, while the power of the engine remains unchanged.

For the capacity of the cylinder being increased, the time of filling it is increased in the same proportion, and the length of the stroke being the same, the velocity of the piston is diminished.

Scholium.—It must be remarked that this proportion and the corollaries deduced from it, hold good only when there is an equal pressure per square inch on the surface of the boiler and that of the cylinder, and there are two causes which may prevent this equal pressure. First, when the apertures between the boiler and cylinder are too confined, which is technically termed "throttling the steam;" and second, when the velocity of the piston is very great as compared to the generation of the steam; for in a high-pressure engine, if the velocity of the piston were equal to that of steam rushing into the atmosphere, it is evident the piston would escape from the steam so as to experience no pressure whatever.

Example.—If a locomotive engine, whose cylinder is 12 inches diameter, length of the stroke 16 inches, and diameter of its crank wheel 5 feet, travel with a load 25 miles an hour, what must be the diameter of another engine's wheel, and at what rate would its piston travel, to draw the same load with the same speed and making the same length of stroke with the same pressure of steam, but whose cylinder is 14 inches diameter?

Here, as $\overline{12}^2 : 60 :: \overline{14}^2\ 81\frac{2}{3}$ inches = diameter of the wheel; also $V : v :: \frac{r}{l} : \frac{R}{L}$; that is, because the length of the stroke is the same in both, or $L = l$; $V : v :: 60 : 81\frac{2}{3} :: 180 : 245 :: 36 : 49$, or as 4 : 3 nearly; that is, the velocity of the piston is diminished, that of the former engine making 16806 strokes in an hour, while the piston of the latter would make only 12347 strokes in the same time.

I am, Sir, yours, &c.

S. Jones.

Great Nelson-street North, Liverpool,
November 4, 1837.

Magnificent Bridge across the Wear. From A Friend.

Of the several great works now in progress calculated to increase and perpetuate the prosperity of this port, none, in a prospective point of view, has greater claims to attention than the Durham Junction Railway, and of which but little is publicly known.

As regards one of the principal objects of the railway, a bolder and more important design could scarcely have been conceived. It branches off from the Stanhope and Tyne Railway, at a place about eight miles from South Shields, and proceeding through the heart of the country, communicates with the valuable South Durham coal-field, so that, when the Durham Junction Railway is in operation, the best coals in that district can be brought for shipment to the Tyne. To effect this it was necessary that a bridge should be erected over the river Wear, and, as this is one of the most surprising works of art ever constructed, I send you the following particulars of its architectural design and dimensions, obtained on inspection of the plans and sections, and from a recent visit to the spot.

The erection of the Durham Junction bridge was commenced about twelve months ago, and is from designs by T. Elliot Harrison, Esq., the Stanhope and Tyne, and Durham Junction Railway Company's engineer, who, so much to his credit, brought the works of this spirited proprietary to a satisfactory conclusion. The building of the bridge has been contracted for by Messrs. John Gibbs and Son, of Aberdeen, the gentlemen who constructed the bridge at Glasgow, and several other similar erections. The general style of the design is at once simple and grand, being elegant and imposing in appearance, without superfluous ornament. In this respect it harmonizes admirably with the surrounding scenery, and will present a magnificent object in the landscape. The bridge has four principal arches besides three smaller ones on each side, inserted in the approaches of wing walls to lighten the masonry, and add unity to the design.

Of the four main arches, three are thrown over the valley, to obtain the requisite locomotive railway level; viz., one on the south side and two on the north side, the river Wear being entirely spanned by one splendid arch. The dimensions of the arches are as follows:—

1. Over the valley on the south side, 100 feet span.
2. Over the river Wear, 180 feet span.
3. Over the valley on the north side, 144 feet span.
4. Over the valley on the north side, 100 feet span.

The length of the entire bridge is 810 feet, 9 inches, and its width between the parapet walls 21 feet. Over the bridge a double line of railroad will be laid, there being on each side a flagged footway.

But the extraordinary height of the bridge forms its most attractive feature. From the foundation of the main pier to the spring of the large arch, is 72 feet; from the spring to the crown of the arch, is 72 feet; and from the crown of the arch to the parapet wall, is 13 feet; making in all 157 feet. From this, to obtain the height for the ordinary water level, we must deduct that portion of solid masonry buried beneath the waves, which makes the observable walling 130 feet; this being (I speak from memory) about 20 feet higher than the justly-celebrated bridge of Sunderland.

In the construction of this gigantic erection, no expense is spared. The stone, which is a hard, durable, well-coloured free-stone, is obtained from Pensher quarry, situated about a mile south of the place, the property of the Marquis of Londonderry, and the outer quoins of the large arches will be composed of granite. The foundations both for the abutments and piers, are based upon solid rock, to obtain which advantage it was necessary, in some instances, to excavate to the depth of 40 feet.

The bridge is formed with turrets above the piers, which will add greatly to its strength transversely; the parapet walls will be very substantial, and care has been taken by Mr. Harrison, the able engineer, to make the erection not only safe, but durable.

Notwithstanding that Mr. Gibb, the contractor, has had about 200 men at work for the last 12 months, the bridge is far from being completed. All the pillars are, however, ready for the arches, and some of the arches are in progress, particularly the one over the valley on the south. At present the first impression of a stranger visiting the works, must be one of astonishment, on account of the unusual height and massive description of the requisite framework. The stone blocks, and other materials are raised to their destined positions by means of a steam-engine, and the other machinery for carrying on the work is of the best description.

The scenery around the bridge is of a bold rocky character,

the steep banks being well wooded. On the north side the scenery is more tame, consisting principally of arable or grass land. The bridge by the river line will be about six miles from Sunderland, eight miles from South Shields, and eight miles from the city of Durham. The land on the south side is the property of the Earl of Durham, and on the north side of John Boulcot, Esq. The Junction bridge will not only, as already observed, present a fine object in the landscape, but, being in so elevated a situation, will command many interesting views, amongst others of Lambton Castle, which is only at a short distance.

Having thus briefly noticed this splendid work of art, which will be a lasting memorial of the skill and public spirit of those gentlemen under whose auspices it is in course of erection, it occurs to me that I may, before taking leave of the subject, not improperly throw out a hint to the spirited Directors of another great public undertaking.

It is a matter of notoriety that the arrangements for some time contemplated between the Directors of the Great North of England Railway, and the Newcastle and Carlisle Railway, to cross the Tyne by the same bridge, *west of Newcastle*, are now broken off, the nature of the country rendering it impossible to obtain the requisite levels for a locomotive line by both companies. It, therefore, follows that if the Great North of England Directors adhere to their Parliamentary line, they must, at a great expense, erect bridges over the Wear and the Tyne, expressly for the transit of their own locomotives, carriages, and trains. Now the nature of the country around Schincliffe, near Durham, presents physical obstacles which can only be surmounted by embanking to an extent almost unprecedented in the history of railroad formations,* and which will require a more than ordinary outlay of capital; and the same remark applies to the neighbourhood of Gateshead.

It therefore occurs to me (and I throw out the suggestion with respectful deference to those who are better acquainted with the more minute details than I can pretend to be) that some plan might be devised by which the Great North of England Railway should cross the Wear over the Junction bridge, (of which I have given a brief description,) and

* On the section we have of the Great North of England Railway, we have not observed these difficulties; our attention, however, has been more particularly called to the other, or southern part of the line, from Hurworth to York, which is distinguished for the apparent absence of difficulties.—Ed.

across the Tyne, at some eligible position, *east of Newcastle*, say about Bill Quay. True it is that such a plan would, if adopted—as all those at all familiar with the country must at once see—make the Great North of England line much longer, but to what extent I do not exactly know. It would also render necessary a short branch from the bridge at Bill Quay (or whatever point on the Tyne might be fixed upon) to Newcastle. Still, looking at the amazing expense that would be thus saved; considering, also, that in a locomotive line, a short additional distance is not of very serious consequence, it does appear that what I have now suggested is worthy of serious consideration by the parties interested.

Sheffield and Manchester Railway.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—My attention has recently been directed to the opposition made to the Sheffield and Manchester Railway. I think the individuals alluded to are mistaken in their calculations. It appears to me, that at the present infantine stage of railway existence, the safest method of reasoning with respect to the profits is by analogy. We will therefore suppose, for the sake of argument, that the cost of formation of the Liverpool and Manchester line, and the Sheffield and Manchester, are the same, in proportion to their length, say for the former 700,000*l.*, and for the latter one million. Now it is evident, from the returns, that if the Liverpool and Manchester Railway carried the whole of the passengers, merchandize, and coal which pass between the two termini, as the Sheffield and Manchester must do, the annual receipts at the present time would be as follows; that is to say, passengers 140,000*l.*, merchandize and coal 90,000*l.*, but the water conveyances take three-fourths of the whole; therefore 90,000*l.* × 4 = 360,000*l.*, what the produce of the Liverpool and Manchester Railway would be at its present charges, supposing it carried the whole of the merchandize and coals; but it is likewise evident, that the charges on the Sheffield and Manchester line will be just double, in proportion to its length, what they are on the Liverpool and Manchester, owing to there being no canal competition; therefore 360,000*l.* × 2 = 720,000*l.*, the produce of merchandize and coals, supposing the whole to pass by railroad at

the price that will be charged on the Sheffield and Manchester line; this added to 140,000*l.*, the passenger produce, = 860,000*l.* Now it is likewise true, that if the charges for merchandize and coal were double the present price, the expences would be little more than one-third of the whole, say 300,000*l.*, which will leave a balance of 80*l.** per cent. per annum on the supposed capital.

Now I think it may fairly be conceded, that when the Sheffield and Manchester line is well established, that at least one-fourth of passengers, merchandize, and coal, in proportion to its length, will pass between the two termini, which now pass between Liverpool and Manchester; and if this be admitted, and the cost of formation does not exceed one million, then it is clearly proved that the profit to the shareholders will be 20*l.* per cent. per annum.

ONE OF THE SHAREHOLDERS.

Sutton in Ashfield, Nov. 15, 1837.

Great Western Railway.

(Continued from our last, page 356.)

SECOND SECTION.—MAIDENHEAD TO READING.—(12¾ MILES.)

THE works on this portion of the line, although considerably advanced, are not of course in so forward a state as those between London and Maidenhead, as the nature of the earth-work is very different. The Directors, we believe, do not anticipate that this section can be opened so far as Twyford (four miles from Reading) until July next, and to the town of Reading itself in the following autumn. The progress, however, already made, would, we think, justify the expectation of a rather earlier completion of this section of the line.

* We have never had, from all the information we could collect, but one opinion of this line, namely, that it would pay well. Our correspondent, from what follows, evidently does not mean to hold out hopes of a profit of 80 per cent. It would be unwise to publish any such statement of profit, however probable it might be. The world would pronounce it to be one of the ranting extravagancies of the Eastern Counties. 10 or 15 per cent. suit our present sobered reason much better: the first (10) is that we believe which the Directors compute from the existing traffic. If our information be correct, this is certainly beneath the mark. The traffic on the line no doubt will be very great; and, as our correspondent truly observes, having no rival in canal, the profits must be out of proportion large.—ED.

The bridge over the Thames at Maidenhead, from which we now start, is to be of two arches, and constructed of brick.* The abutments are all raised above the water line, the centerings of both arches nearly fixed, and several courses of brick-work laid on the western arch. The land arches on both sides are turned, and the brick-work generally is in a forward state. The plank walls are also carried up to receive the embankment, which already reaches it on the eastern side, and in a few days will be quite finished.

The entire distance between Maidenhead and Reading is divided into contracts of nearly equal length, and a locomotive engine is employed on each of them in forming the embankments.

From the Thames-bridge approaches (which terminate at 22 miles 70 chains from London), an embankment proceeds westwards for upwards of a mile, varying in depth from 35 to 20 feet and less. About two-thirds of this (the furthest from the bridge) is finished, as are two bridges by which it passes over roads to Bray. From this embankment a fine view is obtained of a richly wooded country, with Windsor Castle towering proudly in the horizon. A finished cutting succeeds, of about half a mile long, in its greatest depth 18 feet, and averaging about 12 feet. The soil is gravel, mixed with sand and flints, and at the west-end we get into the chalk, which overlying the gravel, &c., in the embankments hereabout, give them the appearance of long mounds of chalk.

We next come to an embankment of a quarter of a mile, also completed, averaging about 9 feet in depth, and passing by a bridge over the road to Boyne Hill. This is followed by a cutting of nearly a mile in the chalk, its greatest depth 20 feet, average 11 feet, and crossed by a bridge, carrying a road to Bray.

An embankment succeeds of a quarter of a mile in length, and from 20 to 11 feet in depth, which is also finished, as well as a bridge for another road to Bray, at its western extremity. From this we enter a cutting of about 3 miles in length, in its greatest depth 31 feet, average about 15 feet, through the parishes of Waltham St. Lawrence and White Waltham. About three-quarters of a mile of this cutting is finished, and a long gully is opened through the

* We wish our correspondent had given us the particulars of this bridge, which we hear is of the greatest span (two elliptic arches of 120 feet span each) that has yet been constructed in brick.—Ed.

chalk for half a mile further, the sides being quite perpendicular. After this, for about a mile, the ground is not opened, but the cutting is partially resumed as we approach the western end, where the full depth is reached, and we come out into the open country upon an embankment, averaging 8 feet in depth, and extending about half a mile. It is completed for about two-thirds of its length, nearly up to the Ruscombe Road, which divides the two contracts, and which is to be crossed by a bridge, now in course of erection. Beyond this the embankment is continued for a quarter of a mile, and we then enter a cutting of three-quarters of a mile in length, averaging 25 feet in depth, upon which a considerable force is working from both ends. At its western extremity we cross the road to Twyford (30½ miles from London), the village lying close on the north side of the line. The cutting here, which is in gravel and clay, is crossed by a handsome bridge, of which the piers are finished. A little further on, a fine open view is obtained of the Loddon valley, from the embankment which follows, of upwards of a mile in length, and 20 feet average depth. About a quarter of a mile of this is completed up to the river Slade, being first carried over New Moor Stream by a very neat two-arched bridge, parallel to which, and on either side of it, two roads are carried upon low arches over the same stream. The bridge over the Slade consists of three land arches, and four as a water-way, all of which are nearly completed. It is of red brick, the arches circular, with stone quoins to the piers. A little further on the piers and flank walls are raised for a three-arched bridge, crossing another stream, and we soon after reach the Loddon river, a beautiful fresh stream. This will be crossed by a bridge, having five arches for the water-way, and two land arches, the piers for all being brought up to the spring of the arches. In construction it resembles that over the Slade. From hence the embankment is being formed for about a quarter of a mile, up to the road to Whistley-green, in Sonning parish, which is crossed by a skew bridge of fine dimensions. From this point a finished embankment carries on the line for a quarter of a mile, till we reach the high ground in Sonning, through which it was at first intended to tunnel, but the line will now be carried in deep cutting. This extends in length about one mile and three-quarters, and may average from 30 to 35 feet in depth. At the east-end, about half a mile is under hand, and about the same length at the west-end, where the London road passes

over the cutting, a little beyond the thirty-third mile. On leaving this cutting, the view of Reading, Holme Park, and the adjacent country, with the Thames and Kennet rivers flowing through the plain, is very striking, and much interest is excited by the great activity shown in pushing on the works at this spot.

From hence the line proceeds towards Reading, upon an embankment of three quarters of a mile in length, and averaging about fourteen feet in depth, which is completed. A short cutting succeeds of about eight chains in length, and varying from one to three feet in depth, passing which we come upon another embankment, carrying the line across the Kennet River and beyond Reading, and being about one mile and a quarter in length to the Caversham-road, where the contract terminates. This embankment is of a nearly uniform depth of about twenty-two feet, and about one-third of it remains to be completed to the Caversham-road.

A temporary bridge is thrown over the Kennet, by which the embankment is carried forward. The abutments for the permanent bridge are raised above the water-line, and the construction of the bridge rapidly advancing. This river is crossed a little south of its junction with the Thames, into which the Kennet falls nearly at right angles.

The crossing of the Caversham-road being about half a mile beyond the point nearest to the town of Reading itself, the station of the Company will probably be fixed in a meadow to the north of Friar-street, whence the best access to the town will be obtained by a direct opening into the centre of that street. This would afford the most convenient thoroughfare, not only for the market-place, but also for all the principal streets, and would not be liable to any interruptions upon the market and fair days, which occasion a very large crowd in all directions about the Forbury and the Market-place.

Between Maidenhead and Reading, the number of bridges passing over or under the railway is thirty, of which nineteen are finished or in course of construction, including seven over rivers and streams. The remaining eleven are all road bridges, and easy of execution. They will all be constructed of red brick, with semi-elliptical arches.

