Journal of the Society of Arts.

FRIDAY, JUNE 29, 1855.

TRADE MUSEUM.

On Friday, the 22nd instant, H.R.H. Prince Albert, President of the Society, attended by Captain the Honourable Dudley de Ros, inspected the Trade Museum (Animal Collection) at the Society's House; and on the following day the collection was visited by their Royal Highnesses the Prince of Wales and Prince Alfred, attended by Colonel the Honourable C. B. Phipps and Mr. Gibbs.

WROUGHT IRON ORDNANCE.

The project of employing wrought iron for ordnance, has brought to light a collateral circumstance in proof of this material. namely, that on the bursting of a gun it does not break up in fragments as does cast-iron, and that thereby the persons who serve the piece are little exposed to danger. Mr. Berkeley has said, that on the second day's trial of the 9 pounder he witnessed at Woolwich, "they did burst the gun, that is it was ripped open about ten inches half way up." It must be observed, however, that the gun in question had apparently been fabricated by welding bars of wrought iron together, the manner in which ancient ordnance was made, and of which many examples still remain, among others, the piece called "Mrs. Peggy," which is preserved in Edinburgh Castle. The bore of this gun is about 12 inches diameter.

It has already been said in the *Journal of the Society of Arts*, that the perfection of large articles of wrought iron depends much upon the velocity and force of the hammer by which it is beaten; since then a gentleman conversant on the subject has given an instance which appears to be in point. At one time, wrought iron anchors for the navy were hammered subsequently to their being forged, but without regard to the weight or velocity of the strokes at different periods of the operation. The result of this hammering was remarkable, an exterior shell of the anchor became of the quality of steel, as it were, but within this indurated coat the remainder of the anchor exhibited the crystallized appearance of cast iron, and was, like it, brittle, and of little strength compared to wrought iron. In the Royal Dockyards, anchors are no longer hammered after being forged, yet, as wrought iron has its strength increased a seventh by hammering, it would seem that, under proper management of the hammer, this practice might be advantageously resumed.

As to steel as a material for fire-arms, "An Engineer" proposed in the *Journal of the Society of Arts*, of the 15th inst., to use steel as a lining for the bore of ordnance; but even for such a lining it would seem essential that some previous experiments should be instituted, for we know not the power of steel to resist without loss of elasticity such violent shocks and strains as are inevitable in the bore of a gun. Carriage springs do afford examples of resistance to sudden shocks, whilst, on the other hand, the springs of locks frequently give way by slamming-to a door; but these examples are but of small force in comparison with that of the explosion of gunpowder in propelling a missile, and we know not what effect the decomposition of gunpowder might have in destroying the elasticity of steel, or otherwise altering its quality. Steel watch springs are, indeed, exposed to that degree of heat which gives a blue colour, and the late mechanist, Mr. Rehe, of Fetter-lane, had, in private trade, to furnish caps for priests in India, which caps were required to be uniformly blue, without diminution of the elasticity of the steel of which they were wholly made. Mr. Rehe effected the purpose by *roasting* the caps; that is, he placed them before a hot, clear fire, upon a frame, continually turning horizontally, so that the caps were exposed alternately to great heat and to a cooling process; he told me that otherwise neither could uniformity of tint be given, nor could the elasticity of the steel be preserved where large masses of it were employed. A piece of ordnance has not time for cooling during an engagement with the enemy, but easy experiment would determine the fitness of steel either for the gun itself or for the lining of it.

It seems now to be a generally admitted fact, that cast-iron ordnance *wears out*. How is this to be accounted for? It could hardly have been so during the wars at the early part of this century; at least, at that time, ordnance, though often changed, never was so on board ship, because worn out. For instance, the guns were the same from first to last that were mounted in the experimental vessels of 1795, and many of which were in constant service to the termination of the war in 1814; those vessels also were more frequently engaged with the enemy than, perhaps, any other vessels, the *Netley* schooner having taken more prizes in the Bay of Biscay, than were made by *all* of the many other vessels on the same station; so in the Helder, at Dunkirk, Copenhagen, &c., those sloops and schooners made much and frequent use of their artillery, but their several successive commanders never hinted that their guns were the worse for wear.

Speaking of those experimental vessels recalls a peculiarity of them all, namely, their shallow draught of water—a quality the want of which seems to have crippled the operations of our splendid fleets in the Baltic as in the Black Sea. Ships of the line could not venture amongst the shoals and islands in the Gulf of Finland; Sir Charles Napier and Admiral Chads were obliged to shift their flags to smaller vessels from the noble first-rates they were usually on board of. In the Black Sea, the place of debarkation for our troops was determined more from the depth of water at Eupatoria than from its vicinity to Sebastopol. General opinion is at present in favour of large ships drawing a deep draught of water, both for ships of war and for commercial purposes, and certainly those of considerable tonnage possess several advantages over smaller craft; the large vessel affords superior accommodation for passengers and for officers; more splendid decorations can be afforded where the expense of them is to be divided amongst many; and, what is of infinitely more importance, officers of superior skill and experience can be engaged with ample remuneration for their services, and in vessels of war the importance of the commander is apt to be estimated according to the size of the vesssel he is appointed to. But on the other hand, when a large ship is lost, the sacrifice of human life is proportionately immense, as has but too fatally been experienced in the large passenger vessels, the *City of Glasgow*, the *Tayleur*, the *Arctic*, and in the Government steamer the *Prince*. The loss of cargo, too, is not the less a *national* loss because those vessels and their contents were insured—insurance only shifting the damage from perhaps an individual to an aggregate of persons. In a commercial point of view it would seem more desirable to supply a market by means of ships of comparatively mall burthen, than to risk the destruction of the whole demand by embarking it in a single ship. The loss of the *Prince* affords a strong example of the fatal consequences of trusting an enormous quantity of goods and missles to the safety of a single ship, for on board of the *Prince* was the whole supply of clothing for our troops in the Crimea, of medicines for the sick and wounded at Scutari, and an immense provision of munitions of war, all, all, lost together! Now, had these articles been shipped in, say, four separate vessels instead of a single one, had only two of the four escaped destruction, their cargoes would have sufficed for the immediate wants of our army in the East.

It is for the mercantile community to calculate the different amounts of loss inherent on the employment of large ships instead of smaller ones, but in regard to vessels of war there are many other points to be considered. It is very true that in open seas, and so long as an enemy may use large ships, it might seem expedient that we should have similar ones to cope with them, and that notwithstanding examples of victories gained by smaller vessels over ships of the line. It is not, however, pretended that a little vessel, armed with tiny six-pounder guns, can successfully combat a first-rate man-of-war, carrying a hundred or more 32 pounders, but it is believed that were the hundred 32-pounders carried in half a score of small ships, they would prove more than a match for the 100-gun first-rate man-of-war. But, as has been above observed, so long as bravery and skill continue to be rewarded by the command of a first-rate, so long a preference to such ships will be given by naval officers. It would seem to be only by a strong effort of the naval administration that this propensity might be conquered. They might give the command of a thousand men and officers to a single captain, though the guns and men were divided on board the half-score vessels. Commodore is already the title of the commander of a small squadron; under this same title, or some more appropriate one, the Admiralty might designate the commander of the ten or twelve vessels of about ten 32-pounders each.

Ships of deep draught of water are unsuitable for many a warlike purpose. They cannot approach a shallow shore, nor enter shallow harbours to annoy the enemy, and capture his vessels sheltered there, as was experienced by the Baltic fleet, not a single ship of the line having ventured high up the Gulf of Finland. Ships of deep draught cannot enter rivers, whereas both the *Arrow* and the *Dart*, each of them armed with 30 pieces of ordnance, all 32-pounders, actually went high up the Scheldt on our expedition against Holland in the year 1799.

One serious objection to shallow vessels has been obviated by Captain Shanks, R.N., who invented *sliding keels*. This improvement in navigable vessels has not, however, been regarded as of the importance it well merits, particularly as against a ship's making lee-way in deep water. The neglect of sliding keels has arisen from their liability to cause leakage, but since iron has been so much employed in naval architecture, there could be no objection to that metal for the formation of keel cases; this part of a vessel would be exempt from injury by shot, the keels and their caps being along the middle line of the vessel fore and aft, and need not to be raised much above the water line. By dividing the sliding keel into two or three parts, the great advantage is obtainable of giving at pleasure a greater draught of water to either the head or stern of the vessel, as circumstances might require.

M. S. BENTHAM.

27th December, 1854.

PARIS WATER SUPPLY.

(From the *Journal des Debats.*)

For several years past public attention has been very much occupied with a matter which greatly affects the health of the capital—we mean the distribution of water in Paris. We have already informed our readers several times in our columns of the improvements made in this important service by the municipal engineers. We laid before our readers, especially in 1852, the full details of a system then proposed by the administration, and which consisted in devoting a sum of 2,800,000 francs for the construction of new reservoirs and new pipes for the purpose of utilising all the water, 104,000 cubic metres, which the city had the right to abstract from the Ourcy canal.

We must now take notice of a consultation made by the Municipal Council in its last sitting, on the subject of a public report by the Prefect of the Seine in last November, upon the water question, and upon a plan of a new system of subdivision, intended to make a complete revolution in the economy of this service. This report comprises two parts: the first contains an account of the source from whence the water is derived, and its distribution in Paris; the second treats of what may be called the drainage of the capital, that is to say, the carrying off under Paris of filth, of rain, and water from the houses. As has been previously said, this new proposal for management is a real revolution. It consists of substituting spring-water for the water of the Seine, and bringing into Paris, by enormous aqueducts, an immense mass of water, drawn from the vallies of the Marne, situated between Chalons and Epernay.

