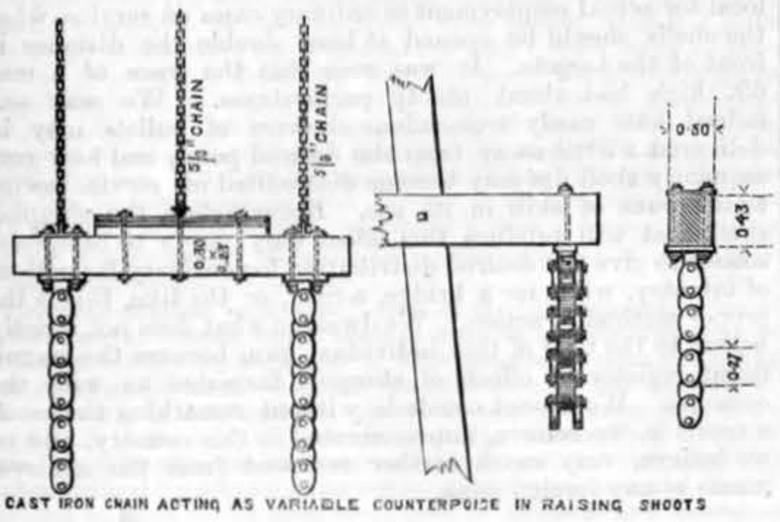
## THE BILBAO IRON DISTRICT.

No. IV.

The harbour works consist of a pier for the shipment of ore with a canal dredged in front of it 3280ft. in length and 320ft. in width. This has not all been sunk to its full depth, but will before long have 18ft. below low-water throughout its entire length. The pier is 902ft. in length, commences with a curve of 197ft. radius, and admits of four steamers of about 1000 tons each being loaded at one time. The rail level is 29½ft. above ordinary high-water mark, and is amply high and a convenient level for steamers, but as so high a fall is dangerous to small sailing vessels another special stage has been provided for them. The pier is of wood, and was erected on contract by Mr. Peter Shade. The piles are of Memel timber 13in. square, driven to a depth of at least 33ft. below low-water, and until they were capable of sustaining a minimum weight of 15 tons calculated by the formula $x = \frac{B^2 h}{(B \times P) e}$ where $x$ = minimum resistance of 25 tons; B = weight of monkey; P = weight of pile; $h$ = fall of monkey; $e$ = distance driven by the last blow. The driving was effected with hand power machines having monkeys weighing 20 cwt. The superstructure is principally of French pine obtained from the Landes, and injected with sulphate of copper. As wooden structures deteriorate rapidly in the Nervion from sea worms, the base of the pier is now being filled with concrete, for effecting which a very complete plant has been laid down. The pier itself cannot be better arranged, and gives every facility for shipping a large quantity of stuff; perhaps out of England, it is second only to the Huelva pier of the Rio Tinto Company in the south of Spain, but the wagons give more trouble in discharging than they should—their construction is certainly defective in more respects than one. The Bilbao Company have one great advantage over the Diputacion Railway, and the other shipping companies which we have yet to notice, in being close to the entrance of the river. All the other shipping places are



CAST IRON CHAIN ACTING AS VARIABLE COUNTERPOISE IN RAISING SHOOTS

from three to five miles upwards, and as steamers can only move at near high water this often saves a tide, besides loaded vessels at this stage are ready to seize the first fine weather to go out, which is another pull in variable weather. Each ship's berth is provided with two shoots, actuated by winches, fixed upon the upper platform. The shoots are arranged to receive the contents of two wagons, weighing about ten tons, at the same time. Owing to the ground swell along the face of the pier when the sea outside is rough an alteration has been made in the mode of raising and lowering the shoots, which is now done by a balance weight suspended at the back of the pier in such a manner that the weight can be dropped and the shoot hoisted almost instantaneously. The time required to hoist the shoot from ordinary loading position as altered is forty-five seconds; rather more than two minutes is required to lower it to the same position. Two men are needed to lower the shoot, and one only to raise it. The present arrangement consists in fixing the shoot at the upper end, and connecting the extreme point by means of two ⅝in. chains passing over pulleys fixed above to a balance weight of two large cast iron chains and weight, as shown below. The ever-varying position of these chains compensates for the increase and decrease of weight of the shoot, caused by the variation of the angle of elevation. The accompanying engravings show the arrangement.

The ore is dropped from hopper wagons into a large wooden hopper, lined with iron bars ⅜in. thick, to the mouth of which the iron shoot is attached to conduct the ore to the ship. The largest amount of ore shipped on any one day has been 3300 tons. The greatest despatch yet given to any one vessel was 150 tons in thirty minutes. An ample supply of buoys and bollards has been fixed for mooring vessels; the buoys are secured to piles 9ft. long, screwed in from 10ft. to 16ft. below the permanent bottom of the canal. A service of fresh water has been provided along the pier for protection against fire. The water is obtained from springs in the tunnel, and pumped into a reservoir 33ft. above the pier level.

A canal has been dredged in front of the pier. Approximately the quantity to be dredged was 785,000 cubic yards, and this has now nearly been effected. The work has been done by one of Messrs. Tilken and Co.'s steam central ladder dredgers, capable of lifting 800 tons per day. The monthly wages cost of this dredger is only £52 12s.

Several classes of barges have been tried; the one ultimately adopted has been a hopper barge of French pine, to hold 50 tons, 40ft. long, by 17½ft. wide. The advantage of this form is that the water brought up by the dredger flows over the sides of the barge when it is nearly full, leaving the sand almost dry. It will likewise float, although the internal compartment may be filled with water. These barges were built at Bayonne, and shipped in pieces to Bilbao. They cost at Bayonne £117 each, and in delivery, duty, and erection, £85 each.

The material dredged—sand and mud—is conveyed in the barges to the discharge stage near the centre of the station, and raised 21ft. above high-water by a hoist driven by one of Robey and Co.'s 12-horse portable engines. The shafting drives two sets of gearing, working each two grooved winding drums with chains coiling in contrary directions, so that whilst one jib is lifting the other is lowering. The skips hold 22½ft. of material weighing 1700 lb., and discharge their contents into tip wagons, working on a platform immediately below.

In a day of ten hours 600 laden skips are hoisted. The spoil is tipped into the original river channel, and the base of the bank is protected by a toe of rubble run ahead of the tip. The face of the toe will be eventually pitched with squared blocks. The actual cost of dredging during seven months is as follows:—

| | d. |
|---|---|
| Dredging and filling barges | 2·10 |
| Barging | 1·61 |
| Discharging barges | 3·41 |
| Haulage and tipping into banks | 2·89 |
| Formation of toe bank of rough stone | 2·13 |
| Total cost of work | 1·02 |
| Total quantity dredged | 70,954 yds. |
| Cost excluding toe banks | 10·00 |

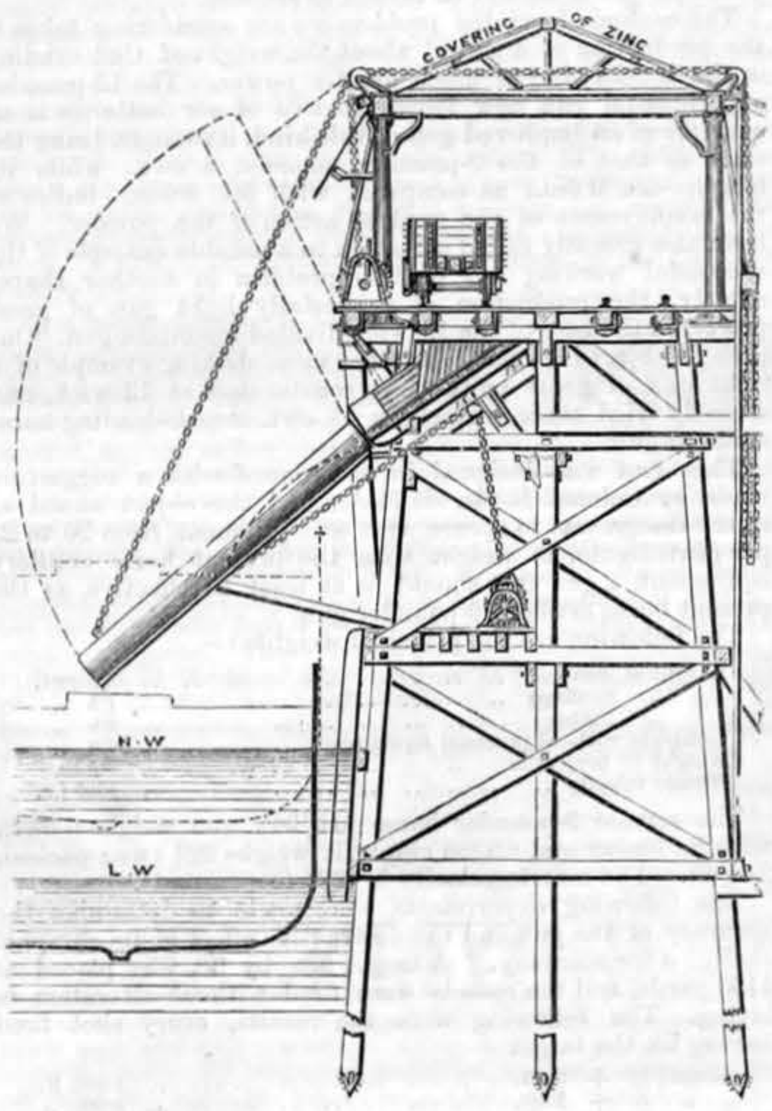
The mines of the company are:—In the district of Galdames:—

| | Acres. |
|---|---|
| 1. La Escarpada | 111 |
| 2. La Cenfa | 45 |
| 3. El Berango | 67 |
| 4. Dudosa | 111 |
| 5. Tardia | 91 |

In the district of San Pedro de Abanto:—

| | |
|---|---|
| 6. Moruecos | 148 |
| 7. Cerillo | 10 |
| 8. Vulcan | 74 |
| 9. Convenio | 62 |
| 10. La Vinerillas | 91 |
| Total area | 810 |

Of those at Galdames only the Berango mine has been opened, and is now being worked. Here the lode apparently extends from north-west to south-east, and it can be traced for a distance of 1640 yards. The ironstone crops out of the side of the mountain in vertical cliffs, one of which has an escarpment of 55 yards. At about the centre of the present workings the lode of ore has been traced to a width of 306 yards at the railway level. There is enough ore above this to employ the



TRANSVERSE SECTION OF PIER

resources of the company for many years. Generally there is but little covering, and a large portion of this having been removed the ore is being worked in steps. The ironstone, a hard brown hematite, is blasted with dynamite and common powder in large masses, which are then broken up with wedge and hammer. The cheapest and most convenient way of reducing the larger blocks is to insert a third or half of a dynamite cartridge into a hole of from 1in. to 2in. in depth, on the upper face of the block to be broken. A block weighing one or two tons will thus be shaken so that a few blows with the hammer will break it up. This is a simple method of dealing with these masses which we have not seen employed elsewhere, and we may mention another plan practised here, which, though not novel, is rarely resorted to, viz.: in the deep holes which are sometimes bored 20ft. to 30ft. for taking down large masses, a small charge of dynamite is frequently employed to enlarge the chamber so as to take a heavy charge of powder, from which, in stoping down the cliffs a better result is obtained than in working with dynamite alone. A self-acting incline has been constructed up to the first shelf or level with a gradient of 1 in 6 and a length of 120 yards. Four wagons are sent up and down this incline at a time with about 20 tons of ore.

The surface earth is removed by bridges and shoots, and tipped into the valley at the opposite side of the railway.

The rolling stock consists of six large locomotive tank engines, made by Messrs. Kitson and Co., of Leeds; three small locomotive tank engines, made by Manning and Wardle; and five hundred five-ton hopper wagons supplied by the Darlington Wagon Company.

The large locomotive engines have ten wheels, six-coupled, with a four-wheeled bogie in front. The leading pair of driving wheels are without flanges. The principal dimensions of these engines are:—

| | |
|---|---|
| Diameter of cylinders | 14in. |
| Length of stroke | 20in. |
| Heating surface fire-box | 70 square feet |
| Grate area | 11·5 square feet |
| External diameter boiler | 3ft. 8in. |
| Length of boiler | 10ft. |
| Number of tubes | 138 |
| Heating surface of tubes | 652 square feet |
| Diameter of bogie wheels | 2ft. |
| Wheel base of bogie | 4ft. 8in. |
| Diameter of driving wheels | 3ft. 6in. |
| Wheel base of engine | 11·2in. |
| Capacity of tank | 550 gallons |
| Capacity of bunker | 30 cubic feet |
| Weight of engine | 26 tons 18 cwt. 2 qr. |
| Water in boiler | 2 tons 15 cwt. |
| Water in tanks | 2 tons 9 cwt. |
| Weight of fuel | 15 cwt. |
| Gross weight | 32 tons 12 cwt. 2 qr. |

These locomotives are capable of taking up the incline trains composed of forty empty mineral wagons, representing a gross load of 110 tons; but for the better regulation of the service they are only required to take up trains of thirty wagons. The gross weight of the descending trains, excluding the weight of the engine, is—load of ore 150 tons, thirty wagons 82 tons, total 232 tons. We may add that, notwithstanding the large traffic and heavy grades on this line, it has been worked for the last three years with only one trifling accident.

## THE SYDNEY EXHIBITION.

No. III.

THE Exhibition has created fully as much interest and excitement as its most ardent advocates could by possibility have anticipated. In some cases the success has already surpassed expectation. On the opening day the Exhibition was very incomplete, the British section being the only large one that was in order; but work was pushed on energetically, and on the first shilling day—Saturday—about 30,000 persons paid at the doors. Mondays and Thursdays are half-crown days, and, in spite of attractive music, are already admitted to be failures. It is extraordinary, after the experience gained at former International Exhibitions, and especially at the crowning instance of the Paris Exhibition of last year, that the directors should have been ill-advised enough to depart from the beautiful simplicity of "one shilling admission." However, they are quite practically-minded enough to alter the regulation, as soon as they see clearly that it will not pay.

The names of most of the British exhibitors connected with the mechanical arts have been given already in the columns of THE ENGINEER, and we need only add that the section makes a large and handsome display, and that the façade is with excellent taste decorated with the names of the cities and towns of Aberdeen, Belfast, Birmingham, Cork, Dublin, Dundee, Glasgow, Hull, Leeds, Limerick, Liverpool, London, Manchester, Newcastle, Nottingham, and Sheffield; with an ornamentation of the rose, thistle, and shamrock. Entering the building by the western tower, the British section occupies the whole of one side of the transept to the nave, where in the centre of the building, under the dome, stands the statue of her Majesty, in bronze, by Mr. Marshall Wood. The unveiling of this statue formed a portion of the ceremony, and was naturally hailed by the performance of the "National Anthem."

The manner in which all the arrangements were made for the opening ceremony deserves a few words. The estrade was large, and brilliant with Wilton carpet and a beautiful collection of plants, with a bust of Sir Hercules Robinson, to whom the Exhibition is greatly indebted. Over the heads of the company were the arms of Great Britain and of the colony, and a profusion of gay bunting. Above was the grand organ, and the galleries on each hand were filled by the chorus, the ladies being in front, with bright uniform dresses of white with blue sashes. The commissioners have acted, we think, wisely in making music a prominent item in their arrangements; at present there is a popular concert on the shilling days, and select music on the fashionable, but thinly attended, Mondays and Thursdays.

The officials and the representatives of the neighbouring colonies of Australia filled not only the estrade but the greater portion of two platforms, on the right and left of the grand estrade; but the most remarkable features of the assemblage, and that best indicating the success of the Exhibition, were the representatives of foreign countries and other colonies, for whom places were reserved in front of one of these platforms. These representatives included, amongst others, Capitaine Mathieu, commissioner-general for France; Dr. Rouleaux, commissioner for the German Empire; Consul Schonberger, Austrian commissioner; Dr. Cox, United States commissioner; M. Van Schelle, Belgian commissioner; Mr. Haruo Sakata, Japanese commissioner; Mynheer J. de Groal Pzn, Dutch commissioner; Signor Oscar Mayer, Italian commissioner; and many other members of the same commission. There were also representatives from Ceylon, Fiji, New Zealand, Tasmania, the Straits Settlement, Switzerland, New Caledonia, Portugal, Hawaii, Brazil, Sweden and Norway, Peru and Russia, generally consuls or vice-consuls. Sydney may certainly plume herself on the fact that the first colonial invitation to the nations of the earth has been freely accepted. The presence of the Rhin, the Bismarck, and the Austrian troopship Heligoland, in the beautiful harbour, and the civilities and entertainment interchanged amongst the officers and the authorities, are also noticeable features. The Exhibition building, from its proximity to the

charming botanic gardens, has received, officially we believe, the appellation of the Garden Palace.

A few words from a commercial point of view, which appeared in the *Sydney Morning Herald* of October 1st, may be worth quoting. After speaking in the highest terms of the exertions and success of the London Commission, and the various Australian contributions, the writer says:—"Turning to the American and European courts, we see what foreigners are anxious to sell to us, and what in their opinion they can sell to advantage. They have naturally brought out what they think most likely to tempt us, and if in some matters they have under or over-estimated the market, still the exceptions are trifling. Many of these nations come directly in competition with each other . . . and we are set upon examing and comparing with opportunities such as have not previously been presented. . . . . But those who are already engaged in trade here consider themselves quite equal and more than equal to all the wants of the country, and see nothing but loss if other traders tried to push in where there is no room for them. In other words, competition, which is severe, is intensified. The consumer may perhaps gain, but the distributor complains. This, however, is an evil which will very soon adjust itself. People will not continue to press into a trade where there are no profits; while if they succeed in finding a business, that is proof that they were wanted. An Exhibition cannot permanently increase the trade of a country. Our buying powers depend on the success of our own industry, and that of course is the thing that we have to attend to most. That we should spend wisely and well is a secondary matter, and yet not unimportant." This is rather of the nature of a wet blanket, and one might ask, "Why then have had an exhibition?" The writer goes on, however, to say that the Exhibition is extremely interesting to those who, born in Australia and never left it, have not the opportunity of seeing the great shows which have taken place in Europe and America, and that it will be highly useful to the workmen of the continent by showing them the best specimens of European styles of manufacture.

Amongst the British exhibits, that of Messrs. Peter Wright and Sons—of Dudley's anvils, vices, and other smith's tools and accessories—have attracted special attention, which is not surprising, for these well-designed and well-made tools could not fail to attract the eyes of practical colonists and pioneers. The steel pens of Messrs. Leonardt and Co., of Birmingham, are also much noticed, not only on account of themselves, but also for the commercial tact which has put them up with special designs to please the taste of Germany, Egypt, and other countries. Messrs. John Rabone and Sons, of Birmingham, have also wisely hit the taste of the colony with their collection of tapes, rules, levels, and other measuring and surveying necessaries. The "metal tapes," and the tapes with a metal wire woven into them, at once rivetted the attention of workmen. These articles, well known at home, seem to be new to the colonists. The style, or, in some cases, we may say, the splendour, of the showcases in the British court, at once attracted much notice. The case of Messrs. Greenlees Brothers, of Argyleshire and London, is a very beautiful piece of cabinet work; and those of Messrs. Clark and Co. and the Clark Thread Company, of Paisley and Newark; of Messrs. J. P. Coats, also of Paisley; of Messrs. Tress and Co., of London, and some others, are models of their way.

The United States Court adjoins that of Great Britain, but it is far from complete, which must be said of many other courts. Our cousins, however, make an admirable show of hardware, tools, implements, ironmongery, metal furniture, and electro-plate, much admired, especially the former, for their lightness, strength, and neatness. The Vermont Sheep-breeders' Association have thought it worth while to send several cases of fine wools to the country of wool. The Waltham Watch Company promise a fine show of their productions.

In the French court the show of Gien faïence, and that of Creil and Montereau ware, are at present the most conspicuous, and divide much attention with the admirable collection of earthenware, stoneware, and china from England, which is large and excellent. An English firm whose names have escaped us show a varied collection of ware made from the clays of Australia.

Germany has but a small portion of her contributions yet visible, and Austria is in the same condition. Holland has a small court quite complete. Italy shows a good deal of statuary, and many specimens of her Florentine and other mosaic and inlaid work. Switzerland has a pretty show of watches, carved work, lace, and embroidery, all in order. Belgium is not so complete, but her court is a large one, and much of it is arranged. Belgium is one of the few exhibitors of machinery. The Cockerill Company, of Seraing, show an admirable collection of iron castings. In the French court we should have said, there is a fine collection of bronze castings, and plate of various kinds.

Japan presents a most attractive corner court, an epitome of the superb show made in Paris last year. Fiji, the Straits Settlements, and Ceylon, are ranged side by side, and present good specimens of their peculiar productions. Amongst other exhibits, Ceylon shows a curious collection of primitive agricultural tools, we cannot say implements. New Zealand makes a good show of her minerals, of her woods manufactured into mosaic and glued on canvas for flooring, and manufactures in jade and other native material. Tasmania has a small but capital show, of which the words tin, timber, and furs will represent the most important items.

The Australian colonies have been wisely careful to select the best of all their products to show their visitors, and a tempting show it is. The courts, with the exception of Queensland, we think, are not finished; but much is to be seen. About the corn, timber, wool, metals, minerals, wines, and other chief products of Australia it is not necessary to speak; but the sugar trade is comparatively new and important; the trophy of the Colonial Sugar Refining Company calls special attention to it. This company in the sugar-making season employs 1000 hands, all Europeans. It possesses 100 steam engines and seventy-five boilers, with an aggregate of 1000 to 1200-horse power. The works recently built at Pyrmont, at the cost of £125,000, can turn out 600 tons of sugar a week. It has also three large mills on the Clarence River, and another in the course of erection on the Tweed River. The Clarence mills produce from 5000 to 6000 tons of sugar annually from home-grown canes. The company's distillery can produce 4000 to 5000 gallons of white spirit and rum per week. The trophy contains samples not only of the finished products but the sugar in crystals, of which there are many varieties—white and yellow—and of the liquors, illustrating the various stages of the process; molasses, golden syrup, &c., all admirably set up.

The International show of sheep and swine brought a considerable number of farmers and wool merchants from all the colonies. England and France are, as far as we yet know, the only Old World countries that send sheep, and England and America the only contributors of swine.

## THE NEW ELSWICK HORSE ARTILLERY GUN.

The greatly increased power of infantry fire, as well as the employment of earthworks on an enormously extended scale, call for more powerful field guns. We have before pointed out that the superior quality of metal which we now possess, both for the manufacture of guns and carriages, furnishes us with the required means to attain this end, for we can increase the weight of the projectile and charge in proportion to the carriage. The employment of slow burning powder, and air spacing, still further facilitates such a task, for it clearly becomes possible to throw more work on gun and carriage, and to cause this work to take the form of a push rather than a blow, so that we have simply to deal with a gun having a very violent recoil. This can easily be controlled by means of a brake, and we all know that a gun and carriage recoiling violently and brought up abruptly by a strong brake does not suffer in at all the same way as a gun acted on by quick burning powder which expends its force rather on the particles of the gun and carriage than on moving them bodily. The necessity for slow burning powder and air spacing has not been felt in the case of field guns much hitherto, because these guns have not been taxed like the heavy ones; in the present condition of affairs, however, it is evident that every available power should be turned to account.

The common form the problem we are considering takes is the production of a gun of about the weight of that existing in the service, but of much greater power. The 13-pounder experimental gun now issued to two of our batteries is an example of an improved gun of this kind, its weight being the same as that of the 9-pounder, namely, 8 cwt., while its length—6ft. 9·6in., as compared with 5ft. 8·5in.—indicates the employment of the gradual action of the powder. We have also recently called attention to a notable example of the successful working out of this problem in another shape, namely, the production of a specially light gun of great power, in the case of the Elswick divided mountain gun. Our present object is to notice another most striking example of a light gun of great power just constructed at Elswick, and recently tried there, namely, a 4½ cwt. muzzle-loading horse artillery gun.