Gradients.—The gradients on this portion of the line are of the same highly favourable character as on the section to Maidenhead, as will be seen from the following table:—

Places.	Gradients per mile.	Inclination.	Length of each plane.	Locality.
From Maidenhead.	feet. in.		ms. chns.	
Level . . .	. .	. . . .	0 10	Bridge over Thames, &c.
Rise . . .	4 0	1 in 1320	10 0	Waltham, Ruscomb, Haret.
Level . . .	. .	. . . .	0 10	Sonning.
Fall . . .	4 0	1 in 1320	1 40	Do.
Level . . .	. .	. . .	1 6	St. Lawrence, Reading.
Maidenhead to Reading (Caversham-road.) . . . miles 12 66 chns.				

CURVES.—There are only two curves in this division of the line, which give it on the whole a southerly direction—

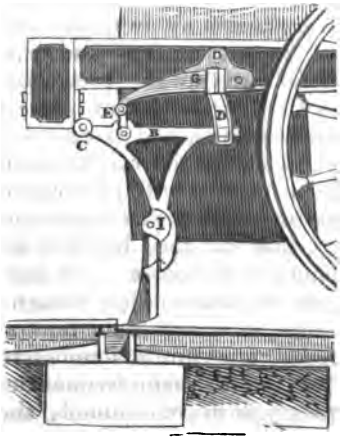
One at Bray of $6\frac{3}{8}$ } miles radius.
One at Sonning of $4\frac{1}{8}$ }

In the entire distance between London and Reading ($35\frac{1}{2}$ miles) the railway passes through twenty-six parishes, intersected in every direction by roads, and very populous. The travelling upon the western road, particularly between Reading and London, is known to be very great, and with the facilities the railway will afford, there is no risk in assuming that it will increase in at least a fourfold degree.* With the attraction also of the Royal residence at Windsor, now made doubly attractive by the interest felt for our youthful Queen, there can be little doubt that of all the lines out of London the Great Western Railway will command the preference for *pleasure excursions*. When a ride of half an hour will land the holiday-folk at Slough, and another ten minutes (at the utmost) carry them on to Maidenhead and its beautiful vicinity, we cannot suppose that any who *ever* leave London, will fail to make frequent excursions on this line, on which they will find no tunnels, and may be whirled along, probably, if they wish it, at the rate of thirty-five miles per hour. The Directors, we understand, have contracted for an ample supply of engines, carriages, &c., for the opening of the line, and some of them are already on the ground.

* See Railway Magazine for October, p. 254.—The Editor's reports on the Great North of England Railway.

Railway Engine Protector.

[We have received the following description of an invention to clear the rails of obstructions, from the inventor, Mr. W. Hawthorn, of Forth, Newcastle. It is the simplest and best contrivance for this important object we have yet seen. We must, however observe, that a great obstacle to the use of these machines, is the pitching of the engine. It would, in our opinion, be advisable to do away with the springs of the engines altogether. They conduce little or nothing to the ease of running on a railway; nor, as we think, do they at all save the machinery, while they add considerably to the expense, and prevent the application of many safe and useful methods of clearing the rails from obstructions. Instead of putting this among the scientific notices, we have deemed it of sufficient importance to form a separate article.—Ed.]



EXPLANATION OF THE DRAWING.

A is the front-end of a locomotive engine; B the protector, connected to the frame of the engine, by the joint C, on which it works; D is a guide for the back part of the protector to slide in; G a steel spring connected to the protector by the link E, by which it is pressed down with a force requisite to give to it a sufficient firmness to remove any loose obstruction from the rails; I is a joint in the

protector, by which it clears any impediment when the engine is moving backwards.

Observations.—To clear the rails from impediments is of the utmost consequence in railway communication. With the railway protector affixed to locomotive engines now in general use, a necessity exists of keeping it about two inches *above* the rail. This is matter of regret, inasmuch as the efficiency of the protector in the removal of dangerous impediments, accidentally or designedly laid in the track of the engine, is thereby greatly depreciated. The reason for allowing two inches between the protector and the line of road is obvious. The protector being firmly fixed to the engine, that space is necessary to prevent the appendage from coming in dangerous contact with the rail, from the undulatory motion of the machine, often increased by irregularities of the railway; and in case of a closer proximity between the line of way and the protector, in those occasional instances where the end of a rail has started up at a joint, or in passing the points of a crossing, the appendage now in use, so far from conducing to safety, would absolutely increase the danger. It is, therefore, desirable that some plan should be adopted, which, whilst it is made to run so close to the rail as to sweep off *small* as well as *bulky* substances, will give way on coming in collision with such impediments as cannot, or ought not to be removed. The subject has, by several engineers, been deemed of sufficient importance to engage their attention; and to accomplish the desired object, the above arrangement has been designed. It will be seen that a protector on the above arrangement could not be firmly fixed to the frame of the engine; it is, on the contrary, connected with it by a joint, with a spring pressure upon it, thereby enabling it to move back and rise when it may chance to strike in contact with such an object as a started rail, as shown in the sketch. When such object is passed, the action of the spring would immediately place the protector in its former position, and enable it to remove from the rail all loose substances.

Vaccination. By the Editor.

In consequence of the facts stated in our last on that subject being copied into the "Times," an individual, under the signature of "T. M.," supposed to be one of the Vaccine Establishment, made a round attack on it in the way peculiar to himself, that is, not by questioning or denying the facts, but by quoting a Report to Lord John Russell, the Home Secretary, signed by Sir H. Halford, Sir A. Cooper, and Drs. Paris and Hue. To this I had no other reply to give but the particulars of the facts I had stated, which I did in the following letter, which appeared in the "Times" of the 8th ult. They have, of course, silenced this would-be banisher of the small-pox, who probably thought it was well to take my advice, and not stir so rotten a subject more. It will be seen that I had been guilty of no exaggerations, and that the actual case is really worse than I stated it to be.

Since then I have received information of parties who have actually died after having been vaccined, and of others out of number who have taken the small-pox. Indeed, it is now pretty generally admitted, among the more reasonable and respectable part of the profession, that vaccination to be effectual requires to be renewed, some say every seven, others every three years, which is one very long step towards admitting its total inefficacy.

If I was asked why the small-pox has so much diminished in our island of late years, I should answer, on account of the improved habits and cleanliness of the people—causes which have banished the plague and almost expelled other diseases, as, for instance, one the consequence of the follies of youth, and vitiated desires. It is probable, too, that this disease, like many others, the alarming cholera, for example, which have had their rise, sway, and decline, without any possibility of explaining the why or the wherefore, has been on its meridian, spent its virulence, and is now rapidly declining. Similar to this last view is that of a gentleman, Mr. C. Davison, who has done me the honour to address a letter to me in the "Hull Advertiser" of Nov. 10th, on this subject, in consequence of the notice in the last number of the Magazine; and precisely similar are the opinions of thousands besides, quite as competent to judge as any members of the medical profession. However, I presume to offer no hypothetical views; I simply state the facts as they occurred, and leave others to draw their own conclusions in the way

the most agreeable to them. One thing I beg to add, namely, that I have no prejudices of any kind, and I had always been the steady advocate of vaccination until the facts related forced on me a conviction that my confidence in its efficacy had been misplaced.—EDITOR.

TO THE EDITOR OF THE TIMES.—NOV. 8, 1837.

SIR,—In your paper of the 2d instant, you quoted from the "Railway Magazine," which is under my direction, a notice on the subject of vaccination. The substance of this article is, that "Four out of five of my children, which had been vaccinated by professional men at different times and from different subjects, had taken the small-pox naturally; that I therefore did not consider it a prevention to the small-pox; and that, from the violence with which one of the children was attacked, I doubted its powers as a meliorative." I also added, "That I was so thoroughly convinced, from these and other circumstances which have fallen under my observation, of its inefficacy, as never to permit it in my family again."

This simple statement of facts has, it seems, given "pain" to an individual who figures in your columns of the 4th instant, under the signature of "T. M." I can only say I am truly sorry for "T. M.," and hope his "pain" will not be long or severe. With regard to his "astonishment," by which I suppose he means fright, I fear I cannot help him; but if he is so terrified at a mere hint of facts, what will he do when he comes to read the "awful" truths I shall now, with your permission, disclose?

Previously to making this "awful" disclosure, I may be permitted to observe, that I am not in the profession, and have no connexion with it; I consequently can have no prejudices, which, indeed, I leave to "T. M.," and vaccine advocates. I may also add, that all the parties named, except Mr. Rolfe, are, I believe, now alive. The particulars, as to the order in which the children took the disease, (which is that in which they are now set down,) the intensity of it, and the gentlemen who vaccined them, I have had from my wife this morning, who is a far better registrar of such matters than I am. The ages are those when they took the small-pox.

ELIZABETH.—Fifteen years. Vaccined by Mr. Huxtable, of Bristol; had the small-pox severely, was blind three days; has been ever since weak in the eyes, and a little marked by it.

GILBERT, two years, two months; LESLIE, one month.—Not vaccined or inoculated; both had it lighter than the rest.

MARIA.—Twelve years, six months. Vaccined by Mr. Rolfe, of Bristol; not marked, but suffers to this day occasionally from swelling in the ancles.

ELLEN.—Six years, five months. Vaccined by Mr. Frogley, of Hounslow; long very weak, but quite recovered.

ALFRED.—Sixteen years, four months. Vaccined by Mr. Rolfe, of Bristol; long very weak, but quite recovered.

HANNAH.—Four years, six months. Vaccined by a non-medical man; did not take the small-pox.

SPENCER, ten years, nine months; EDWIN, eight years, nine months.—Both previously inoculated for the small-pox by an unprofessional hand, and now escaped it.

To this fine proof of the powers of vaccination, I shall add that of John Collins, now a clergyman in Antigua, or in one of the West India islands. He is the son of the late Mr. John Collins, of Picarts, Antigua, and was a fine healthy lad, and resided with me for, I believe, nearly ten years. He had been vaccined, as I was informed by his relatives, by a professional man in Antigua; but at Bristol, in 1820-1, took the small-pox, and had it so badly as to be much and lastingly marked with it.

Of my own family I may observe, that the children are all remarkably healthy, and that neither myself, wife, nor either of our progenitors, as far back as we can trace, have had the slightest tendency to scrofula, or any other cutaneous disease. With respect to my children, this one fact will tell its own tale—namely, that out of eleven births there has not been one death, though the ages range from 1¾ to 22.

Thus, of five healthy children of our house, including Collins, vaccined by almost as many professional men, not one escaped the small-pox; one, the only one that had been vaccined by a non-professional man, did clear it; two others that had neither been vaccined nor inoculated had it lighter than either of the five first; and two that had been inoculated by an unprofessional hand escaped altogether.

On facts such as these, Sir, comment would be thrown away. Contrast them with the following statements, to which "T. M." has affixed the names of Sir H. Halford, Sir A. Cooper, Doctors Paris and Hue, all, I believe, tied by office or otherwise, to advocating vaccination, and let the world hereafter place its confidence in such a statement if it can:—"*If* 300 *children be vaccinated, one will be susceptible of the small-pox afterwards, but only in a mild and perfectly safe form; whereas, if* 300 *be inoculated,* ONE WILL SURELY DIE."

On the almost impious audacity of the last four words, which, no doubt, must be highly convincing of the truth of the rest, it might be expected I should offer a few observations; but I shall not, believing, as I do, that the parties on whom they are fathered could never have descended to such superlative nonsense. Neither shall I trouble myself to reply to the paltry insolence of some of "T. M.'s" remarks, or even to unmask the two little tricks by which he has endeavoured to conceal the authority for the article

complained of. I shall merely recommend to his notice the old adage, "The more," &c., which will very properly apply to himself and vaccination; and though he may either be afraid or ashamed to avow his name, he may, nevertheless, provoke discussion that may open the eyes of the public much more than he may wish. However, this is out of my beat. I have stated briefly and frankly what has happened in my house. Of the almost countless similar cases that I have heard of besides, I have not mentioned one. I have, therefore, done no more than my duty to society, and cannot be accused of wishing to disparage the practice of vaccination, however much I, in common with thousands besides, may detest the mean and fraudulent practices by which the truth is often kept back or misrepresented, for the purposes of bolstering up fashionable whims and lucrative deceptions.

I am, Sir, your obedient servant,

Nov. 6. JOHN HERAPATH.

REPORTS.

GREAT WESTERN RAILWAY.

SPECIAL GENERAL MEETING.—W. U. Sims, Esq., in the Chair.—The Directors having convened the present Special General Meeting of the Company, in the exercise of a discretionary power conferred upon them by the Legislature, consider it their duty to explain more fully the subjects referred to in the notice, which has already made known to the proprietors the specific purposes upon which they are now assembled to deliberate.

In confining their Report to the two points of business mentioned in the notice, (which has been duly advertised,) the Directors are only fulfilling the injunctions of the same authority which enabled them to convene the meeting; the 120th clause of the Act 5 and 6 William IV., cap. 107, providing that "no business shall be transacted at any Special General Meeting, other than the business for which it shall have been called."

The privilege of borrowing money under certain restrictions was mentioned in the last Report of the Board, with an intimation which seemed to receive the unqualified approval of the proprietors then present, that it might be advisable to take early steps for arming your Directors with distinct authority to take up on loan the amount permitted by the Act, at such a rate of interest, and upon such general conditions, as might appear to them most beneficial to the interests of the Company.

The powers and stipulations alluded to, are comprised in clauses

237, 239, 244, and 247, of 5 and 6, William IV. cap. 107, which will be read to the proprietors at this meeting, for their information.

The rights and privileges of the parties lending money on mortgage to the Company, are provided for generally in the same enactments, and further secured by clauses 242, 245, and 246.

It may be here stated concisely, that the Company are qualified to make an order for borrowing the sum of 833,333*l.*, and also to take up, under a similar order, such amount in anticipation of the future calls of the proprietors for the capital of 2,500,000*l.*, as shall not exceed the amount of all the calls still remaining to be made.

The Company may empower the Directors, if they shall think proper, to stipulate periods for the repayment of the money to be borrowed, and in case any of the mortgages shall be paid off, there exists a discretionary power to raise the amount again in lieu of the money so repaid. The form of debenture also is recognised and regulated by the Act.

The Directors now announce "that a sum exceeding 1,250,000*l.* in respect of the money authorised to be raised by subscription for the purposes of the Great Western Railway, has been actually raised and paid up," and they, therefore, submit to the determination of the meeting the propriety of making the requisite orders for borrowing the respective amounts of 833,333*l.*, in addition to the capital, and of 1,125,000*l.* in anticipation of calls still remaining to be made on account of the capital. The proprietors may rely with confidence upon the exercise of all due caution, and of the best judgment which the Directors can apply to the terms and conditions of any loans which may be tendered to them.

This meeting has also been made special, to take into consideration whether it be advisable to invest your Directors with authority to conclude an arrangement proposed with the Cheltenham and Great Western Union Railway Company.

The nature of the proposed arrangement may be briefly stated to consist of a conditional bargain to take their railway from Swindon to Cirencester, including all necessary stations and other buildings, on lease for a period not exceeding ten years after it shall have been completed by that Company for the conveyance of passengers and merchandize, paying an annual rent of 17,000*l.* for all tolls and rates to be levied thereon, and for the exclusive rights of property in the line during the continuance of the lease.

The objects of this arrangement are to secure the immediate construction of 18 miles of continuous railway from the Great Western line towards Cheltenham, Gloucester, Stroud, and other adjacent towns, which will embrace their traffic with the metropolis in a direction equally favourable to all, besides giving great facilities in their general intercourse with the west of England.

The certainty which such a bargain would give to the pro-

prietors of the Cheltenham and Great Western Union Railway of a beneficial return for that expenditure, will raise the value of their stock, and ensure the due payment of the calls. The Directors of this Company have been assured that this step has already been marked with the approbation of, and promise of cordial co-operation from, many who had, on local or other grounds, formerly objected to the undertaking.

The distance from Cheltenham to Cirencester is only 14 miles, with an excellent turnpike-road.

There is every reasonable ground of belief that the traffic on this part of the railway will leave a fair profit to this Company, after paying the rent and all other expenses incidental to the business; and the Directors of the Cheltenham and Great Western Union Railway Company are so entirely under a similar conviction of such a result, that they desire to retain the option in their hands until six months previously to the completion of the railway, whether to grant the lease, or retain the line in their own hands.