The capital is at present supplied from five sources,—the Ourcy canal, the Seine, the aqueduct of Arcueil, the wells of Grenelle, and lastly, from the water of Belle Ville, and from the Près Saint Gervais, more generally termed the Springs of the North. The canal of Ourcy is the most important of these sources of supply; it was made by the First Consul (29 floreal, year 10); it distributes its water by an aqueduct, embracing a space which extends from Villette to the barrier Monceaux, through a course of 4,033 metres. From different points of this aqueduct large mains are laid, which descend towards the Seine, pass over the bridges, and empty themselves into large reservoirs. These great mains, of which the principal are those of the Hospital of St. Louis, the Faubourg St. Antoine, the Marais, the Hotel de Ville, the Halles, the Carousel, &c., &c., are themselves pierced by smaller pipes, supplying the water by numerous openings to the squares (*places*) by public fountains, to the streets by plugs, and lastly to houses through the taps of private individuals. The water of the Ourcy circulates by pressure alone, without machinery, and without trouble, the level of the basin of La Villette being higher than the surface of almost all Paris. As far as regards the water of the Seine, it is distributed by the works at Chaillot and the pumps at Notre Dame and of Gros-Caillon. The waters of Arcueil and of Grenelle, on their side, fall into the reservoir of Estrapade, used also for the water of the Seine. Lastly, as regards the springs of the north, some of those of Belleville are directed into the reservoir which serves the Abattoir Menilmontant; the others, those of the Près Saint Gervais, enter Paris at the Barriere Pantin, and supply the surrounding districts. In short, there exists under the streets of Paris about 312,000 metres of pipes of all sizes, employed in distributing water; 18 reservoirs, capable of containing 60,000 cubic metres, feed these pipes. The aqueduct "*de ceinture*," the basin of La Villette, and the Ourcy canal, contain, besides, a reserve of more than 20,000,000 cubic metres.

This quantity of water is divided into two services, the public service, which comprises 102 fountains, 1,779 plugs, 58 fire-plugs, 105 openings under the foot pavement, and 111 stands for giving water; and the private service, in which are classed 13 market fountains and 7,771 supplies made, either to the State, to municipal and departmental establishments, or to private consumers; in fact, the city can distribute 7,390 inches of water, which, constituting a mass of 147,800 cubic metres, or 148 million of litres of water per day, gives about 148 litres per day to each inhabitant. However, this system of supply having appeared to the government to want uniformity, and, besides, the water of the Seine not appearing to them to unite in itself the three indispensable qualities of all good water, namely, wholesomeness, clearness, and freshness, the Prefet of the Seine directed M. Belgrand, chief engineer of the bridges and highways, to search in the basin of the Seine for purer water than that now used by the Parisians. After numerous experiments, M. Belgrand has discovered a stream called Somme-Soude, which divides itself into two branches, the Somme and the Soude, and falls into the Marne between Chalons and Epernay. The water, says M. Belgrand, taken from these sources, is very fresh, of extreme purity, and most agreeable to the taste. One thousand litres of water can easily be obtained every second from this stream, or 86,400 cubic metres of water in 24 hours. The water leaves its source at an altitude of 106-86 metres, and will arrive at Paris at an altitude of 80 metres, after passing through the plains of Champagne, between the confluence of the Somme and Soude and Epernay, the left bank of the Marne between Epernay and Meaux, and between Meaux and Belleville, the right bank of the Marne, and the foot of the hills situated to the east of Paris. The distance from the source will be 172 kilometres, and the expense from 22 to 25 million francs. But the quantity of water now necessary to feed all the services being 86,777 cubic metres, that is to say, 56,040 metres for public and 30,737 metres for private consumption, the following calculations form the ground-work of the new scheme :—In making a large allowance for the future, 110,000 cubic metres is estimated, instead of 56,040 cubic metres, as the quantity of water necessary for the public service, though for private service, since at the present time 30,737 cubic metres are consumed by only 13 market fountains and 7,771 other supplies, upon a total of 31,500 houses, forming the whole of the property of Paris, we shall arrive at a distribution of 90,000 cubic metres in calculating the number of buildings at 40,000, or a total of 200,000 cubic metres for the general supply of all Paris, public and private. Indeed, the supply for London is not calculated for a larger quantity, though it contains a surface six times greater, and a population two and a half times more numerous than that of Paris. It is reckoned that 107,000 cubic metres of the water of Ourcy, Arcueil, Grenelle, and the northern sources, will be reserved for the public supply, and the private supply would be provided with 100,000 metres of water derived from the aqueduct formed after M. Belgrand's scheme. By this means, more than four-fifths of Paris will be very abundantly supplied by these different sources appropriated to the public use. As to the remaining fifth of the surface of Paris, which the water of the Ourcy cannot reach by its own gravity, and which the water of Arcueil, Grenelle, or the north would not be sufficient to supply, steam-engines must be erected to direct into it that portion of water not required for the use of the rest of the city, or the water of the Seine raised by the pumps of Chaillot, and now intended for the water supply of the Bois de Boulogne. Such is the general arrangement of the first part of the new scheme submitted to the Municipal Council. The remainder, as we have said, relates to the question of the drainage of the capital. In short, it is not enough to supply water abundantly for cleansing streets and for the use of houses in a perfect state of purity, it is also necessary to provide this water with a convenient and regular outlet as soon as it has been used, and use has rendered it unwholesome and inconvenient.

With this view, the decree of the 26th March, 1852, has already initiated altogether a new system, in directing that all rain and waste water from the houses should be directed into special sewers for that purpose. For the requirements of this service, there already exist 163,000 metres of sewer, that is, 140,000 metres more than in 1806. Since the beginning of this century all the uncovered sewers have been successively arched over, and the last of these, the open sewer of Ponceau, disappeared in 1853. Besides, on the two banks of the Seine, large sewers, parallel to the river, have been made, and into these all the smaller sewers empty themselves below Paris.

The sewer of the Rue Rivoli, whose vast dimensions we have already noticed to our readers, is the first application of the system; it now extends from the Place du Marché Saint Jean to the Quai de la Conference, where it empties itself into the Seine. It will be carried as far as the Bastille, in order to communicate with the sewers of the Faubourg Saint Antoine, and on the other side it will be carried from beyond the pumps at Chaillot.

Upon the left bank a main sewer has been made, under the towing-path, from the bridge Tournelle to the bridge Carousel, but the plan of this drain is bad, and its continuation is not yet decided upon. To make the arrangement perfect, every public street should have a sewer with which the property on either side can connect its own house-drain, whilst the channel of the street should only receive the surface water; thus we come to see that there are only 363,000 metres of house drainage, whilst the length of the streets extends to 423,000 metres. Taking the quantity of water distributed for public and private supply, and that which falls in heavy rains, the necessity for new and larger sewers than those which now exist is at once apparent. In short, the whole of this service should be organised in the following manner, according to the terms of the report of the administration. Every principal line of drain should be in connection with a main sewer of large section, having a railway side, as in the sewer of the Rue Rivoli. Sewers of smaller size, but equally provided with rails, and capable of allowing the traffic of workmen and waggons, should follow the secondary lines. A drain of small section, large enough, however, for the passage of wheelbarrows, should surround each block of houses on all sides, which cannot be served direct by one of the principal or secondary sewers. In fine, every other house opposite the partition wall should open into a short cross drain, putting each of these houses in communication with this small drain compassing this block, or directly with the secondary or principal sewer. Into this cross drain the house waters should flow, according to decree of the 26th March, 1852, as well as the clear water from the cesspools, and through this way wheelbarrows should reach the cesspools, and carry off their solid contents.

The better to insure the cleanliness of the town, trapped gullies should be placed in the courts of the houses, through which soil should fall into the sewers, where it would be carried off by the powerful flushing of water, as is now practised at La Villette. Hereafter, by these arrangements, all the pipes would be placed in the main sewer, and the branches for houses will follow the course of the private drains. By this means everything would be placed, visited, and repaired, without the necessity of disturbing the pavement, or interfering with the traffic of carriages or passengers at any point. This same unseen way would serve for the inlet of pure water, and the outlet of muddy and contaminated water, Even the gas-pipes might be laid in this network of drains, the ramifications of which would thus form a subterranean town, following the plan of the city above.

Such are the arrangements of the scheme the plan of which has been submitted to the Municipal Council. On the report of M. Segalas, the Commission has authorised the drawing up of a detailed plan for the execution of the works relating to the supply of water, and at the same time has opened a credit for the creation of a staff of engineers, who, under the orders of M. Belgrand, will be charged with drawing the plans and completing the experiments.

As far as regards the drainage of the capital, a system which has only been put forth as a possible consequence of the new plan for water supply, the Council has expressed its regret that the necessary works for the drains and subterranean means of removing filth had not been conducted contemporaneously with the works for the water supply, in such a manner that the plan of the Prefect could have been tried in its full completeness. We will take care to supply our readers from time to time with the details of this great undertaking, which we have not time now to discuss at full length.

LOW-SPEED RAILWAYS AND CANALS FOR INDIA.*

The papers appended to the despatches of the Madras Government, No. 193, dated 24th April last, and No. 358, dated 15th September, 1853, do not go sufficiently into detail to enable me to offer any useful opinion on the local projects severally adverted to by Colonel Cotton, but his general views on the system of communication best suited to the present circumstances of India, may be gathered from the papers referred to, and from a book published by him during the present year, under the title of "Public Works in India," and on these I proceed to offer a few remarks.

2. The consideration of this question has left me deeply impressed with the importance of the subject, and though I dissent from many of the views expressed by Colonel Cotton, and though I dispute many of his calculations, I cannot but feel that he argues from sound principles, and that his plans for the improvement of communications at small cost, in some localities by means of canals and rivers, and in others by an inferior class of railway, are eminently deserving of attention.