This gun was designed in accordance with a suggestion made by Colonel Boyle, R.H.A., and the object aimed at in the design was to secure with an equipment from 20 to 25 per cent. lighter in weight than the present horse artillery equipment, a gun that should be at least as effective as the present horse artillery 9-pounder gun.

The following are the principal weights:—

| | |
|---|---|
| Weight of gun | 4·5 cwt. |
| ,, carriage | 7·5 ,, |
| ,, limber | 9·0 ,, |
| Complete without personal equipment | 26·0 ,, |
| Weight of projectile | 9·5 lb. |
| Muzzle velocity | 1500 f.s. |

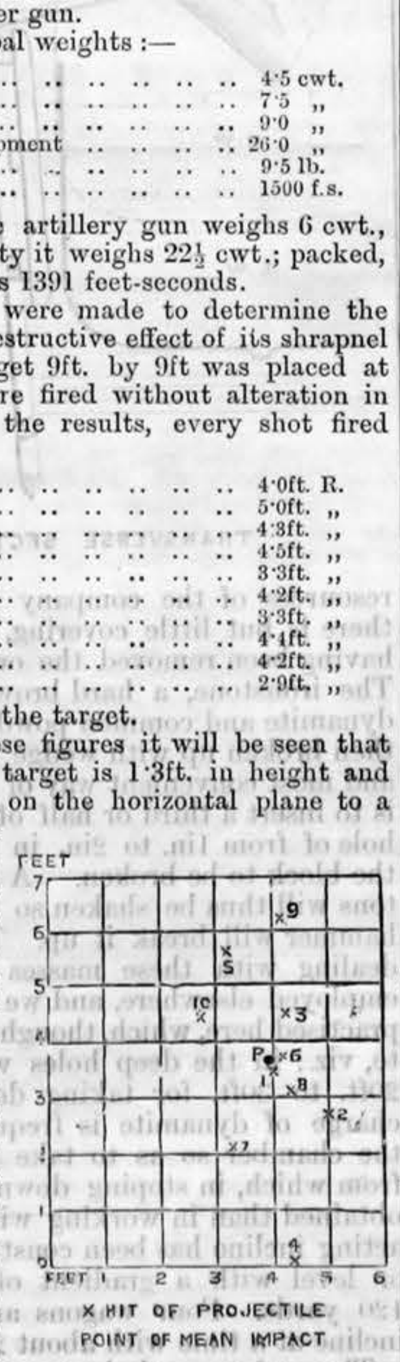
The service 9-pounder horse artillery gun weighs 6 cwt., with its limber and wagon empty it weighs 22½ cwt.; packed, 34 cwt. The muzzle velocity is 1391 feet-seconds.

The following experiments were made to determine the accuracy of the gun and the destructive effect of its shrapnel shell. *a* for accuracy. A target 9ft. by 9ft was placed at 1100 yards, and ten rounds were fired without alteration in laying. The following were the results, every shot fired having hit the target.—

| | | |
|---|---|---|
| Round 1. | + 3·5ft. | 4·0ft. R. |
| ,, 2. | + 2·8ft. | 5·0ft. ,, |
| ,, 3. | + 4·5ft. | 4·3ft. ,, |
| ,, 4. | 0·0ft. | 4·5ft. ,, |
| ,, 5. | + 5·8ft. | 3·3ft. ,, |
| ,, 6. | + 3·7ft. | 4·2ft. ,, |
| ,, 7. | + 2·1ft. | 3·3ft. ,, |
| ,, 8. | + 3·1ft. | 4·1ft. ,, |
| ,, 9. | + 6·2ft. | 4·2ft. ,, |
| ,, 10. | + 4·5ft. | 2·9ft. ,, |

We give below a diagram of the target.

From an examination of these figures it will be seen that the mean error on a vertical target is 1·3ft. in height and ·51ft. in deflection, equivalent on the horizontal plane to a mean error of about 10 yards in range and ½ft. in deflection. Upon another occasion, at the same distance, the mean error was 0·97ft. in height and 0·58ft. in deflection, equivalent to a mean error of about 8 yards in range and 7in. in deflection. After the trial of accuracy, experiments were made to determine the destructive effect of a new description of shrapnel, specially designed for use with field or boat guns. For this purpose, at the same range, viz., 1100 yards, a row of targets, 42ft. in length by 9ft. high by ·8in. thick, was set up; 20 yards in rear of this a second row, 54ft. by 9ft., and of the same thickness, was placed, and again 20 yards in rear was arranged a third row; the length of this third row was 60ft. Four rounds were then fired with the new shrapnel, arranged to burst with the time fuse. The first shell burst 20 yards short, the second burst 30 yards short, the third burst 35 yards short, and the fourth burst 50 yards short. The time fuse was then lengthened a little to burst close up, when the fifth round burst 5 yards beyond the first target, and the sixth fired to burst on graze did so, passing under the foot of the first row. The effect on the targets was then taken, and it was found that there were—




| | | |
|---|---|---|
| Through the 1st row | 408 | bullets or pieces of shell. |
| ,, ,, 2nd ,, | 510 | ,, ,, ,, |
| ,, ,, 3rd ,, | 301 | ,, ,, ,, |
| Total through three rows | 1219* | ,, ,, ,, |

or an average of 203 per shell fired. The effect on the first row was produced by four shell; on the second and third row by six shell. A further lot of ten shell were then fired, arranged to burst by time fuse, and the bursting of the fuses was observed as follows:—

| | | | |
|---|---|---|---|
| 1st Round | burst | 20 | yards short. |
| 2nd ,, | ,, | 50 | ,, ,, |
| 3rd ,, | ,, | 25 | ,, ,, |
| 4th ,, | ,, | 20 | ,, ,, |
| 5th ,, | ,, | 25 | ,, ,, |
| 6th ,, | ,, | 5 | ,, ,, |
| 7th ,, | ,, | 40 | ,, ,, |
| 8th ,, | ,, | 25 | ,, ,, |
| 9th ,, | ,, | 25 | ,, ,, |
| 10th ,, (set a little longer) | ,, | 5 | ,, over |

The effect of the whole sixteen rounds upon the three rows was found to be as follows:—

| | Through. | Struck. | Total. |
|---|---|---|---|
| Upon the 1st row | 1216 | 34 | 1250 |
| ,, ,, 2nd ,, | 1355 | 130 | 1485 |
| ,, ,, 3rd ,, | 788 | 134 | 920 |
| Upon the three rows | 3359 | 298 | 3657 |

or an average of 229 hits per round fired. The effect produced by these sixteen rounds has never been equalled or even approached, if the size of the screens and the calibre and weight of the guns be taken into account.

Each row of targets was divided into vertical bands 9in. wide, and hardly a single one of these bands has escaped penetration over and over again. There is no question that the fuses were excellently set for the peculiar effect here registered, namely, the actual spread of the contents of the shells on targets of limited area. This result was wonderfully well effected, and probably no better test of the efficiency of shrapnel could be instituted. Of course such an effect is too local for actual employment in ordinary cases on service, when the shells should be opened at least double the distance in front of the targets. It was seen that the trace of a man 6ft. high had about ninety perforations. We may see, indeed, how easily tremendous showers of bullets may be delivered a little away from the desired point, and how consequently shell fire may become discredited on service owing to the want of skill in its use. Nevertheless, the shrapnel shell that will produce this effect only needs to be opened sooner to give the desired distribution for ordinary formations of infantry, while for a bridge, a road, or the like, this is the proper method of action. We dwell on what does not strictly belong to the trial of this individual gun, because the magnificent register of effects of shrapnel furnishes us with the occasion. We cannot conclude without remarking that such a result is, we believe, unprecedented in this country, and is, we believe, very much further removed from the achievements of any foreign guns.

The Revival in the United States Coal Trade, and some of its Financial Results.—"The remarkable rise in the coal market during the month of November is," says an exchange, "quite as astonishing and as remarkable in its way as the intense excitement and strong upward tendency on the Stock Exchange. About the middle of October the Reading Company put up its prices for the second time this fall and orders began to fall off. This was only for a few days, however, for notice was given of another advance on the 1st of the month, and it was pretty generally advertised that the companies had got quite enough of working for nothing and finding themselves. Orders began to come in thick and fast, and from places which had been supposed to be full of coal. Every day saw the demand from the furnaces increase, and that amounts to 600 cars a day when all on the line of the Reading Road alone are at work. On the last Saturday in the month, the Reading Coal and Iron Company issued its circular raising prices from thirty to fifty cents, the latter stove coal; and the line and city agent, Mr. Harris, issued one in which he notified all agents not to send any orders for certain collieries, as they were sold up. The demand continued and the company had taken the precaution of limiting all orders to the issue of a new circular, so that they got the advantage of the rise almost at once. All summer they had been in the market for orders, and were ready at any time to meet the market price. Now they found their coal going so fast that they had to raise the price again. Did it check the demand? Not at all. The orders were sent in just the same, and, although it was impossible for them to be got off this month, they were left subject to the probable rise on the 1st of next month. At the same time, the minimum rise on stove coal and the larger sizes was fixed at 1 dols. 40 cents against 1 dol. 15 cents the last time, though it has been as low as 69 cents for months this summer. The Lehigh Valley has again raised its tolls to Mauch Chunk, so that they are now 75 cents a ton, or 50 per cent. more than they were a fortnight ago. And for the first time the individual operators begin to be jubilant. The Lehigh Valley is putting the price ahead almost every day, and refusing any orders beyond the immediate capacity of its collieries. One of the leading shippers, who has collieries in the Shamokin district, reports that he never sent away so many customers as he had during the past ten days. In the first place the colliery was well sold ahead for the month at present prices, and he would not take more than one or two more orders for next week, and that only at 3 dols. 50 cents. He was booking orders then for December, subject not only to any advance in tolls, but also subject to the price ruling then, and he expected that it would be fully 4 dols. He would make no contracts to deliver at Christmas for less than 4 dols. 50 cents. Does not this look like a boom? The increased receipts that this will bring to the treasury of the companies is something enormous. The advance going into effect on Monday is 35 cents on chestnut, 25 cents on lump, steamboat and stove, and 10 cents on egg, broken and pea. The increase in tolls is about 25 cents over the last figures, and 100 per cent. over the minimum of this year. The Reading Company carries about 700,000 tons of coal a month, of which its Coal and Iron Company mines about 400,000. Putting the increased tolls at 50 cents a ton, and the advance in the price of coal at the same figure, though it will average more rather than less, and it will be seen that the increase in the net earnings, even after allowing for the advance in the miners' wages, will be at the rate of fully half a million a month, and that is supposed to be enough to pay all the fixed charges of the company. On the Lehigh Valley the increase in tolls will be about 75,000 dols. a month, or more than half enough to pay its annual dividends. The wages of the miners, too, who never have had such steady work since they have been in the region, will soon be fully up to the 2 dols. 50 cents basis; last month it was only 12 per cent. below, and this month it will be only 8 per cent. below. The result of this advance will also be the taking of the Lehigh and Wilkesbarre Coal Company out of the hands of the receiver by the end of the year if not before."

* Strikes not counted.

## RAILWAY MATTERS.

THE French line from Pondicherry to a point on the Anglo-Indian railways was recently opened amid the rejoicings of the French colony.

IN reply to an announcement recently made by the Alta Italia Railway that 1000 servants were wanted at 1f. 80c. per day, 28,000 applications were received.

AMERICAN locomotive building advices from Philadelphia state that nearly 2500 men are now employed at the Baldwin Locomotive Works in that city. The works have, it is stated, large orders on hand, and new contracts are offered almost daily.

THE Westinghouse Brake Company have received an order to equip the trains of the New York and Philadelphia new line with their automatic air brake. The Central Company of New Jersey, which owns the New York end of the line, has hitherto used the vacuum brake.

THE first lot of "bogie" carriages manufactured in the Victorian colony for the Government railways have lately been delivered by Mr. Phillip Bevan, of the Melbourne Engineering Works. The carriages are 43ft. long by 9ft. wide, and are constructed chiefly of different colonial woods.

IN a recent paper read before the London Association of Foremen Engineers by Mr. M. Reynolds, on practical engine driving, the author spoke of the blinding effect of the glowing white light of the engine fire, a brief glance into which, he said, rendered the person who looked for a time unable to recognise the colours of the signal lamps.

MR. WOODS, the Victorian Minister for Railways, has decided that another effort shall be made to burn "lignite" on the Government Railways. It is found in abundance in Victoria, but it has not hitherto been much used; as apart from the difficulties of burning it properly in the fire-boxes of the engines as at present constructed, the cost is officially stated to be about 16 per cent. in excess of imported (N.S.W.) coal.

IT is now proposed to construct a railway by the Jarentaire and through the Col du Mont, instead of through Mont Blanc, by which it is computed that a saving of seven kilometres might be effected. The promoters, however, seem to forget that the object of a third Alpine railway is to compete with the Gothard line and retain for France the Anglo-Indian traffic; but from Calais to Brindisi the distance by Mont Blanc is 22 kilometres greater than by Mont Cenis, and exceeds by 160 kilometres the distance between Ostend and Brindisi by the Gothard.

OF the 346 axles which failed the first nine months of the current year, 178 were engine axles, viz., 164 crank or driving, and 14 leading or trailing; 16 were tender axles, 2 were carriage axles, 143 were wagon axles, and 7 were axles of salt-vans. 58 wagons, including the salt-vans, belonged to owners other than the railway companies. Of the 164 crank or driving-axles, 124 were made of iron, and 40 of steel. The average mileage of 111 iron axles was 185,629 miles, and of 37 steel axles 153,608 miles. Of the 1377 rails which broke, 1258 were double-headed, 93 were single-headed, 12 were of the bridge pattern, and 13 were of Vignoles' section, whilst the section of 1 was not stated; of the double-headed rails, 785 have been turned: 1168 rails were made of iron, and 209 of steel.

A GOOD deal has been heard lately of the Government purchase of railways. Baron von Weber, in considering the argument of those who support this, that a large amount of administrative expenses might be saved by the concentration of the railroads of a country into the hands of the Government, shows that there is a limit to the economy caused by such concentration, and says that experience shows that the sayings in certain directions are accompanied by greater expenses in other directions; and that a system as large as the large companies of England and France—say 2500 to 3000 miles—is all that a single administration is likely to manage economically and effectively, and he supports his opinion by statistics showing that as railroad systems have grown the proportion of their expenses to earnings has generally increased, and that it has increased most where the systems have grown most.

IN writing of the new fast train of the Paris, Lyons, and Mediterranean Company, the *Kölnische Zeitung* gives figures to show that the speed of this new express is not, as asserted, the greatest attained on the Continent, but is exceeded by that of several German trains. The Paris-Marseilles express makes on an average 66·3 kilometres an hour, or, including the stoppages, 56·2 kilometres. On the Lelviter line, between Berlin and Cologne, the distance of 583·2 kilometres is completed in 9 hours 26 minutes, at a mean speed per hour, including stoppages, of 60 kilometres. Between Spandau and Stendal the mean speed is 71·8 kilometres per hour. On the Potsdam line, between Berlin and Magdeburg, a distance of 142 kilometres is traversed in 2 hours 7 minutes, including stoppages, at a mean speed of 67·9 kilometres per hour. The velocity attained on this line between Brandenburg and Magdeburg, a distance of 80·7 kilometres, is 69·15 kilometres per hour.

IT is proposed to construct a railway from Hambantota to Uva, Ceylon. The present means of transport of the produce of Uva, a large and populous district, is entirely by bullock carts *viâ* Ratnapura to Colombo; *viâ* Newera Elliya to Gampola; and a small percentage finds an outlet by the Batticaloa road. The great bulk of the traffic passes over the Ratnapura road to Colombo, which is 112 miles from Haputale, 136 from Badulla, and 170 from Madulsima. The cost of transport is excessively expensive on account of the great distance from the seaboard; from the losses that have to be sustained by planters in having their coffee stolen from the carts on the road to Colombo; from the deterioration of the crop by being so long on the road; from the uncertainty of transport on account of the mortality of bullocks in unhealthy years, and from the stoppage of traffic by the land slips that are constantly occurring at Halpé. The Government of Ceylon have surveyed a line of railway from Navalapitiya—the present terminus of the existing railway—*viâ* Nanoo Oya and Happutale Pass into Badulla. It is expected that tenders for the construction of the first section will be invited within a month or two; but as the present portion of the line from Nanoo and Badulla will be very heavy, it is, according to a circular by Mr. H. K. Rutherford, not to be proceeded with.

MR. W. T. GUNSON'S improved system of tramways, referred to in a previous number, was again discussed by the members of the Manchester Scientific and Mechanical Society at their meeting on Friday. The president—Mr. J. Bowes—thought that, although the system was a step in the right direction, there were yet some practical defects which would militate against its adoption. One objection would be the amount of skilled labour which would be required in laying, and he thought the smooth surface of the sleepers would be a disadvantage. Mr. A. Jacobs, borough engineer, Salford, also thought the sleepers would work smooth, but he chiefly criticised Mr. Gunson's estimates of cost, which, in his opinion, were considerably below the mark. Mr. McLeod thought a difficulty would be found in the expansion and contraction of the rails, whilst Mr. Heys thought this would be counteracted by the other materials, and with regard to the sleepers, added that he did not consider a smooth surface necessarily a slippery one. Mr. Savage, Deputy Superintendent of the Manchester Fire Brigade, thought that the oscillation which he had found caused to the fire engines in riding through the streets by the present tramway, would be obviated by Mr. Gunson's system. Mr. Gunson having replied upon the discussion, in which he said no serious objections had been raised to his system, and having defended the estimates laid down, the president closed the proceedings by observing that four or five different systems of tramways had already been submitted to the society, but he though they would agree with him that Mr. Gunson's was the best they had yet had the opportunity of discussing.

## NOTES AND MEMORANDA.

A SIMPLE method of classing steel has been proposed by Herr Barus in a memoir discussing the thermo-electric properties and electrical conductivity of steels in relation to their hardening qualities. He divides steel into two classes. One class, which comprises the harder varieties, he finds to be electro-negative to copper; and the other, comprehending the softer varieties, electro-positive.

PROF. A. M. MAYOR, of the Stevens Institute, records that while a thunderstorm was raging at so great a distance off that only the illumination of the clouds told when a flash occurred, he attached one wire of a galvanometer to the water pipes and the other to the gas pipes of his house, thus connecting a vast system of metallic conductors, stretching for miles about the city. Whenever a flash occurred, he records, the needle of the galvanometer was deflected 10 deg. to 20 deg. The two occurrences were simultaneous, so far as could be determined, occurring at the same instant. The storm was ascertained to have been twelve miles distant, and the conclusion is drawn that "at least 500 square miles of the earth's surface had its electrical condition changed at each flash of the lightning."

THE glass industries of Pittsburg, which have reached large proportions, are made the subject of editorial comment by the Chicago *Commercial*, from which we take the following points of interest:—More than half the glass produced in the country is made there. The output has a value of about 7,000,000 dols. per annum, and the capital engaged in the manufacture, in ground, buildings, machinery, &c., will not fall short of 3,500,000 dols. The city has 79 factories, containing, in all, 690 pots. The operatives employed number over 5000, to whom about 3,000,000 dols. are paid every year. Last year, there were consumed in the manufacture of glass in Pittsburg:—German clay, 2925 tons; lead, 360 tons; pearlash, 250 tons; salt, 2760 bbls.; straw, 6055 tons; wood, 4025 cords; coal, 4,525,760 bushels; coke, 703,500 bushels; nitrate of soda, 1218 tons; sand, 48,340 tons; fire-bricks, 150,000.

SPEAKING of the hurricane which swept along the American Southern Atlantic seaboard on the 18th of August last, the U. S. Weather Bureau reports that the wind velocities were among the highest, if not the highest, ever recorded. At Cape Lookout, at 6.30 a.m., the barometer falling very rapidly, the anemometer registered a wind velocity of 138 miles per hour. But this was not the maximum. An hour and a-half later, as the storm centre began to pass away and the barometer to rise, the wind rose to the estimated velocity of 165 miles per hour. An observed velocity of 100 miles an hour was also reported from Cape Henry. The highest winds attending storms near sea level with which these can be compared, says the *Scientific American*, are, perhaps, those of the Liverpool storm of February, 1868—from 100 to 120 miles an hour—and those of the great Guadeloupe hurricane of 1865—from 100 to 130 miles.

AN alloy, containing 70 per cent. of copper and 30 per cent. of manganese, has been produced by a German firm, who use it as an addition to brass or bronze, for increasing the density, tensile strength, and ductility of these metals. The manganese, by its ready oxidation in the process of manufacture, prevents the formation of oxides of copper or tin, which in ordinary practice impair the value of the product. The same parties likewise recommend the use of metallic manganese for the same purposes, and affirm that the addition of as little as ¼ to 1 per cent. of metallic manganese, or of ¾ to 3 per cent. of the manganese-copper alloy, will insure in every case a solid casting. The addition of a larger percentage of manganese is said to have the effect of hardening the metal; and bronze, with such addition, can, according to our authority, be made to assume a hardness approaching that of steel. We refer, for the facts herein contained, to the *Chemiker Zeitung*.

IN a recent number of the *Annalen der Physik und Chemie*, Herr v. Wroblewski inquires into the nature of absorption of gases, by a kinematical method, inferring from the phenomena of motion of gases diffusing in absorbent substances, the condition in which they exist in these. The phenomena in caoutchouc are studied, and the author concludes, *inter alia*, that the absorption of protoxide of nitrogen, carbonic acid, and hydrogen by caoutchouc is a purely physical process, and the gases retain, after absorption, their gaseous state and all characteristic properties. The constant of diffusion of a gas depends only on physical properties, and chiefly its specific gravity, being approximately inversely proportional to the square root of this; but the specifically lighter gases show greater constants than this relation expresses. The constant for protoxide of nitrogen and carbonic acid increases with increase of temperature, and at 10 deg. C. is fifty times smaller than that for carbonic acid in water. A caoutchouc membrane is to be conceived as a porous plate endowed with gas-condensing and rarefying powers.

IN preparing brass for the colourless or nearly colourless lacquer, the goods, after being annealed, pickled, scoured, and washed, are either dipped for an instant in pure commercial nitrous acid, washed in clear water, and dried in sawdust, or immersed in a mixture of one part of nitric acid with four of water, till a white curd covers the surface, at which moment the goods are withdrawn, washed in clear water, and dried in sawdust. In the first case the brass will be bright; in the latter, a dead flat, which is usually relieved by burnishing the prominent parts. Then the goods are dipped for an instant in commercial nitric acid, and well washed in water containing argol—to preserve the colour till lacquered, and dried in warm sawdust. So prepared, the goods are heated on a plate and varnished. The varnish used is one of spirit, consisting, in its simple form, of one ounce of shellac dissolved in one pint of alcohol. To this simple varnish are added such colouring substances as red sanders, dragon's blood, and annatto for imparting richness of colour. To lower the tone of colour, turmeric, gamboge, saffron, Cape aloes, and sandarac are used. The first group reddens, the second yellows the varnish, while a mixture of the two gives a pleasing orange.