Inasmuch as this arrangement must be contemplated by this Company, rather as a means of insuring the construction of the railway, than as an object of direct gain from the use of that portion, when constructed, (the chief motive being to acquire additional traffic on nearly 80 miles of the Great Western Railway, far exceeding the whole proposed rental,) the Directors feel no reluctance in recommending the proprietors to acquiesce in that condition, they being, however, placed, in all other respects, on a perfect equality as to further reservations of right in any lease to be executed between the two Companies.

There is a clause in the amended Act, 6th William IV. cap. 88, which enables the Great Western Railway Company to enter into such an arrangement; and the Directors consider it a seasonable and prudent mode of administering that assistance to this important branch, which has been invariably advocated in their former Reports, and to the principle of which the proprietors have uniformly expressed their ready and full assent.

(Signed) W. U. Sims, *Chairman.*

Princes-street, Bank, Oct. 27, 1837.

CHELTENHAM AND GREAT WESTERN UNION RAILWAY.

The Second Half-yearly General Meeting was held at the Masonic Hall, in Cheltenham, on Friday, the 3d day of November, 1837; William Henry Hyett, Esq., in the Chair.

In the last Report presented to the proprietors, the Directors expressed their opinion, that it would not be politic to engage in works requiring further advances, while serious difficulty was

experienced by individuals in providing the means for the conduct of ordinary commercial business.

The condition of the trading and manufacturing interests, and the state of public credit have been, from the date of that Report until a late period, so discouraging to the prosecution of public works, that your Directors have been unable to make any material progress in the undertaking.

Money having recently become more abundant, and public credit having been comparatively established, your Directors have, for some weeks past, occupied themselves in maturely considering where, and to what extent, they could commence active operations, with the best effect for the interests of the proprietors.

A very general impression having prevailed heretofore that this railway should be commenced at Cheltenham, your Directors had the line definitively set out from Cheltenham and Gloucester, through Stroud, to Sapperton, the strata of the various cuttings proved, and shafts sunk in Sapperton Hill, to ascertain the strata in the course of the tunnel; and Mr. Brunel has reported the result to be more encouraging than he had reason to expect.

The state of the times has, however, induced many of the proprietors to desire that the operations of the Company should be limited, in the first instance, to the completion of some portion of the line, which would yield an adequate and certain return for the capital expended on it, during the progress of the remainder; and as it had been, until lately, very generally considered that that part between Cheltenham and Gloucester would be the most profitable, your Directors consider it necessary to explain in detail the grounds on which they have arrived at a different conclusion, and which induce them to recommend the construction of the portion of the line from Swindon to Cirencester in the first place.

When the Gloucester and Birmingham Railway shall be made to Cheltenham, and the Bristol and Gloucestershire Railway shall be made to Stonehouse, and this line shall be completed, there is no question but that the portion of this line between Cheltenham and Stonehouse will yield an income much greater than any other part of it; for, in addition to the London traffic, common to all parts of the line, there would be the traffic from Birmingham and the north, through Cheltenham, to Bath and Bristol, and the west of England, and between the towns of Cheltenham and Gloucester. The traffic, therefore, on that part of the line would produce, according to the evidence in Parliament, 20 per cent. upon the cost of construction.

Your Directors consider the main feature in this undertaking to be, the establishment of a railway communication between Gloucestershire and London; that, by an extension of the Great Western line from Swindon to Cirencester, 95 continuous miles of this communication would be established; that no less than 10

turnpike-roads, from various parts of the country, meet in the town of Cirencester; that, from the relative position of Cirencester to Stroud, Gloucester, and Cheltenham, the railway, when brought on to Cirencester, would be nearly equally accessible to all those places; that the entire London traffic calculated upon for the whole line would, therefore, go on any part of it continuously with the Great Western, in the direction of Cirencester; and that this portion of the line would, consequently, be useful to the public, and valuable to the proprietors, and would yield an immediate and ample return for the outlay.

Your Directors, under these impressions, desired Mr. Brunel to revise his estimates, and to report to them the cost of the line, in a complete state for work, from Swindon to Cirencester, and they have received from him the following particulars:—

Cost of the line complete from Swindon to the set off of the Branch Railway, to Cirencester, and of the Branch Railway, to be formed according to Mr. Brunel's original plans	£209,500
Add for contingencies	20,000
	229,500
Cost of the same, with all the improvements suggested by further experience, adopted on the Great Western Railway, and which Mr. Brunel strongly recommends as productive of future economy; with a like addition for contingencies	249,500

Your Directors have also caused the traffic, as established in evidence before the Parliamentary Committees, to be dissected, for the purpose of ascertaining the probable income on this portion of the line; and it appears that the net income would be 25,000*l.*, after deducting the annual expense of wear and tear and maintenance, according to Mr. Brunel's estimate. This income is estimated on the assumption, that there would be two passengers by the railway for one now travelling; but your Directors, judging from the ratio of increase on the lines now open, both in this country and abroad, and having considered the evidence given in Parliament by very competent and intelligent witnesses, as to the probable increase of travelling on this line, and the great population of the towns and districts connected with it—feel no hesitation in stating their conviction, that the passenger-traffic on this railway will increase in a much higher ratio than two to one.

On these grounds, your Directors strongly recommend the immediate construction of that portion of the line between Swindon and Cirencester, and they have great satisfaction in stating, they have reason to believe that this suggestion has been generally well received in Cheltenham, Gloucester, and Stroud.

Since it has transpired that the Directors intended to submit this plan of operations to the proprietors, an arrangement with the Great Western Railway has been suggested, for renting the tolls and rates, to be levied on the line from Swindon to Cirencester, when completed, at 17,000*l.* per annum, the lessees maintaining the road for a term of years.

Your Directors conceive that a net income far exceeding that sum may be safely relied upon, from the natural traffic on such a line, and were on that account very unwilling to commit the Company to accept, definitively, a rent of 17,000*l.* per annum, which would, in their estimation, involve a serious sacrifice of income; but they considered it to be their duty to endeavour to secure for the proprietors the privilege of accepting or rejecting these terms, at a more advanced period, when they shall have had greater experience of the increase of travelling, where railways have been substituted for the existing modes of transit.

This arrangement was recommended by the Great Western Directors to their proprietors, at a Special General Meeting convened in London on the 27th of October, and a resolution was passed unanimously, at that meeting, authorizing the Directors to conclude such an arrangement, and to execute a lease, if required by this Company, for any term not exceeding ten years; and they conceded to this Company the privilege of adopting or rejecting this arrangement, until within a period of six months prior to the opening of the railway to the public.

Your Directors deem this proposal important, as affording to distant proprietors, who may have an imperfect knowledge of the traffic which may be reasonably anticipated upon this line, conclusive evidence of the value of their investment.

Calls, to the extent of something more than 30*l.* per share, will be required for the completion of this portion of the line, on the most improved construction, the whole of which will not be wanted under two years and a half, and may be drawn for by easy instalments; and your Directors will not require another instalment on the shares for some months, and will feel it their duty to take steps to secure the general payment of the arrears on the call already made, before any further demand is made upon the proprietors.

The accounts, made up to Midsummer in compliance with the terms of the Act, show a considerable arrear in the payment of the last call, though not so great as might have been reasonably anticipated, considering that it became payable in the midst of the late monetary crisis.

Since those difficulties have disappeared, the payments of the last call have steadily increased, and they amount to upwards of 6,000*l.* since Midsummer last.

As contracts for all the land required for the railway could not be completed within the term prescribed by the Act of Parliament,

with that deliberation which is essential to the interests both of the landowners and the Company, in consequence of the delay which has been unavoidable from the causes before adverted to, your Directors have no doubt that Parliament will consider it just and advantageous to all parties, that the power given for that purpose should be extended; and as the engineer has reported that some deviation from the line laid down in the parish of Sapperton might be eventually necessary, the notices required by the standing orders of Parliament for an application for an amended Bill in the next session, and which could not be delayed, have been given by your Directors on their own responsibility, and they now request your sanction to that proceeding.

Statement of Accounts up to 25th June, 1837.

Receipts.

	£. s. d.
Amount of capital received as deposits of 2*l.* 10*s.* per share, and on account of call of 5*l.* per share, due 10th November, 1836, with interest on arrears	34,272 19 10
By loan on security of the tram-road	17,500 0 0
	51,772 19 10

Expenditure.

Payments up to the 25th December, 1836, as per last statement				16,899	9	6
Payments from 24th December, 1836, to the 25th June, 1837.						
Engineering surveying, &c.	2,200	0	0			
Law charges	1,000	0	0			
Parliamentary expenses, on account of traffic-books	7	7	6			
Printing and advertisements	65	5	4			
General disbursements	294	12	7			
On account of compensation to the Thames and Severn Canal Company, as per agreement	2,500	0	0			
A moiety of the tram-road	17,500	0	0	23,567	5	5
				40,466	14	11
Balance				£ 9,306	4	11

(Signed) W. H. HYETT, *Chairman.*

SHEFFIELD, ASHTON-UNDER-LYNE, AND MANCHESTER RAILWAY.

REPORT OF THE PROVISIONAL COMMITTEE.—The Right Hon. Lord Wharncliffe in the chair.—The sanction of the Legislature having now been given to the undertaking, for which this Company has been formed, it becomes the duty of your Committee, when surrendering into your hands the important trust, which has been provisionally reposed in them, to lay before you a brief statement of their proceedings up to this period, to congratulate you

upon their successful issue, and to offer some observations upon your future prospects.

In fulfilling this duty, your Committee feel that they are called upon to state the reasons which have induced them to make certain alterations affecting the termini, as well as the tunnel through the summit, and the postponement of the branch to Ashton-under-Lyne and Stayley Bridge, by which the amount of the capital required has been considerably diminished.

In the Report of the Provisional Committee, issued on the 25th of November, 1836, the amount required for the whole work was estimated at one million. In this estimate was included a branch of 2 miles 45 chains in length, to connect with the main line the towns of Ashton-under-Lyne and Stayley Bridge. This part of the project, for want of the cordial support of those who appeared to be most interested in its success, your Committee were reluctantly compelled to postpone, feeling that they were not justified in perilling the success of the whole project, in the effort to engraft upon it a branch, the value of which was not appreciated. It may be added, too, that this was a very expensive part of the undertaking, that a perseverance in it would have drawn upon the Company a formidable Parliamentary opposition, which, by the course pursued, has been averted; and, under all circumstances, your Committee believe that they have not compromised your interests by restricting their views for the present to the main object of the undertaking—an object, in their opinion, of too great importance to be endangered for any seconday consideration.

It was contemplated, also, at the time of your Committee's last Report, that the line should terminate at Sheffield in the cattle-market, and at Manchester in Store-street. It was found, however, that an eligible situation for the Sheffield terminus could be formed in the Nursery Gardens, which would save the great cost of carrying the line to the southern extremity of the town.

The terminus of the line at Manchester is now fixed at Chancery-lane, where it joins the Manchester and Birmingham line into Manchester; and in that Company's Act of Parliament, your Committee have procured the insertion of a clause, entitling them to the use of their line into Store-street, on payment of the legal rates of tonnage for one mile only. They have also an agreement with that Company for separate stations, &c., at the terminus:—and your Committee flatter themselves that by these arrangements they have secured their principal object, viz.: a communication with the centre of the town of Manchester, on much cheaper and more advantageous terms for the Company, than by the construction of an independent and expensive entrance of their own.

It was also originally intended, that the tunnel through the Summit Ridge should be of width sufficient for a double line of railway. But on the suggestion of Mr. Locke, concurred in by Mr. Vignoles, this part of their plans has been modified, and it is

proposed to form the tunnel, in the first instance, for a single line of rails only—sufficient land, however, will be taken for the subsequent construction of a second tunnel, if hereafter found necessary, parallel to the first; and by these means, as explained satisfactorily by Mr. Vignoles to the Committee on the Bill in the House of Lords, the tunnels for the two lines will not be more expensive, and will be less liable to the possibility of accident, than the original scheme of one tunnel with a double line of rails. The saving in the estimates produced by these alterations has enabled your Committee to reduce the capital of the Company to its present amount of 700,000—which sum, they have good grounds for believing, will amply cover the cost of the undertaking thus modified. Before proceeding with the measure to Parliament, your Committee were most anxious to avoid the expenses of opposition; and where opposition could be obviated without sacrificing the interests of the Shareholders, they endeavoured by honest and fair treaty to reconcile conflicting interests and to allay jealousies, which, if met by other than conciliatory treatment, might have excited an expensive and harassing contest. Your Committee are happy to say that in the course adopted by them, they have been completely successful; ensuring a result to which they cannot advert without satisfaction, that of having carried your Bill through all its stages at a moderate expense, without having had to concede one point of importance to the undertaking.

Your Committee now proceed to lay before you, under general heads, an account of the expenditure of the Company—being the total amount paid, or contracted for, by your Committee, up to the 14th of October, to which date their books were made up.

General Abstract of Expenditure of the Company, including all outstanding claims to 14th October, 1837.

Dr.	*Receipts.*	£.	s.	d.
To amount of deposits paid on Shares, and Interest		29,106	8	10
		29,106	8	10
To balance at the Company's Cr. after payment of all claims		11,926	4	5
To this balance is to be added banker's interest, from the 31st Dec. 1836	between	500	0	0

Cr.	*Expenditure.*	£.	s.	d.
By office expenses, including salaries to Secretaries, stationery, postage, petty charges, office furniture, &c.		743	5	8

	£	s.	d.
By engineering and surveying, including engineers' attendances in Parliament, engraving maps, plans, &c., for the use of Parliament, the Board of Directors, surveyors, engineers, &c., and plans to deposit	8,585	14	8
By law expenses, including solicitors' bills, fees to counsel, country and town agents' bills, &c.	4,314	7	11
By expenses of traffic taking, serving notices on owners and occupiers of land, getting assents, and disbursements of Committee, &c.	1,402	5	11
By expenses of witnesses in London, of deputation on the Bill, and travelling expenses of same	1,334	6	7
By Parliamentary agents' charges, including printing of the Bills for Members, printing of the Act, fees, &c.	1,209	8	4
By expenses of advertising, reports, prospectuses, notice of application to Parliament, &c.	190	15	9
Nett balance to the Cr. of the Company, after the payment of all claims	11,326	4	5
	£29,106	8	10

Your Committee feel that they are called upon to offer but few remarks upon the above statement. The only item which appears large in amount is that under the head of "Engineering Expenses." This, however, when the length of the line to be surveyed is taken into account, its difficult nature, and the importance of going before Parliament with the best possible route, so as to preclude the necessity and the expense of future applications for powers to deviate, &c., can scarcely be considered excessive.

They have to state, in further explanation, that the surveys made under the direction of Mr. Vignoles, extend over a period of nearly nine months: and that, in the anxiety of your Committee to spare no pains or cost to satisfy themselves, the subscribers, and the public, that they had secured the best line which the country afforded, they were induced to incur the expense of a further survey by Mr. Locke, the engineer of the Grand Junction Railway, gaining thereby his additional concurrence in the line, which has now received the sanction of the Legislature.

Your Committee have judged it most prudent, during the period which has elapsed since the passing of the Act, to restrict their attention to such business only as was necessary to enable them to lay before the proprietors a statement of their past proceedings; and to be guided in their future efforts by what may appear to be the wish and feelings of the whole body of proprietors.

At the same time they are deeply impressed with the necessity of securing, by prompt and energetic measures, the accomplishment

of an undertaking not only valuable to the important districts connected with it, but which they are also confident will be profitable to the shareholders.

The first object towards which they would entreat your co-operation and exertions, is the disposal of the shares still unappropriated. In urging upon you such exertion, your Committee may be excused for calling your attention to a few important features in the undertaking.

The decision of a Committee of the House of Commons against the line projected by the Manchester South Union Company has, in a great measure secured to the Sheffield and Manchester Company, so far as railway communication is concerned, the traffic from the East and Midland Counties towards Manchester and Liverpool. Your Committee had already calculated upon a portion, both of the merchandize and passengers from those counties, but the adoption of a line from Manchester towards London, which leaves those districts unprovided with any better means of communication with Manchester and Liverpool than those which had previously existed, will have the effect of bringing from thence upon your railway, a considerably greater amount of traffic than your Committee had ventured to calculate upon in their estimate of traffic. In your Committee's report of the 25th November, 1836, they were anxious not to exceed what might fairly be presumed to be the rational prospect of remuneration to the subscribers. That estimate has been carefully revised, and your Committee are satisfied that even with the deduction to be necessarily made in the Ashton-under-Lyne and Stayley Bridge traffic, from the postponement of the branch line to those towns, the gross revenue will not fall short of the former calculation. The great increase in the consumption of coal at both ends of the line, and especially in that part of the manufacturing district at the Manchester end through which the railway passes, promises a large augmentation to that portion of the revenue which is derived from the transmission of minerals.