3. In reporting to Government the result of my anxious but imperfect investigation, I shall confine myself strictly to engineering questions regarding the cost, economical use under various circumstances, and comparative value of canals and railways of more or less perfect construction. I shall not attempt to analyse closely Colonel Cotton's calculations of the direct and indirect pecuniary value of the several modes of communication. Being based on hypothetical, and sometimes questionable data, they are very open to criticism, but they serve as striking illustrations of the projector's views, and perhaps were intended for nothing more. It may safely be conceded that railways and canals constructed and worked at anything like the estimated rates, would command all the existing traffic on their respective lines, would probably stimulate its growth, would admit of the interchange of commodities between different districts now prohibited by cost of transport, and would certainly diminish the cost of almost every description of export merchandise.

4. As regards railways, the questions for solution may be thus stated:—What are the essential differences between a high-speed and a low-speed railway? What is the description of railway on which goods can be carried at minimum cost, taking all concomitant circumstances into account? What will be the usual velocity on such railways, under the condition of minimum cost? And to what extent ought they to supersede the system of high-speed railways now contemplated for India?

5. The questions of cost, of original construction, and of working railways, should be considered separately, and yet with close reference to each other. It is fallacious to apply to a cheap (inferior) railway the rates for working which are found to obtain in the most perfect works, for the superior solidity and accuracy of construction which cause the difference of expense are intended, and do really conduce, to diminish the draft. The cost of railway traffic consists of working expenses and interest on capital, and there is no invariable rule that when the latter is at a minimum, the total cost is so likewise, for instance, it appears from data specified below,† that the net load moved at 10 miles an hour by a given power on gradients of 1 in 100, and 1 in 1000, are respectively as 73 and 224, or 1 to 3, and that the estimated cost of locomotive engine power to move a ton a mile on these gradients, is respectively, 0·150d. and 0.049d., the difference being one-tenth of a penny per mile, so that with a traffic of 100 tons a day, or 31,300 tons per annum, the saving in locomotive power would be £13 per mile, which, capitalised at 5 per cent., would give £260, or Company's rupees 2600, as the sum per mile which it might be good economy to spend in obtaining the difference of gradients above mentioned; and similarly the retardation from quick curves, from want of rigidity in the rail, and from inaccurate joints, has in each case an appreciable effect in augmenting the working cost.

6. Thus it appears that speed is not the only object in expensive construction, nor is it necessary that railways on which speed is possible, should always be worked at high velocities. Even on the so-called high-speed railways now under construction in India, the rate of speed which will admit of the most economical working will be that universally adopted for goods traffic, viz., 10 to 14 miles an hour.

7. For analagous reasons, the width of gauge, which regulates in some measure the size of goods waggons, should be determined with reference to the cost of working, as well as to that of first construction. The distribution of a given load on a large number of small waggons, is less economical than its concentration on a few large ones. In the latter case the friction is less, and the net load bears a higher proportion to the dead weight. No gauge less than the narrow gauge of England would be in this point of view economical. The difference in cost of construction due to one foot more or less of gauge, is not important.

8. The railways now under formation in India, or at least those of Bengal, are not being constructed with reference to high speed so much as to durability, security, and economical working; and, provided that they are to be worked by engine power, I do not believe that their cost could be materially reduced, even were the speed to be restricted to 10 miles an hour. In this case the weight of the rail might be diminished 30 per cent., and the size of the sleepers and thickness of the ballast might be slightly reduced, but these would not lessen the total cost by more than one-sixth. If it were determined to substitute animal power altogether for engine power, a much greater reduction might be made, and many expensive accessories might be dispensed with. This is, I believe, the only conditions under which cheap railways ought to be constructed in India.

9. In Colonel Cotton's Minute advocating a project for a low speed railway between Cuddalore and the Salem district, he estimates the cost of the works at 6,000 rupees per mile. In his book he variously estimates the cost of such works at 6,000 rupees,* 12,000 rupees,† and 20,000 rupees.‡ The variations refer apparently to various modes of construction, but in all the estimates of which any details are given, I observe the omission of some items of unavoidable cost, or of some parts usually admitted to be essential to an effective railway. In the estimate for 6,000 rupees § per mile, for instance, where he proposes to use a rail of 25½ lbs. to the yard, resting on a broad flange, but having no chairs or sleepers, he has provided no ballast or cross ties. The sectional area of such a rail is 2·583 square inches,—a very light rail, even without the flanges which are to give it a hold on the ground. I calculate the smallest sectional area of rail capable of being used without chairs and sleepers at 5·8 square inches. It would weigh about 58lbs. per yard, and would require cross-ties and fishing plates at 8lbs. per yard of single track, and even then there would be need of ballast to bed the rails, and to form a hard surface for the feet of the draught cattle. In the piled railway (page 139 of Colonel Cotton's book) no road or bridges are provided for the cattle, supposing animal draft to be employed, nor, if engine-power is to be used, has he estimated for fencing, turn-tables, watering apparatus, &c., which form such

* MEMORANDUM by the Consulting Engineer in Bengal, on "Low-Speed Railways," as proposed by Colonel A. Cotton. Madras Engineers, and on certain projects by the same officer for the improvement of internal communication by means of canals. Called for in Under-Secretary Mr. G. Couper's letter, No. 613, dated 9th June, 1854.

† A table in the Aide Memoire Royal Engineers, page 181 part I., vol. III.

* Page 139. † Page 122. ‡ Pages 129 and 181.
§ Minute dated 10th June, 1853.

considerable items in railway estimates, neither has he provided for sidings—an indispensable part of a single track railway, nor for stations, nor for engineering and surveying expenses, which in a cheap railway would bear a higher ratio to the total cost than in an expensive one.

10 No estimate for a railway not based on a carefully-taken section can be entirely relied upon; but the following, which I have prepared with due advertence to the considerations stated in paragraphs 5 to 7, is an approximation to the cost, under favourable circumstances, of a railway which would admit of the cheapest description of land transport:—

Estimate of the Average Cost of One Mile of a Low Speed Railway, Embankment 12 feet wide at top, 3 feet high.

		Rupees.
Average section 45 square feet; 237,600 cubic feet, at 2 rupees 8 annas per 1,000		594
Brickwork in drains and culverts, about 4,000 cubic feet, at 16 rupees per 100		640
Bridging—average 15 yards, at 170 rupees per yard forward		2,550
Ballast—sectional area, 15 square feet; 79,200 cubic feet, at 2 rupees 8 annas per hundred		1,980
Fencing and gates		1,000
Turntables, goods stations, &c.		250
Engineering, surveying, and supervision		700
Total, exclusive of permanent way		7,714
Permanent way, consisting of bridge rails, 30lbs. to the yard, on longitudinal wooden bearings, with cross-ties at every six feet:—		
47 tons for one mile, at 100 rupees per ton	4,700	
Inland carriage at 12 rupees per ton	564	
3,960 cubic feet of timber at 1 rupee per foot	3,960	
Laying permanent way, at 8 annas per yard	880	
		10,104
Total		17,818
Add 10 per cent. for sidings, ½ mile at every 5 miles		1,782
Add for unforeseen contingencies		400
Total estimated cost for one mile (Company's rupees)		20,000

The above rates refer to actual cost. If the agency of contractors be employed, the amount must be raised from 20 to 25 per cent.

11. Such a railway as I have estimated above is calculated to be worked ordinarily by animal draught, but on extraordinary occasions could bear a light locomotive engine running at moderate speed, with the ordinary carriages and goods waggons of a substantial railway. I have reduced the quantity of iron to a minimum with reference to the present high price of that material, and to the difficulty of freight; but whenever India may supply her own iron, a different mode of construction may be advantageously adopted. The gauge would be 5 ft. 6 in., corresponding with that fixed for the railway system of India. The inconvenience incident to a break of gauge would thus be avoided in transferring goods from the inferior to the more substantial railway, and the political advantage of being able on an occasional emergency to transport troops or stores with rapidity, would be secured to the Government. I must, however, repeat my opinion that a rail of 30lbs. to the yard is not adapted for habitual use by a locomotive engine, and that where such habitual use is contemplated, more attention to perfect and solid construction than would be covered by this estimate is absolutely necessary.

12. Where animal power is employed, the most economical rate of speed is that of the natural pace of the animal—if a horse, 2½ miles an hour, if a bullock (Bengal) 1½ miles an hour—and to these paces respectively I would limit the goods waggons. The passenger traffic, which, weight for weight, is always willing to pay higher than goods, could afford to sacrifice some useful effect to velocity, and might attain the rate of 6 miles an hour. If higher speed be required, it becomes questionable whether steam power should not be employed. The load which a horse can draw at 2½, 6, and 10 miles an hour respectively, are given by Tredgold as in the ratio of 14, 6, and 3·6.

13. In calculating the cost of transport, which consists partly of interest on the capital expended in making the road, it is necessary to assume some amount of traffic. For the purposes of this comparison, I shall reckon upon 100 tons per day—this being the lowest prospect of freight which would justify the construction of any kind of railway,—and I shall assume that on the low-speed railway the goods traffic will pay three-fifths of the dividend, and two-fifths on the first-class railway, which, from its higher speed, will be more attractive to passengers. The draught on a rail or tram-way compared with that on a good road of similar gradients is stated by Tredgold at 8 to 1. The cost of goods transport on a metalled road in India is a little more than 1 pie per ton per mile, and on a light railway with cattle draught, may be taken at one-sixth of an anna, or two pie. The proportion of interest on 20,000 rupees—the cost of one mile (calculated as above), would be 600 rupees, which, divided on the amount of traffic, (100 tons per day, or 31,300 tons per annum), constitutes an additional charge of 3 pie per mile, making a total of 5 pie per ton per mile. It must be noted, however, that the charge in this calculation of one-sixth of an anna, is the price merely of the draught and the use of the vehicles; it does not include loading and unloading, warehousing at either terminus, protection from weather, and from pillage while *in transitu*, or for maintaining the road in repair.