THE following specific gravities at 15 to 16 deg. C. = 59 and 60·8 deg F. have been recently published as determined by Dr. H. Hager by the method published in this column of a recent impression:—Butter fat, clarified by settling, 0·938—0·940; do. several months old, 0·936—0·937; artificial butter, 0·924—0·930; hog's lard, fresh, 0·931—0·932; do. old, 0·940—0·942; beef tallow, 0·925—0·929; sheep's tallow, 0·937—0·040; beef and sheep's tallow, mixed 1:1, 0·936—0·938; butter of Cacao, fresh, 0·950—0·952; do. very old, 0·945—0·946; do. and beef tallow, mixed 1:1, 0·938—0·939; expressed oil of nutmegs, 1·016—1·018; do. extracted with carbon disulphide, 1·014—1·015; do. adulterated with fatty acids, 1·010—1·011; do. crystalline, 0·965—0·966; stearic acid, melted and in drops, 0·964; do. crystalline, 0·967—0·969; wax, yellow, 0·959—0·962; do. African, 0·960; do. yellow and resin, mixed 1:1, 0·973—0·976; do. and paraffine, mixed 1:1, 0·916—0·919; do. and yellow ceresin, mixed 2:1, 0·942—0·943; ceresin, yellow, 0·925—0·928; wax, Japan, 0·977—0·978; do. very old, 0·968—0·970; do. white, very old and true, 0·963—0·964; do. new, 0·916—0·925; do. and stearic acid, mixed 1:1, 0·945; wax, specific gravity 0·963, and stearic acid, specific gravity 0·963, mixed 1:1, 0·975; ceresin, very white, pure, 0·905—0·908; do. white, 0·923—0·924; Araucaria wax, 0·990; resin—fr. pine—yellow transparent, 1·083—1·084; do. whitish, opaque, 1·044—1·047; do. very dark colophony, 1·100; shellac, light coloured, 1·113—1·114; do. darker, 1·123; do. bleached, 0·965—0·968; dammar, old, 1·075; copal, East Indian, 1·063—1·070; do. West Indian, 1·070—1·800; do. very old, 1·054—1·055; benzoin, Siam, 1·235; do. Penang, 1·445—1·155; do. Borneo, 1·165—1·170; guaiac resin, pure, 1·236—1·237; amber, 1·074—1·094; sandrac, 1·038—1·044; mastic, 1·056—1·060; Balsam of Tolu, old brittle, 1·231—1·232; kamala, 1·115—1·120; lycopodium, 1·016—1·020.

## MISCELLANEA.

IT is expected that ere long considerable quantities of petroleum will be exported from Peru.

THE New York Stock Exchange has decided on the establishment of a mining department.

A CABLEGRAM from Liverpool has, it is stated, been received at Pittsburg offering 10,000 tons of Bessemer steel blooms to be delivered at Baltimore at £8 sterling per ton, quality guaranteed for steel rails.

NICKEL-PLATING continues to acquire favour at the hands of marine engineers, and considerable quantities of engine fittings are now being plated by the Plating Company, Stockton, for the Admiralty.

WE are informed that the John Cockerill Company has work assured to it for six months in advance. A few days since it obtained orders for 20,000 tons of rails on foreign account. Of these rails 6000 tons were ordered for America at £5 16s. per ton free on board at Antwerp.

MR. EDWARD SHIPLEY ELLIS, chairman of the Midland Railway, died on Wednesday evening at The Newarke, Leicester, in his sixty-ninth year. By a strange coincidence Colonel Duncombe, chairman of the Great Northern Railway, died on the same evening at his residence, Eaton-square.

THE U.S. Minister to Japan reports that during the past year the imports from the United States amounted to three and a-half million of dollars, and the exports to the United States seven and a-half million of dollars. The tonnage of American shipping is greater than that of all the European countries combined, except Great Britain. The commerce of the United States with Japan is rapidly increasing.

IT is thought that before long the cotton mills in New England will be built one story high only. The advantages claimed are increased safety, convenience, and higher speed for machinery. A gingham company has tried the experiment, and finds that a building of that description, covering about an acre, cost £4600, has saved in gas alone a sum equal to the interest on the cost of the building, and obtained an increased speed of 12 per cent.

A REPORT from the English Consul at Florence draws attention to the decline of some branches of English trade with Italy. In steel rails, locomotives, tools and other Sheffield ware, Germany is, he says, pushing England out of the market. His inquiries lead him to the belief that the foreign manufacturers have shown greater foresight in regard to the needs of Europe for railway material than their English competitors, and that the benefit they are now receiving is partly due to this cause. He adds that this foresight is probably assisted by "the continental system of publishing all the lowest prices to which contracts are given," and the custom of Belgian manufacturers and shippers meeting weekly and exchanging ideas as to prices and rates of freight.

NOTICE has been given by the Lower Thames Valley Main Sewerage Board that they intend applying to the Local Government Board for a provisional order enabling them to put in force the provisions of the Lands Clauses Consolidation Acts, 1845, 1860, and 1869, with respect to the purchase and taking of lands otherwise than by agreement for the purposes for which the Lower Thames Valley Main Sewerage District was formed, and for, *inter alia*, the construction of sewerage and sewage works, and works for the purification, utilisation, filtration, and disposal of the sewage of the said district, and for the erection of pumping and lifting stations, tanks, machinery, and plant, and for any purposes connected with the carrying out of a system of sewerage for the said district.

AN American method of casting is being adopted by light iron-founders, who have felt the introduction of American wares affecting their businesses. Instead of the articles from which the cast is taken being embedded in sand, as upon the English principle, they are now being embedded in plaster of Paris. The sand "odd-side" took several hours to make up, lasted only a week, and cost a few shillings; the plaster odd-side can be worked from for months. It costs as many pounds as the other does shillings, but it can be worked from much more rapidly. There is a saving of space in the casting shop and of working utensils under the new system. The castings are clearer, more easily worked up, and when of malleable iron the finished work is pronounced equal to wrought iron.

THE introduction of American anthracite coal into Switzerland has had the effect of directing the attention of the Swiss engineers to their own mines. Americans have taught them that anthracite is excellent fuel, and they have learnt from them how to use it. They urge that it would be possible to mine the large amount of coal used by the country (almost 500,000 tons) hitherto imported, from their own anthracite coal basin. In support of their claims for the domestic coal they give the following analysis of the coal taken from the field which extends from Saint-Maurice to Brigue, in the Valais:—Biendron Mine: carbon, 88·16; hydrogen, 2·15; oxygen and nitrogen, 1·34; ash, 8·35. Experiments with this Valais coal for regenerating steam in the locomotive which was sent to Paris by the Philadelphia and Reading Railroad, have been made with good success.

THE proposed Algerian Sea is still discussed in scientific circles in France. M. Roudaire, its projector, in a recent letter to M. de Lesseps, gives the following *résumé* of its supposed advantages. These will be, as we glean from the *Popular Science Monthly*, "an immense amelioration of the climate of Algeria and Tunis, since the moisture evaporated from this vast expanse of water will be carried by the prevailing southerly winds over these countries, and must, in consequence, lessen the intensity of the solar rays and retard the cooling of the earth by radiation during the night. The proposed sea, also, being navigable for ships of the largest draught, will open a new commercial route for the districts lying to the south of the Aures and the Atlas range, while water-courses, which, from the south, west, and north, converge toward the 'shottes,' but which are now dry during the greater part of the year, will again become rivers, as they once undoubtedly were, leading ultimately to the fertilisation of vast tracts of now desert land on their banks." M. Roudaire, whose faith in the ultimate realisation of this work is unbounded, estimates its cost, from preliminary surveys, at about 20 million francs. To form the proposed sea, will, according to M. Roudaire, simply require a cutting through the narrow isthmus separating the head of the Gulf of Gabes from the ancient lake-bed of El Djerrid.

THE total product of the rolling mill and steel works of Pittsburgh last year was 417,147 net tons, and that of the blast furnaces 217,299 net tons; which show that the furnaces make only about 50 per cent. of the pig iron consumed by the first two classes of manufactories. The total amount of iron rolled in Allegheny county last year, including rails, was 282,333 net tons, against 268,486 tons in 1877, 247,943 in 1876, 239,069 in 1875, and 274,625 in 1874. The quantity of pig iron made last year was 217,299 net tons; in 1877, 141,749; 1876, 128,555; 1875, 131,856; 1874, 143,660. Crucible steel made—1878, 27,876 net tons; 1877, 24,747; 1876, 25,009; 1875, 22,942; 1874, 17,915. All other steel, including Bessemer ingots: 1878, 106,948 net tons; 1877, 82,401; 1876, 54,467; 1875, 15,498; 1874, 6000. Total make of steel, net tons: 1878, 134,814; 1877, 107,148; 1876, 79,476; 1875, 38,440; 1874, 23,915. Thus more pig iron was made in Allegheny last year than in any other district in the country except one. In the Lehigh Valley, where there were fifty-one blast furnaces, 416,907 tons were made, and in Allegheny county, where there were twelve completed furnaces, 217,599 tons were produced. The other leading districts made the quantities shown below: Schuylkill Valley, 144,558 tons; Lower Subsquehanna Valley, 137,719; Mahoning Valley, 134,400; Shenango Valley, 122,958; Upper Susquehanna, 84,547; Hocking Valley, 65,690; Hanging Rock, 64,650.

# THE HASSE-SIMON PATENT POWER HAMMER.

MESSRS. B. AND S. MASSEY, OPENSHAW, MANCHESTER, ENGINEERS.

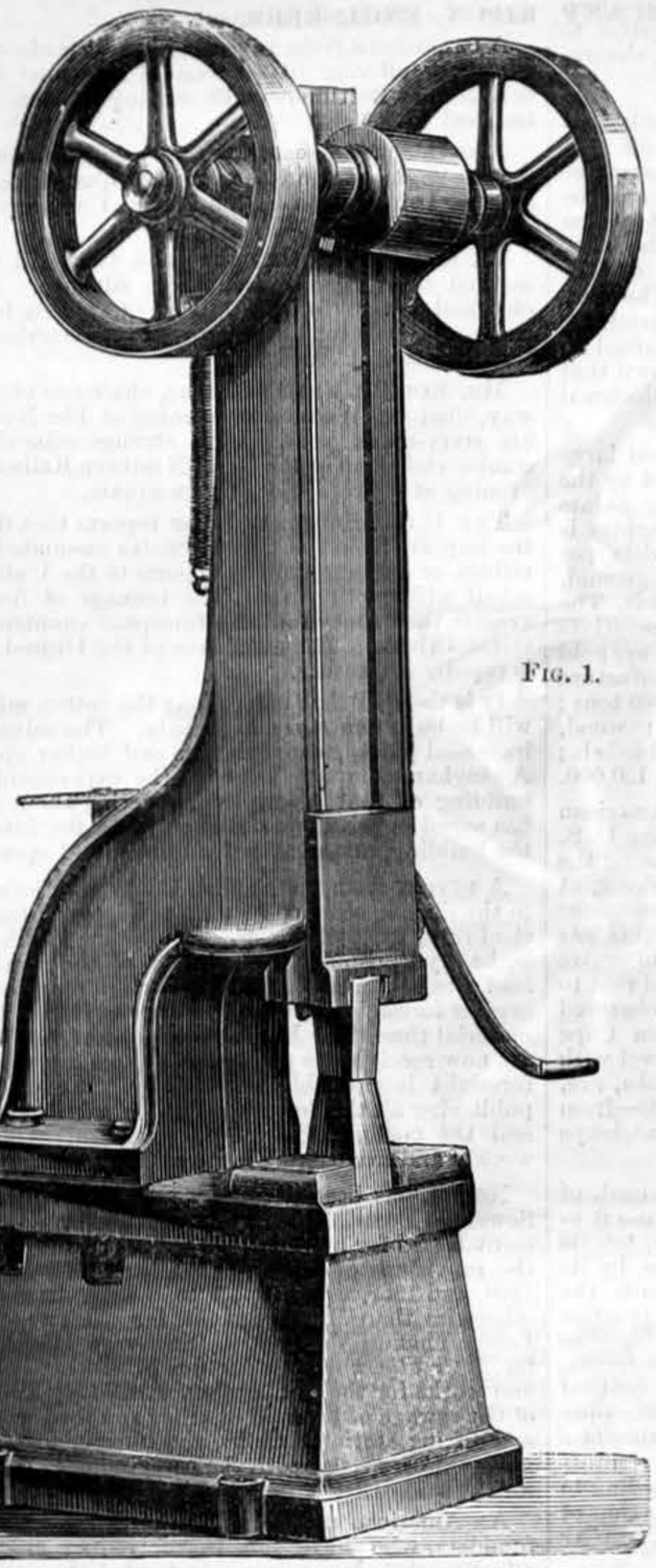


Fig. 1.

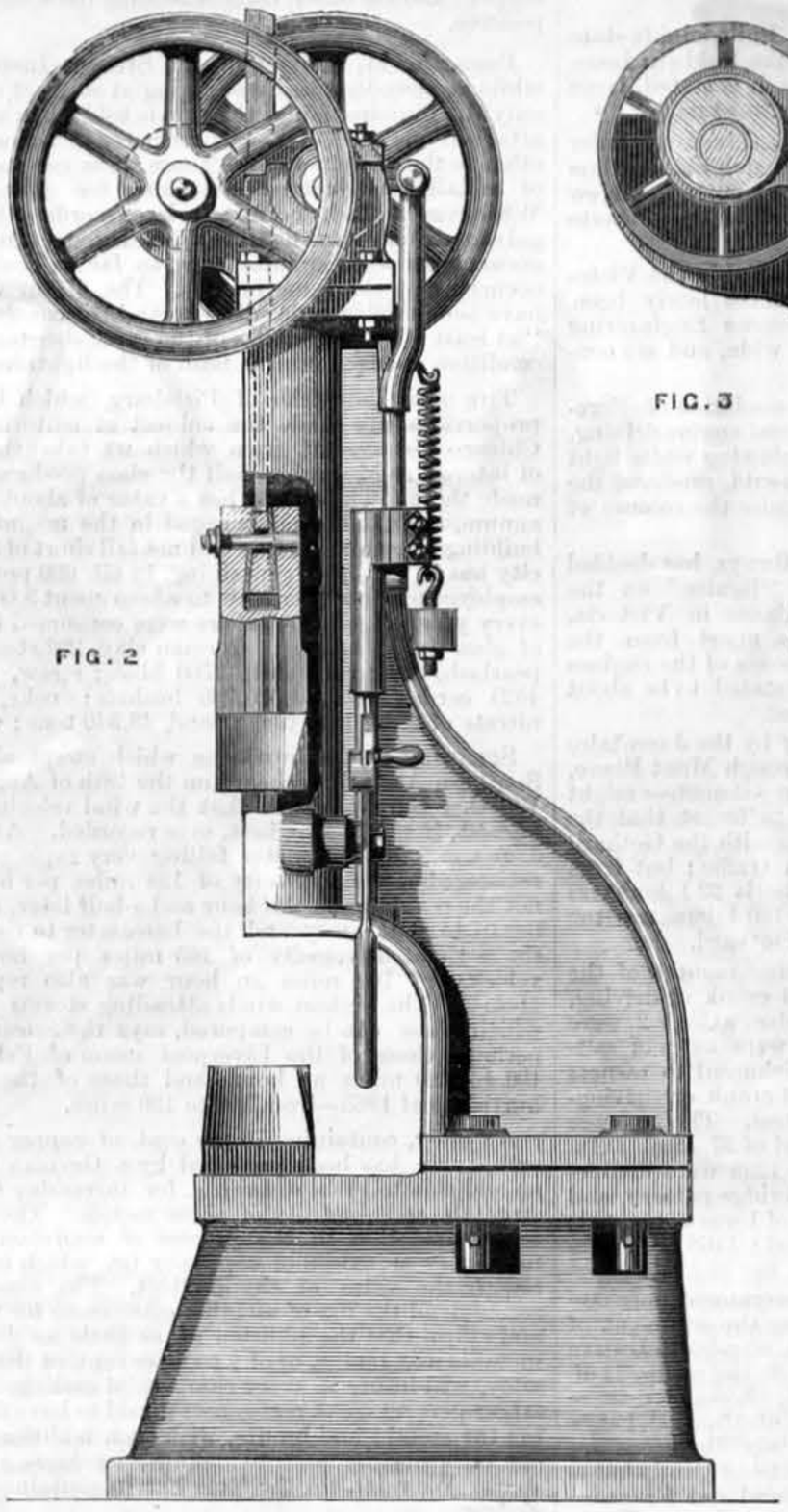


FIG. 2

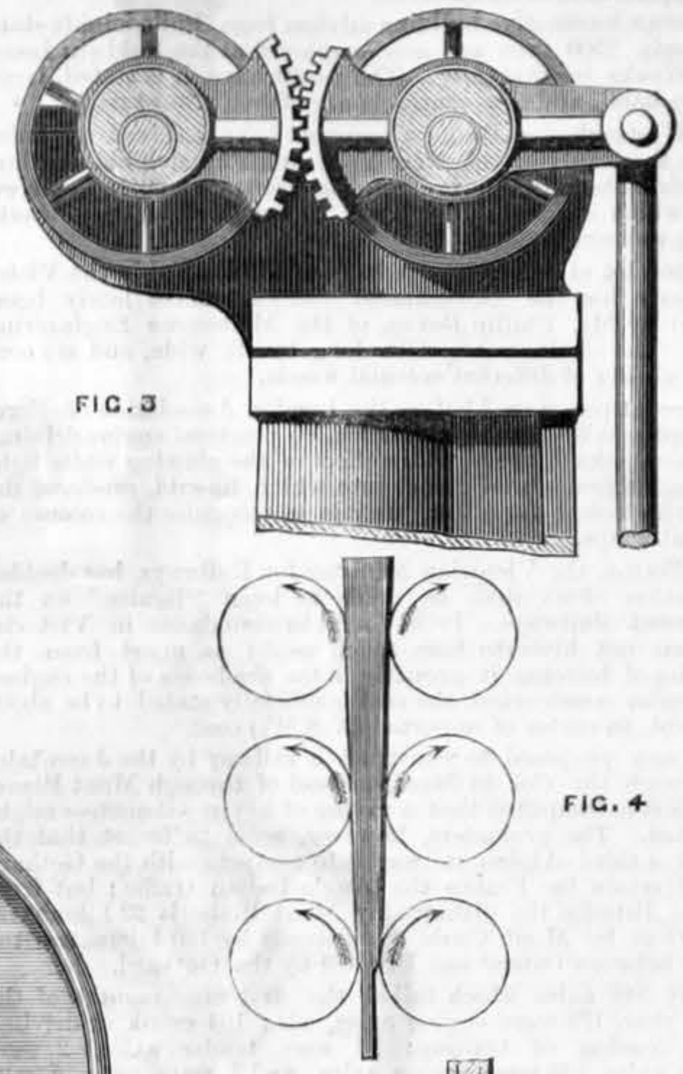


FIG. 3



FIG. 4

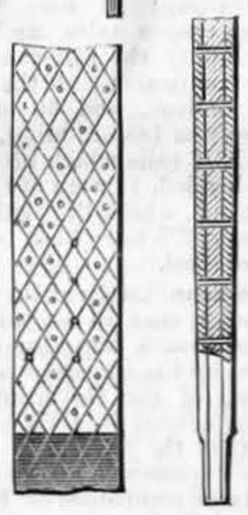
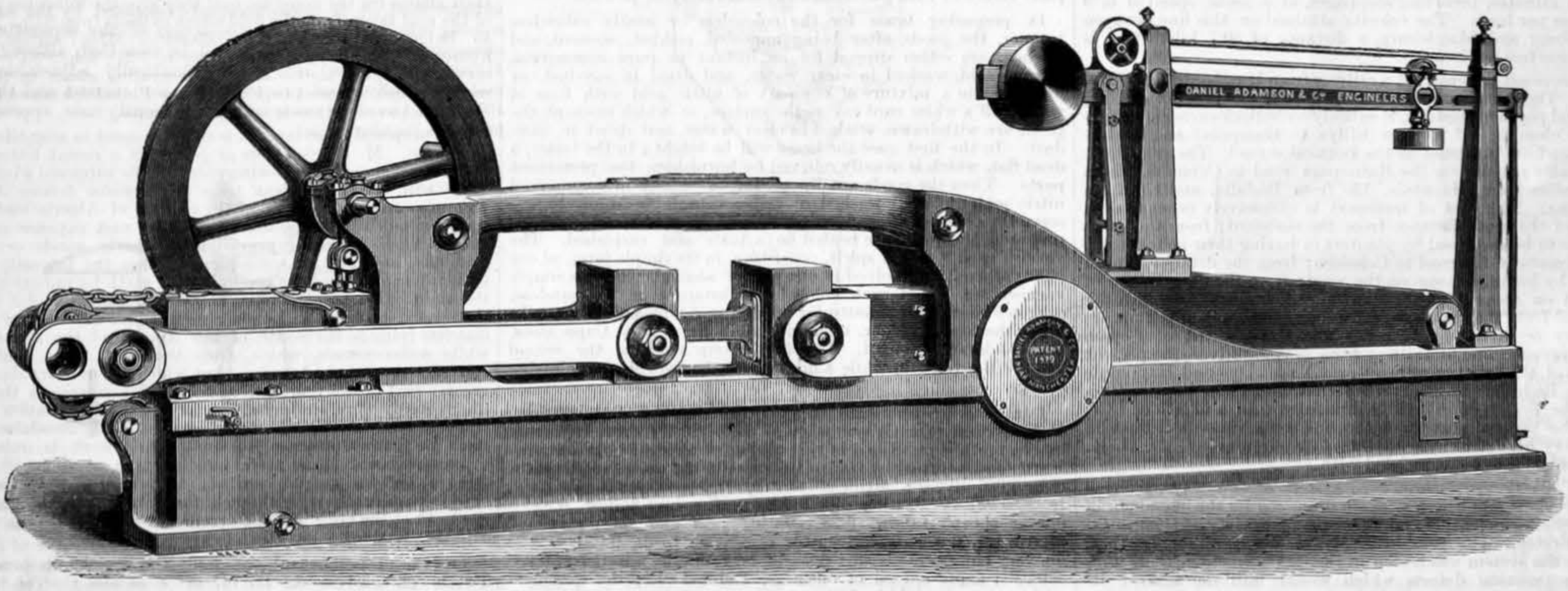


FIG. 5

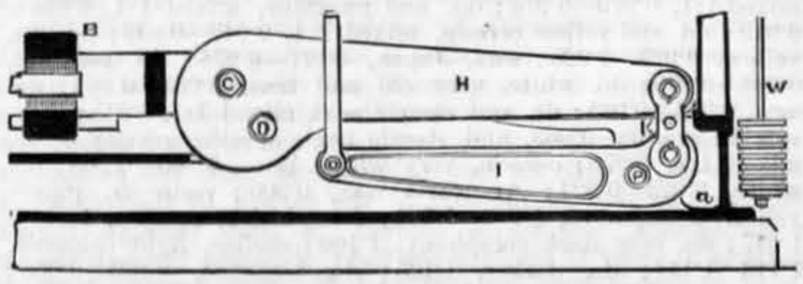
We illustrate above a new power hammer, for which it is claimed that, although somewhat similar in appearance to other power hammers which have been made in England and America with only moderate success, this hammer contains just those points of difference which were necessary to make it what it professes to be—a power hammer applicable, not to one class of work, but to all purposes. It is driven by two belts—one open and one crossed—direct from the main shaft, without any intermediate countershaft, at a speed of about 120 revolutions per minute. The tup, or hammer-head, is lifted by means of a flat bar, the upper part of which is placed between two revolving friction rollers. This flat bar is made of hard wood, and its distinguishing feature is, that instead of being parallel, as in other power hammers, it gradually increases in thickness from the bottom to the top. Simple as this improvement is, the difference that it makes in the working of the hammer is great. Instead of having to put great pressure upon the bar, in order to lift the hammer, the lightest upward movement of the hand lever is sufficient. And when the hand is removed it remains suspended in whatever position it has reached. When falling 4ft. 6in., it can be arrested in an instant, so as not to strike the anvil. No foundation is required, except a very simple and inexpensive one of timber. Our engravings explain themselves. Figs. 1 and 2 are elevations, Fig. 3 is an enlarged view of the compressing gear, Fig. 4 illustrates the action of the pulleys in different portions of the bar, the construction of which is shown by Fig. 5.

# PATENT TESTING MACHINE.

MESSRS. DANIEL ADAMSON AND CO., ENGINEERS, DUKINFIELD, MANCHESTER.