Your Committee cannot impress too strongly upon the attention of the shareholders in this undertaking, the important fact of its being entirely free from competition, arising either from other railway, or from water communication, and the improbability, on account of the nature of the country, of its ever being subjected to such competition. On the Liverpool and Manchester Railway, the carriage of merchandize is subject to the competition of three water conveyances, and the consequence is, that a very small part of the income, comparatively speaking, is derived from that source, while the whole of the traffic between Sheffield and Manchester, and upon the line, must necessarily pass along the proposed railway, with the exception of that trifling portion which may possibly be forwarded by land carriage for short distances.

In conclusion, your Committee venture to add a few observations

on the engineering part of your project. It has been urged, and with great plausibility, that the difficulties arising from the inequalities of the country, and the necessary steepness of the gradients throughout, will tend to render this railway less valuable to the subscribers and the community than it would otherwise have been. The gradients upon this line are certainly not such as will allow of the maximum rate of travelling, or the country such as will warrant the minimum of expenditure in its formation. But all improvements are comparative, and the improvement upon the present modes of conveyance is greater on this than on most other lines, and the outlay less in comparison to the benefits conferred. It must be borne in mind too, that the question is not as to this line or another, but to this line or none. By no other than a railway communication can the approximation of the two important towns of Sheffield and Manchester be accomplished; and your Committee are quite confident that by no other line than by this can such an object, with the coincident advantages meditated, be so fully secured—and the question, therefore, now is, whether the inhabitants of those towns, and their respective neighbourhoods, as well as the public in general, are sufficiently impressed with the great advantage of such a communication.

SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

BRITISH SCIENTIFIC ASSOCIATION.—(SECTION B.)—CHEMISTRY AND MINERALOGY.

[Abridged from the "Athæneum," by a Friend, for the "Railway Magazine."]

Anthracite Coal.—A paper by Mr. G. Crane was read, on the application of Anthracite coal to the smelting of iron ore by means of the "hot blast." By the use of this description of coal, in combination with the application of the hot blast, Mr. Crane states, that a saving of two-thirds on the quantity of coal is effected, above that of the old method of cold blast, and coke made from bituminous coal; and, also, that the quantity of iron smelted in each furnace is increased from 40 to 50 per cent., in consequence of the reduction of the ore requiring a much shorter time with the hot than with the cold blast.

Crystallization of Metals by Galvanism.—A paper by Mr. Golding Bird was read, giving a description of some experiments made for the purpose of testing the accuracy of those described by Mr. Crosse, at the Bristol meeting last year. Mr. Bird's experiments confirmed the possibility of metallic veins being produced by reduction of the various salts containing in solution the metallic base, and that the mere passage of the electric current was suffi-

cient to produce the result without the presence of poles. Nearly all the principal metals were experimented on, and produced similar results. The most extraordinary fact connected with these experiments, is, that the deposition of the crystals was not the most abundant at the metallic electrode, but was generally found most plentiful on the surface of plaster of Paris, which was used for securing some parts of the apparatus.

Dr. Faraday seemed to entertain some doubt whether this effect could really occur if the sulphate of lime (plaster of Paris) were perfectly pure. He considered the negative electrode ought to be the recipient of the metallic crystals.

Corrosion of Iron by Salt Water.—Mr. Hartley read a paper on this subject. He considered, from his experiments, that brass protects both wrought and cast iron from the action of salt water; and, contrary to all previous experiments on electro-chemistry, he stated that the brass itself remained unaffected.

Chemical Action of Nitric Acid on Metals.—Dr. Andrews read a paper on the singular phenomena produced by the contact of platinum with metals exposed to the action of nitric acid. In some cases the acid ceases to produce any effect whatever on the metal, after the metal has been touched by a bar of platinum. In others the usual effects are modified in various ways, the effects varying greatly with different metals.

The result of these experiments, as well as those of Mr. Hartley, on the action of salt water on iron and brass, were considered to open most important questions respecting the laws of electro-chemistry; and the President urged the attention of the section to further experiments in elucidation of these apparent anomalies.

Fermentation Produced by Electricity.—A paper by Mr. Black was read, stating some effects produced on the fermentation of saccharine fluids by thunder-storms. The specific gravity of the fluid he also found to be increased by the same cause.

New Variety of Alum.—Dr. Apjohn made some observations on a new variety of alum from Africa, of which he exhibited a specimen. This variety does not crystallize in octahedrons as the alkaline alums, but occurs in fibrous masses, and splits into threads. The protoxide of manganese here takes the place of the potass, or of the soda contained in the usual kinds of alum. Some doubts were entertained whether or not this were a true variety of alum.

Constitution of Salts.—Professor Graham read a paper on the theoretical constitution of salts. This was followed by some remarks by Dr. Clarke on a method proposed by him for more readily introducing the atomic theory to chemical pupils.

Hydro-oxygen Gas.—A letter from Professor Hare, of Philadelphia, to Dr. Dalton, was read, detailing some experiments with the hydro-oxygen blow-pipe, by which he had succeeded in fusing large masses of platinum. In the letter, the professor takes occa-

sion to observe that the light derived from the burning of hydro-oxygen gas on lime, generally known as the invention of Lieut. Drummond, was originally used by himself, and is detailed in the 14th vol. of "Tillock's Philosophical Magazine."

Composition of Cast-iron Smelted by the Hot and the Cold Blast.—Dr. Thomson read a paper on this subject. The different irons which were the subject of his analyses, were all from the Glasgow fields. The richest of these ores contained in 100·38 parts, 83·4 of carbonate of iron. The specific gravity of iron smelted by the cold blast is lower than that by the hot blast; the average of the former being 6·7034, and the latter 7·0623. The analysis of six different specimens of cold blast iron, gave the following average composition:—Iron 91·154 + maganese 2·037 + carbon 3·855 + silicon 1·177 + aluminum 1·651, with a small admixture of magnesium in one of the specimens. The composition of hot blast, No. 1. pig-iron, obtained by a mean of five specimens was—Iron 95·58 + manganese ·87 + carbon 2·099 + silicon 1·086 + aluminum ·422, with ·792 of magnesium in one of the specimens. The atomic proportions deduced from these analyses would be, $3\frac{1}{2}$ atoms of iron and manganese + 1 atom of carbon, silicon, and aluminum, for the cold blast iron; and $6\frac{1}{3}$ atoms of iron and manganese + 1 atom of carbon, silicon, and aluminum, for the hot blast iron. The quantity of coal consumed by the process of smelting one ton of iron by the hot blast, Dr. Thomson stated to be reduced to about 2 tons, 19 cwt., instead of 7 tons, 13 cwt, required by the old method; and the produce of iron from each furnace, in a given time, is about double the amount by the hot, to what it is by the cold blast.

This paper gave rise to much discussion; some persons stating that, notwithstanding the greater purity of the hot blast iron, as shown by Dr. Thomson's analysis, more waste occurred in the process of puddling and refining with hot, than with cold blast iron. This opinion was combated by Dr. Clarke and Dr. Thomson; but we understand that the most intelligent iron-masters affirm that the result of their experience proves that greater waste always occurs with hot, than with cold blast iron.

Antimonial Pigment.—Dr. Trail read a paper on a new antimonial compound, applicable as a pigment. It is of an ultramarine colour, and obtained by adding the solution of ferrocyanide of potassium to muriate of antimony.

Improved Safety Lamp.—Dr. Arnott communicated to the section a plan for an improved safety lamp for coal mines. It consists in conducting atmospheric air through pipes, terminating in the lantern, and forced into the mine by the engine used for ventilation.

Action of Water upon Lead.—Mr. Pearsall addressed some observations to the section on this subject. He stated that experiments had been formerly made, which proved that lead is acted

upon by pure water, though saline waters produce no effect. Some recent cases of poisoning had occurred, which appeared to confirm this opinion. A discussion ensued, and some persons appeared to think that the lead, when pure and free from copper, could not be acted on in this manner. It appears, however, that the effect is due to the oxygen of the air which is contained in the water.

Compounds of Carbon and Hydrogen.—Professor E. Davy stated that a new bicarburet of hydrogen, which he had obtained, when enclosed in a tube, and subjected to a series of sparks, communicated through platinum wire, deposited carbon, without any alteration of its volume. The residual gas he considered to be new. It is insoluble in water, will not ignite with chlorine, but explodes with a volume and a half of oxygen, and yields one volume of carbonic acid and some water. The gas therefore appears to be a binary compound of carbon and hydrogen.—Professor Johnston described a variety of hatchettine, from a coal-mine at Newcastle. He found it, on analysis, to yield three distinct substances; the most abundant being a binary compound of carbon and hydrogen.

Expansion of Minerals by Heat.—Professor Miller communicated to the section the result of some experiments on the unequal expansion of minerals, in different directions, by heat. A slice of gypsum, which was a portion of a twin crystal, was cut perpendicularly to the direction of cleavage, which passes through both. In consequence of the unequal expansion by heat, the two portions of the twin crystal alter their form; and the artificial section of the two crystals, which, at the ordinary temperature, forms one continuous plane, becomes distinctly two planes, forming a very obtuse angle with each other, and meeting in the line of junction of the two crystals.

Analysis of Organic Substances.—A paper by Professor Liebeg, on the ultimate analysis of uric acid and some other organic substances, was read. The important effects which result from uric acid and from urea, in the human frame, render them eminently deserving of the attention of the chemist and the physiologist. The predisposition to gout is closely connected with the presence of these substances; and it is unquestionable that they are the products of organization, as they are not discoverable in any part of our food. Urea is one of the substances which can be compounded by art, the resulting substance being precisely similar to the natural production; but the complete knowledge of the nature of the composition of uric acid from its elements, promises to be of the highest consequence in medicine, by rendering unnecessary the use of external agency in removing human calculi from the bladder. The researches for this purpose, undertaken conjointly by Professors Liebig and Wöhler, are not yet complete; but the analysis of uric acid has pointed out sufficient to stimulate to further exertions. The decomposition of uric acid, with hyperoxide

of lead, yields oxalic acid, urea, and a peculiar substance resembling allontoin, which is a compound of cyanogen and water; and though the exact manner in which the elements unite to form uric acid is yet undetermined, it is probable that it consists of urea, xanthic oxide, cystic oxide, and oxalic acid. The symbolic formula of its elementary composition is established beyond a doubt to be $C_{10} + N_4 + H_4 + O_6$; but the manner in which these elements are combined, is a problem of the highest interest in medical chemistry.—A report on organic chemistry is promised to be drawn up by Professor Liebig and M. Dumas, for presentation to the section next year.

Specific Heat of Alcohol and Nitric Acid.—Dr. Thomson read a paper on this subject, in continuation of one read at the Bristol meeting last year. He confirmed the law established by Petit and Dulong, that, for simple substances, the multiplication of the atoms by the specific heat, always gives the constant ·375; and he considered that for binary compounds this method of multiplication would give a product equal to $\cdot 375 \times 2$. The evolution of heat, when alcohol or nitric acid is mixed with water, he accounted for on this principle.

Effects of Vegetation on Carbonic Acid.—A paper by Dr. Dalton was read. By numerous experiments made in hot-houses, he had found that the quantity of carbonic acid was precisely the same both by day and by night, and was in no respect different in quantity from that of the external air. The idea that vegetation was necessary for the purification of the air, by decomposing the carbonic acid, he considered unfounded; for he calculated that in 5,000 years the respiration of the animals supposed to exist, would only produce ·001 of carbonic acid gas, in our atmosphere.

Crystallization of Metallic Copper.—Mr. Robert Mallet read a paper on some peculiar effects observed in a copper-mine in Ireland. He has discovered crystals of metallic copper adhering to the timber, in the mine which was covered with water; and there was but little doubt that they were produced by galvanism. Some specimens of native sulphate of copper and iron, from the same mine, were also exhibited, which appeared to present some anomalies in their composition, as their analysis did not agree with the usual atomic proportions.

Colouring of Gun Barrels.—Mr. Ettrick described a method of browning gun barrels. His plan consisted in mixing one part of nitric acid with one hundred parts of water, and applying this mixture to the barrel with a rag slightly moistened. This is to be repeated several times, and the rust rubbed off with a fine wire brush. The oxide thus formed is then to be coloured by applying a solution in the same manner, consisting of one part of nitrate of silver in five hundred parts of water: this is to be repeated several times, and the barrel then to be polished with bees' wax.

Influence of Earths on Vegetation.—It was the opinion of Chaptal and Davy, that an earth, to be fertile, must be composed of silex, chalk, and alumine. This is confirmed by the experiments of M. Pelletier, who adds, that it must be a simple mixture, and that the fertility will diminish in proportion as one of the three predominates, and nearly disappears where the mixture presents the properties of only one, and becomes almost immediately sterile if combination of the earths takes place. M. Pelletier recommends, to ameliorate the soil, the admixture of earths of different natures, marling, exposure of marls to the action of the atmosphere, ploughing or digging *(les laboures)*, composts, &c. We believe all this is perfectly conformable to the practice of the most scientific agriculturists in the neighbourhood of London. It is well understood by them that fertility consists in the mixture of varieties of soil, and it is a very common saying among them, "that a good digging in the summer is as good as a half dressing."

Hot Air Engines.—Some French engineers are busily engaged to supplant steam by means of compressed heated air. Two of them, M. Burdin and M. Bresson, have separately fallen, it seems, on precisely the same plan. The former has addressed a long letter to M. Arago, in which he maintains that his invention consumes only one-fifth the fuel of locomotives of the same power or pressure. The latter acknowledges that he has had great difficulty in practice, owing to the rapid destruction by the fire, of the parts forming the machine, as the valves, pistons, slides, &c. However, he has obtained a patent, and is now constructing an engine, which he calls "*Enginairfeu*," of six-horse power, which will set the merits of it at rest.

Steam Pipes to Locomotives.—In opposition to the almost unanimous opinion of engineers, we many months since stated our opinion, from a scientific investigation of the subject, that the steam was too much throttled in its passage to the cylinders; and we made some calculations, showing that the apparent phenomenon of high wheels working faster and more economically than low, was entirely attributable to the smallness of the supply pipe. This we believe has had the effect of calling the attention of engine-builders to the subject, and we have been informed by Mr. Roberts, of the firm of Sharp, Roberts, and Co., of Manchester, that they are building some engines for the Great Western Railway, in which the supply-pipes are 6 inches diameter, and that they expect thereby to gain the power of making a velocity at least 20 miles an hour more than with duplicates of the same engine in which the steam-pipes are of the ordinary size.

Mr. Crosse's Experiments.—Mr. Crosse, who made so conspicuous a figure at the Bristol Meeting of the British Association, was not this year at Liverpool. It was stated that the experiments made by this gentleman, in which living animals had been pro-

duced, have been negatively disproved by the total failure of others in the same way, and with the same object in view. It will be recollected that ours was almost—perhaps the only—journal of the day in which no account of such wonders appeared, and amidst all the excitement, the far-fetched hypotheses, and the extraordinary dreams of men to account for the phenomena, we quietly held our peace. In short, we did not believe the experiments; we simply thought it impossible either that animals could be so created, or so resuscitated after a lapse of some twenty or thirty centuries. We concluded there must be some error, and so it has turned out. Yet we must at the same time observe, that full justice should be done to Mr. Crosse for his other experiments, namely, those which relate to crystallization. Though we believe Mr. Crosse's merits on this subject are fully acknowledged, where they can be best appreciated, on the Continent, we are sorry to observe, that those among his own countrymen, who twelve months since would have licked the dust off his feet, are now ready to deny him that merit to which he is justly and honestly entitled.

Railway Experiments.—We mentioned in a former Number, that a grant was made by the British Scientific Association at Liverpool, for determining what is called "railway constants." Dr. Lardner, who is one of the Committee appointed, is gone to Liverpool for the purpose of commencing the necessary experiments on the Liverpool and Manchester Railway. Instead of trusting to the rough and erroneous statements of engine-men, we understand the experimental locomotives are to be supplied with an apparatus to enable them to record the details of their own performances, the rate at which they travel, the amount of their exertion, &c., &c.

Harbours and Sand Banks.—The storm on the 1st November raised such a bank of shingle at the mouth of the Dover Harbour, that none of the ordinary means, we have heard, would clear it, and vessels, unable to enter, were obliged to pass on. We have been informed by a gentleman of great experience at sea, that whenever these banks appear, it is almost invariably at the mouths of harbours running out perpendicularly to the coast, and seldom at those which run out very obliquely. Presuming on this, there would be but little difficulty in removing so dangerous an attendant in almost any case; nature herself points out the means.