14. I will not attempt to estimate the working charges on an inferior (light) railway, worked with steam power, for it would be impossible to fix with precision the increase of cost due to imperfect construction. As an illustration, however, of what this difference may be, I may mention that Dr. Lardner gives the actual working expenses of goods transport in America, on the average of 28 railways, at nine-tenths of a penny per ton per mile; whereas on the more solid structures of Great Britain the expenses amounted only to about one-fourth of a penny, or two pie, a rate at which perhaps we may be able to work the traffic on first-class railways in this country, though I fear that, owing to the dearth of fuel, we are not unlikely to exceed it.

15. The average cost of the East Indian Railway, from Calcutta to the collieries, according to the latest estimate, (submitted to government on the 17th March, 1853), was 72,761 Company's rupees per mile; that of the extension from near Burdwan to Allahabad (forwarded on the 22nd idem) was 86,777 Company's rupees per mile; but a large portion of this line passes through the rice grounds of Bengal, and for 80 miles it runs parallel with the Damooda, and is exposed to the necessity of providing against the infrequent but formidable outbreaks of that capricious river. From Burdwan to Allahabad it crosses all the drainage that enters the Ganges from the south and west; the works on this part of the line are, therefore, unusually heavy, but from Allahabad onwards the cost will not exceed 48,000 rupees per mile. The average for construction on the whole line will be about 70,000 rupees per mile, and the total cost per mile, with a fair supply of rolling stock, may be taken at 80,000 rupees per mile. This line may perhaps be accepted as a fair sample, as regards cost, of a high-speed railway for India. The rails are heavy and the construction of the most substantial kind; some saving of first cost might be possible on these items, but would not, in my opinion, eventually conduce to economy.

16. In estimating the cost of transporting goods on a first-class railway by engine power, I will adopt the calculation in the preceding paragraph, and assume the cost

of the road to be 80,000 rupees per mile, giving 1,600 rupees per annum as the proportion of dividend chargeable on the goods tonnage of each mile. From the table quoted in paragraph 5, I take the cost of locomotive power for a ruling gradient of 1 in 500 at 0·057d., and for the use of carriages at 0·062d.; total 0·119d, the terminal charges and those for police and maintenance of way being covered by 0·31d., making together ½d. or two pie per ton per mile for all working charges. The proportion of dividend as above, on 31,300 tons is ten pie per ton, and the total charge would be one anna per ton per mile.

Before comparing the results obtained in paragraphs 13 and 15, it will be necessary to assign a pecuniary value to the risk and charges omitted in the former. I have no sure data for doing so, but see no reason to estimate them lower than they are found to be on a first-class railway. Goods travelling at 2½ miles an hour, and stopping "anywhere," require more watching than those which are conveyed at 10 miles an hour, and stop only at appointed stations, under the eye of the police. The cost of guarding and the risk of injury from weather are both dependant on the time of transit during which the goods are exposed; and this is four times greater on the low-speed railway than on the other. I consider, then, that one pie per ton per mile (as on the first-class railway) is not too much to cover these risks and sundry charges; we have, therefore, for 31,300 tons per annum, on a low-speed railway, a cost per ton per mile:—

For all working charges	3 pie
For proportion of dividend	3 ,,
Total	6 ,,

On a first-class railway:—

For all working charges	2 pie
For proportion of dividend	10 ,,
Total	1 anna

But if the first-class railway could obtain the carriage of 76,800 tons a year, or 245 tons a day, it could afford to charge 6 pie per ton per mile; and should the traffic reach 640 tons per day, the first-class railway could carry it cheaper than the low-speed railway, even supposing, which is not likely, that by the latter such a traffic could be conveyed at all.

18. Colonel Cotton justly attaches great importance to celerity of construction, and shows that the saving of time would justify and compensate for a considerable increase of cost; but his views of the method of construction best suited to secure this object are directly contradicted by our experience up to the present time. Colonel Cotton supposes that the large use of iron in substitution for wood and brick, and even for earthwork, would expedite this work, but the chief difficulty experienced and anticipated in the Bengal line is that of obtaining an adequate supply of iron. I am inclined rather to reverse Colonel Cotton's proposition, and to state my opinion that the smaller the quantity of iron required for a given railway, the more rapidly can it be constructed and brought into use. For this reason I would reject the piled railway proposed in Colonel Cotton's book (p. 139), if there were no other objections to that mode of construction.

19. I would thus calculate the comparative celerity in constructing second-class railways, such as I have specified in paragraph 10, and first-class railways, such as are now under construction in Bengal. I allow four years as the time within which the most difficult work likely to occur on the first-class line of railway can probably be completed, and three years for a similar object on a second-class railway; and I assume that the embankments, cuttings, and minor works, through any length, may be finished within either of these periods. The first-class railway will require 180 tons of iron; the second-class railway will require 47 tons of iron per mile. Lastly, I assume the tonnage available for importing ron at 15,000 tons per annum. Then we might have in 1 years 3,828 miles of second-class railway, at a cost of Company's rupees 76,560,000 (7½ millions sterling); or 999 miles of first-class railway, at a cost of Company's rupees 79,920.000. In round numbers the same cost in the same time would produce four times the length of second-class railway that it would of first class railway. This is undoubtedly a great difference, but would not, in my opinion, justify the postponement of the political and social advantages which exclusively belong to a trunk line of high-speed railway.

Colonel Cotton most unreasonably calculates the future from the past rate of progress in extending the railway system throughout India, forgetting that the retardation has not been owing to any physical or unavoidable obstacles, that the first operations at each of the presidencies were called "experimental," and were strictly limited to short lines, and that much of the previous delay was incurred in discussing and refuting the class of objections which he is now endeavouring to revive.

21. In the opening chapter of his work pp. 2—3, Colonel Cotton, in reference to the Bengal railway, falls into the error of supposing that its assumed incapability of carrying 10,000 tons a day, besides 1,600 passengers, entirely overthrows the calculations of profit; and this he gives, "as a curious instance of the superficial way in which the question has hitherto been considered." But this supposition is quite unfounded, for I have already shown, in paragraph 15, that a goods traffic of 100 tons per day, at 1d. per ton per mile, would pay a dividend of 2 per cent. on the capital; and a similar calculation will shew that 480 passengers per diem, paying 6 pie (3 farthings) per mile, will give 3 per cent more, bringing the dividend up to 5 per cent., and relieving the government from their guarantee. Any excess beyond this very moderate estimate of traffic, may be applied either in augmentation of dividend or in reduction of tolls.

22. By this and similar argument Colonel Cotton endeavours to establish his position that high-speed railways are uncalled for in the present circumstances of India, and that they will be even mischievous in their results; and though it were admitted that works of this description, constructed by private capital, certain to be eventually and very soon independent of state assistance, inducing the investment of European capital in India, and interesting a large section of the British public in the welfare and good government of this country, though it be admitted, I say that such works cannot but be beneficial to any country, still he would object that these benefits are obtainable by the investment of money in other works supposed to be more useful in themselves, and coming into more immediate operation. It must not, however, be overlooked that there are advantages which exclusively belong to high-speed railways, and which are undeniable; I allude to the facilities they afford for the rapid concentration of troops, for the transmission of mails, and for that rapid locomotion which admits of and encourages travelling for information and amusement, and thus conduces to the moral and intellectual improvement of the more intelligent classes. Railways worked by animal draught can never, in these important particulars, supply the place of high-speed railways, though they would be most valuable as branches to the trunk lines, or in localities not likely to supply traffic for an expensive railway.

23. In concluding this branch of the subject, I may be permitted to express my regret that an officer, apparently so anxious for the welfare and material improvement of India, should have directed the influence due to his abilities and reputation against a system, the value of which, after years of controversy, has at length been recognized, but which is not yet so firmly established as to be safe from the risk of further delay and injury by adverse discussion.

24. It would be superfluous to enlarge upon the importance of inland navigation, whether by canals or rivers. The example and experience of the most industrious nations in the world, England, Holland, America, China,

shew the vastness of the efforts that have been made to obtain canal navigation, and the beneficial results which have invariably followed its establishment.

25. The statement so often advanced, that railways have superseded canals, is denied by Colonel Cotton, and I think justly, for existing canals and navigable rivers will always compete successfully with railways, especially for goods traffic; where neither of these modes of communication already exists, and a choice is to be made between them, it will be impossible to lay down any general rule. The method best suited to each locality must be considered separately, and the rival projects must be judged on their own merits, for the circumstances most favourable to one description of work are sometimes those most adverse to the other.

26. Two of the projects advocated by Colonel Cotton's Minute, dated 28th October, 1853, appear to illustrate this position. The first is for a system of coast canals extending from Ganjam to Tuttacorin; and the second for a canal and river communication from coast to coast from Cuddalore to Poonany, crossing the summit level of 600 feet, and passing through much undulating country. On the coast lines the country seems to be nearly level, while the channels forming the deltas of numerous large rivers, which would prove such formidable obstacles to a railway, would only serve as links in the chain of canal navigation. On the other hand, the east and west line from coast to coast, would require very heavy works in locks and aqueducts, embankments and tunnels, and the formation of reservoirs to supply water for lockage, whereas a railway would far more easily accommodate itself to the undulating surface of the country.