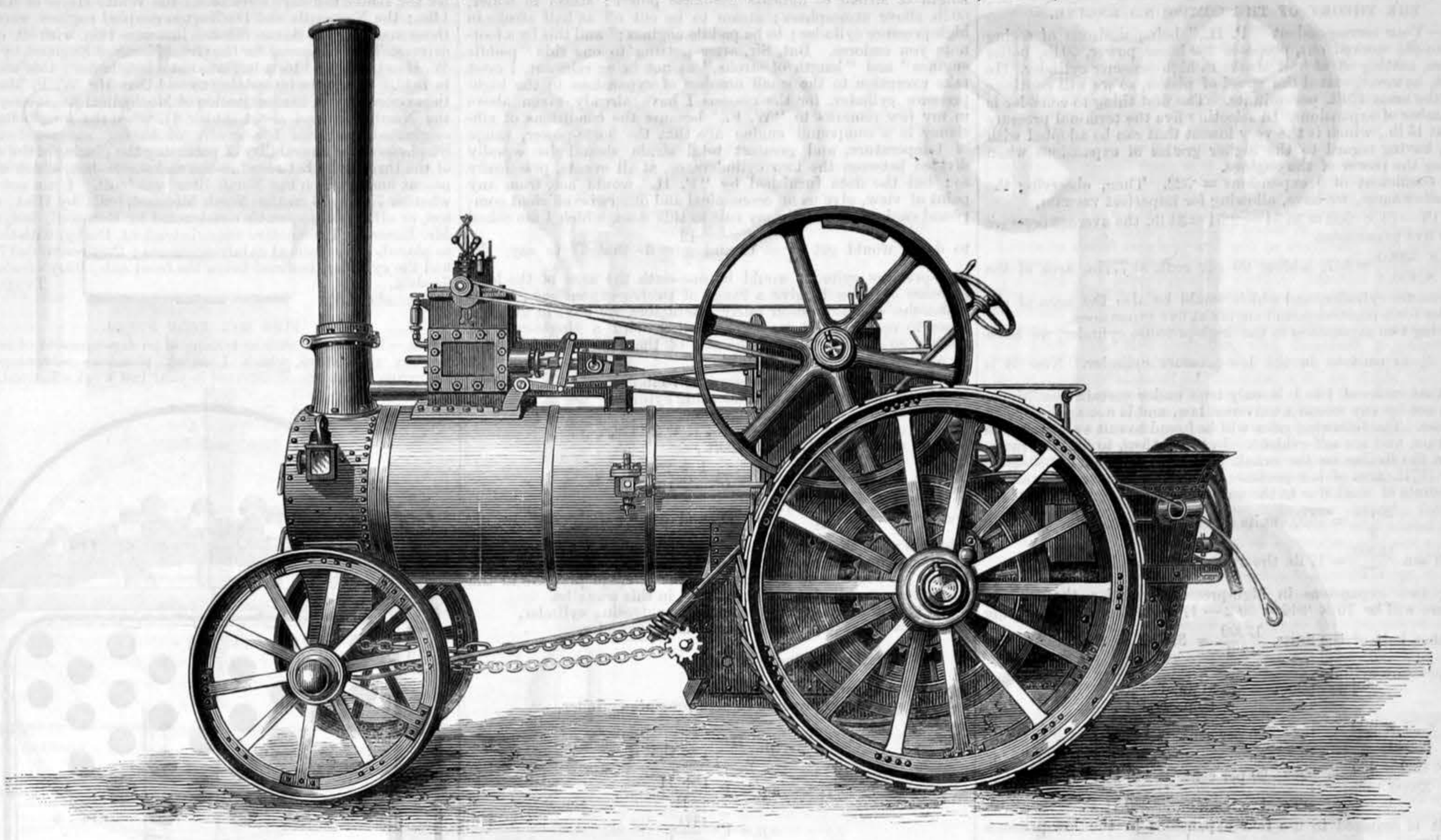

These machines, one of which we illustrate herewith, are entirely self-contained, and nearly self-registering, and can be used by any youth knowing the simplest calculations. In the smaller machines the specimen to be tested may be either 4, 5, 8, or 10 inches long, whilst the larger machines are constructed to take a much larger test piece. No preparation of the specimen is requisite, it being simply gripped by means of wedges, thus considerably reducing the cost of preparing the sample. The test strain is produced by a hydraulic ram working in a forged steel cylinder, and put in action by two pumps actuated by a double crank shaft and hand fly-wheel. All the bearing points of the entire lever apparatus are hard knife edges on hard, smooth surfaces, the friction being thus reduced to a minimum. The elongation percentage can be read off by a scale fixed on the machine, and every condition developed by the test can be noted with accuracy and dispatch. These machines are constructed for either tensile, compression, punching, or bending tests, and can, when required, be arranged for torsional tests. These machines are made in various sizes, from 5 tons to 2000 tons. The illustration is



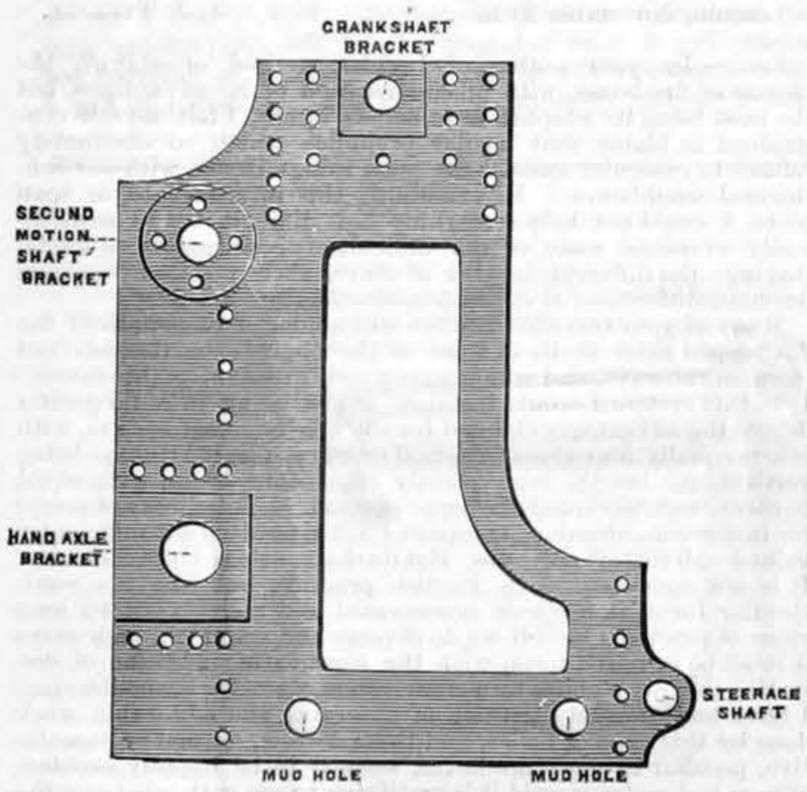

that of a 100-ton machine. The machines are constructed on the decimal system, so that the total force applied is readily obtained by one multiplier. The chain seen at the end of the machine is used to restore the ram to its place in the cylinder by the aid of a weight in a pit below. The diagram shows the arrangement of the levers. One end of the specimen to be tested is gripped in the block B, which is hinged at the knife-edge centre G to the horizontal lever H working on the knife edge fulcrum D; and at the end of this lever is the link K for connecting the lever H to the lever I, working on the knife edge fulcrum D, and the long arm of this lever is connected by a link to an ordinary steel-yard lever, provided as usual with an adjustable weight to balance the whole system of levers. The weights W are to give a fixed increase of load as the stress increases. The test by compression is effected by connecting the steel yard block and cross block by stirrups to the actuating ram block at the opposite sides, and then applying the force from the pumps, while the registered force of compression is read off from the levers and steel yard as before. Five specimens may be tested in one hour, and the results given accurately.

# SIX-HORSE TRACTION ENGINE.

THE DURHAM AND NORTH YORKSHIRE STEAM CULTIVATION COMPANY, RIPON, ENGINEERS.



THE engine which we illustrate herewith, by the Durham and North Yorkshire Steam Cultivation Company, Limited, Ripon, is of 6-horse power, and presents some novel features. It has a single cylinder 8¼in. diameter by 10in. stroke; fitted with a liner of hard metal, the space between it and the cylinder case forming a steam jacket open to the boiler. The top cover gives direct access to the stop and governor valves, and carries two safety valves fitted with spring balances. The driving gear is of crucible cast steel distributed equally on both sides of the engine. The heating surface of the fire-box and tubes is 135 square feet; the fire-grate area is 5 square feet; the diameter of crank shaft is 3½in.; the second motion shaft 3¾in., and the road wheel axle 4¾in. One of the chief features of the engine is the use of wrought iron side plates as shown, to which all the bearings are fitted.




These plates are bolted to planed angle irons rivetted to the back and front of the shell of the fire-box, and at the top are secured by two cross plates, bolted together at the four corners by planed angle irons, and forming a rigid box in which the crank shaft works. The plates thus fixed receive the strain of the gearing and prevent the liability to leakage common with the ordinary horn plates. They can be easily removed without affecting the steam or internal arrangements of the boiler, and this is found convenient in case of repairs. The main driving axle is fitted with differential gear of cast steel and with Messrs. Burrell's patent winding drum. The main driving wheels of wrought iron are 5ft. 6in. diameter, by 16in. broad, and the front wheels are 3ft. 6in. diameter by 10in. broad. The driving gear is controlled by a single lever, arranged for two speeds, the slow speed being one and a-half miles, and that of the quick being three miles per hour, at the nominal speed of the engine, viz., 150 revs. per minute.

## HEINRICHS' ELECTRIC LIGHT REGULATORS AND ELECTRIC CANDLES.

A SHORT time since Mr. C. F. Heinrichs exhibited his new electric lamps to a number of gentlemen assembled at Sage's Commercial-buildings, Gray's-inn-road. The same lamp was also recently exhibited to the members of the British Association at Messrs. Tasker and Sons' Works, Sheffield. The lamps which we illustrate herewith were also referred to by Mr. J. N. Shoolbred, in a paper read before Section G of the British Association.

The objections to ordinary lamps and candles are for the most part (1) the short period during which the lamps will burn without a fresh supply of carbons, viz., from one to four hours; (2) the length of time which elapses before a lamp becomes re-lighted after it has from any cause become extinguished; (3) the shadow thrown by the framework of the lamp supporting the mechanism which holds or feeds the carbons.

In Heinrichs' regulator and candles the use of curved carbons allows of a large supply of carbon within a small compass. Thus, a ring 12in. in diameter gives a length of 36in. of carbon rod, which if rectilineal would be difficult to handle. This length of carbon, about 12 millimetres in thickness, will burn for a period of twelve hours with a current of from 1200 to 1800 candle power. Thus the first objection is overcome. In regard to the second, the mechanism described below is employed, by means of which the lamp, should it become extinguished, is relighted in a period of time so short that the eye does not easily detect any cessation of the light. With respect to the third objection, the mechanism which holds and feeds the carbons is placed above the arc, so that no shadow is thrown downwards, and there is consequently no loss of light in this direction.

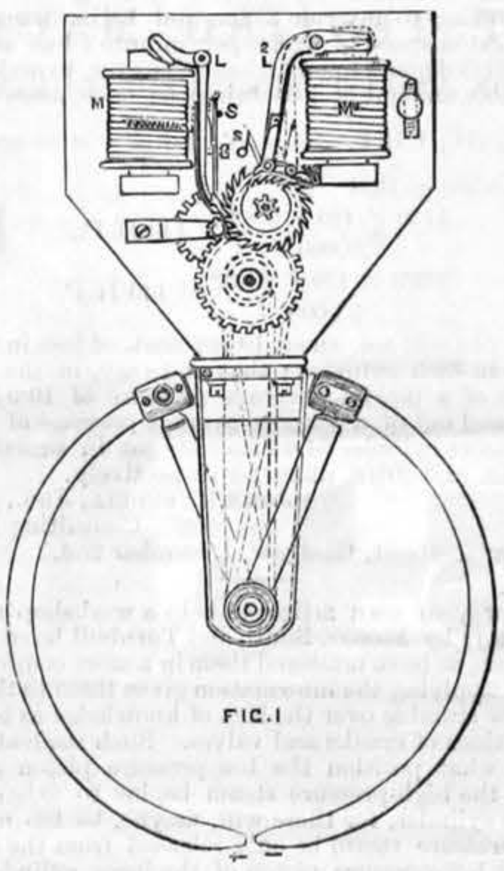
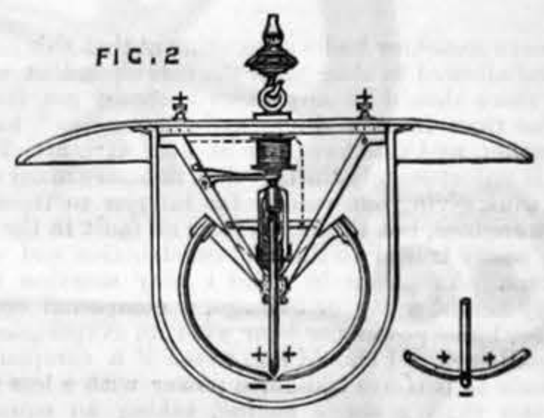



Fig. 1 shows the regulator, in which the semicircular carbons become separated, and are fed by means of a new feeding arrangement. The feed of the carbons takes place step by step, and prevents the carbons from ever coming into actual contact whilst burning. The carbons are brought together by the weight of the two metal arms which hold them. These arms are connected, by means of two chains, with the pulley, as shown; and the latter is in gearing with the spindle to which are fixed the escapement and ratchet wheels. The lever $L^2$, with its pawl, acts upon the ratchet wheel in order to effect the separation of the carbons to the required extent; and the lever L, with its two pallets, acts upon the escapement wheel to produce the feed of the carbon by the following mechanism:—When a current is sent through the apparatus in order to produce the light, it passes through the coils of the electro-magnets M and $M_1$, thus causing both armatures to be attracted and bringing both levers, L and $L^2$, into action. The latter, by leaving the position shown by the dotted lines, releases its pawl, and allows it to fall into the ratchet wheel, moving it so as to separate the carbons sufficiently to produce the light. Before, however, this lever —$L^2$—comes to rest, it raises the pawl from the ratchet wheel by means of the stud $s_1$, thus leaving the wheel free. But at the same time the lever L comes into action, and its outer pallet holds the escapement wheel, thus maintaining the carbons apart. But when by the burning away of the carbons the distance between them becomes too great, the current is correspondingly weakened, and the magnet M loses some of its attracting power, and thus allows the spring between the inner pallet and the lever L to press backwards this lever with its outer pallet. This allows the escapement wheel to advance nearly by one tooth; but by the action of the spring the innet pallet, which is pivotted to the upper end of the lever L, is pressed forward and stops the motion. By this advance the carbons come sufficiently together to increase the current, the magnet M gains power, the armature is slowly attracted into its former position, the lever L presses the inner pallet against the stud *s*, thus allowing it to leave the escapement wheels, and thus the remaining portion of the motion through one tooth is accomplished, and the arrangement is ready for the next step in feeding the carbon. But should the current fail altogether, both levers will be withdrawn by the action of the spiral spring shown on the magnet M and the spring attached to the armature of $M_1$, and there is then nothing to prevent the carbons from coming immediately into contact. The spiral spring here referred to is so weak that it is able to withdraw the lever L only when no current passes. Thus should the lamp from any cause become extinguished, it is instantaneously relighted by the carbons coming into contact, and by the action of the separating mechanism above described. It will be seen that, although Mr. Heinrichs' carbons are not automatically adjustable with mathematically exact proportion to the current and the arc, it seems to be a very near, if not sufficiently near, approach to practical requirements.




Mr. Heinrichs has also designed the electric candle shown in Fig. 2, in which no clockwork or mechanism is required for feeding the carbons. In this apparatus two sets of the semicircular carbons are used, constituting two segments of circles crossing each other at right angles; the arc being produced between the carbons at the point of crossing. The lower carbons are connected to the negative pole of the source—when a continuous current is employed; the upper set, which is movable and fixed to the armature as shown, being connected to the positive pole.

When no current passes, the upper carbon rests upon the lower; but, as soon as the current is transmitted through the apparatus, the upper carbon is raised by the attraction of the armature, so as to separate the carbons to a sufficient distance to produce the arc. The feed of the carbons takes place automatically by the weight of the metal arms which hold them. The two views of the carbons at the point where the arc passes show how they become affected by a continuous current. When alternating currents are employed, the four points all obtains a pointed form. A candle of this form may be constructed to burn from ten to twenty-four hours without replacing the carbons. In order to obviate the resistance opposed to the current by long carbons, these are electro-coated with copper. It is stated that carbons of circular form, as manufactured by Messrs. Johnson and Phillips, are not more expensive than those of the ordinary form.

## LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### THE THEORY OF THE COMPOUND ENGINE.

Sir,—Your correspondent "P. H.," being desirous of seeing an example worked out, proposes 280-horse power, 60 lb. boiler pressure, cutting off at half stroke in high-pressure cylinder. He has not, however, stated the speed of piston, so we will continue to use the same 420ft. per minute. The first thing to consider is the number of expansions. In selecting five the terminal pressure is about 15 lb., which is the very lowest that can be adopted with safety, having regard to the higher grades of expansions when reducing the power of the engines.

The coefficient of 5 expansions = ·522. Then, observing the usual allowances, we have, allowing for imperfect vacuum,

$(60 + 15 - 5) \times \cdot522 = 36\cdot54 - 2\cdot54 = 34$ lb. the average pressure due to five expansions.

$\frac{280 \times 33000}{34 \times 420} = 647$, adding 20 per cent. = 777in. area of the low-pressure cylinder, and which would be also the area of the cylinder for a non-compound engine at five expansions.

Having two expansions in the high-pressure cylinder, we have $\frac{5}{2} = 2\frac{1}{2}$ expansions in the low-pressure cylinder. Now it is clear that ratios of 4 to 1 is only true under certain conditions, and is not by any means a universal law, and is not applicable in this case. The following rules will be found to suit every possible condition, and are self-evident. In order, then, to find the ratios so that the strains on the crank pins will be equal at 280-horse power 777in. area of low-pressure cylinder × 34 average pressure 26418 units of work due to the entire engine.

$\frac{26418}{2} = 13209$ units due to each cylinder.

Then $\frac{13209}{777} = 17$ lb. the average pressure in L.P.C.

Being two expansions in high-pressure cylinder, the average pressure will be $70 \times \cdot846 = 59\cdot2 - 17 = 42\cdot2$ lb. Then, taking the other half of the units, $\frac{13209}{42\cdot2} = 313$in. = the area of the high-pressure cylinder.

The diameters are 31¼in. L.P.C.
20in. H.P.C.

$\frac{777 \times 17 \times 420}{33000} = 168 - 20$ per cent. = 140 H.P. for L.P.C.

$\frac{313 \times 42\cdot2 \times 420}{33000} = 168 - 20$ per cent. = 140 H.P. for H.P.C.

Total ... ... ... 280 H.P.

If it is required to use four expansions in the low-pressure cylinder—

Then $\frac{5}{4} = 1\frac{1}{4}$ and $70 \times \cdot978 = 68\cdot4 - 17 = 51\cdot4$

$\frac{13209}{51\cdot4} = 257\cdot9$in. for H.P.C. 18¼ diameter.

If five expansions in low-pressure cylinder, the 70 — 17 = 53 lb.

$\frac{13209}{53} = 249\cdot2$in. = $17\frac{13}{16}$ in all the cases using the same area of ow-pressure cylinder.

Applying these rules to the example in your own article in The Engineer at eight expansions, 500-horse power, 27 lb. average pressure, 80 lb. boiler pressure, and 420ft. per minute, we have

$\frac{500 \times 33000}{27 \times 420} = 1455$ area of L.P.C.

$1455 \times 27 = 39285$ units of work on entire engine.

$\frac{39285}{2} = 19642\cdot5$ units due to each cylinder.

$\frac{19642\cdot5}{1455} = 13\cdot5$ lb. average pressure in L.P.C.

There are two expansions in high-pressure cylinder, so that $80 \times \cdot846 = 67\cdot6 - 13\cdot5 = 54\cdot1$, say, 54 lb. average pressure in high-pressure cylinder.

Taking the other half of the units $\frac{19642\cdot5}{54} = 363$in. area of H.P.C. The diameters are 43in. L.P.C.
21½in. H.P.C.

$\frac{1455 \times 13\cdot5 \times 420}{33000} = 250$ H.P. for L.P.C.

$\frac{363 \times 54 \times 420}{33000} = 250$ H.P. for H.P.C.

Total... 500 H.P.

11, South Lambeth-road. Joseph Henry.

---

Sir,—I have somehow had a presentiment that this controversy would not be allowed to close until the correspondent who "fails to see why there should be any more economy got from a compound engine than from a single cylinder engine" had sent in his contribution, and this has come at last with Mr. Tattersall's letter. It is unfortunately the fact that there are many compound engines at work giving out results far inferior to those given by many single engines, but this arises from no fault in the principle, but may be easily traced to the mal-construction and mal-design of the makers. As a case in point I may mention that I had placed in my hands, a day or two ago, a compound engine using 10 lb. fuel per horse power per hour with an evaporation of 6 lb. Mr. Tattersall says, "I should like to see if a compound engine could be made to perform 300-horse power with a less amount of coal and water than a single engine, taking an equal evaporation in each case." I answer him by saying that in every case it can be accomplished, and I will gladly undertake to effect a saving of 25 per cent. by compounding the best single engine at present at work. It is difficult, nay—almost if not actually—impossible to prove by formula why the compound engine is more economical than the single engine; but this much may be said, you get a more equable range of temperature which partially prevents loss by condensation, as you erect a barrier between the cooling influence of the condenser and the higher temperature of the initial pressure from the boiler.

"W. F." says that, "One would think some attempt would be made to show that certain ratios of cylinders are the best for certain pressures or for given rates of expansion by logical reasoning." This I have gone into in my "Short Treatise on the Compound Engine," but he has surely passed over my formula for practice as given in your columns in one of my letters, viz., to divide the boiler pressure by the constant 5, and the square root of the quotient gives at the same time the ratios of the two cylinders, and the number of expansions in the high-pressure cylinder. The logical reasons for using the formula are:—(1) that the power given out by each cylinder will be about equal; (2) the variations of temperature in each cylinder will be about equal; and (3) the initial blow—that is, the respective areas multiplied by their respective initial pressures—will be about equal.

Mr. Henry, in flattering himself that anything he has written in this matter had "driven me into a corner," is fondling a sweet delusion. I am sure it must be a matter for regret that he has occupied your columns, and approached this subject with no higher aspirations than he would a game at chess, solely to checkmate his neighbour, for we have had no information from him of any kind whatever—nothing but profitless cavil.