Consumption of Ducks.—From the little town of Aylesbury, whose population is only 4,900, there are annually sent to London, through the hands of the higglers, 800,000 ducks, that is, about 160 for every man, woman and child the place contains. Verily this place must be a very thriving soil for the quacks.

Turnips and Mangel Wurzel.—There is an abundance of turnips and mangel wurzel in Norfolk, Suffolk, and Essex, and an almost total failure of the same, especially turnips, in Berks and part of Wilts. The earwig is the cause in the last-mentioned counties.

Let philosophers inquire why this year they are so abundant, particularly in new houses. To dahlias they have been destructive. A black grub now attacks the turnips, and what is remarkable, it is a class the ducks are unwilling to devour. These are facts the entymologist should account for. Another circumstance has occurred, that whilst the herring fishery is very successful, great quantities of cod are found, where formerly they were seldom caught. A manufactory of sugar from beetroot is established in Essex. Whether Government will be wise enough to forbear interference till a proper trial has been made, time will show. Our West Indians will not look on with indifference.

Steam Navigation Rivalry.—Though the Woolwich steamers have carried in the course of this season from 200,000 to 300,000 passengers, such is the effect of the lowness of their fares, that they have barely cleared their expenses, we hear, but have not anything in the shape of profit.

Stupendous Locomotive Engine.—On Thursday last, at the celebrated works of Messrs. Robert Stephenson and Co., of this town, the trial of a splendid and powerful locomotive engine, constructed for the Great Western Railway Company, took place. This machine is called the "North Star," and is destined for the Great Western Railway, and calculated to run at the rate of fifty miles an hour with fifty tons burthen attached, and with the tender only, at the immense speed of eighty. Several eminent engineers were present on the occasion, who expressed themselves highly satisfied with it.—*Tyne Mercury.*

The Married and Unmarried.—Some very curious facts on the subject of marriage, as connected with longevity, are stated by Dr. Caspar, in a letter of his lately published at Berlin. It had been long ago vaguely asserted that bachelors are less long-lived than married men. Hufeland and Deparcieux were of this opinion: and Voltaire observed that there were more suicides among those who had not given hostages to fortune than among those who had. Odier, however, was the first who set on foot the inquiry with exactitude, and he found (*Bibl. Britannique*, 1814), that, in the case of females, the mean duration of life for the married women of 25 was above 36 years; while for the unmarried it was about 30½. At 30 there was a difference of four years in favour of the married, and at 33 two years, and so on. It may be said, perhaps, that married females ought to be considered as picked lives; but, as Dr. Caspar observes, this is far from being generally the case, especially in the middle and upper classes of society; it is chiefly among the lower orders, where a livelihood is procured by labour, that importance is attached to the bodily health and vigour of the female. With regard to men, we gather from Deparcieux's and the Amsterdam tables, that the mortality of those from 30 to 45 years of age is 27 per cent. for the unmarried, while it is but 18 for the married; and that for 4

who attain the age of 40, there are 78 married men. The difference becomes still more striking as age advances. At the age of 60 there are but 22 unmarried men alive for 48 married; at 70, 11 bachelors for 27 married men; and at 80, for the three bachelors who may chance to be alive there are nine Benedicts. The same proportion very nearly holds good with respect to the female sex; 72 married women, for example, attain the age of 45, while only 52 unmarried reach the same term of life. M. Caspar, in conclusion, considers the point as now incontestably settled, that in both sexes marriage is conducive to longevity.—*Times.*

Expenses of Steam-boats.—A steam-packet of 100 horse power, equipped as it ought to be, costs about 20,000*l.*; expenses of fuel, wages, and victualling, about 250*l.* per month; tonnage duty, lights, pilotage, and port charges, 200*l.* per annum; insurance about 100*l.* per month; small repairs, and winter expenses, about 500*l.* These items, with the expense of boiler, which amounts to about 1,500*l.* in the ten years a vessel is calculated to last, and a reserve fund of about 2,000*l.* per annum, for the construction of another vessel, make altogether the sailing expenses of such a vessel about 1,000*l.* per month.—*The Reformer.*

Bank Notes.—Aggregate amount of notes circulated in England and Wales, by private banks and joint-stock banks, and their branches, between the 1st of July and the 30th of September:—

Private banks	£6,701,996
Joint-stock banks	3,440,053
	£10,142,049

—*Birmingham Herald.*

Alarm Gong.—In our Eighteenth Number we published an invention of a notice or alarm gong, by Captain G. Smith, for preventing accidents at sea. Our attention has since been called to the following, published in a journal now no more, in Nov. 1836:—

"Several plans have been suggested to prevent accidents from steam-vessels, some of which are deserving of attention. The use of the gong would, I think, be as likely to effect the object as any thing which has been named. It should, however, be confined to steamers, and the peculiar sound of this instrument would then sufficiently distinguish the approach of these vessels from all others. A kind of telegraphic code of sounds might be established,—short, but comprehensive enough to indicate which side of the river she was coming, and which way she was putting her helm. Still it is to be feared that during the fogs so prevalent at this time of the year, such accidents cannot be altogether prevented. It becomes then a matter of consideration how they may be rendered as harmless as [illegible]. We hear of vessels having 'their throats cut,' 'their [illegible] away,' 'their bows stove in,' of their being 'cut [illegible] their 'bulwarks carried away,' and even of more [illegible] as in the instance of the Red Rover, and many

others. It appears to me all these may be prevented by the use of 'fenders;' I would have every steamer provided with a set of substantial and efficient fenders, such as are used by ships when hauling into docks, or even more powerful ones. These might be slung within board ready to throw over at a moment's notice, and should be carried without board in thick weather and at night. Three might answer the purpose,—one across the cutwater, which might be triced up by day, and in fair weather, and one on each bow. In the event of a collision these would act like the buffers of the railway frames, and so effectually deaden the shock, that in most cases the vessels would rebound, and clear each other without any material injury accruing to either."

Cements.—Colonel Pasley said, that his attention had been directed to the subject of cements from reading in Smeaton's works that all water limes were composed of carbonic acid and clay; since, on dissolving these limes in carbonic acid, clay, of which brick could be made, was left. From this remark he had been led to make experiments similar to the following: he took *two* parts of chalk and *one* of clay. The chalk being pounded and mixed with the clay, balls were formed, which being burnt in a crucible, were ground and mixed as cements usually are. Some of these experiments failed, but he attributed their failure to his having used clay which was coarse and sandy; whence it appears that substances will unite when in the form of a fine powder which will not unite when in a coarser form. These experiments were made in the years 1829, 30, 31, and 32. Subsequently, in 1836, he repeated his more successful experiments, but without the same success; and he attributed their failure to the fact of the clay (the blue clay of the Medway) containing a greater proportion of carbonate of lime than it had contained five or six years before. Continuing his experiments, he found that *four* lbs. of dry chalk and *five* lbs. of the moist blue clay, fresh from the Medway, made the strongest cement, but he had determined many other proportions which set immediately under water. With cement made according to the above proportions, thirty-one bricks had been set out from a wall, one brick being added every day, omitting the Sundays. He had cemented bricks together, and he found in every case that the bricks gave way and not the cement. He estimated the breaking force at the joints at about 5,000 lbs. on the thirty-six square inches, the surface of the brick. On comparing the strength of this cement with the chalk mortar which had united some bricks more than thirty years, he was led to consider the adhesive power his artificial cement forty days' old as at least twenty times the power of the mortar.

Mr. H. H. Price called the attention of the Institution to the importance of ascertaining what are really the constituent elements of Artificial Hydraulic Mortars and Cements; several memoirs have been read before the Institute of France on this

subject, but they exhibit great discrepancies as to the principles of the formation of these cements. It is of the greatest importance to the engineer to know from the materials at hand how to make a cheap average hydraulic mortar. Colonel Pasley remarked that he considered Smeaton's Researches* as the only ones of value; the French philosophers had followed out many of his suggestions in great detail. Two systems appear to have been pursued in France, the one in which the substances are burnt previously to their being mixed, the other in which they are mixed in a state of minute division previous to their being burnt. The Aberthaw limestone used by Smeaton consisted of carbonate of lime and clay; *one* part of the lime from this stone and *two* parts of sand make a cement which sets very hard in time, but the joints must be protected at first by Sheppey or some similar cement. Mr. Lowe was of opinion that very much must be attributed to the presence of silica; this evidently played a most important part. Limes have exceedingly different qualities; two makers using the same quarry would produce very different limes; if lime is flareburnt, that is, burnt at a white heat, all the carbonic acid is driven off suddenly; the properties of lime burnt at a slow heat will differ much from the properties of the preceding. The mechanical mixing is also of the greatest importance; the Barrow lime is a natural hydraulic lime, but it must be well beaten with water and silica or sand.

The conversation on artificial cements being resumed, several members expressed their opinions on the causes to which the hardening of mortar was to be referred. Hydrate of lime is the basis of all mortars, but this will not make a water mortar, or cement, without the addition of a metallic oxide. The addition of clay will effect this, but most clays contain a metallic oxide. Mr. Francis Bramah gave the analysis of Dutch Terras, of Basalts, and of Puzzolana, according to different experimenters; in all these there is a considerable proportion of iron; and the addition of any of these to hydrate of lime will make a water mortar. Thus it appears that we must carefully distinguish between a good mortar, and a good water mortar, or cement. Hydrate of lime is the basis of both. Good mortar depends for its excellence on the slow absorption of carbonic acid, and the slow absorption of this is, according to Tennant, the essential condition for good mortar. It is remarkable that, according to Pliny and Vitruvius, the Romans kept their mortar for three years, and it is now the custom among builders to bury mortar, or to keep it in a cellar; it is thus prevented from absorbing carbonic acid from the atmosphere, or, in other words, from being reconverted into limestone. According to some experiments of Tennant it appears, that mortar in three years and a quarter will regain 63 per cent. of the carbonic acid of which it had been deprived. The absorption of carbonic acid

* See Smeaton's *Edystone*, Arts. 148—206.

being the condition of mortar hardening, if it be used under circumstances such that this absorption cannot take place, as under water, some other material must be supplied, and the addition of a metallic oxide appears to supply the required element. With respect to an hypothesis of Kirwan's which had been mentioned, as to the peculiar properties of iron and clay, Mr. J. I. Hawkins stated a singular fact which had come under his own observation, namely, that the rust of iron has a peculiar disposition to travel through moist clay; the rate of this transfer was in one case about *one* inch per month.—*Proceedings of the Institution of Civil Engineers.*

Ice Boat.—Mr. Ballard places strong planks, covered on their upper side with sheet iron, in the front of a boat, so as to form an inclined plane pointing downwards, the lower end of which goes under the ice. The boat, drawn by a horse, is steered by a person walking on the shore with a long shaft attached to a pole projecting over the stern. It is believed that one boat, horse, and boy, would thus break much more ice than three boats worked in the usual manner.—*Ibid.*

Rails for Railways.—The pattern, which Herman Kosler describes, is by American engineers called the inverted T rail (⊥), and was introduced in order to avoid trouble and expense, which railways are liable to where the rails are placed in chairs and fastened with keys. The material used for this need not be of first quality, but in cases where it is expedient to support a general confidence in the quality of the iron, good and sound rails can be made of two-fifths of No. 2, Welsh iron, and three-fifths of No. 3, employing the better quality for the head and bottom, and No. 2 for the stem of the rail, rolled in such manner that the lamina of the iron lie horizontally throughout. The experience of all railways seems to confirm the opinion that chairs and keys to keep the rails firm to their places are a great and expensive inconvenience, and a dangerous construction whether wood or iron be the material of the keys. The author then details the advantages of the rail, especially if laid on a continuous line of stone or wooden sleepers at a small distance apart. Wooden railways are at this time used in Germany, and the author has laid nine miles betwixt Leipzig and Dresden. Wooden sleepers, eight inches square, are placed upon trenches cut across the embankment at every yard, and filled up with a bed of broken stones, one foot deep. Notches three inches and a half deep are cut into these cross ties to receive the wooden rails of six by nine inches, which are shod with iron plates of one inch thickness and two and half inches width. At their joints they put together on iron plates one-eighth of an inch thick, to prevent their being pressed into the wood. The rails are wedged firmly to the sleepers by wooden wedges. The head of the spikes with which the iron rails are fastened to the wood are of a conical form and fit into corresponding holes, these having an elliptical form to pre-

vent the spike from being drawn or bent on the contraction and expansion of the iron rail. The ends of every iron plate rail are fastened with screw bolts, passing through the whole height of the wooden rails, firmly to their places, which is a very important precaution, as the engines are apt to catch the points of the plate rails with their wheel flanches and to run off.—*Ibid.*

River Cleaning Machine.—The application of this machine by W. B. Hays, to scour out small rivers consists in taking advantage of an artificial head of water to force on, with the assistance of a small current, a boat armed with scrapers. At the stern of the boat is lowered a vertical frame, with scrapers at the bottom, and to the sides of the boat, near the stern, are attached wings, which being opened out make a dam. Thus a small head of water may be obtained, and the boat is forced on; the mud and weeds being raked up are carried down to the mouth of the river.—*Ibid.*

Decay of Timber.—The decay of timber in contact with stone was discussed, and several instances were mentioned in which the only decayed part of timber was that in contact with stone. This decay is entirely obviated by inserting the wood in an iron shoe, or by placing a thin piece of iron betwixt the wood and the stone. Several cases were mentioned in which the iron shoe had been found a complete protection against dry rot and decay; a hard crust is formed on the timber in contact with the iron, which seems effectually to preserve it. It was suggested that the system of grouting must contribute to the early decay of timber; bond timber had consequently been replaced by bond iron. Bond timber is used very generally at Manchester, and answers exceedingly well, but the high temperature of the buildings may be a preventive against the decay of the timber, as the walls are very soon dried.—*Ibid.*

Levelling Machine.—Mr. Harrison proposes to construct a machine which should make its own section of the country as it passes over it. This machine, of which the general appearance is like a caravan, is to be drawn on four wheels by horses, the machinery being moved by the wheels of the carriage. A section is generally made by marking on the base line the lengths; and on perpendiculars through these points the heights; and joining the points so marked off. But in this machine the section is to be made by the continued motion of a point acted on by two forces, one of which would carry it in a horizontal line uniformly with the space gone over by the machine, and the other vertically, according as the machine is rising and falling. The machine is thus divided into two distinct parts for effecting these purposes, and the way in which this may be practically effected is described in detail by reference to an isometrical drawing accompanying the paper.—*Ibid.*

Chester Bridge.—Mr. Trubshaw presented to the Institution a model of the centre employed by him in the construction of the Chester bridge. The peculiar feature of this centre, which is

described in detail in the first volume of the Transactions, consists in the absence of horizontal timbers, the timbers being so arranged that their load is received end-ways, and in the lagging being supported over each rib by a pair of folding wedges. Mr. Trubshaw entered into the details of the construction and method of striking the centre, explanatory of the account contained in the Transactions.—*Ibid.*

Electric Magnetic Telegraph.—Mr. Alexander has exhibited a model of his telegraph to the Society of Arts, which is very fully described in the "Scotsman," from which we take the following abridged account: Thirty parallel copper wires are contained in a wooden chest, to correspond with the letters of the alphabet, the usual points, and an asterisk to denote the termination of a word. At one end, say the south, they are fastened to a line of wooden keys, like those of a piano-forte, with a letter of the alphabet, point, or asterisk on each. Each key has a wire which may be pressed down into a narrow trough of mercury, communicating with a galvanic battery of a pair of plates. At the other end of the chest are thirty magnets, about four inches long each, suspended over the wires, each carrying a square bit of paper, which, when the key is not pressed down, covers its letter or point, painted on a screen beneath. When the key is pressed down the magnet turns round, as is well known, carrying with it its paper, and of course uncovers the letter corresponding to that on the key; which again resumes its place, and covers the letter as soon as the pressure is removed, and the key flies back. In this way words are spelt, sentences communicated, and intelligence transmitted. To prevent having a return wire for each key, which would be needful to make a circuit, Mr. Alexander, a few inches this side of the magnet's end, terminates them all in a transverse wire, from which a single one proceeds back to the trough. The breadth and depth of the chest are each three feet, which it is considered would be sufficient for any length of communication. No one can doubt the ingenuity of this contrivance, but whether it will be successful for long distances remains to be proved.

REVIEW OF BOOKS.

A Review of Remarks on the Influence of Mental Cultivation and Mental Excitement on Health. By A. Beigham, M.D., *with Notes by* R. Macnish, M.D.