27. But little has been done in the Bengal Presidency for the improvement of the river navigation. In 1828, and for several years following, the Sappers and Miners were employed in blasting rocks which impeded the navigation of the Jumna, but I have never seen any returns showing the effect on the amount of traffic of those measures, nor of those more recently adopted by the Lieut.-Governor of the North-Western Provinces for the improvement of the Ganges. The labour annually bestowed on the Nuddah rivers has sufficed to keep their channels open for boats of greater or less burden; a return of traffic on these rivers from 1837 to 1853 is appended to this Memorandum, but shows no growth of the traffic.

28. I have seen no details of the works proposed by Colonel Cotton for the improvement of the Godavery navigation, and have no reason to question their suitableness, but I do not attach much value to the suggestions he has offered for the improvement of the Ganges, or for supplying its place by a parallel navigable canal.

29. The proposed weir, or anicut, across the bed of the Ganges, below the head of the Bhaghiruttee river, would be a stupendous work, and in the absence of stone within reasonable distance, from the dearth of fuel, and from the treacherous nature of the soil, would be of almost incalculable cost. An inspection of the map (No. 1) attached to the Report on the Nuddah Rivers (No. 2 of the selections, Bengal Government) will show that the limits of navigation in the course of the river at this particular point have extended to 8 or 10 miles between 1825 and 1847; and if this occurred under the operation of natural causes, it is impossible to say how much further the river might cut into a yielding soil, when checked and exasperated by artificial obstacles; or how far the line of works must be extended to prevent its flanks being turned by so active an enemy.

30. The proposal to extend the Ganges canal from Cawnpore to Allahabad, and thence down the valley to Calcutta, appears to me still less practical. A project for the easiest portion of this line, from Cawnpore to Allahabad, was drawn out by Colonel Cautley, at Lord Ellenborough's desire, and was rejected by the Government, as inexpedient. The remaining length, following either bank of the Ganges, and on either, crossing numerous tributaries (not navigable in the dry weather, but subject to formidable floods in the rains), would be a work beset with difficulties insuperable at any advisable cost.

31. His third suggestion, being one of a more general nature, whose application is not proposed to be confined to the Ganges, is, as such, worthy of the fullest consideration, though it does not, to my mind, promise success in this particular case. Colonel Cotton proposes to increase the depth of the Ganges during the dry months by the regulated discharge of water stored up in reservoirs, to be formed in and near the Hills, and to be filled annually by the periodical rains. The extension of this well-known expedient for storing water to so large a purpose as that of supplying the deficiencies of navigable rivers, has been suggested by Mr. Ellett, an American engineer, in reference to the improvement of the Ohio and other tributaries of the Mississippi, and by Colonel Cotton himself (p. 96), in reference to the navigation of the Severn, but I am not aware that the plan has ever been put to a practical test.

32. There are some obvious objections to this project, for instance, the uncertainty attending the probable cost of carrying it out; the difficulty of finding space for the artificial lakes without drowning fertile land; the danger of breaches in the high dams, causing destructive inundations; and the slow, but sure process of silting, which must in time render such reservoirs useless. None of those, however, need be considered insuperable, and I am so impressed with the advantage in this country of storing water, and with the certainty that some useful application will always be found for the water so stored, that I would earnestly recommend the encouragement by Government of all investigations having this object in view.

33. The great drain on the resources of the Jumna (and henceforth on those of the Ganges) to feed the irrigation canals of the North-Western Provinces, confers additional interest and importance on any promising scheme of compensation.

34. It may, I think, be assumed with confidence that under certain circumstances, advantage will immediately be taken by the people of any new line of canal navigation that may be opened up to them. Such will surely be the case in the neighbourhood of any river or lake already much frequented by native boats. I may instance the remarkable success of the Calcutta canals, and that when I was employed in Sindh in 1843, I noticed that the inundation canals of the Indus, though dry for six to eight months in the year, were no sooner filled by the overflow of the river than they were thronged with boats conveying to marts on the river bank the agricultural produce, which had apparently been reserved in store for such opportunity.

35. For these reasons I should anticipate that the proposed system of coast canals in the Madras presidency, if carried out, would come into immediate and full use.

36. The navigable capabilities of rivers, especially when more or less imperfect, are not always taken advantage of by the natives, and in localities where boat navigation has hitherto been little known, it would, I believe, be very slow in coming into operation on a canal. The Jumna above Agra, and the Ganges above Ghurmookteesir, are very little used, though they might easily be navigated, by boats of light draught, to the foot of the Hills. The Jumna canals have not been used for the transport of goods, excepting rafts of timber, though on the Western Jumna canal, cargo boats were provided at the expense of government and offered to traders, gratis at first, for the sake of encouragement. One East Indian accepted the offer, and made two or three voyages between Jagadree and Delhi, but had not energy to carry it on, and the experiment was never repeated. Subsequently, when irrigation became fully established, the fluctuation in the level, and the frequent failure of water at the extremity of the canal, would have been quite incompatible with steady navigation.

37. Judging from past experience, I expect that many years will elapse before full use is made of the Ganges canal navigation; nor could I hope that the proposed im-

provement of the Godavery would be attended immediately with the important results anticipated by Colonel Cotton. He mentions in his book (p. 72), that "not a ton of anything but timber is carried by the Godavery, though it is now navigable for at least six months in the year;" and afterwards (p. 96), he states the navigable period at eight months; he attributes this circumstance to "want of enterprize in the natives, and the interference of petty Zemindars on its (the Godavery's) banks." The interferences may be overruled, but I doubt whether the removal of obstructions to navigation during the remaining four months, would obviate the other causes, whatever they may be, of the past and present disuse of the Godavery as a commercial road.

38. The motive power applicable to canals and navigable rivers may be derived from steam, from cattle draught, or from the labours of men in rowing and tracking. Each of these may be aided, and sometimes retarded, by winds and currents. Steam is not applicable in channels of small capacity. Cattle draught requires continuous and firm towing paths, and could not be advantageously used on short lengths of canal, connecting wide rivers or lagoons, such as are (I suppose) called "backwaters" at Madras. The labour of men is resorted to in rivers with irrigation banks; it is more expensive than animal power, but more easily accommodated to varying circumstances.

39. I am not sanguine that inland steam navigation will ever attain in India to the perfection of speed or cheapness of working anticipated by Colonel Cotton. It is no longer in its infancy. The inland steam department of government has had the experience of more than twenty years, during which there has been no bar to the adoption of improvements, but rather the stimulus of competition by private companies, one of which attempting a nearer approach to the American model, has been far less successful than the other. None of these have ever approached the average speed even of sea-going steamers, except when they have had a strong current in their favour, nor have they been able to carry freight at a price that would compete with a railway. To obtain American results we must have rivers of American depth and capacity, and free from the silt which clogs and dissipates in numerous shallow channels the waters of our Bengal rivers.

40. I believe that in such rivers as we have, steam boats will be more usefully employed as tugs, drawing one or more flats after them, than in any other way. And in canals also, a small screw steamer, making two or three miles an hour, with a train of boats, would probably answer well, and would not create a ripple injurious to the banks. I have no data to estimate the cost of traction by this method, but I believe it would be low.

41. The cost of cattle draught at the natural pace of the animal, on a canal with good towing paths, is theoretically one-thirtieth of that on a good metalled road, which I have stated above to be in this country rather more than one anna per ton per mile, so that the minimum cost for traction would be less than half a pie, an immense advantage, which could not but tell upon all descriptions of traffic in which time is not of prominent importance. The cost of river navigation, when the progress is dependent on the exertion of the boat's crew, and on the use which they can make of wind and tide, can only be calculated on the average of actual results, and of these I have entered on the annexed traffic table all (of authenticity) which I have been able to collect. I would take three pie per ton per mile as a fair average, but some indefinite addition must be made for delay and considerable risk.

42. I infer that inland water communication might frequently be found preferable to a low-speed railway, even if the cost of construction were equal, but that it would not answer the important purposes of an ordinary railway, though it might, and in the case of the Ganges valley, probably will, compete with it for heavy goods traffic.

43. In conclusion, I would beg to state my opinion, that no prospect of future better communications should be allowed to interfere with the present construction of good cart roads, since they will be required for many years, and since even the most perfect system of canals or of trunk and branch railways will not eventually supersede their necessity. I believe that the effect of railways will be in India as it has been in England, to increase rather than diminish the aggregate amount of traffic on common roads.

44. I would briefly enumerate the conclusions at which I have arrived in the preceding paragraphs—

1. That an imperial system of trunk lines of railway, such as has been lately sanctioned, is essentially necessary to meet the military, political, and social requirements of India.
2. That the greater expenditure on high-speed railways is chiefly for objects that conduce to economical working.
3. That the ordinary traffic of high-speed railways should be worked at that velocity which will secure the most economical results.
4. That a heavy traffic can be worked more cheaply on a substantial railway than on an inferior one.
5. That a low-speed railway should be calculated for animal draught, though made fit to be used on emergency by light locomotive engines.
6. That the gauge of all low-speed railways should be fixed at 5 feet 6 inches.
7. That such railways are applicable only as branches to trunk lines and in localities where the traffic is light.
8. That celerity of construction, being dependent on the supply of iron, may be four times greater for an inferior railway than for a superior one.
9. That the system of coast canals proposed for the Madras Presidency appears to promise very beneficial results.
10. That canals in localities suited for their construction are preferable to low-speed railways.
11. That great speed in canal and river navigation is not likely to be attained in India.
12. That the improvement of rivers and formation of canals, will not lead immediately to extensive boat navigation in localities where it was before unknown.
13. That the most perfect system of canals or railways will not supersede the necessity for good cart roads.

(Signed) W. E. BAKER, Major,
Consulting Engineer to Government.

C. Allen, Esq.,
Sec. to Government of India.
7th July, 1854.

P.S.—Since closing this memorandum I have received from Captain R. Baird Smith, the following particulars regarding the temporary railway used in the construction of the Solani aqueduct, on the Ganges canal.