"P. H." proposes that I, amongst others, should "give you the sizes of the high-pressure and low-pressure cylinders, and length of stroke to indicate 280-horse power; steam in boiler, 60 lb. above atmosphere; steam to be cut off at half stroke in high-pressure cylinder; to be paddle engines;" and this by a footnote you endorse. But, Sir, after putting to one side "paddle engines" and "length of stroke," as not being relevant, I must take exception to the small number of expansions in the high-pressure cylinder, for the reasons I have already given above in my few remarks to "W. F.," because the conditions of efficiency in a compound engine are that the horse-power, range of temperature, and greatest total strain should be equally divided between the two cylinders, or, at all events, practically so; but the data furnished by "P. H." would not, from any point of view, give us an economical and otherwise efficient compound engine. To apply my rule to this data, which I am asked to do, I would get $\frac{60}{5} = 12$ and $\frac{12}{2} = 6$—that is to say, the high-pressure cylinder would be one-sixth the area of the low-pressure cylinder to give a range of twelve expansions; but to make the whole question fairly intelligible, we have in the first place to reason as if we were dealing with a single-cylinder engine, so as to determine the size of the condensing cylinder of a compound engine, and taking

P = absolute initial pressure = 75 lb.,
A = area of single or condensing cylinder,
R = total number of expansions = 12,
H = hyperbolic logarithm of R = 2·4849,
S = speed of piston = 420ft.,

$a\,p$ = average pressure = $75\ \frac{1 + 2\cdot4849}{12} = 21\cdot78$.

we get $\frac{A \times 420 \times 21\cdot78}{33{,}000} = 280$, and consequently A = 1010·1, which is alike the area of a single engine and condensing cylinder of a compound engine, to give out 280-horse power with the data given. We have now to determine the average pressure in the high-pressure cylinder, and it is found in this way: let

$P^1$ = absolute initial pressure in condensing cylinder,
$ap$ = average pressure in condensing cylinder,
$r$ = ratio of cylinder = $\frac{A}{a}$,
$H^1$ = hyperbolic logarithm of $r$,
$ap^1$ = average pressure in high-pressure cylinder,

we get

$$ap = P^1 \frac{H^1}{r - 1}, \text{ so that if}$$

$$a\,p = P\ \frac{1 + H}{R}$$

$$ap = P^1 \frac{H^1}{r - 1}$$

then $(a\,p - ap) \times r = ap^1$ = average pressure in high-pressure cylinder, and applying these general laws to "P. H.'s" data, we get $a\,p = 21\cdot78$, $ap = 13\cdot438$, and $ap^1 = 50\cdot052$. To find the power developed in the condensing cylinder we have

$\frac{1010\cdot1 \times 420 \times 13\cdot438}{33{,}000} = 172\cdot8$ H.P.,

and the power developed in the high-pressure cylinder

$\frac{168\cdot35 \times 420 \times 50\cdot052}{33{,}000} = 107\cdot2$ H.P.,

which is an unequal distribution of power, temperature, and strain; whereas by my rule $\sqrt{\frac{60}{5}} = 3\cdot464$ we would get by the above formulæ $a\,p = 21\cdot78$, $ap = 10\cdot9$, and $ap^1 = 37\cdot68$, and the power in condensing cylinder would then be

$= \frac{1010\cdot1 \times 420 \times 10\cdot9}{33{,}000} = 140$ H.P.,

and the power in high-pressure cylinder

$= \frac{291\cdot5 \times 420 \times 37\cdot68}{33{,}000} = 140$ H.P.,

being an equal distribution of power and an almost equal range of temperature and total strain, thus making the diameter of cylinder according to my rule 35⅝in. and 19¼in. diameter respectively for a piston speed of 420ft. per minute; but as the areas 1010·1 and 291·5 depend upon no loss whatever, to make provision for a reasonable amount of loss brings us once more back to my original rule, viz., I.H.P. × 4 = A, and $\frac{A}{r} = a$ = area of high-pressure cylinder, so that

$\frac{1120 \times 420 \times 9\cdot82}{33{,}000} = 140$ H.P.,

and $\frac{323\cdot3 \times 420 \times 34\cdot02}{33{,}000} = 140$ H.P.

This allows, you will see, about 10 per cent. of loss in the average pressure due in each cylinder; that is to say, in the condensing cylinder out of a possible average pressure of 10·9 lb., 9·82 lb. may be got, and out of a possible average pressure of 37·68 lb. in the high-pressure cylinder 34·02 may be got in practice with the cylinder 37⅜in. and 20¼in. diameter respectively.

John Turnbull, Jun.,
Consulting Engineer.

184, Buchanan-street, Glasgow, December 2nd.

---

Sir,—After your own article to help a workshop student, the excellent letters by Messrs. Smith and Turnbull have placed such of your readers as have mastered them in a more comfortable position; but in applying the information given them to their practice they will now stumble over the lack of knowledge as to the proper relative positions of cranks and valves. Such students need to be informed in what position the low-pressure piston should be at the moment the high-pressure steam begins to exhaust into the low-pressure cylinder, for there will, maybe, be too much "gap" if the high-pressure steam be only released from the small cylinder when the low-pressure piston of the large cylinder has made nearly one-half its stroke, thus merely filling up a space already left behind by the low-pressure piston.

This question is one more perplexing to practical workshop students than the points that have already been explained and discussed.

I trust Mr. Smith and Mr. Turnbull will both enlighten practical students on this point.

Apprentice not Ignorant of Mathematics.

Liverpool, December 2nd.

---

### LINKS IN THE HISTORY OF THE LOCOMOTIVE.

Sir,—The North Star was constructed for the Northern and Eastern line, 5ft. 3in. gauge, and I believe had 13in. cylinders and double fork reversing gear. The Prince of Wales on the York and North Midland was a similar engine for the 4ft. 8½in. gauge, and another made about the same time was No. 70 of the North Midland, 14in., which had Dodd's patent wedge motion and four coupled wheels. No. 71 was somewhat like this in external appearance, but had link motion. The Hercules and Jupiter, 15in., for the York and North Midland, and No. 74 for the North Midland, were the pioneers for the long boiler six-wheel coupled goods engines. I think you will find that 15in. cylinders were not applied to passenger engines at this time, so that your remark that they were usually 15in. for that class of engine is incorrect. I am unable to call to mind any uncoupled passenger engine with 15in. cylinder—unless the four made for the Yarmouth and Norwich line with outside cylinders had 15in.—prior to the A engine for the gauge experiments. Some outside cylinder engines for the Baden railways were 13in.; the White Horse of Kent had 14in.; the Newcastle and Darlington coupled engines were 14in.; those made for the Saxon Silesian line were 14in. with 5ft. coupled drivers. The Richmond for the Great North of England, by R. and W. Hawthorn, had 16in. but was not a long boiler; this was made in 1846. It may be interesting to add that Mr. W. P. Marshall, the ex-secretary of the Institution of Mechanical Engineers, was on the North Midland about 1840 or 41, when the long boiler plan originated, and has the credit of having suggested to Mr. Stephenson the desirability of patenting the placing of the centres of the three axles between fire-box and smoke-box, which was the patent under which the North Star was built. I am not aware whether 75 and 76 on the North Midland, built by Hick, of Bolton, or others subsequently constructed by Rothwell, designed by Mr. Kearsley, Locomotive Superintendent, Derby, with the axles so placed, were claimed as infringements; they resembled 74, but had the cylinders inclined below the front axle, Bury's frames and fire-box.

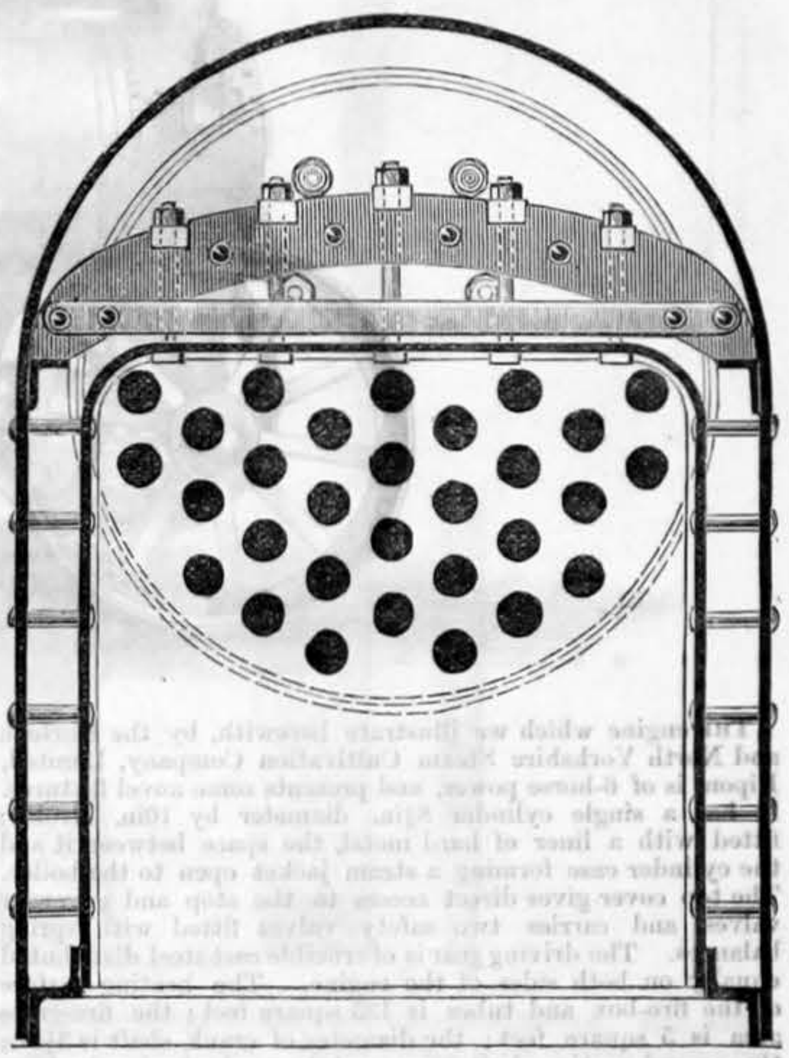
Tyneside.

December 3rd.

---

### FIRE-BOX ROOF STAYS.

Sir.—Herewith I enclose tracing of an arrangement of mine for fire-box roof stays, which I think possesses advantages not belonging to the plan illustrated in your last week's journal, more



especially for portable and traction engines, as the outer casing plate is left quite clear for the attachment of the cylinders, brackets, &c., and every stay bolt has a square bearing.

Lincoln, November 25th. J. J. Tyrrell.

---

Sir, — In your notice of Leach's method of staying the crowns of fire-boxes, with an enumeration of its advantages, not the least being its adaptation to boilers in use, I felt myself constrained to blame that insular prejudice which so obstinately refuses to recognise some of the good things in use with our continental neighbours. In examining this intermediate, or span plate, I could not help remarking how difficult it is to satisfactorily overcome some of the difficulties consequent on radial staying—the different lengths of stays, their positions, unequal burdens, differences of expansion, shouldering, &c. &c.

Many of your travelled readers will no doubt have noticed the flat topped outer shells of some of the engines on Russian and German railways, and which have yearly grown more into favour. It is this system I would instance as possessing in a far greater degree the advantages claimed for the above-named system, with others equally important in actual practice, viz.: All stays being vertical, one length, consequently expansions equal, with equal burdens, uninterrupted discharge of steam globules, easy of access for inspection, cleaning, or repairs; a desideratum not sufficiently valued—all these it possesses. But its shape—there is the difficulty. It is not consistent with English practice, but like the semi-circular form, it has been consecrated and stereotyped by long years of practice; and if we do diverge and adopt through stays it must be in radial form, with the aggravating addition of distorting the crown plates by a cruel system of setting or shouldering. I have had unusual facilities of observing the admirable work done by this class of boiler, and those defects, normal or cumulative, peculiar to most fire-boxes, seemed to be happily avoided. Where bad water is used it is gratifying to see with what ease the accumulated deposit is swept away; and is in marked contrast to the periodical chipping and grubbing peculiar to the old form.

In this æsthetical age it would be argued that they are uncomely, but it would be very difficult to find more compact engines than those delivered, for example, by the firm of Kitson and Co., Leeds, some few years ago to the Alsace and Lorraine Railway, and which moreover for economy in consumption stand almost unique in the statistics of locomotive rolling stock.

Burton-on-Trent, Nov. 28th. R. Weatherburn.

---

### THE WANDERER.

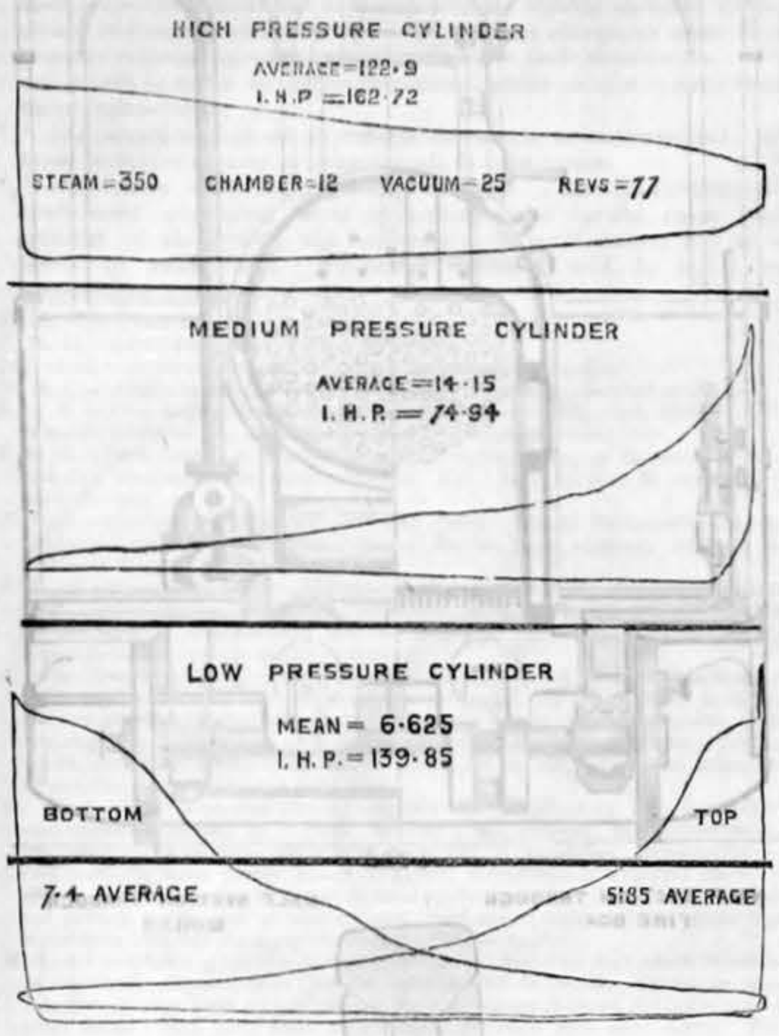
Sir,—With reference to your leading article on the steam yacht Wanderer in your issue of the 28th ult., may I be allowed to make a few remarks, especially as Mr. Spencer is absent in South America?

The engines of the steam yacht Wanderer have run 100 revolutions per minute, but were not indicated when so running. In the event of failure, only the high-pressure part of the machinery was to be removed, so that the ordinary compound part might take its place, and which was called 120-horse power nominal.

Of the indicated horse-power required to drive the vessel a certain speed I have no reliable data, but the fastest speed I have any return of is 13·66 knots, against a strong tide, in one hour and eleven minutes, between the Cumbraes and the Cloch on the Clyde. The engines were running about 80 revolutions per minute the first part of this distance, and the latter part up to 100 revolutions per minute. You state, "Mr. Perkins fitted lantern brasses to the feed pumps." I merely suggested this, and it was followed. Also "that Mr. Perkins overhauled the machinery when the Wanderer returned to Falmouth from her cruise in the Bay of Biscay." This I did not do, the crew alone having done all that was necessary by sweeping the flues and cleaning the water gauges, which ought to have been done at sea. The vessel

then proceeded without delay with the owner and his family to Cowes, running, as you state, about 12 knots per hour.

The defects in the slide valve showed themselves from the first, but as this had nothing to do with the "Perkins system" or my company's contract, Mr. Spencer stated correctly that "there was an entire absence of trouble affecting the system or pressure, either in engines or boilers, with 400 lb. of steam," evidently meaning that the low-pressure slide had nothing to do with the company's contract, as the cylinder and slide were to remain in the ship if the high pressure part was removed. Nevertheless, the responsibility of this slide was thrown upon my company, who rather than that the machinery should fail, paid all costs of the previous experiments with this slide, in which, however, they were not allowed the deciding voice, and even protested with respect to some of them. The slide was eventually cured by adopting a plan which was proposed by me almost from the first.




I enclose in this letter indicator diagrams taken during a fifty hours' trial after the alteration; the extreme consumption of fuel during this trial in any one watch being 490 lb. per hour, and the indicated horse-power on these cards being 377·51 lb. or 1·29 lb. of coal per indicated horse-power per hour, the engines running steadily during the whole trial. This consumption, I believe, would be decreased after the slide had been some time in use. The cards were taken by Mr. W. N. Harris, the ordinary crew of the ship having charge of the boilers and engine.

Of course I expected when the ship was officially tried she would have been worked up to from 500 to 600 indicated horse-power, and that the whole experiment would be under mine or Mr. Spencer's charge—as provided for by the contract—when it would have been seen that the boilers had been properly swept and cleaned, and the whole of the machinery in an efficient condition.

You state also in your article that 1·9 lb. of coal per horse-power per hour is a usual consumption in regular work with the ordinary compound engines at sea. I should be extremely obliged if you would name a ship fitted with engines of 120 nominal where this result is obtained, and where one could verify it. You also state that a "leakage of a feed pump is fatal to the high-pressure system." Now, this is not really the case. The Wanderer is fitted with a complete apparatus for producing fresh water at sea from salt water, and the only result which would arise from using this water is that the boilers would be liable to the same decay which now takes place in the ordinary boiler, and which does not occur when distilled fresh water is used, the boilers being then comparatively indestructible.

I would add that the Loftus Perkins is a paddle steamer for carrying passengers on the Tyne—with a Board of Trade certificate—and not a tug boat. LOFTUS PERKINS.

Queen Victoria-street, London,
December 2nd.

[The engines of the "Stag" line ships Eglantine and Camilla are 130-horse power nominal, and burn in regular work under 2 lb. of coal per horse per hour. In another place will be found particulars of the last run of the Eglantine.—ED. E.]

---

SIR,—In a leading article on the steam yacht Wanderer in last week's ENGINEER, you refer to Mr. J. F. Spencer, and in a way which seems unfair throw upon him responsibility for the failure of the Perkins engine with which that vessel was fitted. Mr. Spencer left England last summer to attend to some professional business in South America. He is still absent, and cannot know of your statements or reply to them for months to come. Under these circumstances you will no doubt allow me space for a few words on the subject. I may say first that I have not seen the Wanderer's engines, and did not know till last Saturday that they were to be taken out of the ship; but I had frequent conversations with Mr. Spencer about the engines, both before and after he arranged to adopt the Perkins system.

It was the satisfactory results obtained from a number of smaller engines working on Mr. Perkins's system that led to its adoption for the Wanderer, but the owner of the yacht and all the parties concerned clearly understood that the construction of such large engines on the Perkins plan must be regarded as an experiment.

Mr. Spencer frequently told me that he was adopting in his plans everything that Mr. Perkins's experience could suggest, and further, that if the engines proved a success it was to Mr. Perkins and not to him that all the credit was due. On the other hand, Mr. Perkins assumed all responsibility, and agreed to take the engines out if they did not prove satisfactory. This being so, it does not appear at all likely that any conflict, such as you indicate, could exist between Mr. Perkins and Mr. Spencer in reference to the drawings.

Competent engineers, who have seen the engines, say they are in all respects excellent examples of design and workmanship. Passing over the difficulty which arose from leakage at the feed pumps, which appears to have been soon overcome, all the trouble and mischief seem to have been caused by the slide valve of the low-pressure cylinder. In fact, it appears that it was the cutting up of this valve which proved fatal to the engines. Now, anyone might infer from your article that the cutting of this slide valve clearly arose from faulty design; but there does not seem to be any proof of this. What was, doubtless, the real cause, is an essential part of the Perkins system. In the Perkins engines no lubricating matter can be used for the valves. You did not even allude to this well-known fact in your article, although it seems the reasonable and clear explanation of all the trouble which was experienced with the main slide. This unfortunate cutting of the slide valve shows that very large slide valves cannot be safely worked without lubrication, although small ones made of Perkins metal may be working and wearing well under such conditions. It does not prove, however, that the Perkins system for large engines is a failure; other valves which work with less friction can be used, and it is possible that the complete success of Mr. Perkins's engines, which appeared at first to be fully realised in the Wanderer, may yet be attained. WILLIAM INGLIS.

Bolton, December 3rd.

---

## STRAINS ON GIRDERS.

SIR,—I have attempted, so far as time permitted, to find the reactions, bending moments, &c., of the continuous girder figured in last week's ENGINEER.

Let A E be the girder of four spans, each $= l$.

Let $M_0$, $M_1$, &c., = bending moments at A, B, &c., respectively.

Then $M_0 = O$, and $M_4 = O$.

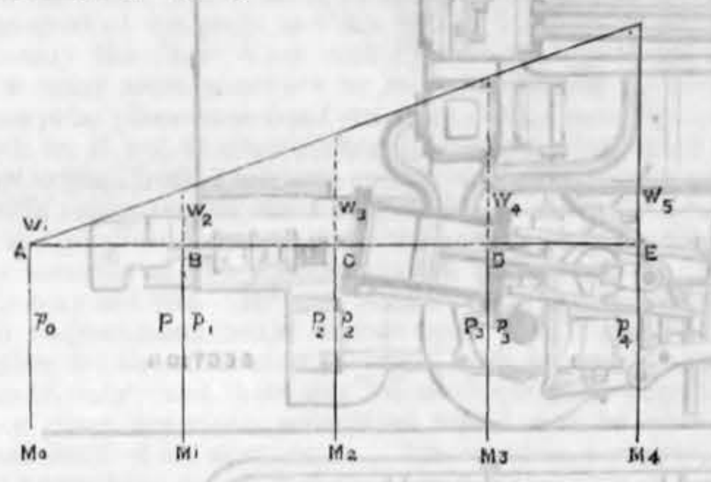
Let $p_0$ = reaction at A.
$P_1 + p_1$ = ,, B; $P_1$ being taken to the left.
$P_2 + p_2$ = ,, C; $P_2$ ,, ,,
$P_3 + p_3$ = ,, D; $P_3$ ,, ,,
$p_4$ = ,, E.

It will be found convenient to call the intensity of load at A, $w_1$; at B, $w_2$; &c.; and afterwarde to substitute $w_1 = O$, $w_2 = W$, $w_3 = 2W$, &c.

In span C D, if M = bending moment, distant $x$ from C, we shall find

$$M = M_2 + p_2 x - \frac{W_3 x^2}{2} - \frac{w_4 - w_3}{6 l} x_3.$$

Proceeding in the ordinary way, we shall find the equation connecting $M_1$, $M_2$, $M_3$, is—




$$240 M_2 + 60 (M_1 + M_3) + 15 w_3 l^2 + 28 w_2 l^2 - 13 w_1 l^2 = O.$$

This reduces to—

$$240 M_2 + 60 (M_1 + M_3) + 19 w l^2 = O.$$

Similarly, $240 M_3 + 60 M_2 + 49 w l^2 = O$; and

$$240 M_1 + 60 M_2 - 11 w l^2 = O.$$

Hence—

$$M_1 = \frac{2}{35} w l^2, \quad M_2 = \frac{-19}{420} w l^2, \quad M_3 = \frac{-27}{140} w l^2.$$

The reactions are—

$$p_0 = \frac{94}{420} w l, \; P_1 + p_1 = \frac{423}{420} w l, \; P_2 + p_2 = \frac{611}{420} w l,$$

$$P_3 + p_3 = \frac{1543}{420} w l, \; p_4 = \frac{689}{420} w l.$$

The points of contrary flexure in each span are obtained by putting M (the bending moment) = O, and solving the resulting cubic.

Max. M in each span is got by substituting the proper value of $x$ determined by the equation $\frac{d M}{d x} = O$. $\frac{p}{v}$ I.

November 19th.

---

## SPECIFICATIONS FOR IRONWORK.

SIR,—I was much pleased to see your article on this subject; it is one that needs to be discussed with a view to amendment. Specifications are in most cases stereotyped things, and old errors are reproduced again and again; but engineers put a quite different construction on the meaning of a specification from that put by contractors. For example, it is a common thing to stipulate in bridge work that all angle and tee irons shall be planed at their ends, yet it is a clause very troublesome to enforce. Again a specification will say, "all plates are to be planed so as to make close and accurate butt joints." Yet it is impossible to get floor plates of bridges laid with joints in contact with each other, while planing is never dreamt of. A clause will run thus, "Rivets to be made of the very best quality of rivet iron." Yet contractors will supply what they call "good ordinary rivet iron," and if censured, will reply, "Oh, such things are put in specifications, but are not expected to be given." Another item that inspectors of iron bridges have to contend against is this—when they reject bad work they are accused of obstructing the progress of the work. The following clause is often put in specifications; "All disputes are to be referred to the engineer, whose decision is to be final, conclusive, and binding both on the owner (or corporation) and on the contractor." Now every lawyer knows this clause is worthless, because in this country no dispute of the kind will be left to any single umpire to judge, especially one personally interested. Why put such things in? INSPECTOR.