The value of a work is not to be estimated by its size. The *multum in parvo* may be applied to mental as well as material productions. This is true in the instance before us. It is a suitable appeal to parents and instructors, on a subject deeply affecting the rising generation. Nor is it founded on theory, or designed to

introduce a particular system. Whilst foreign and national authorities are quoted, upon well-authenticated facts the arguments advanced depend. The author proves the danger of too early exercising the mental faculties. The editor, in the advertisement, p. 5, says, that the brain is impaired by such early exercise, and a natural consequence is, the want of a healthy medium of manifestation, like a sparkling gem, which appears dim in muddy water. He adds, the plan too often pursued in modern education can only be attended with one result. A temporary blaze of intellect is excited, which astonishes and delights the deluded parent, but it is as a blaze of flax, whose rapid burst of brilliancy is almost as rapidly extinguished. The author shows that the intelligence displayed by highly-gifted children, is in most cases the effect of disease, or of a state of brain closely bounded thereon. He is no materialist. He only advocates the intimate connexion between the brain and the mind. He mentions the weight of the brain in a new-born infant, and compares that with an adult, and states that in childhood it is soft and almost liquid, and its different parts cannot be clearly distinguished. Still at that time it is supplied with more blood, in proportion to its size, than at any subsequent period. It then grows most rapidly, more so than any other organ; hence the nervous system being connected with the brain, is early developed, and becomes the predominating system in youth. "Infancy," the celebrated writer on general anatomy remarks, "is the age of sensation. Everything attracts the notice; that which to us is an object of indifference, is to the child a source of pleasure. It is then necessary that the nervous cerebral system should be adopted, by its early development, to the degree of action which it is then to have." The tendency of too early mental excitement to produce insanity is powerfully exhibited, and well deserves the serious consideration of those who are solicitous to render their relatives distinguished for precocious attainments. The sixth section on moral education and the influence of example cannot be too closely studied. In p. 105, the author says, "The great object, therefore, in moral education should be, to call into repeated action those organs that manifest the good qualities, and increase their activity and power. For this purpose it is necessary to study the character of children when quite young, and when certain moral qualities appear to predominate, that are likely to produce bad traits of character, great efforts should then be made to call opposite qualities into activity." We will not discuss the question, whether phrenology ought to be ranked as a science, but we may be allowed to assert that it presents useful hints to the reflective observer. If selfishness be discovered in a child, what virtuous parent would not wish to inculcate benevolent feelings; if pride and a desire to domineer over others be witnessed, what Christian instructor would not aim to recommend meekness and brotherly affection? None will doubt the efficacy of good example and

the importance of selecting subjects for imitation, who may be most worthy of being imitated. Dr. Brown has in vol. ii. some admirable observations on this topic, and Dr. Dugald Steward has elucidated the same in his chapter on the principle of sympathetic imitation. Let it not be supposed that because Dr. Beigham contends against too early employment of the brain, that he objects to its cultivation at a proper time. The seventh section is occupied in proving, that instead of its then being injurious, that it contributes to the promotion of health. The eighth section contains an inquiry into the influence of mental cultivation, in literary persons, in occasioning dyspepsia. The author considers that irritation of the brain is one principal cause of that disease. We have entered more largely on the contents of the work, than from its smallness might have been expected; but those of our readers who will carefully peruse the publication will thank us for having recommended it to their examination.

A Practical Treatise on Warming Buildings by Hot Water, and an Inquiry into the Laws of Radiant and Conducted Heat; with Remarks on Ventilation, &c. &c. By Charles Hood, F.R.A.S., &c. Whittaker and Co., London.

Various methods of warming buildings have had their "rise, progress, and decay." All, however, have hitherto failed to afford a system free from objections; even our powerful agent, steam, which was much used at one time for this purpose, has almost ceased to be employed to any considerable extent. The method of warming by hot water, has, of late years, been much used, and its application is rapidly extending. The present appears to be the first treatise which has been written on the invention, combining practice with theory; and it seems to treat very fully and scientifically upon the subject. Much of the first part of the book is of a practical character, interesting principally to those who wish to erect or to use this description of apparatus. It contains, however, throughout, much scientific matter, and, in the second part, which treats "on ventilation," and on "the various methods of distributing artificial heat, and their effects on animal and vegetable physiology," not only are the researches of the chemist and the physiologist made available, but the various branches of physical science are laid under contribution, and applied to the illustration of the subject. The chemical changes produced on atmospheric air by respiration, and by the various methods employed for distributing artificial heat, have been far too little considered. They exert a most material influence on health, and therefore affect, more or less, every individual. Seeing the great importance of the subject, and how much it has been neglected, the Institution of Civil Engineers have proposed this as one of the principal questions for discussion during their ensuing session. The popular illustration of these matters is worthy the

attention of men of science, and Mr. Hood appears to have performed his task in a manner deserving of great credit. The book contains much valuable information, and will undoubtedly become popular; for the style is unaffected and clear, and the subject interesting, not only to the man of science, but to every individual who values health and comfort.

Grand Junction Railway Companion. By Arthur Freeling. Henry Lacey, Liverpool; and James Wyld, Charing Cross, London.

This little work, which has an almost unprecedented run, gives a neat history of the undertaking, and concisely describes every town, object, and place of interest on and near the line. To it is prefixed an excellent map of the whole railway on a large scale, showing the towns and stations, gradients, curves, cuttings, and embankments throughout. The whole forms a neat little and very interesting pocket companion.

Blunt's Civil Engineer and Practical Machinist. Ackerman and Co., Strand.—Engineers, &c., will be glad to hear that division B of this work will appear in the early part of December.

Conversations on the Human Frame and the Five Senses. By the Author of "Aids to Developement," "A Gift to Mothers," &c. Printed by Darton and Clark, Holborn.

No stronger proof can be required of the superiority of modern over former plans of education, than the class of publications now written for the benefit of the rising generation. The memory was formerly burthened with stores which were only fitted to excite the imagination and mislead the judgment. Mind is now called forth. Subjects are introduced that awaken useful inquiry, inform the understanding, and amend the heart. To this character the work is justly entitled, which is prefixed to these observations. It is written in plain but correct language. Scientific terms are accurately explained, and pictures are added to render the subject intelligible to every reader. The conversational form is adopted, in which a mixture of piety and affection is well combined. The work does the publisher credit, who has presented it in a dress as suited to the drawing-room table as to the school library. There is a propriety in this plan; as the subjects discussed belong to every class of the community, and are especially interesting to parents, and to those who are to instruct the young. To such we warmly recommend the perusal of these conversations.

Researches, Antediluvian, Patriarchal, and Historical. By T. Clarkson, M.A.

The name of the writer will excite attention; a name that future ages will venerate, not only as the historian, but a chief agent in accomplishing the abolition of the slave-trade. The motive for this publication is stated in the preface. "One evening an inquiry

arose in my mind—how the first men obtained a knowledge of God and religion. To this an answer seemed ready—from a revelation made to them by God himself. At that moment the decalogue was recollected. But it immediately occurred to me, that this answer was not satisfactory; for this knowledge of God and his laws had been given to the second race of men, who were the descendants of Noah; whereas the question related to the *first*, namely, to Adam and his descendants. I therefore resolved to give the subject a full investigation, and commenced by a careful perusal of the Pentateuch. The book of Job was closely examined, which the revered author considers to have been written before the time of Moses. He proceeded to study the accounts of the patriarchs, and the historical books of the Old Testament. The result is given in the first part of the publication, "that the great principles of morality, or the distinction between right and wrong, was made known soon after the creation." The second part contains an inquiry into the notions which prevailed among the Jews, the Samaritans, the people of the East, and the Romans, at the coming of Christ. Hence he draws the conclusion, that in the fulness of the time predicted, the desire of the nations appeared. The style of the work is plain. The author is cautious to avoid rash conclusions. He therefore occasionally prefers repetition to want of precision. His wish is to search for truth. It is pleasing to see, in advanced age, the mind thus employed. Nay more, when the sun is almost gone down, benefiting posterity by its setting ray.

The History of the Christian Religion and Church during the three first Centuries. By Dr. Augustus Neander.

This work was written in Germany. The author has acquired celebrity in that country. The Rev. H. Rose is the translator. He asserts, that he has "endeavoured to transcribe faithfully the ideas of the author, and in words as nearly approaching to his own as possible. In translating a work of imagination, the great point is to convey the spirit of the original; in translating the history of the Church, to say every thing the author says and nothing whatever he does not say. A paraphrase is dangerous in subjects where one word may make a considerable difference." We perfectly accord in Mr. Rose's opinion, and give him credit for the greatest fidelity in the translation. We also approve of the candid manner in which he has stated his own views, in some cases differing from those of the author. His expressions are—"The views which the author has propounded in this work, he has honestly embraced and maintained them with a zealous love of truth, and in a truly Christian temper; but still I cannot accede to the arguments by which some of them are supported, especially those which relate to the early form of Church government." The reader will not wonder at this when he peruses the work, and

remembers the translator is a fellow of St. John's College, Cambridge. He will rather express surprise that it should have been undertaken by a clergyman. His motive deserves praise to introduce an useful work to the knowledge of Englishmen. It embraces subjects at all times important, but especially in the present state of religious inquiry into the formation of the church, church discipline, and church divisions. These subjects are discussed in the second section. In the third, the History of Schisms, and subsequently public worship, its forms, and times of observance. The style is sometimes obscure, which arises from two causes, the one from crowding too many ideas in one sentence, the other from the difference of idioms in English and German. This volume comprises only part of the author's plan, and we shall look forward to its completion with peculiar interest. It breathes a spirit calculated to benefit both Churchman and Dissenter; and imparts information without bitterness, and invites inquiry by stating the evidence on which opinion is advanced. Well would it be for the world if such a proceeding were universally adopted.

Railway Practice. By S. C. Brees, C.E. 4to. John Williams, Library of Science and Art, 106, Great Russell-street.

This work, which has just appeared, contains a collection of working plans and details, from the many great public works executed and in progress, in near ninety large folding plates. The author might well call his book "Railway Practice," for nothing appears to be his object but to make a plain useful work for the practical engineer; ample in the various details and descriptions, yet unencumbered with superfluous matter. To the illustrations of existing works, the author has added twelve plates of original designs, for bridges, tunnels, viaducts, &c., in various styles of architecture, in which he has shown considerable taste and compass of invention. We quite agree with him that ornament in railway works has been too much neglected. We certainly should be the last to advocate extravagance in any shape, but we do think with the author, that where "such enormous sums are being expended upon railway works, the opportunity should not be lost of erecting edifices which should command the attention of the refined and contemplative, as well as of the scientific, of future ages."

RAILWAY NOTICES.

American Railway Rails.—The Americans have lately shown a decided preference for the inverted T rails, as adopted by our most celebrated English engineers. This form, laid on continuous Kyanized wooden bearers, probably is an improvement that is not

likely soon to be surperseded, either for strength, durability, or comfort to the travellers.

Birmingham Railway.—It is not usual with us to notice railway accidents, because we do not think they come properly within our sphere; but two having lately succeeded each other on the Birmingham Railway, one of which has excited considerable sensation, we have inquired into the circumstances of it. Strange to say, it appears that of all the establishment, the men only who accompany and manage the engines are those which are not under the immediate control of the Company. For the purpose of insuring speed and efficient engines, the Directors contracted with Mr. Berry, of Liverpool, to supply engines, at his own cost and expense, to do certain duties, at so much per mile; and hence the reason of his own men working them. The inconveniences of this arrangement have, however, been felt, and will be shortly altered, at least so far as concerns the control of the men. In the case in which the unfortunate accident of the 4th ult. happened, by which one man with the engine lost his life, it appears that the men had been drinking a little too freely, and were putting the engines forward at a fearful rate, over what is called the galloping ground, that is, in a cutting, when, finding the engine pitching violently, they suddenly put on the damper, and arrested its progress. The whole train, with the tender, of course immediately came on the engine, and as the train was then running in a curve, though not a sharp one, the central buffer of the tender struck that of the engine, probably so obliquely as to cause a heavy lurch, and drive it off the rails. The engine itself seems to have tumbled over, and what is very remarkable, fell within the curve, while the tender was thrown without. The poor man who lost his life seems not to have been the one in fault, but another who escaped. Lamentable as this accident is, it does not appear that the Company's immediate servants were at all to blame. It seems that the guard was so much alarmed at the immense speed he found the train going at, as actually to apply the brake in one instance, and frequently to caution the men, which was unattended to.

Belgian Railroad.—Brussels, Nov. 18.—We are assured that the subscriptions opened yesterday at the Bank of Belgium for thousand shares of the Rhenish Company of the iron rail-road from Cologne to the Belgian frontier, amounts to the immense sum of 629,000 francs. The result of this subscription gives one certificate for 30,000 francs, and one for a sum below that amount. For every demand exceeding a million 34 certificates will be given for the first million, and one for every additional 300,000.—*Sun.*

Birmingham and Gloucester Railway.—In the "Birmingham Herald" of October 26, appears a series of questions and answers to and from Mr. Locke, relative to the capabilities of this line and the estimates, of great interest to the shareholders. From a recent examination of the traffic, it would appear that the opening of the

Grand Junction line has so much increased the existing traffic, as to raise the profits from 8 to 12 per cent. on the capital.

Birmingham and Derby Junction Railway.—The line of railroad between Hampton-in-Arden and Tamworth is being staked out.—*Philanthropist.*

Brighton Railways.—We regret to see the want of unanimity between these concerns of quondam rivalry. Mr. R. Stephenson has published another report, much too long for our pages, on Captain Alderson's, in which he condemns almost everything the latter has recommended, an answer to which, we understand, will be given by Captain Alderson. Mr. Mills again, the engineer of Cundy's line, has held meetings, in which he complains of his own Committee in not having proceeded, when, if our recollection be right, it was owing to some defect in the engineer's plans, by which they could not pass the Standing Orders. Again, in our advertising columns of this number, appears a strong but temperate letter from Messrs. Pearson and Wilkinson, solicitors to the railway without a tunnel, (Cundy's line that was,) to Thomas Wood, Esq., Secretary to the consolidated line, calling on his Directors to convene a meeting of all the shareholders, and to reopen the question as to the merits of the respective lines. All this argues an unsettledness and a turbidness in the component elements, for which we are sorry there should be, if there is, any cause. As to our part, we abstain from making any observations on either side, because, in the present state of things, we really could not do it in fairness to our readers and to all parties. We anxiously await the report of Sir John Rennie and Mr. Rastrick, which, we are informed, by deviations here and there—with the perfect concurrence of the landowners, when beyond the Parliamentary limit,—will exhibit a much improved section, and free from many of the objections of the one that passed.

Bristol and Exeter Railway.—Bristol, Nov. 22, 1837.—Sir,—In your number for the present month, I find a very circumstantial and highly satisfactory report of the state and character of the works of the Great Western Railway; and it rejoices me to learn that there are solid reasons for believing that the expectation of the Directors to open the line as far as Maidenhead before the end of December, will be realized. But there is another line immediately connected with the Great Western, regarding which you do not give any information. I mean the Bristol and Exeter. Your silence startled me the more, as the report in your preceding number was so exceedingly favourable, especially as to the probable revenue, and as the Directors had declared themselves to be so fully determined to prosecute the undertaking with vigour, that I had made up my mind to double my interest in it, if your Magazine for November should bring any corroborative statement. Finding myself deprived, however, of this guide, and having a day to spare, I took a ride down the line from near Hill's Bridge, where it is

intended to join the Great Western down to Backwell and Nailsea; at these two points I found a great number of men employed, and, to my agreeable surprise, a considerable portion of the line, with the requisite bridges and other works completed. Similar activity was observable on either side of Cambridge Batch, Yanly Lane, Long Ashton Brook, Great Engine Coal-works, Bedminster Down, Knowle Lane, Redcliff Mead, and Pyle Hill.

The practicability of thus forwarding the operations at so many different points at the same time, which arises entirely from the natural advantages of the ground, will, I should presume, if the Directors redeem their pledge of applying all due vigour to the prosecution of the undertaking, insure its very early completion, without any necessity for that heavy expense which must always attend the crowding particular places with large numbers of men. It struck me also as worthy of observation, and as evidencing superior management on the part of the contractor, that the whole of the work is executed with locomotive engines upon sound temporary rails, which he has laid down in so effective a manner, as to be, in my humble opinion, fully equal to those of more than one permanent line.

The height of the embankments being only a few feet, the locomotive engines are available from the commencement to the very close of the works; and, as soon as the permanent rails are laid down, the railway will be ready for travelling; as it will not be necessary to wait for the settlement of the embankments.

Should you have no other communication on this subject for December, perhaps you will do me the favour to insert this.

I am, Sir, your obedient servant, A SHAREHOLDER.