"1. The English bridge rails used on our railways weigh from 26 to 27lbs. per linear yard."

"The common flat bar iron used on our railways has varied very much in size, but may be averaged at $2\frac{1}{2} \times \frac{5}{8}$ths and in weight 15.9lbs. per linear yard."

"2. The accounts for the railway have not been kept separately as regards English rails and rails of flat bar iron, but previously to the advent of the English rail, the flat bar iron railroads, formed by us, cost as follows:—

"Single roads	8,809	9	4	per mile.
"Double do	18,867	12	5	"

"Since the arrival of the English rails, and on the 31st October, 1853, I find that our roads consist of about three-eighths English rail, five-eighths flat bar, and that the average rate on the whole was for double roads, C. Rs. 23,184 11 4 per mile."

"3. It should be borne in mind that our railroads have not to bear the expense of the embankments on which they are raised, and that they are not always ballasted."

"4. Haulage."

"By horses, Company's rupees ...	0.032	per ton per mile.
"By men " ...	0.041	"

" These are simply the rates of merely drawing the waggons by horses, or propelling them by men, and include nothing for maintenance of waggons in proper order."

" 5. Our waggons contain 50 cub. ft. of earth, or 33 cwt."

" One horse draws two loaded waggons easily at the rate of 2.85 miles per hour."

" Three men propel one loaded waggon at a speed somewhat less than that of horses."

The cost of construction detailed in paragraph 2, is stated to refer merely to the provision and laying of permanent way materials, including *some* ballast. With the addition of the other items provided in my estimate (paragraph 10), it will stand as follows:—

		C. Rs.
Half of Ganges canal last cost of double way		11,592
Additional items from my estimate (par. 10)	7,714	
Less half cost of ballast	990	—6,724
Total		18,316
Brought forward		18,316
Add 10 per cent. for sidings		1,831
Grand total		20,147

which nearly corresponds with my estimate.

The cost of haulage by horses is three times that which I had estimated for animal draught on a second class railway. This is probably owing to my calculation having been based on the results of bullock draught, and tends to prove that on railways worked with animal power, either a more expensive animal must be employed, or the speed must be reduced to that of a bullock. The adoption of either alternative would tell in favour of steam versus animal power.

(Signed) W. E. BAKER, Major,
Consulting Engineer to Government.

10th July, 1854.

RATES OF LAND AND WATER CARRIAGE.

LOCALITY.	Nature of Goods.	PARTICULARS AND DETAILS.	Rate per Ton per Mile. As.	Pies.	AUTHORITIES.
		ROADS.			
Sova Mookee to Calcutta	Sugar.	By cart	1	10½	J. Erskine, quoted by Mr. Stephenson.
Mirzapore to Calcutta	Cotton.	By cart on Trunk Road	1	0	Major W. E. Baker, from inquiry on the spot.
Do. to Jaunpore	Do.	Do. District Roads	2	0	
Wallaja Muggur to Madras	General.	Do. on Common Roads	1	10	Major T. Pears, C.B., Railway Reports.
Palamauiar to Madras	Sugar.	Do. do. (part of the road very bad)	2	0	
Various places in Madras Presidency	Salt.	Do. (cost of carriage, deduced from comparison of prices.)	0 2	11 1	
Madras Waggon Trunk Road.	General.	By Cart	1	6	P. W. Commission, Madras.
Berar to Bombay	Cotton.	On Pack Bullocks	6	11	
Baroda to Tankaria	Miscellaneous.	By Cart in dry weather	2	4	Captain Trench's pamphlet, Baroda and Tankaria Railway.
Do. Do.	Do.	Do. Do. (by another account)	2	6	
Jambooseer to Tankaria	Cotton.	Do. Do.	2	8½	
Allahabad to Agra	Miscellaneous.	By " Allahabad and Agra Carrying Company's Waggons"	1	10	Advertisement in Exchange Gazette.
Agra to Allahabad	Do.	Do. Do. Do.	0	11	
Allahabad to Cawnpore	Do.	By Government bullock train, Pucca road. Guarding and haulage in dry weather	1	0½	P. M. General N.W. Provinces, 1850. Selections N.W.P.
Meerut to Amballa	Do.	Do. Do. Kucha road. No charge for cost or wear of carts	3	1½	
Calcutta to Mirzapore	Piece Goods.	By Cart along Trunk Road	3	9	Rustomjee, Esq., quoted by Mr. R. M. Stephenson.
		RIVERS AND CANALS.			
Calcutta to Mirzapore	Piece Goods.	By River boat	0	7	Rustomjee, Esq., quoted by Mr. R. M. Stephenson.
Mirzapore to Calcutta	Cotton.	Do.	0	5⅓	
Trichinopoly to Tranquebar	Granite.	Do.	0	7⁵⁄₇	P. W. Commission, Madras.
Cochrane Canal	Firewood.	By Canal Boat	0	3	
Trichinopoly to Tranquebar	General.	By River boats	0	6	Major Lawford, quoted by Col. Cotton
Rajahmundry Channels	Do.	In River boats, short trips, 20 and 10 miles	0	3	Colonel Cotton's Book, page 112.
Ghazeepore and Chupra to Calcutta	Sugar and Saltpetre.	Calculated according to distance by the river, insured	0	5	From invoices furnished by the late Bamboo Matting Hall Seal.
Do. Do.	Do.	By counting boats, not insured	0	2¼	
Monghye to Calcutta	Grain.	Do. do. not insured	0	2	
Erie Canal	General.	In Boats towed by horses	0	7¼	Mackay, quoted by Colonel Cotton.
St. Lawrence Canal	Do.	In Steam-boats	0	4	Ditto, Ditto.
Scindh	Miscellaneous.	By Government steamers on the Indus up stream	0	11½	P. W. Commissioners, Madras.
Ditto	Do.	Do. do. down stream	0	4	
Calcutta to Allahabad	Goods exceeding 25lbs. per cubic foot.	By I. G. S. N. Company's steamer, calculated on direct distance, viz., 500 miles	2	7	Advertisements in the Bengal Directory.
Allahabad to Calcutta	General.	Do. Do. Do.	0	8	
Do. Do.	Cotton half screened.	By G. S. N. steamer, do. do.	0	8	
		RAILWAYS.			
German States	Not classed.	By Railway	4	7	Lardner's Railway Economy, page 488.
Ditto	1st class.	Ditto	2	3¾	
	2nd class.	Ditto	1	8½	
	3rd class.	Ditto	1	7	
France	Average.	Ditto	1	0	Ditto, page 451.
Belgium	Do.	Ditto	1	4	Ditto, page 425.
Moscow to St. Petersburgh	Grain and Flour.	By the Government Railway	0	6	A memorandum in my note book; authority omitted.
	Flax and Hemp.	Ditto, Ditto	0	8	
	Other Articles.	Ditto, Ditto	1	4	
New England and New York.	General.	Average of Goods carried by 28 principal Railways in 1847	1	2½	By Economy, page 407.
East Indian Railway	1st class.	Rates provisionally sanctioned by government	0	9	
	2nd class.		1	6	
	3rd class.		2	0	

ABSTRACT of the Annual Amount of Tolls collected on the Nuddah Rivers, from 1st May, 1837, to 30th April 1854, being a period of Seventeen Years.

Years.	Amount of Tolls collected. Rs.	a.	p.	REMARKS.
1837-38	206,064	1	0	A reduction of 25 per cent. on the rate of toll leviable on the Bhaghiruttee was made in 1837.
1838-39	184,333	11	9	River channels closed early in the dry season.
1839-40	193,345	7	7	
1840-41	222,959	1	11	The state of the river was very favourable.
1841-42	229,506	7	7	
1842-43	246,994	6	11	
1843-44	233,069	13	0	The reduction of rate made on the Bhaghiruttee in 1837, was extended to the Jelinghee and Matahangha in August, 1843.
1844-45	216,634	0	6	
1845-46	222,186	6	0	
1846-47	208,640	10	3	In 1846-47, the channels were much obstructed.
1847-48	238,728	13	9	In 1847-48, the state of the rivers were very favourable.
1848-49	201,322	12	9	In 1848 49, all three rivers were easily closed to navigation.
1849-50	218,822	0	3	In 1849-50, the Bhaghiruttee was most favourable for navigation.
1850-51	210,850	1	9	In 1850-51, the state of the Jelinghee was very favourable.
1851-52	228,062	12	9	In 1851-52, the Jelinghee continued favourable.
1852-53	201,510	1	7	In 1852-53, all three rivers closed early in January.
1853-54	203,934	15	4	In 1853-54, the Matahangha alone continued open for boats of small draught throughout the year.

(Signed) J. LANG, Major,
Superintendent Navigation Rivers.

Calcutta, 10th July, 1854.

Home Correspondence.

THE WORKING CLASSES AND MECHANICS' INSTITUTIONS.

SIR,—It is a well-known fact, and one greatly to be deplored, that the class of persons for whom Mechanics' Institutions were first established, do not avail themselves of the facilities such Institutions afford of improving the taste, cultivating the mind, and of imparting a knowledge of those principles of science which should regulate the craftsman in his handiwork. A workman, in the absence of such information, labours mechanically only; his labour is a drudgery to him, for the simple reason that he performs it in ignorance. As it is admitted on all hands that the failure of Mechanics' Institutions of reaching the working classes is a fact to be deplored, it will only be my present effort to make a few remarks upon the probable causes of this failure, and to endeavour to point out what appears to me the best means of enlisting their sympathies.

In this I cannot hope to be altogether successful, yet I shall be excused venturing to bring the subject under public notice if it only be the means of drawing the attention of those far more able than I am to discuss so important a question.