London, November 29th.

[We are afraid "every lawyer" would be against our correspondent on his view of the arbitration clause—ED. E.]

---

## TENDERS.

SIR,—The usefulness of public tenders and the advantages of publishing the results must be very great when we see such a difference in price as two to one, being the results of the tender for machinery to be put up at Darenth as stated in your last issue. Again in your number for Nov. 21st the results of a tender for sewerage works at Belgrave, the difference is exactly three to one. Does the one who tenders at the lowest ever get a profit, and does the one who tenders at the highest ever get a contract? Of course allowances must be made for locality, price of material, transit, &c., but they are nothing compared with the great difference of price. Why, a contractor in New Zealand could compete with the highest on the list. In the Belgrave sewerage list it is not one contractor who put such a high price, but there are no less than eight who go into four figures. The townsfolk of Belgrave may now rejoice in the knowledge that they can purchase three sets of sewage machinery for the price they might have had to pay for one set if they had not gone in for public competition.

Peckham, December 1st. E. S.

---

## THE BESSEMER PROCESS.

SIR,—The world is not yet supplied with Bessemer steel manufactured from Cleveland pigs, cooked in lime-lined converters, with Blue Billy sauce. I see, however, a move has been made in the right direction, and a patent has been taken out for blowing lime into the converter, a process which I should have imagined should have preceded that of lime linings, when the relative specific gravities of lime and melted iron are taken into consideration. As the blowing down of air upon the surface of melted pig iron has been superseded by the upward blowing of air through it, so it is reasonable to suppose that lime, forced through melted phosphoric iron, will prove more effective as a purifier than when simply brought into contact with that iron.

Some time back I called attention to a process, patented by Mr. Edwin Pettitt, of Cheltenham, for blowing roll scale or hammer slag and other substances into melted phosphoric iron, and I detailed an experiment—a successful one—in which Heyford pig iron, as phosphoric as that of Cleveland, was practically dephosphorised, and converted into Bessemer metal, possessing all the properties of malleable iron, and this without the use of a lime lining, or of lime in any form, and without either spiegeleisen or manganese. Besides calling attention to this curious fact in the public papers, I wrote to M. Pourcel, asking him if he could explain the remarkable result, and elucidate its chemical nature. I never received any reply. Possibly the fact might have come into awkward collision with some pet theory and was best let alone. I believe I first started the blowing-in system more than twenty years ago, and one of my patents, viz., for blowing carbonaceous matters into the converter, is, I think, still in use at some of the continental works.

The drawback to the blowing-in of substances, in order to purify the melted cast iron, lies in its tendency to chill the metal and cause it to set in the converter before a sufficient amount of the substances employed can be forced in. Like other difficulties I have no doubt this may and will be overcome, and what to me appears an important step towards this desirable object is embodied in a patent process recently enrolled by Mr. W. H. Fryer, of Coleford, for desiccating the atmospheric air employed as a blast for the Bessemer converter or for the blast furnace. At present of course a large amount of moisture is introduced with the blast into the converter, and, therefore, a quantity of hydrogen dissociated with its well known cooling effect. Now the previous desiccation of the blast will, no doubt, occasion a considerable accession of temperature in the converter, thus affording a far wider scope for the blowing in of materials, as in Mr. Pettitt's process, suitable for dephosphorising or otherwise purifying the melted iron operated upon.

As I have mentioned hydrogen, I may, perhaps, add that many years ago I pointed out that the cells or honeycombs in cast steel ingots were not caused by carbonic oxide. This puerile conceit, as it was then considered, was very properly sat upon, and extinguished at the time; and yet a high continental authority has recently demonstrated that hydrogen, and not carbonic oxide, is the chief agent in the formation of these cells. Now, Mr. Fryer's process, which deprives the blast of its moisture, deprives it of the hydrogen contained in that moisture, and therefore we may infer that the ingots of steel produced by it will be free from the cells or honeycombs which are due to the presence of hydrogen, and which constitute in many instances so serious a defect.

Cheltenham, December 3rd. R. F. MUSHET.

---

## WIRE-ROPE STREET RAILWAYS.

SIR,—In the description of the Clay-street-hill wire-rope railway in this city, given in No. 1241 of your excellent journal, you mention Mr. A. Hallidie as the engineer of that road. Mr. Hallidie was one of the promoters, and is now one of the owners of it; but the engineer of the first section of the road was Mr. Wm. Eppelsheimer, now building a similar road in Geary-street, in this city. I saw, frequently, Mr. Eppelsheimer making the drawings and superintending every detail of the road.

E. J. MOLERA,
Late Assistant Lt.-Ho. Engineer for California,
San Francisco, November 8th.

---

## AN APPRENTICESHIP DIFFICULTY.

SIR,—Can any of the readers of your valuable paper inform me whether there is any remedy for the following case:—Having been apprenticed to a civil engineer through the medium of an advertisement, foolishly unsupported by any references, I find that a course of tyranny and gross and abusive language, only to be heard in the lowest slums of London, practiced upon the other pupils by the principal, is directed towards me after the second half of the premium has been paid. Having a little spirit in me not unmixed with self-respect, I refuse to stay and submit to such gross insults on every occasion even where censure may be merited, and as I can get no guarantee that I shall not be subjected to this injustice in the future, I am anxious to know if there is any remedy. I hope this will serve as a warning to people not to put their faith in advertisements without making full enquiries on the subject. AN ARTICLED PUPIL.

November 28th.

---

# TENDERS.

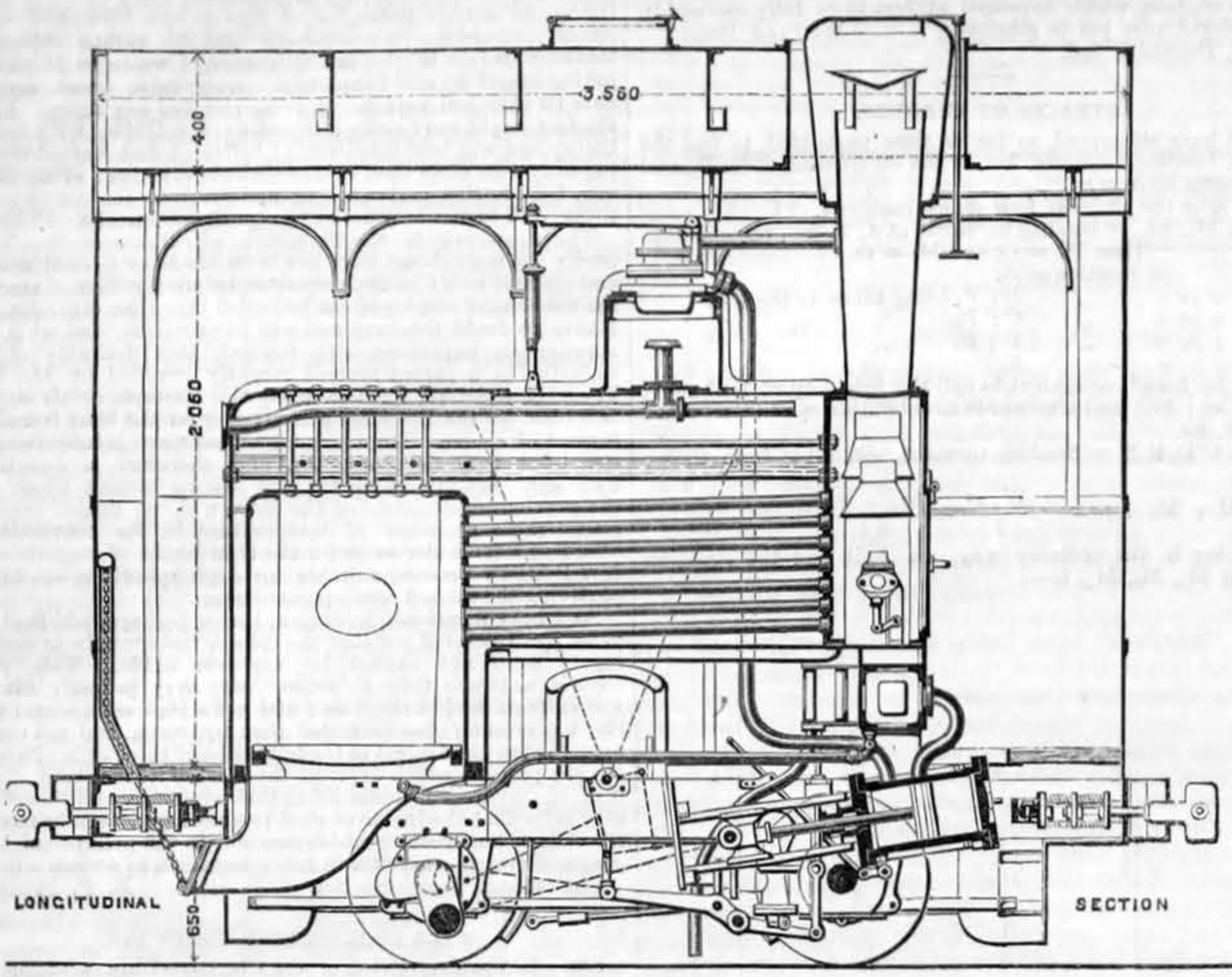
## DORCHESTER.

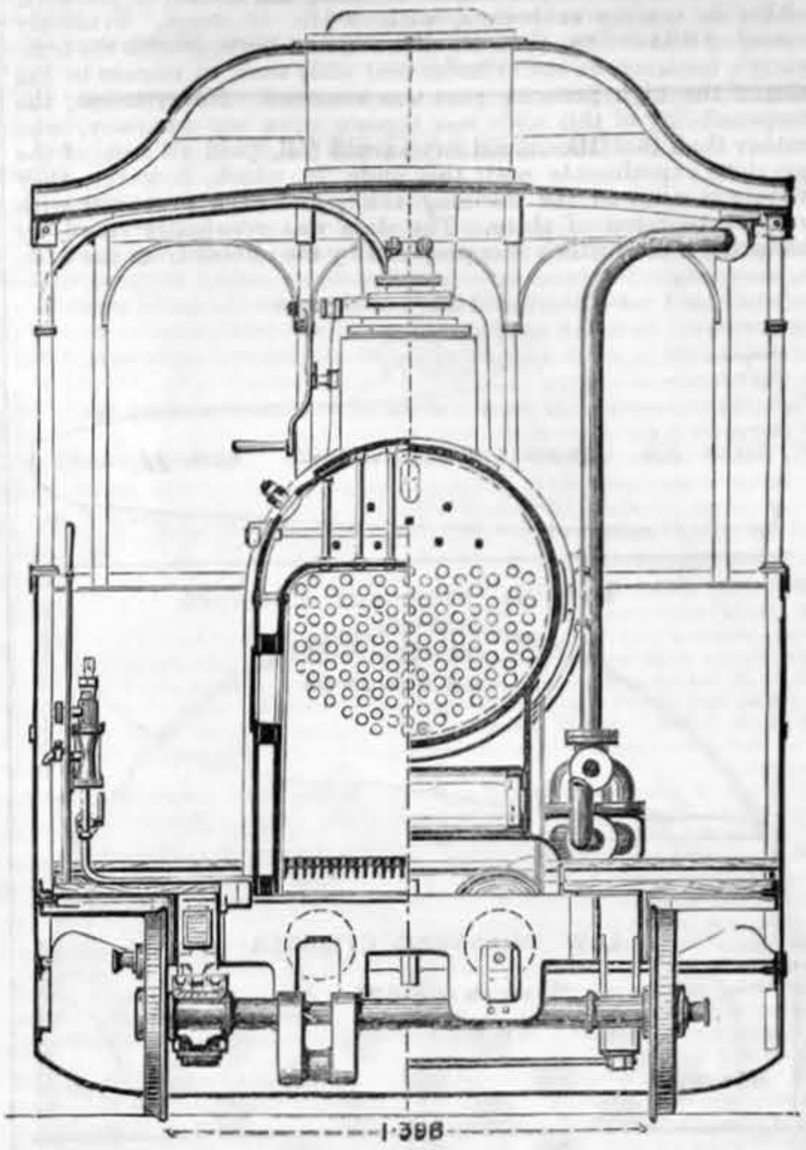
FOR supplying and erecting iron columns, girders, &c., and brewery plant for the new brewery, Dorchester, for Messrs. Eldridge, Pope, and Co. Messrs. Scamell and Colyer, civil engineers, 18, Great George-street, Westminster. Quantities for the iron columns, girders, &c., supplied by Messrs. Curtis and Son.

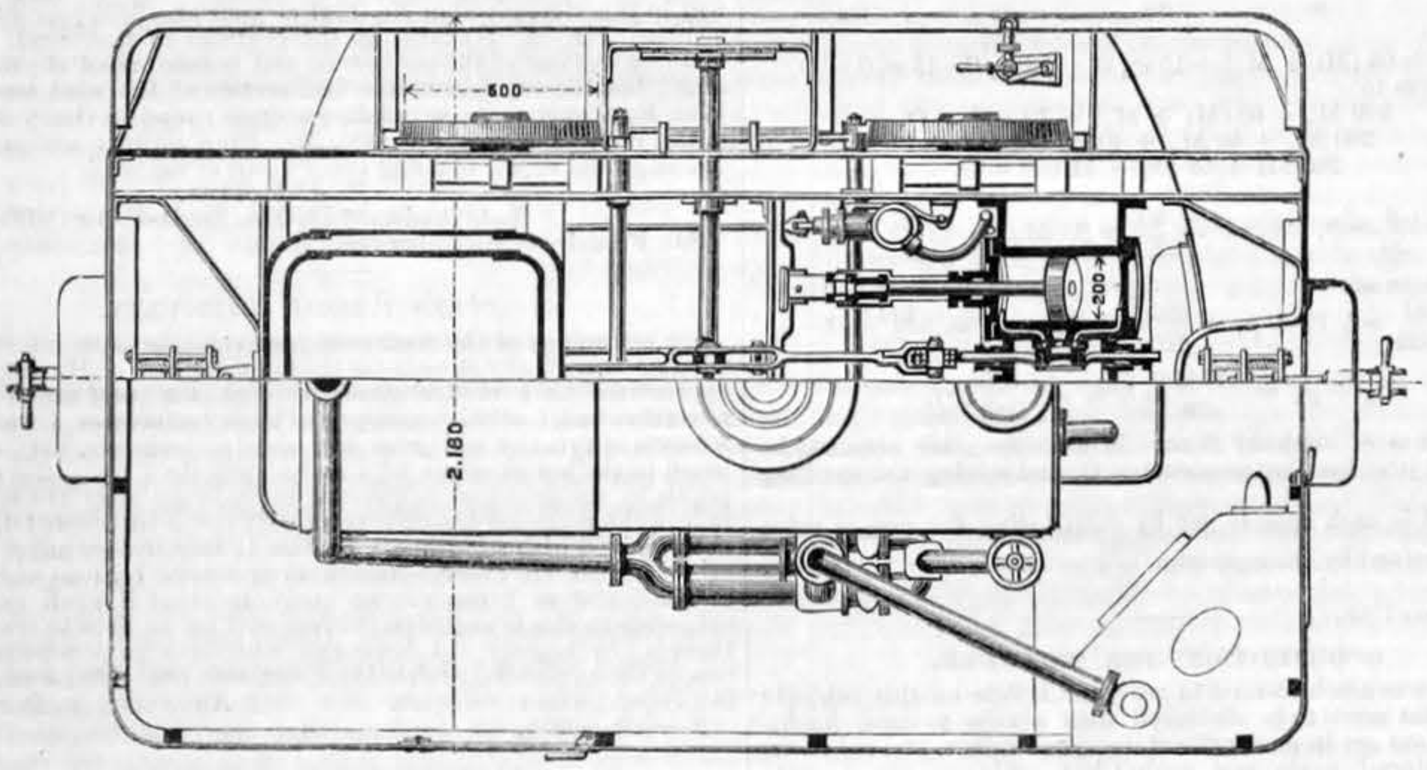
| | £ | s. | d. |
|---|---|---|---|
| CONTRACT No. 1.—IRONWORK. | | | |
| Macnaught, Robertson, and Co. (declined) | — | | |
| Westwood, Baillie, and Co. | 3732 | 0 | 0 |
| Horseley Iron Company | 3686 | 0 | 0 |
| Appleby Bros. | 3620 | 0 | 0 |
| Cochrane and Co. | 3532 | 0 | 0 |
| Handyside and Co. | 3474 | 6 | 9 |
| Cockey and Co. | 3450 | 0 | 0 |
| Thornewill and Warham (accepted) | 3185 | 0 | 0 |
| Oxley and Co. | 3160 | 0 | 0 |
| CONTRACT No. 2.—BOILERS. | | | |
| Horton and Sons | 965 | 0 | 0 |
| Thornewill and Warham (accepted) | 897 | 0 | 0 |
| Waller and Co. | 888 | 0 | 0 |
| Seaward and Co. (declined) | — | | |
| CONTRACT No. 3.—COPPER, HOP BACK, &c. | | | |
| Dale | 1181 | 0 | 0 |
| Shears and Son | 1160 | 0 | 0 |
| Oxley and Co. | 997 | 0 | 0 |
| Bennett | 990 | 0 | 0 |
| Pontifex and Sons (accepted) | 958 | 0 | 0 |
| Blundell Bros. | 890 | 0 | 0 |
| Pontifex and Wood, for copper only | 450 | 0 | 0 |
| CONTRACT No. 4.—MILLWRIGHTS' WORK. | | | |
| Scott and Co. | 5520 | 0 | 0 |
| Horton and Sons | 4317 | 0 | 0 |
| Pontifex and Son | 4274 | 0 | 0 |
| G. Waller and Co. | 3392 | 0 | 0 |
| Thornewill and Warham (accepted) | 3275 | 0 | 0 |
| Oxley and Co. | 3204 | 0 | 0 |
| CONTRACT No. 5.—BACKMAKERS' WORK. | | | |
| Carty | 731 | 0 | 0 |
| Bennett and Son | 670 | 0 | 0 |
| Oxley and Co. | 581 | 0 | 0 |
| Church and Co. | 540 | 0 | 0 |
| J. Colyer and Co. (accepted) | 496 | 15 | 0 |
| CONTRACT No. 6.—SLATE BACKS. | | | |
| Sessions and Co (declined) | — | | |
| Temple and Co. do. | — | | |
| Stirling | 518 | 0 | 0 |
| Brindley and Co. | 511 | 0 | 0 |
| Braby and Co. | 510 | 0 | 0 |
| Sharp (accepted) | 510 | 0 | 0 |
| CONTRACT No. 7.—PIPE CONNECTIONS. | | | |
| Pontifex and Wood (declined) | — | | |
| Shears and Son do | — | | |
| Lawrence and Co. | 2241 | 0 | 4 |
| Siebe and Gorman | 2084 | 0 | 0 |
| Bennett and Son | 1510 | 0 | 0 |
| Pontifex and Son | 1455 | 0 | 0 |
| Oxley and Co. | 1400 | 0 | 0 |
| Blundell Bros. | 1235 | 0 | 0 |
| Thornewill and Warham (accepted) | 1045 | 0 | 0 |
| CONTRACT No. 8.—REFRIGERATORS. | | | |
| Lawrence and Co. (accepted) | 179 | 0 | 0 |

# STANDARD ROLLING STOCK AND PERMANENT WAY, BERGAMO AND LODI TRAMWAY.

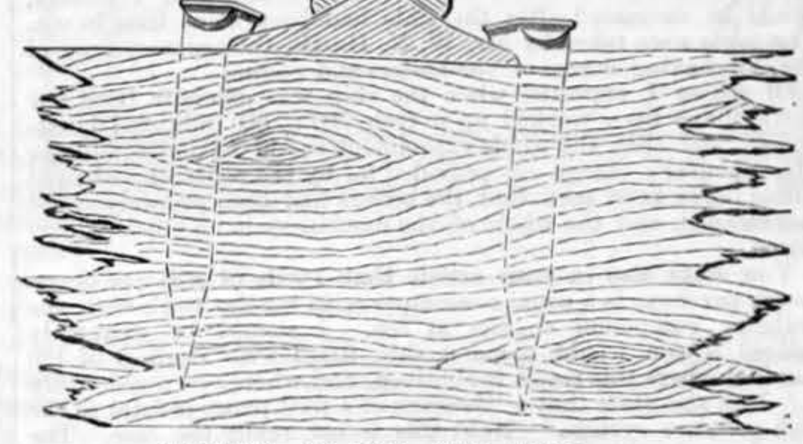
(*For description see page* 421.)