To the Editor of the Railway Magazine.

Chester and Crewe Railway.—We perceive, by an advertisement in our present month's wrapper, that the Chester and Crewe Railway Company, who, we believe, lost their Bill last year by the death of the King, intends again to proceed to Parliament. The line itself is one of unusually favourable gradients, and very light in its earth-works. Though 21 miles long from Chester to Crewe, where it joins the Grand Junction, the estimate is only 240,000*l.*, or 11,430*l.* per mile. It appears, too, from the report in the advertisement, to which we refer our readers, that the estimated profits will be 13½ per cent., a sum no one ought to grumble at.

Cork and Passage Railway.—The first General Meeting of this Company will take place at Cork on the 1st of January next. We hope the Directors will not be discouraged from proceeding, as from all we have heard it is likely to be a very profitable speculation, from the immense number of passengers.

Naples, Oct. 29.—The railroad from this city to Castellamare will be commenced in the month of November. M. Bayard, of Paris, the contractor, arrived here several weeks ago.—*Morning Chronicle.*

Dublin and Kingstown Railway.—The returns on this railway are steady and productive. Every half year a portion of the Government debt is paid off. The extension to the packet wharf at Kingstown has been productive of the very greatest accommodation to the public, and convenience to the Post-office.

Eastern Counties Railway.—Neither our friends the Directors, nor the wonder manufacturing Secretary, have dared to accept our invitation to disprove our computation of their traffic. Gross receipts of 127,000*l.* per annum, indeed! to the poor little town of Chelmsford, above those of the Liverpool and Manchester line, 3 miles longer, too, could never have been put forth to be discussed, and it was probably very naughty of us to attempt it. We are happy to hear that the Directors intend to follow our advice, and publish no more of this silly twaddle, which might do to make bumpkins stare, but only gets laughed at by others. Some of them, we believe, are heartily ashamed of that stupid document, and others issued from the Board. Who is the author or authors of all this nonsense, why not silence or give him or them a gentle hint to quit? Are they afraid, or dare they not? By-the-bye we forgot to put a question or two relative to the last report, which we hope the Directors will pardon us for omitting so long.

1st Question.—Was it not distinctly stated at the General Meeting, July, 1836, that there were no outstanding debts? And were not some accounts that came in afterwards refused payment on that score? If this be true, how came 1,510*l.* in the last report for outstanding "accounts subsequently presented and audited?" We have no doubt—we could not suppose otherwise—but that these accounts were all bonâ fide due, but we simply ask how the books could have been kept, that 1,500*l.* should be owed, and not known?

2d question.—We much admire the very pretty manner, as every one must, in which William Heath, Esq., moved for 1,500*l.* to the Provisional Committee for past services, and 2,400*l.* per annum for future. It was all the kinder, as Mr. Heath did not, as he said, know or was known to any of the Directors. Pray, may Mr. H. be any relation to a gentleman who then held, and we believe now holds, a post of 150*l.* per annum, or thereabouts, for doing something in the Company's offices? This question is, of course, one of mere curiosity, and we beg pardon for it if considered any ways too free.

3d Question.—It appears, per last report, that the amount spent for engineering and works had been 9,101*l.*, and the annual amount of the engineering, 7,000*l.*; which, taken from the former, leaves 2,101*l.* for the sum spent on the works. Add to this 35,424*l.* paid for land and compensation, and 6,112*l.* said to be due for ditto, and we have 43,637*l.* paid and to be paid for

works, land, and compensation, of which the works amounted only to 2,101*l.* Now, the total amount received, 113,231*l.*, deducting a "nett balance" in hand of 10,943*l.*, leaves 102,288*l.*, which has all disappeared, if we understand the accounts, for executing 2,101*l.* of works, and paying for land and compensation, 41,586*l.*; that is, 102,288*l.* have vanished,

"Leaving not the baseless fabric of a wreck behind,"

except a little printed paper, a little land, and 2,101*l.* of something called works. If we are wrong in this, we hope the Directors will set us right, for we have no desire to misstate or undervalue anything.

4th Question.—Is it true that two of the officers hold about 3,000 shares, that is, to the amount of 75,000*l.* of the capital between them? We do not ask whether the calls have been duly paid, because as honest and honourable men towards the other shareholders, the Directors have no doubt insisted on that; but we cannot help admiring, if it be so, that the Eastern Counties should have for servants a couple of men who could spare out of their private funds, 75,000*l.*!!

5th Question.—By the report the "engineer's department for remainder of 1837," that is from July 4th, not a half-year, is 3,500*l.* Do we understand this aright; namely, that one officer's staff, all, we believe, kept under the Company's roof, amount to 7,000*l.* per annum, the fruits of which in works for the last year have been only 2,100*l.*?

The Directors will please to pardon our troubling them with the above few, out of many things we do not probably understand as well as they do, in the report and accounts. We ask for the information of others, as well as of ourselves, and, of course, our pages will be open to them to reply.

We do not put questions we have been requested to do, respecting the amount paid on the last call, namely, whether it reaches 5,000*l.*; nor do we make any observations on what we have heard of a threatened prosecution of a Liverpool shareholder for non-payment, and of the feeling it has excited among the Liverpool proprietary, because we are not desirous to rake up any difficulties the Company may have. For like reasons we shall not quote a clause in the Act (§ 128), as requested, by which it is said that 20 shareholders holding among them 500 shares might call a meeting if the Directors refused, and dissolve the Company.

Now, seriously, seeing all the difficulties around them, would it not be better to close this concern at once, than to spend any more of the hard earnings, perhaps, of many of the shareholders? We ask this in sincerity and friendship, and we hope it will be attended to.

Foreign Railroads.—The railroad system appears to have gained more favour in Austria than in some of the minor states of Germany. While the King of Bavaria declares in an official ordinance that he will make no concession to the proposed railroad between Manheim and Darmstadt, a letter from Vienna, dated the 30th ult., states that the Emperor would in person lay the first stone of the Great Northern Railway, and would, with the Empress and the whole *corps diplomatique*, make the journey from Wigram.—*Times.*

Greenwich Railway.—Before the publication of our present Number, we believe Mr. Macintosh will have commenced operations for the arches between the Ravensborne and Greenwich; so that all doubt will be removed as to its completion into Greenwich. Should the weather remain open during the winter, the works are expected to be finished in the spring. It appears that the Croydon Railway will commence running in May next, which must greatly benefit the Greenwich line.

The traffic on this line, notwithstanding the shortness of the days, the advanced period of the year, and other disadvantages, continues to average about 3,700 passengers daily; the average daily receipts exceed 84*l.*, or 590*l.* per week. The present length of this railway is 3¼ miles, which distance is daily traversed by three locomotive engines, making 56 trips between London-bridge to Deptford, and 56 more from Deptford to London. Each of these engines daily makes 38 journeys *, and consequently runs over 120 miles of rails each day. There has passed along this railway, from the 14th of December, 1836, to the 23d November, 1837, a total of 1,376,589 passengers, and the number of miles travelled by the engines, between the same dates, exceeds 214,400 (no account being here taken of the extra hours of running). It is a remarkable fact, that not one serious accident has occurred to any of the passengers during the whole time, now upwards of a year and three-quarters (the carriages first ran for hire on the 8th of February, 1836), that the railway has been open to the public, and during which time but two lives have been lost by accident. Can as much be said of coach travelling?

Grand Junction Railway.—This Company is preparing to go into Parliament, for a new line from Prescot-brook, near the foot of the Whiston incline, to join their present line at Huyton. By this means they will avoid the two inclined planes, the Whiston and Sutton on the Liverpool and Manchester line, and the Warrington incline on their own line; and will shorten the distance from Liverpool to Birmingham 7½ miles. The distance by the proposed

* In this number are included the journey up to London at a quarter to eight in the morning, to take down the first train to Deptford, and the last or return journey from London to Deptford, after ten o'clock at night, without a train.

new piece, over Fidler's Ferry is nine miles, by the route now taken round Warrington it is sixteen. The estimate for the new piece is about 250,000*l.*; we have, however, been since informed, that 300,000*l.* or 400,000*l.* will not complete it. If so, it must be acknowledged it is a serious sum to lay out, almost before the shareholders will have derived the slightest benefit from the present line. We understand the Company could divide a profit of six per cent. for the first half-year; but it is intended to divide only five, or at the rate of ten per cent. per annum.

Great Western Railway.—We hear that the line is completely formed from Paddington to Maidenhead, with the exception of about six miles, which has the ballast on the spot ready for being put on. The culvert which has given way at Paddington is not under the railway, nor does it interfere with it; but under a new road made by the Company in lieu of a turnpike road. We understand it was built under the direction, and from a plan laid down by the Court of Sewers. The figure was certainly bad. It consisted of a circle with its lower part cut off. From the excessive pressure of the superincumbent embankment on the extremities of the circle, these probably sunk, and the chord burst up in the middle from the resistance of the sub-soil, which was also accompanied with a similar burst inwards of the sides of the arc. We have inquired at head-quarters, and have been assured that not the least apprehension is entertained of the slip at Hanwell, mentioned in our last, delaying the opening of the railway. The Company intend to borrow 800,000*l.*, as permitted by Parliament, to complete the works.

Great Central Irish Railway.—We are informed the plans have been all lodged, and all the necessary formalities complied with, to renew the application to Parliament in the ensuing session.

Great North of England Railway.—The contract for the formation of about eight miles of this railway, south of Darlington, was let on the 31st ult., the works of which will be commenced forthwith.—*Hull Advertiser.*

German Railroads.—It is so confidently hoped that all our iron railroads will be duly completed, that negotiations are already on foot for establishing steam-boats between Stettin and London, when the railroad to the first place shall be finished. A negotiation for the abolition of the Sound duties is even spoken of, which seems a ticklish question. Stettin is certainly making great efforts to rival Hamburgh, which will then find a railroad necessary, and the plan has been several times proposed to it. Our first merchants say these circumstances will bring Hamburgh to join in our tariff. —*Berlin, Oct.* 11.—*True Sun.*

Hull and Selby Railway.—The name of this railway will, ere long, we expect, be changed to that of the Leeds and Hull Railway—a much more appropriate title. Two more contracts

are advertised for this line, which will make 17½ miles out of 30½, the whole length of the line, and the works of the part already under contract are proceeding with vigour. Early next spring the works will commence near Hull, which have been hitherto delayed on account of the demands of the parties owning the Foreshore. The Wrighton embankment is proceeding rapidly, and so are the bridges over the Ouse and the Wrighton Canal. 20,000 tons of iron rails were contracted for before the rise in iron, and therefore on favourable terms. We hear the second call of *5l.* has been responded to exceedingly well, which is scarcely remarkable with so respectable a proprietary. Bad as last year was, we understand the export of cotton twist from Hull amounted to 60,359,519lbs. What will it amount to when Hull comes to be connected, as it will be by the railway, with the great commercial towns of Liverpool, Manchester, &c.?

Lancaster and Preston Railway.—The whole line of railway has been remeasured, and some slight variations and improvements have been determined on. We understand the plans for the owners of property on the line are now mostly made out, and that the Directors are engaged in negotiations for the purchase of lands with the various owners through whose property the railway is intended to pass.—*Lancaster Guardian.*

Manchester and Birmingham Railway.—We are authorized to state, in the event of the Manchester and Sheffield Railway being abandoned, it is the intention of the Directors of this Company to consider carefully the best means of connecting, by a desirable branch, Ashton-under-Lyne, and Staly Bridge, with their intended main line, so as to give to that important and extending district the benefit of a railway communication with Manchester.—*Manchester Guardian.*

Manchester and Sheffield Railway.—Notwithstanding the efforts of many individual shareholders in this concern to break it up, we are assured that the main body of proprietors are extremely desirous and fully determined that it shall go forward. The character of Lord Wharncliffe, the Chairman, and of the other Directors, is quite a sufficient guarantee to the public of the soundness of this great undertaking. We understand that the statement of the prospects, accompanied by authenticated tables of traffic, are now printing, and will be put before the public very shortly. The misrepresentations of overspeculators will be completely refuted, and one of the most interesting and important railways be better understood. The General Annual Meeting of the Company at Sheffield, in the very early part of February, is looked forward to with great anxiety; and a trial of strength between discontented and perhaps impoverished subscribers, and the extensive and sound proprietary, will, we doubt not, end by placing the concern in a much higher light.

Midland Grand Junction Railway.—Active measures are

now being adopted towards the introduction of this project to the notice of Parliament.

Midland Counties Railway.—The works between Nottingham and Derby are proceeding with great spirit under that active and experienced contractor, Mr. William Mackenzie, who was the confidential assistant of the celebrated Telford, and, as such, had the management of some of his most important works. The district between Rugby and Leicester was let in the beginning of November to the Messrs. Macintosh; and the remaining unlet portions of the work from Leicester to the Trent, including the Trent bridge, will be finally concluded on the 22d of December. There is no doubt that the whole of the railway will be efficiently completed and opened to the public in the summer of 1840; and without exceeding the capital of the Company. Mr. Vignoles is the principal engineer of this important line, and Mr. Thomas Woodhouse, well known as long connected with railways, is the resident engineer. Some of the designs for the constructions on this line are represented as combining economy with much taste and novelty of construction, without in the least trenching on the proper solidity necessary in such great works.

We have just seen some interesting and authenticated tables of traffic on this line, with all the particulars set forth, in which the existing traffic, taken at railway prices, amounts to above 11½ per cent., the whole receipts being estimated at 98,547*l*. Now this is something reasonable; men can believe it. It is not like the Eastern Counties document, which frightens one half who read it, and puts into convulsions the other. The Secretary of this Company is a respectable veracious man, who does not deal in the marvellous.

Newcastle and Carlisle Railway.—The Directors of this line of railway intend to apply in the ensuing Parliament for powers to enable them, by raising a further sum of money, to finish this important work. We regret that this plan had not been sooner entertained, as, if it had, the Directors would have been enabled, at a much earlier period, to have brought the work to a completion. —*Newcastle Journal.*

Newcastle-upon-Tyne, Edinburgh, and Glasgow Railway.— We are glad to learn that this undertaking is making rapid strides in public estimation.—*Newcastle Journal.*

North Union Railway.—The late accident on the works of this line, by the failure of the great culvert over the river Yarrow, will not occasion any delay in the opening of the line on the 1st of August in next year; neither will the amount of damage be so great as was at first supposed. We shall hope to obtain, before our next publication, some particulars about the accident, as well as the mode in which the passing of the Yarrow will be reconstructed, and, if so, we will not fail to lay them before our readers.

On the south, or Wigan end of the line, three fine locomotive

engines are at work, bringing down the materials for completing the great embankment, which almost forms a fortification round the sides of the town. The beautiful iron bridge over the Wallgate-street is advancing.

At Preston, the magnificent bridge of five arches, each of 120 feet span, is in a forward and very interesting state. Four complete sets of centres are up, and the fifth in course of erection. The north arch, next the town is keyed. The second arch, over the deepest part of the Ribble, will be keyed before Christmas, and the whole of the arches will be complete early in May, and perhaps sooner.

The utmost activity prevails everywhere along the line. The stations are in course of construction, and the tunnel under the principal street of Preston, to connect the North Union Railway with the Preston and Lancaster Railway, has been commenced.

Engines and carriages are building at various places, and there is now no doubt that the continuous line of railway from London to Preston will be open to the public next summer; as, by the time the North Union Railway is ready, little will remain to be done on the London and Birmingham Railway.

Northern and Eastern Railway.—The Directors have determined on carrying on the works from Tottenham Mills to Broxbourne during the winter. This part of the line for eleven miles is a dead level, and the embankment to be formed is little more than what is necessary to secure the necessary dryness. Should the winter be sufficiently mild, the works between Tottenham Mills and Kingsland Turnpike, will also be proceeded with simultaneously, but the brickwork on this part renders caution necessary to guard against probable frost. The prospects of this railway are most encouraging.

Prussian Railroad.—The cost of the railroad to be constructed from Strasburgh to Basle is estimated at twenty-five millions of francs. The subscription in the two cities already amount to nearly sixty millions of francs.—*Mining Journal.*

Preston and Wyre Railway and Harbour.—The works are proceeding vigorously, and in a highly satisfactory manner. The embankment with the harbour will be fully completed early in the ensuing year, or spring; and the principal part, if not the whole of the line, will be open for traffic in the autumn. We hear there is now little or no doubt but this will be the connecting link of communication between London and Glasgow, *via* Ulverstone; as this appears from a recent survey to be the line that will be adopted, and if so, the advantages connected with this undertaking will far exceed the expectations originally anticipated from it.