When Mechanics' Institutions were first established, it was thought by their promoters that the advantages held out would be acceptable to few except workmen, or those in a similar position. They were mistaken. Workmen *did then* join the newly-formed institutions in large numbers, but "classes not contemplated in the original scheme, and supposed to be removed by their circumstances from the need of such means of instruction, in still greater numbers availed themselves of them."* Time has proved that whilst the latter class of persons continue in their support of, and advantage from, these Institutions, the latter has gradually diminished in number. The question then is, *Why is this?* An answer to the question (transmitted to your Journal) from those interested in the subject, and who have had the opportunity of personal observation in different parts of the country, might lead to most useful results.

My impression is, that when a working man leaves his labour, he is either too tired to make any change in his dress, and, therefore, thinks himself unfit to frequent a reading-room made use of by persons in a different position to his own, or that, not being sufficiently educated to read *comfortably*, he finds it altogether irksome. To remedy these objections, the management of an Institution should consist of men who would show themselves friendly to the working classes by *mixing amongst them*, and striving to show that the mere *dress* of a working man is no disgrace to him, but that, on the contrary, *discreet conduct alone* is sufficient to make his presence agreeable to those who may be placed higher in the social scale. Then, with respect to those who read with difficulty, I might suggest the establishment of weekly lectures on the events and topics of the week. News is acceptable alike to the educated and the uneducated, and the latter might thus be judiciously led to feel a desire to read for themselves. A class for the study of reading would, in all probability, follow in due course, and the first step in the progress of education would then be pointed out to many a thirsty mind.

Trusting these few hurried lines may not be barren of good,

I remain, sir, faithfully yours,
SAMUEL LEE RYMER.

Croydon, 25th June, 1855.

* See *Manual for Mechanics' Institutions*, chap. 3, published by the Society for the Diffusion of Useful Knowledge. London, 1839.

Proceedings of Institutions.

PORTSEA.—On the evening of the 13th inst., Mr. J. Spence, one of the vice-presidents, gave a "Reading from Burns's Works," at the Watt Institute. In reply to a vote of thanks, the lecturer stated that the best way of thanking him was by the members coming forward and giving a reading from some celebrated author every month.

ROYSTON.—On Tuesday, 26th June, Dr. Trevethan Spicer (of London) delivered a very interesting lecture, at the Mechanics' Institute, on "The Curiosities of English History." Dr. Spicer took a very comprehensive and entertaining view of the subject—tradition—the various nations that have peopled our island—the English constitution—commerce—the law of evidence; these topics were all ably descanted on. He also instructively reconsidered several historical characters, and concluded with a sketch of the past, present, and future of England. The lecture, which was delivered for the benefit of the Institute Building Fund, was listened to with deep attention throughout; and, at the conclusion, a vote of thanks to Dr. Spicer for his liberality was carried unanimously.

MEETINGS FOR THE ENSUING WEEK.

Mon. Society of Arts, 11. Conference of Representatives of Institutions in Union.
Royal Inst. 2. General Monthly Meeting.
Entomological, 8.
Tues. Society of Arts, 4½. One Hundred and First Anniversary Dinner at the Crystal Palace.
Wed. Society of Arts, 7. Election of Officers.
Sat. Asiatic, 2.
Actuaries, 3. Anniversary.

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par. No.

Delivered on 14th June, 1855.
291. Army, Commissariat, and Ordnance—Accounts.
295. Customs Duties (Colonies)—Return.
Eastern Papers (Negotiation at Vienna)—Part 14.
Delivered on 15th June, 1855.
284. Real Property, &c., Commissions—Return.
302. Schools (Scotland)—Return.
304. Sea of Azoff, &c.—Copies of certain Correspondence.
307. Army Civil Departments—Copy of an Order in Council.
168. Bill—South Shields Parochial Districts.
Delivered on 16th and 18th June, 1855.
273. Newfoundland—Copies of Correspondence.
312. Metropolis Roads—Return.
305. Wines and Spirits—Account.
306. Wines—Return.
170. Bill—Court of Exchequer (Ireland).
Public Records—16th Report of the Deputy Keeper.
Delivered on 19th June, 1855.
299. Copper, &c.—Account.
300. East India—Home Accounts.
311. Court of Chancery—Returns.
313. Oyster Fishery—Copies of Letters.
316. Education Grants (Scotland)—Return.
171. Bills—Roman Catholic Charities.
172. Bills—Cambridge University.
Delivered on 20th of June, 1855.
303. Canadia (Transport)—Copy of Report.
309. Foreign Shipping—Account.
315. Guano—Copy of Consular Despatches.
Poor Laws (Ireland)—8th Report of the Commissioners.
324. War with Russia (Loss of Officers and Men at Hango)—Copies of Letters.
Charitable Donations and Bequests (Ireland)—10th Report of the Commissioners.
Bleaching Works—Report of the Commisssoners.
Criminal Offenders (Scotland)—Tables.
Delivered on 21st June, 1855.
327. Assay Offices (York, &c.)—Return.
328. Liverpool Docks Bill, and Birkenhead and Liverpool Docks Bill—Special Report from the Committee.
318. Army before Sebastopol—5th Report from the Committee.
240. Lunacy—9th Report of the Commissioners.
173. Bills—Absconding Debtors (Ireland) (Amended).
174. Bills—Union Charges Act Continuance.
175. Bills—Rating of Mines (No. 2).
176. Bills—Youthful Offenders (No. 2).
177. Bills—Christ Church (Todmorden) Marriages Validity.
178. Bills—Administration of Oaths Abroad.
179. Bills—County Palatine of Lancaster Trials.
Delivered on 22nd June, 1855.
169. Bills—Coal Mines Inspection (Amended).
180. Bills—Justices of the Peace Qualification (Amended).
181. Bills—Woollen, &c., Manufactures (Scotland).
183. Bills—Ecclesiastical Courts (as amended by the Lords).
184. Bills—Huddersfield Burial Ground Act Amendment.
185. Bills—Ramsgate Harbour.
Delivered on 23rd and 25th of June, 1855.
321. Education—Return.
326. Vessels and Tonnage, &c.—Return.
330. Militia—Return.
331. Loan—Copy of the Contract.
335. Birkenhead and Liverpool Docks Bill—Copy of Communication from the Board of Trade.
323. Letters Patent—Patents for Inventions—Return.
272. East India Railways—Return (a Corrected Copy).
187. Bills—Haileybury College.
188. Bills—Merchant Shipping Act Amendment.
191. Bills—Indemnity.
193. Bills—Stock in Trade.
The River Tyne—Report of the Commissioners.
Delivered on 26th June, 1855.
329. Poor Law (Strath)—Copies of Communications.
338. Kneller Hall—Copy of Minute.
189. Bills—Metropolitan Buildings (as Amended by the Select Committee).
192. Army Prize Money.
British Fisheries—Report by the Commissioners.
Delivered on 27th June, 1855.
339. Stage Carriage Duties—List of Memorials.
182. Bills—Dublin Carriage Acts Amendment.
190. Bills—Piers and Harbours (Scotland).
197. Bills—Infants' Marriage (as Amended by the Lords).
Public General Acts—Cap. 27, 28, 29, 30, 31, 32, and 33. (Delivered 23rd June.)

PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, June* 15*th*, 1855.]

Dated 27th April, 1855.
962. E. Muller, and J. and X. Gilardoni, Paris—Hooked tile.
Dated 23rd May, 1855.
1158. L. Ochs, St. Josse ten Noode, near Brussels—Paper from leather. (A communication.)
Dated 28th May, 1855.
1212. Captain E. G. Swinton, Warrash House, near Titchfield—Grinding corn.
Dated 4th June, 1855.
1269. G. H. Ingall, Bartholomew-lane, Railway couplings.
1271. W. H. Graveley, 40, Upper East Smithfield—Cooking apparatus.
1273. E. Morewood and G. Rogers, Enfield—Coating sheets of wrought iron.
1275. W. E. Newton, 66, Chancery lane—Ships' augur. (A communication.)
Dated 4th June, 1855.
177. J. Gedge, 4, Wellington-street south, Strand—Currycombs. (A communication.)
1279. J. Gedge, 4, Wellington-street south, Strand—Distribution of motive power. (A communication.)
1281. T. Barrows, Massachusetts—Treatment of wool.
1283. T. Barrows, Massachusetts—Treatment of wool.
1285. J. Tenwick, 24, Orchard-hill, Lewisham-road—Water gauges.
Dated 6th June, 1855.
7291. P. Lolmède, Saux, France—Instrument for administration of medicinal substances.
1293. H. Leech, J. Robinson, and R. Burrows, Preston—Spinning machinery.
1295. H. Nunn, Mabledon-row, New-road—Invalid carriages.
1297. W. Baines, Hunter's-lane, near Birmingham—Railways.
Dated 7th June, 1855.
1299. J. Ramsbottom, Longsight, near Manchester—Safety valves and feeding apparatus.
1301. M. Heap, Blackburn—Grinding dye-woods or roots.
1303. A. Orange, Edinburgh—Representations of articles for sale.
1395. D. Fehrman, Liverpool—Lamps. (A communication.)
1307. R. A. Tucker, Lenton, Using gas and smoke arising during combustion.
Dated 8th June, 1855.
1309. R. Caunce, Bolton-le-Moors—Sizing, dressing, and warping yarn.
1310. P. A. le Compte de Fontaine Moreau, 4, South-street, Finsbury—Iron shovels. (A communication.)
1311. F. Weaver, Handsworth—Grinding bones.
1312. I. Lippmann, Paris—Leather.
1313. G. F. Chantrell, Liverpool—Charcoal.
Dated 9th June, 1855.
1314. H. Sibille, Paris—Decortication and preserving of grain.
1315. J. S., E. J., and J. H. Nettlefold, Holborn—Locks. (A communication.)
1316. E. J. Lafond, and Count de Chatauvillard, Bellville, Paris—Lighting.
1317. H. Teague, Lincoln—Meters.
1319. T. Bright, Carmarthen—Prevention of waste in water or other fluid supplies.
1320. M. J. Cooke, Newcastle—Preserving food.
1321. J. Robinson, Poplar—Tables.
1322. J. Greenwood, Irwell Springs, Bacup—Purifying oils.
1323. S. Colt, Pall-mall—Firearms.
1324. S. Colt, Pall-mall, and W. T. Eley, Broad-street, Golden-square—Cartridges.
Dated 11th June, 1855.
1325. W. K. Hall, Mark-lane—Railway breaks.
1326. H. B. Barlow, Manchester—Cotton machinery. (A communication.)
1327. F. C. Bakewell, 6, Haverstock-terrace, Hampstead—Bench planes. (A communication.)
1328. J. D. Kind, Birmingham—Lock spindles and handles.
1329. J. L. Casartelli, Manchester—Pressure and vacuum guages.
1330. E. V. Gardner, 24, Norfolk-street, Middlesex-hospital, and J. H. Walker, Cole-street, Dover—Separating vegetable substances from fabrics containing wool, and preparing wool for re-manufacture.
1331. W. Barrington, Limerick, and W. R. Le Fann, Dublin—Joining bridge rails.