SECTIONAL PLAN




SECTION OF RAIL AND JOINT

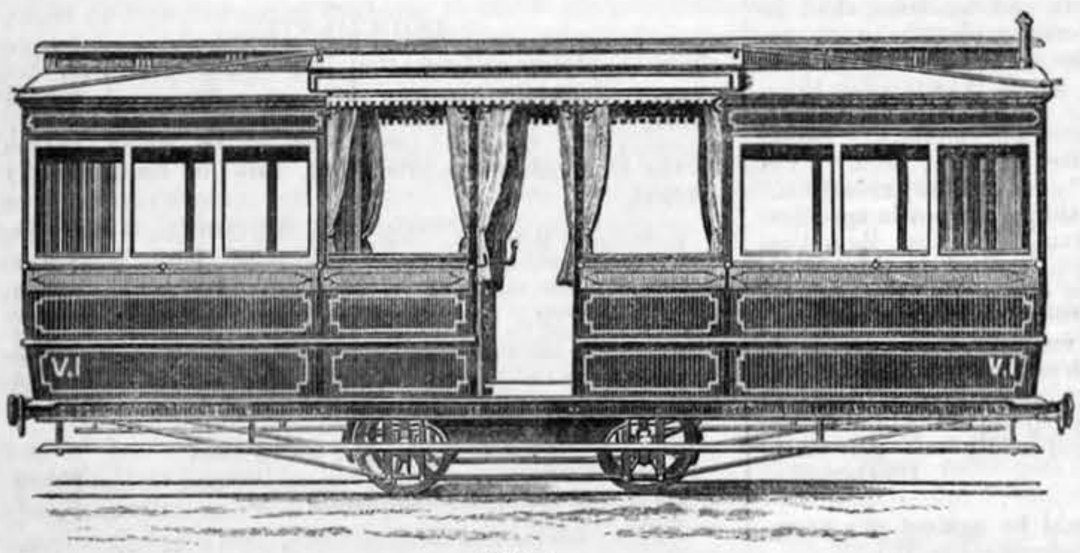



FIG.1

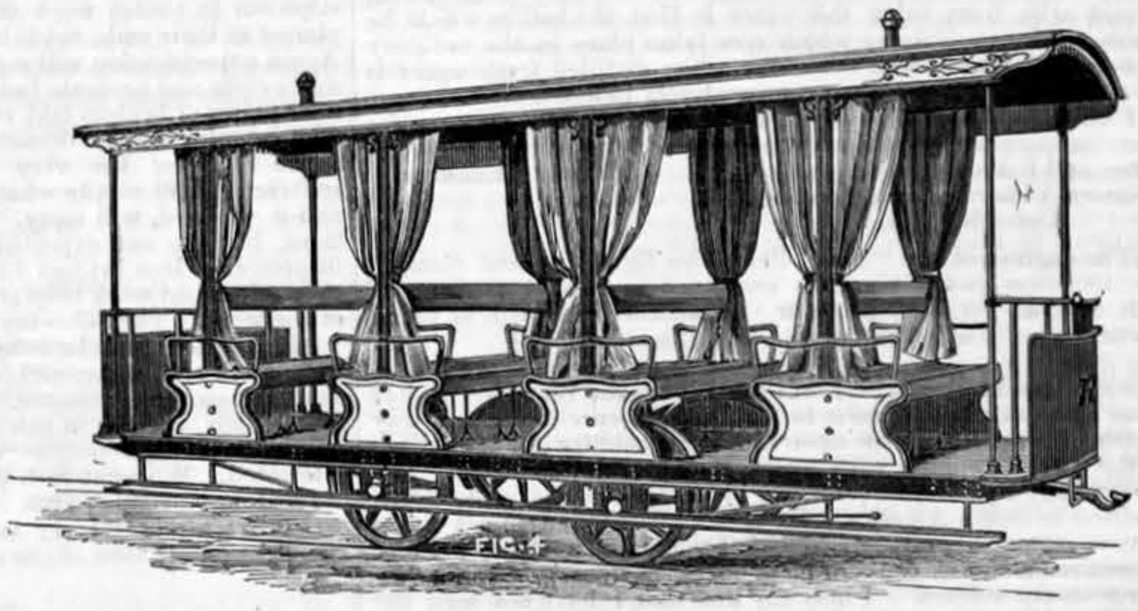


FIG.4

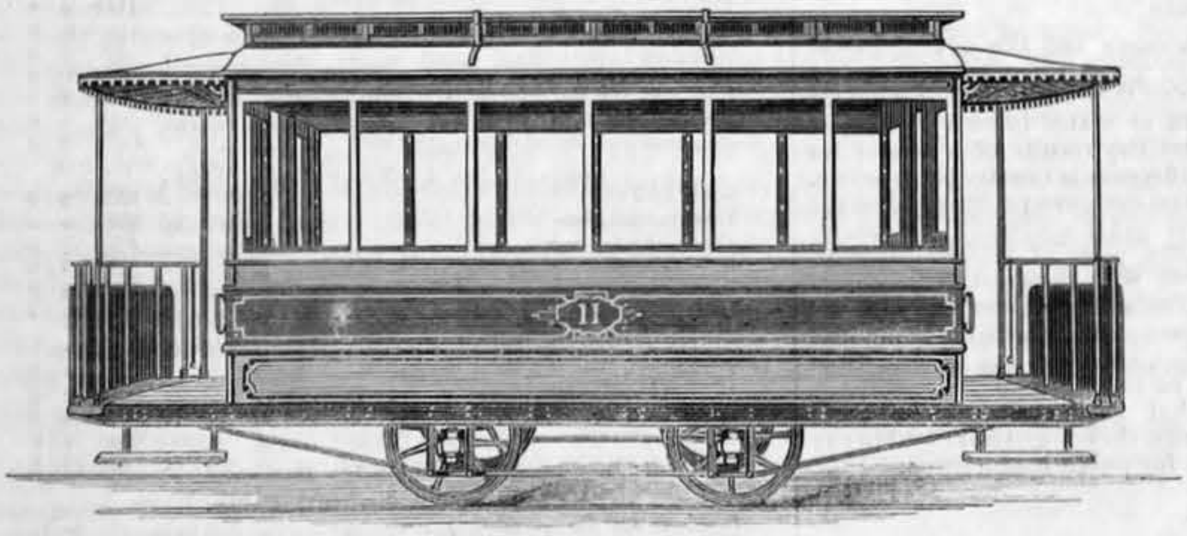



FIG.2

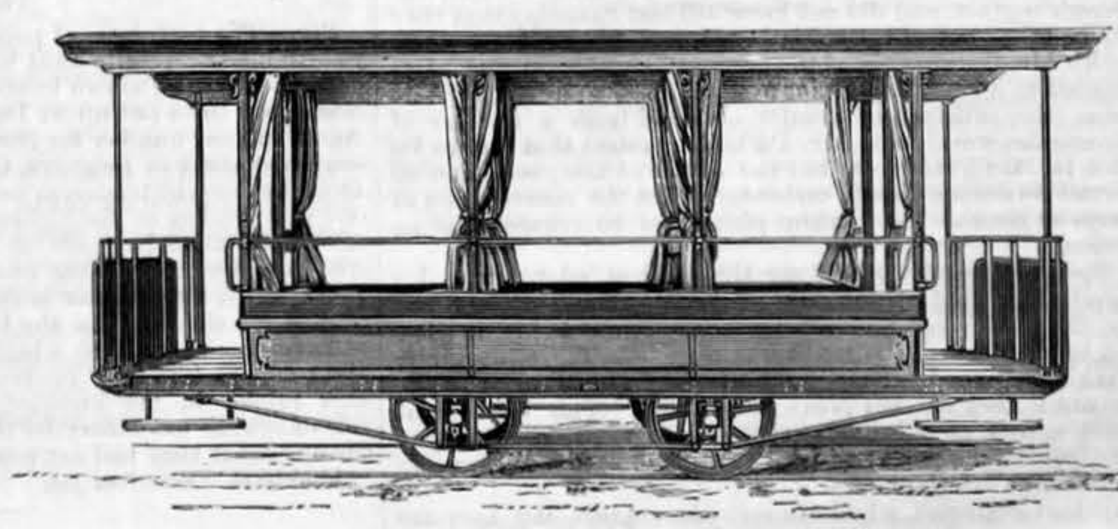
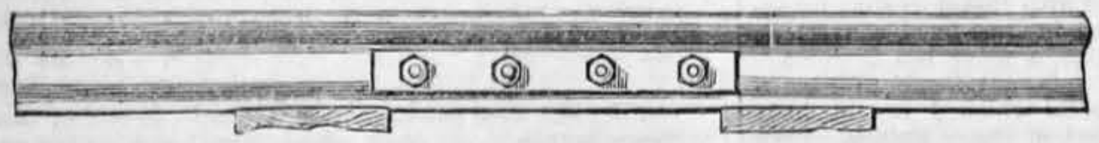
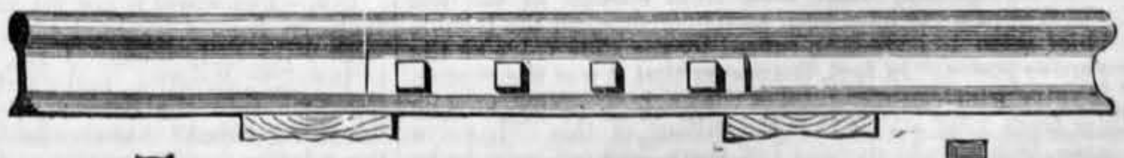


FIG.3

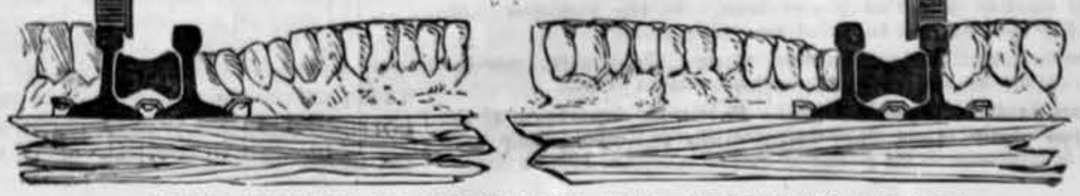


SIDE VIEW FROM B



SIDE VIEW FROM A

CROSS SECTION OF PERMANENT WAY



CROSS SECTION OF PERMANENT WAY, GUIDE RAILS & PAVING

**FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.**

PARIS.—Madame BOYVEAU, *Rue de la Banque.*
BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-street.*

## TO CORRESPONDENTS.

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a 2d. postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

F. M. W.—*There are no such books.*

C. R. H.—3404, *Sept. 30th*, 1875. *Price* 10*d.*

INQUIRER.—*Pewtress and Co.*, 15, *Great Queen-street, London.*

G. M. C.—*Apply to the Barrow Shipbuilding Company, Barrow-in-Furness.*

S. C. H.—*You may possibly obtain luminous clock dials from Messrs. J. J. Wainwright and Co., Cambridge-street-buildings, Birmingham.*

F. G. H. (Port Royal).—*Messrs. Spon, of Charing Cross, or Crosby Lockwood and Co., Stationers'-hall-court, London, E.C., may be able to supply you with the book.*

P. E. J.—(1) *Scott Burn's book of "The Farm.* (2) *No trustworthy book of the kind.* (3) *Bourne on the "Steam Engine," last edition; Rigg on the "Steam Engine."*

J. H. (Heating with Gas).—(1) *Your questions were fully answered in our last impression, in which we published a drawing of the apparatus.* (2) *We think it probable that you can obtain a gas engine for blowing an organ from any maker of gas engines.*

A SUBSCRIBER.—*If the flame of a Bunsen burner is not permitted to touch a cold surface it will not be more unwholesome or unpleasant than an ordinary illuminating gas flame. Bunsen burners liberate carbonic acid and water, and there is also produced under certain circumstances actelyne, which has an extremely disagreeable smell. It is only produced when the temperature of the flame is very high.*

H. V. Z.—*The pressures carried supply no satisfactory evidence of the evaporative efficiency of a fuel. Of two fuels, however, that might be the best for a given purpose which kept steam best, a result due, perhaps, to one fuel burning more freely under the fixed conditions of draught than the other. The true value of a fuel is fixed by the quantity of water evaporated, not primed away, per pound of coal, and unless both coal and water are accurately weighed the experiments are good for nothing.*

R. T.—*Your letter gives rise to nice questions of law and fact which it would be impossible for us upon present information to decide. Certainly your neighbours may have a right to run their drainage through the sewer under your house; they may have an easement through your own sewer. This easement may have been acquired by express grant or by uninterrupted user for twelve years. If the easement exist any interruption by you of the proper flow of sewage will give your neighbours a right of redress. You should consult your solicitor.*

W. H.—*We never asserted that gas used in any form of boiler could be as economical as coal. How can a comparison be drawn between the cost of gas at* 3*s.* 6*d. per* 1000*ft. and that of coal at* 3*s.* 6*d. per ton? If our correspondent had to deal with metropolitan conditions he would find the balance not quite so heavy against gas. The South Metropolitan Gaslight and Coke Company, for instance, sell gas at* 3*s. per thousand, while the cheapest coal that could be used costs* 20*s. to* 21*s. per ton, or nearly six times as much as he pays. At these prices you could heat about* 70*ft. of* 3*in. pipe for* 1*s.* 2*d. per day with gas, or* 300*ft. with coal. In the majority of cases no one wants to heat more than* 30*ft. or* 40*ft. of pipe with gas, and you will find that the consumption of coal to do this would be nearly, if not quite, as great as would suffice to heat twice as much piping. You have not said where your* 300 *yards of piping are fixed or the temperature maintained.*

### EMERY AND GLASS CLOTH MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers give me the address of manufacturers of machinery for making emery cloth and glass paper? EMERY.

London, N.W., December 2nd.

### SMALL BLOWERS.

(*To the Editor of The Engineer.*)

SIR,—Will any of your correspondents kindly name makers of small blowers with reciprocating motion, say of 8in. to 10in. stroke, and to work 100 double strokes per minute; also particulars of the same?

London, November 29th. E. D.

### BALL-AND-SOCKET JOINTS FOR WATER MAINS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers furnish information as to the ball-and-socket joint for water mains, which we believe was patented by a Mr. Craven in America? We should be glad to communicate with any one holding a patent for England, or give us particulars. B. AND B.

London, November 27th.

### MILLS' AUXILIARY BUFFER.—PATENT No. 1082.

(*To the Editor of The Engineer.*)

SIR,—In the Abstract of Specification of above you state that "*between* the ordinary buffers is fitted an additional buffing apparatus," &c. If you look at the Patent-office specification you can at once see by the drawings that my machinery is upon the *outer frames*, and at pages 13, 14, and 15, the description is quite clearly given. F. A. MILLS.

Waterford, November 29th.

*SUBSCRIPTIONS.*

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office, on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. .. £0 14*s.* 6*d.*
*Yearly (including two double numbers)* .. .. .. £1 9*s.* 0*d.*

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* THE ENGINEER *is registered for transmission abroad.*

*Cloth Cases for binding* THE ENGINEER *Volume, price* 2*s.* 6*d. each.*

*The following Volumes of* THE ENGINEER *can be had, price* 18*s. each:—Vols.* 3, 5, 10, 14, 21, 24, 25, 26, 38, 39, 40, 41, 42, 43, 44, 46, *and* 47.

*A complete set of* THE ENGINEER *can be made up, comprising* 47 *volumes.*

*Foreign Subscriptions for Thin Paper Copies will, until further notice, be received at the following rates. Subscribers paying in advance at the following rates will receive* THE ENGINEER *weekly and post-free. Subscriptions sent by Post-office order must be accompanied by letter of advice to the Publisher. Thick Paper Copies may be had, if preferred at increased rates.*

*Remittance by Post-office Order.*—Australia, Belgium, Brazil, British Columbia, British Guiana, Canada, Cape of Good Hope, Denmark, Egypt, France (Paris only), Germany, Gibraltar, India, Italy, Japan, Malta, Natal, Netherlands, NewBrunswick, Newfoundland, New South Wales, New Zealand, Portugal, Roumania, Switzerland, Tasmania, Turkey, United States, West Coast of Africa, West Indies, China *viâ* Southampton, £1 16s.

*Remittance by Bill in London.*—Austria, Buenos Ayres, Ceylon, France, and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Singapore, Spain, Sweden, £1 16s. Chili, Borneo, and Java, £2 5s. India, *viâ* Brindisi, £2 5s. 0d.

ADVERTISEMENTS.

*** *The charge for Advertisements of four lines and under is three shillings for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more the charge is ten shillings per inch. All single advertisements from the country must be accompanied by stamps in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

ADVERTISEMENTS CANNOT BE INSERTED UNLESS DELIVERED BEFORE SIX O'CLOCK ON THURSDAY EVENING IN EACH WEEK.

*** *Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. George Leopold Riche; all other letters to be addressed to the Editor of* THE ENGINEER, 163, *Strand.*

### MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Dec. 9th, at 8 p.m.: Discussion, "The Passenger Steamers of the Thames, the Mersey, and the Clyde."

THE SOCIETY OF TELEGRAPH ENGINEERS.—Wednesday, Dec. 10th: Council meeting at 7 p.m., annual general meeting at 8 p.m., for the reception of the annual report of the Council, and for the election of Council and officers for the ensuing year, the ballot for which will be open until 8.30 p.m. The following paper will be read: "On the Operations Connected with the Laying of the New Marseilles-Algiers Cable," by Mr. E. March Webb, Associate.

# THE ENGINEER.

*DECEMBER* 5, 1879.

### MARINE ENGINE ECONOMY.

Low freights and keen competition have rendered economy in the working of steamships a matter of almost national importance. We are just now the ocean carriers of the whole world. How long we shall retain this position rests very much, but not altogether, with ourselves. The people of the United States begin to look even now with hungry eyes at the magnificent fleets of merchant steamers which belong to Great Britain, and on which the American farmer has to rely for the transport of his grain and his wheat to English shores. Already the New York and Philadelphia journals ask how many more years are to roll over before American enterprise places merchant steamers on the ocean to share with us, if not to absorb altogether, the profits which we now extract from American commerce? The extravagant tariffs ruling on the other side of the Atlantic have done us this good at all events, that they have entirely prevented the building of iron steamers in the United States. But this may not last. By one stroke of the pen the American Government could throw open the ports of the nation for the admission of ship-plates, bars, and angles free of duty; and there can be no doubt that were this once done American enterprise would not be slow to avail itself of its advantages. America has, however, as yet everything to learn concerning the building of ocean steamships and their engines, and some time must at the worst pass away before our own shipowners will have serious competition to contend against. It is none the less necessary that they should not rest content with past achievements, but push steadily on to greater economies and greater successes than they have yet obtained. Not so long ago steam communication with America could only be sustained by the aid of large Government subsidies. On this point the late Dr. Lardner has been much misunderstood. We hear it stated over and over again that he maintained that an ocean steamship was a mechanical impossibility, the truth being that he never said anything of the kind. He did assert that such ships were commercial impossibilities, and according to his lights, he was quite right in this. While ships propelled by paddles were fitted with engines burning 6 lb. to 8 lb. of coal per horse power per hour, they could not be made to pay. Neither engineers nor speculative capitalists rested content with bridging the Atlantic by ships partly maintained at the cost of the Government of the country. Improvement upon improvement was effected, and we have now reached such a measure of success, that while Australia and India can be reached by steamer in not much over a calendar month, the consumption of coal has been brought down to under 2 lb. of coal per horse per hour. As an example of what has been done very quietly and unobtrusively by men who build and own and engine what are sometimes contemptuously called cargo boats, we may give here some particulars of the last voyage of the steamship Eglantine, one of the "Stag" line, from Copenhagen. The ship is 257ft. long, by 32ft. 6in. beam, and draws about 19ft. She is propelled by compound engines built by the North-Eastern Engineering Company, Sunderland, the engines, designed by Mr. Allan, the manager of the company, being very similar to those illustrated in THE ENGINEER for June 9th, 1871. The high-pressure cylinder is 28in. and the low 54in. in diameter, with a stroke of 2ft. 9in. Steam is supplied by two boilers, with two furnaces in each, of the ordinary type. The safety valves are loaded to 75 lb. The Eglantine left Copenhagen with a fair wind at 8 a.m. on the 26th ult., and reached Gravesend at 11.40 a.m. on the 29th, thus making something like 10 knots the whole way. Her cargo consisted of 1800 tons of oats, linseed, and tallow. The engines indicated very uniformly throughout the run 522-horse power; the screw which is common, four-bladed, and 13ft. pitch by 14ft. in diameter, making 64 revolutions per minute. The coal—a good north-country—used was carefully weighed during twelve hours, and was as nearly as might be 10 tons 5 cwt. per twenty-four hours. This is equivalent to a consumption of but 1·83 lb. per horse-power per hour, and it must be remembered that the ship had been lying in Cronstadt for some time before; and that she ran thence to Copenhagen at slow speed, detained by fogs and gales. Neither her engines nor boilers were in a condition specially established in order that a high result might be got; and her engineers regard her performance as nothing abnormal, or more than they expected, except as regards her speed, which was augmented by, as we have said, a stiff north-easterly wind. We have no reason to doubt that the performance of the engines of the Eglantine can be paralleled by that of the machinery of other ships, and we may take 2 lb. coal per horse per hour as a basis on which to estimate the chances for and against securing still further economy.

It is not probable that the boilers of the Eglantine evaporated more than 10 lb. of water per pound of coal, probably their duty was less, but in any case this gives rather less than 20 lb. of steam per horse-power per hour. The initial cylinder pressure by the cards before us is 72 lb., or 72 + 15 = 87 lb. absolute. The temperature corresponding to this is 318 deg. The pressure at the moment the exhaust port opened was 7 lb., nearly, absolute, corresponding to a temperature of 177 deg., and 318 deg. — 177 deg. = 141 deg., as the range between T the temperature of reception, and $t$ the temperature of rejection. Then 141 deg. × 772 = 108,852 foot-pounds of work to be had from each pound of steam during expansion. Allowing for clearance, we shall not be far wrong if we take the work done by each pound of steam during the full pressure part of the stroke as 57,000 foot-pounds. Then 57,000 + 108,852 = 165,852. A horse-power exerted for an hour = 1,980,000 foot-pounds, and $\frac{1,980,000}{165,852} = 11{\cdot}93$, say 12 lb. of steam. That is to say, the weight of 87 lb. steam required to develope one horse-power under the stated conditions would be about 12 lb. But 20 lb. were actually used; what becomes of the difference? It is, no doubt, lost partly by cylinder condensation, and partly by leakage past pistons and glands. If greater economy is to be had, it must be got by some expedient which will give a portion of the 8 lb. of steam used per horse-power per hour in excess of the quantity theoretically necessary. We say this because it is improbable that any marine boiler can be made which will, in regular work, evaporate more than 10 lb. of water per pound of coal.

There are just two ways in which a higher duty can be got from each pound of steam. The first consists in augmenting the initial pressure and temperature. Thus with an initial pressure of 400 lb. on the square inch, we have T = 445, and $t$ may be as low as 170 deg. The range will then be 275 deg., and the relative economy of 87 lb. and 400 lb. steam will be apparently as 141 deg. is to 275 deg. But to get this range 87 lb. steam must be expanded about 12·4 times, while 400 lb. steam must be expanded over sixty-six times. In practice such a range of expansion as this last cannot be adopted with any hope of success, for no matter what precautions are taken, the condensation in the cylinders and pipes would be enormous. Indeed, it is almost certain that a better result can be got in practice with an expansion of 7 or 8 to 1 than with any other ratio. It is evident, therefore, that further economy in marine engines is to be sought rather in reducing cylinder condensation—whether in the cylinder or the jacket—and leakage, than by any attempt to increase much the pressure and range of expansion. At another time we may return to this subject; we have for the present said enough, we think, to indicate one direction which future developments of steamship economy must take.

### WATER METERS IN MIDDLESBROUGH.

IT has long been said that no such thing as a good water meter exists; and recent events in Middlesbrough go to show that in the opinion of some persons a trustworthy meter has not yet found its way there. A very remarkable petition, prepared under circumstances which deserve full publicity, has been submitted to the Local Government Board. The petition emanates from the principal water consumers of the district, and is signed on behalf of Hopkins, Gilkes, and Co.; Fox, Head, and Co.; Gilkes, Wilson, Pease, and Co.; Bolckow, Vaughan, and Co.; and eleven other firms of first-rate standing. To make matters plain we must explain that the Stockton and Middlesbrough Corporations Water Boards measure the water which they sell to consumers by meters. It sometimes happened that the meters showed a lower consumption than the officials of the Water Company expected, and to make matters right they have adopted, we are told, the very simple and effective expedient of pushing on the hands of the instrument until the indications of the meter coincided with their notions concerning the quantity of water which ought to have been used. In order that our readers may make no mistake, we may say that if the meter examiners of a London gas company finding that Mr. Smith, Mr. Jones, Mr. Brown, and Mr. Robinson had used each but 2000 cubic feet of gas when they anticipated a consumption of 2200, were to put on the hands of the meters until they indicated 2200, and then charged the consumer accordingly, they would do just what the Middlesbrough Water Board is said to have done.

The petition deserves to be placed on record in our pages, as something unique. It is addressed to the President of the Local Government Board, Whitehall, and runs thus:—"This petition of ironmasters, iron manufacturers, and other persons carrying on business at Middlesbrough, in the county of Yorkshire, humbly showeth—That whereas we, the undersigned, are all large consumers of water for trade purposes, and that such water has been for many years supplied from certain waterworks situated near Darlington, in the county of Durham, now in the possession of the Stockton and Middlesbrough Corporations, and managed by a Board called the Stockton and Middlesbrough Corporations Water Board; that the said Waterworks belonged in 1877, and for many years previously, to a company constituted under a special Act of Parliament, and called the Stockton and Middlesbrough Waterworks Company, which company sold their enterprise to the present Corporations Water Board in 1878, the principal servants and officers of the former company being re-engaged by the present Board and carrying on the detail business connected with the waterworks as formerly; and whereas we, the undersigned, have been accustomed to be charged and to pay for such water as we have used both to the old company and the new board according to the accounts sent in to us quarterly, and purporting to be based upon the registration of the water meters placed on our respective premises and belonging to the waterworks, and under the care and control of the waterworks officials alone, and which are kept sealed so as to prevent access to any persons other than the said waterworks officials. Now this petition showeth that we have reason to believe that over the whole period of occupation by the present Water Board, and for about six years at least of the occupation of the old waterworks company, the indexes of the said water meters have been at various frequent times tampered with or

altered by the works officials in such a way as to cause them to indicate a greater consumption of water than would otherwise have been indicated by the meter. That the accounts sent in to us from the waterworks have been in accordance with such altered readings of the index, and that therefore we have been overcharged and have overpaid considerable sums of money; that such alterations of the indications of the meters were made without our knowledge or consent; and we have evidence to prove that they were made with the knowledge and consent of some of the leading officials connected with the works; and we submit herewith a statement made by one Enos Amos, an inspector of the Water Board, admitting that on several occasions he has interfered with the indexes of meters in the manner referred to, by instructions from his superior officers. We submit also correspondence proving that responsible persons connected with both the old and the new Water Board have recently been fully apprised of what has taken place:—That the late directors of the old company refuse to entertain any allegation or claim, and throw all responsibility on the present board; that the latter have conducted, by a committee of their own body, an investigation, limited to a single case of overcharge; that they admit that case was proved, and offer compensation for the amount involved; that they have nevertheless declined or failed to investigate any of the other cases of overcharge, or to make or offer restitution for them, although nearly three months have elapsed since the allegations were in their possession. We believe this failure to do what we consider justice to be largely due to various local interests, which may obviously tend to prevent a full, free, and impartial inquiry. We now petition your honourable board, after having perused the evidence we herewith submit, to send down into this locality a Commissioner, with power to call witnesses and receive any evidence which may be tendered bearing upon this matter; that such Commissioner should make a thorough investigation, and if the allegations submitted should be found to be substantiated, that then your honourable board should take such action as you may deem fit to bring offenders to justice and to compensate those who may be found to have suffered injustice."