Railroads in Austria.—The Austrian Government has at length resolved on executing a double project of vast utility to its Italian possessions—that of establishing two railroads; one from Vienna

to Trieste, and the other from Vienna to Milan. A regular weekly steam-boat communication is already established between Trieste and Venice, and this station will receive an adequate augmentation of its efficiency when the railroads are finished. The railroad from Venice to Milan is to be subdivided into three branch lines; the first, sixty-two leagues in length, will intercept the whole Lombard-Venetian Kingdom; the second, about the same length, will traverse Mantua, Lodi, the Milanese, and the whole of Lower Italy; and the third, sixty-four leagues in extent, will traverse the rich vicinity of the Lake of Guarda, and pass the great towns of Brescia, Padua, Vicenza, and Verona.—*Augsburg Gazette.*

Railways in France.—As we were on the eve of going to press, we were favoured with a sight of the report of M. Vallee, "Ingénieur en Chef Directeur des Ponts et Chaussées" to the French Chambers. The report is too voluminous to allow us the opportunity of referring at present to it in detail. The line proposed by M. Vallee is intended to pass from Paris by Creil Clermont, taking the course of the rivers Are and Noye to Amiens. Hence the line proceeds eastward along the rivers Ancre and Sensée by Corbie Bapaume, Vitry, Douai, and Henin, Lietard, to Lille, and from thence to the Belgian Frontier, falling into the line to Ghent, Ostend, Bruges, and Brussels. Westward of Amiens the line proceeds along the valley of the Somme, by way of Abbeville, Rue Montreuil, Etaples, to Boulogne and Calais. A branch is also contemplated to Dunkirk. We understand that the capital necessary for these works has been already subscribed, and it remains only to be seen whether the French Government will entrust a private Company with powers to execute them, or undertake them themselves as a national work, like those of Belgium. The prevailing opinion in Paris is, that the latter course will be adopted. All parties, it appears, are agreed on one point, viz., the necessity of immediately determining the course of proceeding; and we are informed that very early in the approaching session of the Chambers the course will be determined. Under whatever auspices the works may be undertaken, they cannot fail of being highly important to the Dover line of railway, to which M. Vallee, in the course of his report, refers very frequently, as a means of communication of the greatest consequence to France and the Continent of Europe. In our next number we hope to be able to enter more fully on this interesting subject.

Stupendous Locomotive Engine.—Thursday, at the works of Messrs. Stephenson, of Newcastle, the trial of a splendid and powerful locomotive engine, constructed for the Great Western Railway Company, took place. It is called the "North Star," and is calculated to run fifty miles an hour with fifty tons burthen attached to it, and with the tender only at the immense speed of eighty! Several eminent engineers were present, who expressed themselves highly gratified with it.—*Tyne Mercury.*

St. Helens and Runcorn Gap Railway.—The Directors of this Company are about to apply to Parliament to alter a portion of their line. The traffic in coal from the collieries to the dock now exceeds 1,000 tons daily.

Southampton Railway.—This railway is progressing most satisfactorily. The formation level may be said to be completed for the first twenty-three miles from London, with the exception of the cutting and embankments of the far-famed St. George's-hill. It is already known that this cutting has, by an arrangement with the proprietor of the Oatlands' estate, and a deviation of the line, been reduced to one of thirty-eight feet deep instead of 116 feet, as originally proposed, and at the rate of progress with which the work has proceeded for some months past, the excavation will be completed by the end of February next. The permanent railway is being laid down with rails weighing seventy-five lbs. per yard.

We are glad to hear that this Company are proceeding to lay their rails on wooden Kyanized sleepers. Seven tanks, from 2,000 to 4,000 cubic feet each, are already forming, or about to be formed, three at Ditton and four at Walton. We could have wished, instead of transverse sleepers, they had adopted longitudinal Kyanized continuous bearers.

Salt Monopoly in India.—We beg to refer our readers to an excellent commentary, appearing in the "Mining Journal" of the 4th ult., on the able article in our last on this interesting and harrowing subject. We assure them they will not lose their time in reading the judicious and sensible remarks and information of the editor of that journal.

Standing Orders.—We are happy to see that an Honourable Member, Mr. Guest, has given notice of his intention to call the attention of the House to the Standing Orders relative to railways. We have not the pleasure of knowing the Honourable Member personally, nor the view that he takes of the Standing Orders; but we do think they cannot be made worse for public improvement, unless they be altered to prevent the introduction of any Bill whatever for railways.

Thames Haven Railway.—We believe it is the serious intention of this Company to proceed with their works. The Directors are acting most economically. They have never touched a sixpence of their salary, nor, we understand, broken a biscuit at the expense of the Company. All salaries of officers, and every expense, are suspended. It appears by the advertisement on our wrapper, that the amount in full of the last call is to be paid back to such of the proprietors as have paid it and do not choose to go on with the concern. This number, we understand, is very few; the others, after a strict examination of the accounts, situation, and prospects of the Company, being determined to persevere.

Thames Tunnel.—At a few minutes before four o'clock on

Friday morning (it then being nearly high water, and a remarkably high tide), a sudden irruption of the river took place and filled the tunnel. Every necessary precaution had been previously taken to secure the retreat of the workmen in case of any accident occurring; but unfortunately, on calling over their names, one of the miners was found missing, and on inquiry it was ascertained that he had been last seen returning towards the shield, instead of attending to the orders then given for all the men to leave it, and to ascend the shaft, and which was effected safely by about seventy other individuals. [We believe this leak has been effectually stopped.—Ed.]

South-Eastern Railway.—The Half-yearly Meeting of this Company took place on Monday, the 27th ult., at the office of the Company in Coleman-street. The Meeting was numerously attended, and the report of the Directors on the present position of the Company, and of the engineer on the state of the works at Dover, appeared to give perfect satisfaction. The report of the Directors is too voluminous for insertion in our present number, but it will appear in our next. We publish, however, the report of the engineer, as well as the resolutions passed at that Meeting.

Transmission of Letters by Railroad.—Mr. Baring moved for, and obtained, on the 27th ult., a Select Committee to inquire into the present transmission of letters by railroad. This is supposed to refer to the irregularities of the mails by the Grand Junction.

Waterman's Friend Steam-boat Company.—Among the novelties of the day stands the above Company, which we understand is in progress, and promises to be beneficial to the poor waterman as well as to the shareholders. For the particular objects of this Company, we beg to refer our readers to the prospectus, to be obtained at the Office, 3, Charlotte-row, Mansion House.

Whitby and Pickering Railway.—At the half-yearly Meeting of the proprietors of this Company, it was stated that a great increase has taken place in the tonnage, amount of traffic, and number of passengers conveyed on the line during the last half-year, the increase of the latter being 8,000 and the former 6,000 tons over the previous half-year; and, had there been a greater number of waggons for the conveyance of goods, this augmentation to the business of the Company we are assured would have been still greater.—*Hull Packet.*

SOUTH-EASTERN RAILWAY.—ENGINEER'S REPORT.

TO THE BOARD OF DIRECTORS.

London, 25th Nov., 1837.

GENTLEMEN,

I have now the satisfaction to report, for your information, that the works along the Chalk Cliffs at Dover, preparatory to the formation of the line of railway there, commenced on the 21 instant.

The operations now in progress consist in cutting a benching, or roadway, along the face of the cliff, between the Shakspeare Cliff and Lydden Spout, being that portion described in the Parliamentary plans as comprising short tunnels and gallery works.

The object of this roadway, or benching, as it is technically called, is to enable the resident engineer to set out the gallery works for the railway, and as a road of approach for the workmen, in getting to and from the works; and being in itself the most difficult and dangerous of the whole works to be executed, affords a fair criterion by which to judge both of the practicability and cost of the railway along these cliffs.

After three weeks' work and the completion of half a mile of a benching or gangway along the face of the cliffs, I have much pleasure in being able to report the perfect practicability of the measure, and that the completion of a safe and permanent railway along these cliffs and through the Shakspeare Cliff, is not only easily practicable, but comparatively inexpensive also, as the chalk rock works remarkably well, and in most parts, stands perfectly upright; is very solid, and will be still more so when worked further in for the railway itself; so that from the experience we have now had,

my confidence with regard to the ease, expedition, and economy with which the railway in this part of the line may be constructed, is stronger than ever.

The contractors for the Shakspeare tunnel (who are the parties now executing this benching along the face of the cliffs) are ready and anxious to commence that work, being satisfied (from the specimen they have now had of working in the chalk) of the safety of their undertaking and correctness of their calculations for that work, which, I believe, will not exceed in its cost one half the sum originally estimated as the cost of the tunneling along the Dover cliffs.

Under these circumstances, I have no hesitation in recommending the Directors to proceed with all convenient speed in the formation and completion of that portion of the line of railway from Dover to Folkestone, because, as being that part upon which most doubt has been thrown, whether as regards its safety, practicability, or cost, the sooner these doubts can be removed, by the best of all arguments, the actual completion of the works in a safe and substantial manner at a reasonable cost, the better.

In order to afford every means of information to the Board, and to the General Meeting, I have directed the resident engineer, Mr. Wright, to attend on Monday, in order to answer any inquiries that may be made relative to the nature, cost, or peculiarity of the works. And, in conclusion, can only assure the Board of my increased confidence as to the ease of execution and cost of the railway generally, but also of this portion in particular; and further, that if these five miles were completed between Dover and Folkestone, some advantage would directly arise from having it at work, for independently of connecting Dover and Folkestone, Hythe, Sandgate, and other watering places along the coast, the peculiarity of the work itself would be a great inducement to visit and travel along the line.

(Signed) W. Cubitt.

SECOND HALF-YEARLY MEETING OF THE PROPRIETORS.

At the Second Half-Yearly Meeting of the South-Eastern Railway Company, held in pursuance of the provisions of the Act of Incorporation, at the Office of the Company, No. 10, Coleman-street, London, on Monday, the 27th day of November, 1837,

PASCOE ST. LEGER GRENFELL, Esq., in the Chair,

It was Resolved,

First, That the Common Seal of the Company be affixed to the Register of Proprietors, (the Seal was affixed accordingly in the presence of the Meeting).

Second, That the Report of the Directors as now read be received and adopted, and that the same be printed and circulated among the Proprietors.

Third, That it is the opinion of this Meeting, that the Directors should take such measures as in their judgment may be necessary for completing the Registration, and thereupon, unless they shall see special cause for suspending the operation of this Resolution, for declaring forfeited all shares on which the call of 5*l.*, due in January last, shall remain unpaid.

Fourth, That the best Thanks of this Meeting be given to the Chairman and Directors for their valuable services.

PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

NAMES OF RAILWAYS.	No of Shares.	Share.	Paid.	Prices sold at.			Dividend per Cent.
				Highest.	Lowest.	Last Price.	
		£.	£.				
(3) Birmingham and Derby	6,000	...	15	7	5½	6¾	
(3) Birmingham and Gloucester	9,500	100	12½	3¼	3¼	3¼	
(2) Birmingham, Bristol, and Thames Junction	660	20	3				
(2) Bristol and Exeter	15,000	100	10	..	..	3½	
(2) Cheltenham and Great Western	7,500	100	7½	..	..	1	
(3) Commercial, Blackwall	12,000	50	2	..	..	1½	
(3) Dublin and Kilkenny	8,000	100	2½				
(2) *Eastern Counties*	60,000	25	3	..	..	¼	
Edinburgh and Dunbar	.....	...	2				
Edinburgh and Glasgow (old)	13,000	50	2	17s 6d	15s	17s 6d	
Ditto, ditto (new)	....	...	4	..	..	1½	
(3) Edinburgh, Leith, and Newhaven	5,000	20	3				
(3) Great North of England	10,000	100	7				
(2) Great Western	25,000	100	55	67	64	66½	
(1) *Grand Junction*	10,919	100	90	209	187½	209	
(2) Hull and Selby	8,000	50	10			par	
(2) Llanelly Railway and Dock Company	2,000	100	35	..	..	..	6
(1) *Liverpool and Manchester*	5,100	100	100	193	192	193	9
Liverpool and Manchester, ¼ shares	....	...	25	..	..	46½	
Do., ¼ *shares*	.....	...	20	56½	56½	56½	
(1) Leicester and Swannington	1,500	50	50	..	..	..	6
(3) London and Brighton	36,000	50	5	2½	1⅓	2½	
Do. Rennie's	.....	...	...	8s 6d	6s 6d	7s 6d	
(4) Do. and Blackwall	12,000	50	3	9s.	8s 6d	8s 6d	
(2) Do. and Birmingham	25,000	100	90	148½	139	148	
Do. ½ Shares	.....	...	5	21½	19½	21½	
Do. Bonds, 4 per Cent. 1843							
(2) Do. and Greenwich	20,000	20	20	17½	13½	13½	3
(2) Do. and Southampton	20,000	50	45	34½	27	34½	
Do. do. New	16,000	25	3	14½	9	12½	
(2) Do. and Croydon, Trunk	7,000	20	20	18	16	18	
Do. Scrip	7,000	14	2	6½	5½	6½	
(3) Do. Grand Junction	12,000	50	5				
(3) Manchester and Birmingham	10,000	50	5	3½	2¾	3½	
(2) Do. and Leeds	30,000	100	10	15	9⅔	15	
(2) Midland Counties	26,000	100	10				
(3) Northern and Eastern	12,000	100	8	..	..	2¾	
(2) North Midland	15,000	100	15	23½	22½	23½	
North Union	.....	...	100			69	
Do. New shares	.....	...	10	26¼	26½	26½	
(2) Preston and Wyre	2,000	50	28				
(2) South-Eastern and Dover	28,000	50	7	3	3	3⅛	
South Midland	..	50	1				
(1) *St. Helen's Runcorn Gap*	...	...	100	..	..	25½	
(1) Stockton and Darlington	1,000	100	100				
(3) Thames Haven	9,000	50	2½				
(3) York and North Midland	6,000	50	3				

*** Those in Roman letters are London prices; the Italics Liverpool. The former are to the 27th ult. inclusive; and the latter to the 24th.

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ERRATA OMITTED IN VOL. II.

Page 350, line 16 from bottom, for *form* read *from*.

ERRATA IN VOL. III.

Page 7, line 24 from bottom, dele *much*.
— 77, in table, for + 227 read + 277.
— 81, line 12, for *when* read *where*.
— 121, for *calculations of* read *calculations on*.
———, for *frustum* read *frustrum*.
— 227, line 2 from bottom, for *is is* read *it is*.
— 309, line 21, read *a* after *for*.
— 324, line 5 from bottom, dele Σ.
———, line 7 from bottom, in $\frac{\Sigma\, r^4\, u\, k\, \varpi}{2}$ dele Σ.
— 327, line 8 from bottom, for *tan* read *tan* φ.
— 365, for

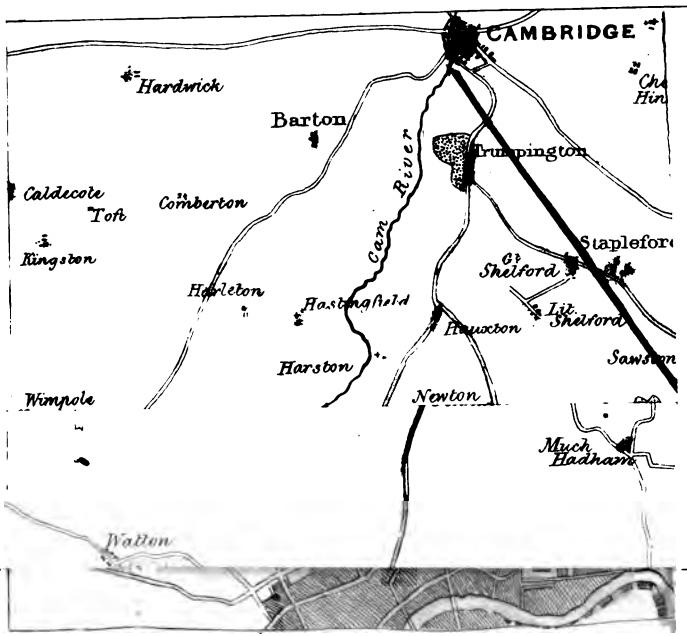
$$N\overset{m\ 1}{\text{——}}(N\text{—}1) \text{ and } N\overset{m\ 1}{+}(N\text{—}1)$$

read

$$N\overset{m-1}{\text{——}}(N\text{—}1) \text{ and } N\overset{m-1}{+}(N\text{—}1)$$

— 367, line 21, for *effected* read *affected*.
— 375, line 19 from bottom, for *station* read *stations*.

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CAMBRIDGE
Hardwick
Barton
Trumpington
Caldecote
Toft
Comberton
Cam River
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