1332. F. T. S. Bards, Royal Exchange—Card cases.
1333. J. H. Johnson, 47, Lincoln's-inn-fields—Metallic pens. (A communication.
1334. J. H. Johnson, 47, Lincoln's-inn-fields—Governors. (A communication.)
1335. I. Lippmann, Paris—Dyeing skins.

Dated 12th June, 1855.

1336. I. J. Liebisch, London—Rails for railways.
1337. W. Armitage, Manchester—Union bags and sail-cloth.
1338. N. Hackney, Hull—Earthenware, china, and porcelain.
1339. S. Coulson, Sheffield—Sulphate of baryta.
1340. W. B. Johnson, Manchester—Steam boilers and safety valves.
1341. T. Metcalfe, High-street, Camden-town—Collapsible hats and bonnets.
1342. C. Parker, Dundee—Weaving.
1343. H. W Ford, Gloucester—Agricultural machinery.
1344. J. C. Brant, 8, Surrey square, Old Kent-road—Permanent way.

WEEKLY LIST OF PATENTS SEALED.

Sealed June 15th, 1855.

2660. Charles Frederick Stansbury, 17, Cornhill—Improved life-car or buoy. (A communication.)
2664. Edwin Whele, Birmingham—Improvements in oil and other lamps.
2680. R. B. Huygens, Holland—Improvements in ordnance and fire-arms, and in the projectiles to be used therewith.
2681. John Paul, Manchester—Improvements in machinery or apparatus for colouring or staining the surfaces of paper, leather, woven fabrics, and similar materials.
2693. William Greener, Birmingham—Improvements in repeating military rifles, carbines, and pistols, and in cartridges to be used therewith.
30. Louis Dominique Girard, Paris—Improvements in applying steam fluids and gases for the purpose of obtaining motive power, parts of which are applicable for compressing and rarefying air and gases, and for raising liquids.
46. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improved mode of obtaining alcohol.
95. Gustav Warnecke, Frankfort on-the Maine—Improvements in preserving vegetables and fruits.
96. Joseph Claudot, Paris—Improved stucco.
124. James Webster, Collingham—Improvements in the application of motive power.
248. Benjamin Goodfellow, Hyde, Chester—Improvements in ordnance.
384. John Hyde Pidcock, Leighton Buzzard—Improved method of propelling and steering vessels, which is also applicable to the forcing and directing of liquids and fluids.
471. Benjamin Dickinson and John Platts, Clough House Mill, near Huddersfield—Improvements in machinery or apparatus used in finishing woollen and other textile fabrics.
679. Archibald Turner, Leicester—Improvements in the manufacture of elastic fabrics.
749. Frederick Joyce, Upper Thames-street—Improvements in the manufacture of percussion caps and other primers.
769. William Bennett Hays, 47, Cambridge-street, Pimlico—Improved breakwater.
888. Alfred Vincent Newton, 66, Chancery-lane—Improved machinery for manufacturing bolts and other like articles.

Sealed June 19th, 1855.

2710. Felix Marie Baudouin, Paris—Improved means of isolating, and testing the isolation of, the wires of electric telegraphs.
2735. Margaret Williams, Chelsea—Improvements in suspending swing looking or dressing glasses.
113. James Simkin, Bolton-le-Moors—Improvements in rifles and other fire-arms.
603. Thomas George Shaw, Old Broad-street—Improvements in apparatus to facilitate the "tilting" of casks, barrels, or other similar vessels of capacity.
637. William Mac Naught, Rochdale—Improvements in machinery or apparatus for spinning cotton and other fibrous substances.

Sealed June 22nd, 1855.

2705. Frederic Prince, Haverstock-hill—Improvements in the nipples of firearms.
2706. Edward Loysel, Rue de Grétry, Paris—Improved apparatus for cooking or preparing edible substances.
2722. Benjamin Bishop and Joseph Dyer, Birmingham—Improvements in the manufacture of hinges.
2752. James Pillans, 40, Brompton-crecent—Improvements in the preparation of Hematosin and fibrinous and serous matters.
2758. Francis Preston, Manchester—Improvements in bayonets, and in the machinery for manufacturing the same.
2760. Robert Sam North, Gorton, near Manchester—Improvements in switches and crossings for railways.
2764. Samuel Smith Shipley, Stoke Newington—Improvements in fittings suitable for dressing cases, and for other purposes of elegance and utility.
6. Bashley Britten, Anerley—A cheap and convenient method and apparatus for obtaining a copy of writings, drawings, or tracings in ink.
17. Samuel Aspinwall Goddard, Birmingham—Improved firearm, a portion of which is applicable to ordnance.
20. Charles Hustwick and William Bean, Kingston-upon-Hull—Improvements in buffers and springs for railway carriages and other purposes.
31. Robert Ashworth, and Samuel Stott, Rochdale—Improvements in machinery for preparing, spinning, and doubling fibrous substances.
40. George Hallen Cottam and Henry Richard Cottam, St. Pancras Iron Works, Old St. Pancras-road—Improvement in the manufacture of iron bedsteads.
42. William Grindley Craig, Gorton, near Manchester—Improvements in railway buffer cases and rams.
58. Ebenezer Bow, Glasgow—Improvements in the manufacture or production of "blackening" for foundry purposes.
84. Ezra Miles, Stoke Hammond, Bucks—Improved coupling joint or connection for tubing or other purposes.
87. Francis Preston, Manchester—Improvements in ordnance, and in projectiles for ordnance and small arms.
88. William Barningham, Salford—Improvements in connecting the rails of railways.
135. William Johnson, 47, Lincoln's-inn-fields—Improvements in the application, treatment, cleansing, and dyeing of fibrous substances and products.
316. George Hallen Cottam and Henry Richard Cottam, St. Pancras Iron Works, Old St. Pancras-road—Improvements in the construction of iron buildings.
343. Benjamin Gower, Stratford—Improvements in cannons and pieces of ordnance, and in shot and projectiles for cannons and pieces of ordnance.
464. William Hodges, Stafford—Improvements in boots and shoes.
569. John Kidder, Plaistow—Improvements in the construction of castors.
700. John Blair, Glasgow—Improvements in hats and other coverings for the head.
707. William Crozier, Sunderland—The better extinction of fire.
741. Peter Rothwell Jackson, Salford—Improvements in machinery for making patterns and for moulding therefrom.

Sealed June 26th, 1855.

2724. Frederick Samson Thomas, Hook's-villa, Fulham, and William Evans Tilley, 6, Kirby-street, Holborn—Improved process for plating or coating lead, iron, or other metals with tin, nickel, or alumina.
2727. George Carter, 42, Lombard-street, and Henry Cyrus Symons, 52, Castle-street, Southwark—Improvements in boilers and furnaces, and in the apparatus for supplying and regulating the fuel, air, water, and steam.
4. George Cram, and John Jackson Crane, Chester—Improved composition, applicable to the coating of ships' bottoms and other useful purposes.
12. John Keir Harvey and Daniel Pearce, London—A calender inkstand.
13. Félix-Gabriel-Celestin Dehaynin, Paris—Improvements in the purification of hydrogen gas.
14. Hippolyte Fontaine, Marseilles—Improvements in engravers' presses.
21. Alexander Southwood Stocker and Samuel Darling, 11, Poultry—Improvements in the manufacture of bottles, pots, jars, tubes, and other receptacles, part of which improvements are applicable to various other purposes for commercial and domestic use.
43. John Huggins, Birmingham—Improved machine for the manufacture of lint.
65. William Coles Fuller, Bucklersbury—Improvements in the construction and adaptation of india rubber springs.
72. Alexander Robertson, Upper Holloway—A new manufacture of packages for dry goods.
90. Richard Archibald Brooman, 166, Fleet-street—Certain means of de-vulcanizing india rubber and other similar gums, or of treating such gums after having been vulcanized.
401. William John Macquorn Rankine, and John Thomson, 59, Saint Vincent-street, Glasgow—Improvements in machinery for laying subaqueous electrical conductors for telegraphic communication.
735. George William Friend, 22, High Holborn—Improvements in umbrellas and parasols.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
3731	June 22.	A Mourning Hat	Wm. Mountcastle & Son	Manchester.
3732	"	Improved Valve Plug for the bottom of Ships' Boats and Boats in general	Captain John Olive	Liverpool.
3733	" 26.	The Luffer Chimney Top	John Martyn Fisher	Taunton.