The petition is dated November the 15th. We have not yet heard what reply has been received.

Not the least remarkable feature in the whole transaction is, that as we understand, certain members of the Water Boards are actually justifying the action of their officers, while other gentlemen deny the statements of Amos. However, a small committee of the Board, consisting of the chairman and their solicitor, have investigated one case, admitted that the accusation was proved, and have offered compensation to the injured parties. But they flatly refuse to carry the investigation any further, and Amos has been dismissed without notice and without a character. It is abundantly clear that Amos has accused the Stockton and Middlesbrough Water Boards of fraud; it is evident that all those who have signed the petition have repeated the accusation. It is before all things expedient that a public body against the official honour of which so grave a charge has been urged, should, without a moment's delay, rebut the charge, and demand investigation. We find, however, that only a section of the Board has adopted anything like this course. Others do not deny that Amos may be quite right, and assert that the officials of the company did no wrong when they made a meter show a larger consumption than it had measured; while two of the Board held a kind of private investigation, admit as a result that Amos only spoke the truth, and having offered compensation, refuse to proceed further in the matter. Was ever anything like this heard of in England? Let it be supposed that the meters were untrustworthy; then it was the duty of the Water Boards to have them removed and replaced by accurate instruments. If it be answered that none more accurate could be had, or that the cost of new meters would have been too great, then the consumers should have been consulted, and they ought to have received notice that the Water Boards were not content with the meters, and would push on their hands to make them right. No doubt against such a course the consumers would have indignantly protested; so to save trouble the Board officials shifted the indices and said nothing about it. If we called things by their proper names we should have to print a very ugly word indeed in giving the action of the Board its true title, and we find it very difficult to refrain. As to the literal truth or falsehood of the charge, we refuse to express any opinion more positive than that it is to the last degree improbable that fifteen great manufacturing firms, composed of shrewd business men, would have sent in such a petition as that we have reprinted above unless they had good reason to believe that its statements were quite true; yet if we accept this view, what a picture of official life have we before us? It is much to be desired that the independent investigation sought for should be made. If the Water Boards are innocent, they have nothing to fear, and should court the inquiry. Let us hope they will use all their influence to induce Government to grant the prayer of the petitioners. This would look well at all events. If the charges are proved, we also hope that no false delicacy will induce the Government to spare the guilty. The prosecution of a water company for fraud on the consumers, would, it is true, be a novel spectacle; but it would teach a very valuable lesson. Nothing encourages the spread of fraud more than immunity enjoyed by the fraudulent; and companies and boards are disposed to be rather lax in drawing the line between what is right and what is wrong. This kind of thing ought to be checked with a firm hand, and should the Stockton and Middlesbrough Water Boards be found guilty they ought to be punished with strict justice for example sake. Meanwhile, perhaps it would be just as well if someone would invent a meter which the officers of water boards could not tamper with. If the meter was one which would not break down or wear out, and which moreover, would let its personal equation be calculated, so that its errors might be estimated with some approach to accuracy, a stumbling-block would be removed from the way of water boards. Can it be possible that the Stockton and Middlesbrough Water Boards enjoy the proud pre-eminence of being the first public body accused of attempting to defraud its customers? Perhaps so, if open accusation be meant. We fear, however, that other bodies supplying water, and even gas, have been silently accused before now of charging for something never supplied. An injustice may thus have been done. After all, it would save boards of all kinds from some suspicion if consumers felt that they could say, speaking of a board, "It dare not cheat me," as well as "It would not cheat me."

### NORTH-EASTERN RAILWAY WORKS.

It will not be unpleasant news to those interested in the North-Eastern Railway, to find that whilst there is commencing an increase in the receipts of the company, there is a prospect of a further reduction in the expenditure on capital account. During the last half year that expenditure was to the large extent of £232,820; and in the present half year that expenditure is expected to reach about £293,276; but it is probable that in future half years there will be a reduction. It is expected that the expenditure on the enlargement of Leeds new station will cease after the end of the present year; that the York railways and station expenditure will be complete. There has for some years been expenditure on the Swinton and Knottingley line and branches, which will cease, whilst the smaller works at Tweedmouth will be financially completed, as also the larger works in connection with the Byker and Percy main line. In addition to these, the immense dock works at West Hartlepool are approaching completion, and the ensuing six months, at the present rate of expenditure, will exhaust the estimate; the Monkwearmouth Junction lines should at the current rate of expenditure cease to demand money after January; and the same remark applies to the Castle Eden and Stockton branch. The South Shields Station works and the Leeds and Pontefract and York Cattle Market lines will be completed in the next half year, so that there should be a large reduction in the expenditure. There are two works of moment in progress—the Whitby, Redcar, and Middlesborough Junction, on which £24,600 have been expended up to the end of the last half year; the current expenditure is at the higher rate of £2800 monthly; but after the close of the present year £200,000 remain to be expended. On the Pickering and Seamer branch £1600 only have been spent; the current expenditure is £4100 monthly; and after the close of the year £124,000 will be needed. A series of additions to lines at West Hartlepool will in future half years claim £44,000, and others between Newcastle and Heaton a further sum of £99,000; and of that there are still capital works of moment before the North-Eastern. The growth of trade at West Hartlepool, and the revival in the Cleveland district, with the demands for additional accommodation on the Tyne, may cause further works to be needful; but at present the total estimated expenditure on capital account on the North-Eastern line after the close of the current half year is £829,705, so that a very marked reduction may be expected in the expenditure on that account after the close of the present half year—a reduction brought about chiefly by the completion of works that have long been in progress. As trade revives there may be, and probably will be, further demands for facilities to meet it, especially at the Durham shipping ports to which larger steamers will trade; but subject to this there will be a very material reduction in the capital expenditure of the great mineral railway.

### THE "BLOWING-UP" ARGUMENT.

Persuasion by powder is again being practised in the Sheffield district. In the days of the notorious William Broadhead, gunpowder was not so rare an argument as it has been of recent years. Mild cases of "rattening" have not been uncommon, and they have been favoured by the usual immunity from police discovery; but it has been left for colliers to revive the more emphatic form of outrage which gave Sheffield so bad a name at the time of the Trades' Union Commission. At Birley Colliery, which belongs to the Sheffield Coal Company, 1100 men and boys were employed. The owners desired to change the system of working the pit, and with that view gave their *employés* notice. They declined to accept what they regarded as a reduction of 15 per cent., but the employers insisted that it really was not 15 per cent., but 7½ per cent., with a stoppage of what are called "quarter" coals. Walter Taylor, and his father-in-law named Whitaker, did not join the "lock-outs," but continued to work, and their conduct gave great offence to their late companions. At midnight on the 26th ult., Taylor and his family were aroused from slumber by a terrific explosion, and their bedroom was filled with smoke. When they had recovered from their surprise they proceeded downstairs, where they found that a can filled with gunpowder had been exploded in the back kitchen, causing much damage. Fortunately the windows were blown out, otherwise there might have been serious injury to the seven inmates of the house. Two men were apprehended and brought before the Sheffield magistrates on a charge of being concerned in this affair, but the evidence was insufficient to support the accusation and they were discharged. The Birley colliers deny that they had anything to do with this outrage, and assert that Taylor blew himself up! Curiously enough this is the same argument which was employed by Broadhead and his companions when their victims were blown up and seriously injured. It does not appear to strike the colliers that it seems very singular that a man should go upstairs to his bed, and then walk down at midnight for the express purpose of blowing himself up again. To other minds the pastime appears so very peculiar, that it may really be doubted whether any person, even if afflicted with a "twist" in his humorous faculties, could be found courageous enough to indulge in it with a view to while away the monotony of these dull November days.

### CONTRACTS AND THE HIGHER PRICES.

Engineers will do well to note when they tender that it will be unsafe to reckon upon a continuance of even the present advanced scale of prices for materials as nearly the maximum. If the iron market does not take a very different direction from that which usually characterises it when it has gone the length now observable, much higher than the late existing scale of quotations will soon prevail for both raw and rolled iron. The most satisfactory feature in our reports is the striking improvement in the demand and the prices touching rolled iron in the Middlesbrough market. Thence many engineers have of late been accustomed to get their girder and bridge plates and their angles. Engineers have now to run the gauntlet for such iron with the shipbuilders, who are getting busy upon the Tyne and the Tees, as well as upon the Clyde. The result is the prices we this week cite from the North. Instances are within our knowledge in which contractors are likely to prove heavy, though not disastrous, losers by contracts entered into about August and September. They will not all find themselves treated with the consideration which has been shown to Mr. F. Espley, of Stafford. He had agreed to erect in that county town a new sanitary depôt at a cost of £5500. Barely had his offer been accepted before iron commenced to rise, and as he would require a considerable quantity of that material, the prospect before him was uninviting, though not especially grave. He applied to the Public Health Committee of the Corporation to advance the total of the tender, and was so successful that the committee prevailed with the Town Council at their meeting on Tuesday to increase it to £5750. Mr. Espley is to be congratulated. Nor did the Corporation act unwisely in the interest of the ratepayers. But a contractor less known where he may be doing work would be unwise to speculate upon the same success in a similar application.

## LITERATURE.

*Bells and Bellfounding; a Practical Treatise upon Church Bells.* By X. Y. Z. Bristol: J. H. Arrowsmith, Quay-street. 1879.

The author of this thin octavo of 57 pages, which might be more properly called a pamphlet, appears from internal evidence to be Mr. John Llewellyn, jun., of the firm of Llewellyns and James, eminent as bellfounders in Bristol, who dedicates his work to "George W. Edwards, Esq., thrice Mayor of Bristol, in consideration of his constant endeavours to promote scientific culture and musical taste amongst his fellow-citizens." The practice of trade advertising and puffing—the "puff oblique" has been known since the days of the Critic—under the disguise of scientific *brochures*, has grown to such dimensions in the United States that at the first glance we were disposed to think this was an example of the same degrading device, which had reached our own country, and to pass it by as unworthy of serious notice. A second and more careful glance, however, showed us that the work, though, perhaps, not quite free from ultimate trading views, was really of a genuine and able character, coming from a mind well acquainted, both theoretically and practically, with the subject of bellfounding in its highest department, namely, that of casting "bells in peal," an art which, ancient as it is, has long been, and still continues in Great Britain a sort of craft or mystery in the hands of a few master founders or firms, and which to the present hour is without an adequate literature; for such popular treatises as Mr. Denison's and some encyclopædia articles on bellfounding are far from adequately representing in theory and practice an art which, perhaps more fully than any other branch of technical metallurgy, is based on purely scientific foundations. The mere casting of one or more bells, sometimes of immense dimensions, came into Europe from the East, where, as in China, Thibet, and other parts of Central Asia, its origin transcends tradition. Thence it migrated into Christendom, and taking example from the observances of the early Eastern Christian churches, which, as respects bell-clanging as forming part of worship, continue as barbarous in Russia at the present day as they did 1500 years ago or more. As an instrument of superstition and priestcraft, church bells before the eighth century had become almost universal throughout Europe; and their ecclesiastical uses had gradually engrafted upon them many of the strangest idolatrous notions. They were treated as if living and sentient folks; were baptised when first admitted as part of the paraphernalia of a church; special liturgies were instituted for their baptismal service, and having once received the formal sanctifying benediction of mitred abbot or bishop, they were supposed to be endowed with many undefined miraculous powers.

"Vivos voco, mortuos plango, fulgura frango."

"I call the living, I mourn the dead, I dissipate the thunder," was, as we may learn *inter alia* from Schiller's noble poem, the "Song of the Bell," a frequent motto of mediæval bells. We may notice in passing that some of the most ancient bells used in the early Western churches were not cast, but rudely formed of beaten-out plates of metal rivetted together. Thus the mass bell of St. Patrick, which some have placed as early as the fourth century, and which still exists in the archæological collection of the Royal Irish Academy, was thus formed. Most of our readers have no doubt read in popular works some account of the enormous bells of Nankin, of Moscow, Novgorod, &c., which number amongst them probably some of the most enormous castings ever made in any metal except cast iron; far exceeding in weight the most enormous of the brass or bronze castings made at a far earlier period, by Hiram for Solomon's Temple, two of which, namely, the pillars for the gate of the temple, must, if the dimensions handed down be correct, have weighed nearly 40 tons each, and were "loam castings," made in the "clay-land of Succoth." But the production of these tremendous instruments of barbaric noise was not bellfounding in its highest sense, namely, the casting of large bells in peal, that is, so that an entire ring of bells from three to ten, or even more in number, should give forth sounds having regular musical intervals between them. We have said ten or more, for while a few church peals to be rung by hand—or, as in the East, by pulling the clapper against the bell—have comprised twelve bells, the ancient carillons, of which a noble example exists at Bruges, comprised as many as sixty bells, chimed at intervals by clockwork. The most ancient bells had their form derived from a simple cylinder, or short wide tube open at one end and suspended by the other. This form was gradually improved upon, the mouth opened, the lip thickened, and a certain proportion between the

diameters of the mouth and the crown arrived at by tentation, until, passing through the long and nearly cylindrical-shaped, most ancient bells to be found still in many parts of the South and East of Europe, the modern form of church bell was gradually arrived at; but there still remained an immense gap between this and the establishment upon fixed physical or acoustic principles of the relative sizes of bells, like in form, but differing mainly in dimensions, which should yield sounds differing by regular musical intervals. No doubt the monks who gradually perfected the far more complex instrument of sound, namely, the church organ, may have made considerable tentative progress towards determining the proportionate sizes of similar bells to sound in peal before acoustics had reached the grade of a branch of physics, and such dimensions could be fixed on a sure scientific basis; but it was not until the seventeenth century that the laws of elastic solids transmitting their vibrations to the air as the medium of sound were sufficiently established to enable the bellfounder's art to take rank as one of those resting on scientific principles.

Our author's firm is happily situated at Bristol, in the midst of those south-western counties of England which in pre-reformation times formed the wealthy paradise of Churchmen, and of all the arts and artisans that hung upon their skirts; and within the compass of his few pages he gives some interesting notices of the early bell-founders of the West and of some other parts of England:—The Purdues, of Salisbury; the Rudhalls, of Gloucester; Miles Gray, the great founder of the eastern counties; and Phelps, of London, afterwards succeeded by Lester, Pack, and Chapman, the founders of the celebrated "Bow Bells." For this and much more of historical information we have no space but to refer to the little work before us. In one respect its history is defective; it takes no notice of the class of itinerant bell-founders who wandered through the southern counties of England during the latter half of the seventeenth and earlier portion of the eighteenth centuries. These men, some of whom tradition says were gipsies, picked up their old copper and tin how and where they could; set up their simple melting furnace at the back of any suitable clay dyke near the tower of the church that was to be supplied with bells, carried their "mould-boards" and other tools along with them on pack donkeys, and cast the bells close to where they were to be hung. Such was the way in which the bells of the old church of Northtawton, and of some others on the borders of Dartmoor, in Devon, were produced at a period not more remote than two generations from the beginning of the present century. It is seldom, we think, that abstract acoustic physics and practical bell-founders' knowledge are found combined in the same person. Mr. Llewellyn's theoretical knowledge enables him to correct a mathematical formula enunciated by the redoubtable Mr. Denison, in his book on "Clocks and Bells," and another on the part of a gentleman much less likely to fall into error as a physicist, namely, Professor S. Haughton, F.T.C.D. On the other hand, or practically, the author's experience and observant powers are shown in several suggestions or hints which would never occur except to one to whom the foundry pit and the melting furnace had been long familiar, nor even to such an one without a more than average power of observation. Almost all that is to be found in the English language on the subject of bellfounding is comprised in a few articles or notices in encyclopædias or works of like character, and there we find but little more than the empirical rules and illustrative diagrams arrived at centuries ago. Every section of a bell in a plane parallel to the lip or mouth is a circle, that at the crown being half the diameter of the lip or mouth. Every section orthogonal to these and passing through the axis of the bell, consists of segments of seven or more circles, falling into the former series of mouth sections, and having a common tangent at each of their own junctions. For the fixing of the radii of these curves, sufficient instructions are given, but for passing in dimensions from one bell to another of a peal the book information available in a collective form is very defective. There would be ample room and it would be very desirable that a man of Mr. Llewellyn's theoretical and practical knowledge should undertake a comprehensive and exhaustive work on all that relates historically, acoustically, and practically to bell-founding, mounting, and ringing. Were it necessary to enforce the importance of such a work, we might point to the rather humiliating fact that the biggest bell in England—that of the bell-tower at Westminster—when at last hung, after abortive attempts at casting, was cracked almost at the first blow of the clock hammer, and can give out but a shivering and feeble tone, compared with what had been justly expected of it. We find some masterly hints on the mounting and hanging of large bells, and on the proper construction of the towers to contain them—far from needless when we reflect that the celebrated peal of Bow Church, Cheapside, has not been rung for many years, for fear that the tower designed by Sir Christopher Wren should be brought to ruin by the oscillation they produced. On this part of the subject some excellent remarks, with designs, illustrative of the construction of some of the best belfry towers on the Continent, may be found in Rondelet's great work, "L'Art de Bâtir;" but we cannot dwell longer on a subject that has so many fascinating relations—so much to interest the man of science, the historian, and poet, and, lastly, the metallurgist and founder.

THE LIBEL ON MR. WELDON.—A memorial to the Home Secretary, praying for the remission of the further imprisonment of Mr. J. Mortimer, is open for signature at the *Figaro* Office, 35, Saint Bride-street, London. The principal ground taken is that the defendant did not write nor inspire the libellous article, and was not even aware that it had appeared in the columns of his journal until several weeks after its publication.

## STEAM TRAMWAYS IN NORTH ITALY.

By R. GERVASE ELWES, M. INST. C.E.

No. I.

THE lines actually at work and visited by the author during his stay in Italy last winter comprise the Milan, Saronno, Tradate Tramway; the Milan, Vaprio Tramway; and the Vercelli, Trino Tramway, all worked by steam power, and the Milan Monza Tramway, at present worked by horses. The Milan, Saronno, Tradate line is twenty-four miles in length. It was opened to Saronno in June, 1877; to Tradate in August, 1878. It commences in the interior of the city, in the Foro Bonaparte, a street of considerable traffic, runs for some distance along this street and past the Amphitheatre, round two sides of the Piazzi d'Armi, and out through the Simplon Gate, the total length traversed within the walls being about 1940 yards. There are five trains each way daily over this portion of the line in winter, in addition to six extra trains each way on Sundays and holidays. In summer there are short suburban trains every half hour. This frequent passage of the engines and trains does not appear to cause any inconvenience, and the author heard no complaints in Milan of the horses being frightened. The permanent way in the city and in the towns and villages passed through consists of an ordinary grooved tram rail, carried on longitudinal timbers, which are connected by timber cross ties. The weight of the grooved rail is about 50 lb. to the yard. Outside the city and as far as Saronno the permanent way—except in the towns—consists of a steel Vignoles rail of 24 lb. to the yard, and piked to cross sleepers, placed 0·55 metre apart. From Saronno to Tradate the line is laid with old double-headed—bull-headed—rails, purchased from the ordinary railway companies, and turned upside down, weighing 72 lb. to the yard, supported in chairs upon cross sleepers 1·50 metre apart.

The engines employed on the line are nine in number, of which six are of the "Winterthur" class, two of the "Brown" class, and one of the "Krauss" class, of Munich. The director did not appear completely satisfied with any of these, but on the whole preferred the "Krauss" engine with some modifications. No special means are employed to condense the steam or to prevent noise, but as a matter of fact none of these engines make any objectionable noise, except for a few moments at starting in blowing through the cylinders. These engines may all be described generally as small locomotives, having a canopy over them, so as to resemble in outward appearance an ordinary car, and having sheet iron shrouding close to the ground, for the triple purpose of concealing the machinery, keeping out mud and dust, and preventing any person or child accidentally knocked down from getting under the wheels. The fuel at first employed was coke, but the director complained that it burned the boilers, probably from unskilful management of the fires; and they now use a steam coal, which gives off a little smoke at times, but it is not objected to by the authorities or the public.

Steam traction was first used on this line at the beginning of October, 1877, so that up to this time about eighteen months' experience has been gained. The director states that there have been no accidents from frightened horses, and that the only persons injured on the line have met with accidents through their own imprudence in mounting or leaving the cars while in motion. The paving in the city and in the streets of the towns passed through consists of round pebbles laid in sand, like those employed in the streets of Milan generally; but although the grooved rail is laid down in the streets, it is not always accompanied with even this amount of paving. In some places it is simply laid in the macadam. On those parts of the line where the Vignoles or the double-headed rail is laid the line is ballasted with macadam slightly rounded off at the sides to allow depth below the top of the rail sufficient for the flange of the wheels. Openings are left here and there under the rail to allow water to flow off. In certain parts of the line where the road is very wide the company has been allowed to place the guard stones—usually set up along the sides of the principal roads in Italy at 10 metres apart—between the tramway and the rest of the road, so that carts cannot conveniently pass along the zone occupied by the tramway. The latter then becomes practically a light railway, alongside of but separated from the public road. But where the road is not considered wide enough for this arrangement the tramway forms part of the surface of the road itself, but being placed at one side, carts do not usually cross the rails except to pass each other when there is not room to do so otherwise. There appears to be no practical difficulty in maintaining a good road surface between the rails, as we have not here the difficulty which occurs with horse traction, that the horses treading always in the same track kick up the road surface and reduce it to loose rubbish.

The traffic arrangements are of the simplest description. There is a station building at the Milan terminus, with accommodation for the administration and a waiting-room for passengers, but at other stopping-places there are no buildings at all. The line runs through the streets of the villages, and the train pulls up opposite some *café*, which in wet weather serves as a waiting-room. Tickets are served out and collected on board the cars. There are two classes, the fares being 0·08 and 0·12 lire per mile, say ¾d. and 1½d. The proportion of first-class passengers is about 25 per cent. of the whole. The total number of passengers carried in 1878 was 1,734,626. The population of the communes passed through—exclusive of Milan, which has 300,000—is stated to be about 75,000. This gives about twenty-three single journeys per annum for each inhabitant, excluding Milan, or about five single journeys per inhabitant including Milan.

The winter cars are arranged like an ordinary omnibus with longitudinal seats, but are furnished with a covered platform at each end giving standing room for eight persons each. The summer cars have transverse seats, and are open at the sides, with curtains to keep out sun and dust. Upon this line the trains are stopped at any point to take up or set down passengers. The line is divided into sections; the fare for traversing each section is uniform, and for each unit or section a ticket is given out. Thus, if the passenger travels over five sections he receives five tickets. By this plan only two forms of ticket are required, one for each class, and the checking of the receipts is much facilitated.

The convenience to the public of this tramway is greatly appreciated. The frequent trains, the facility for joining or leaving the train at any point, the passage of the trains through the streets and before the very doors of the people, the absence of the formality, and fussiness, and tedious delays attending an ordinary railway journey on the Continent, the speed, comfort, and economy of the tramcars as compared with diligences, omnibuses, or private cabs and hired vehicles, all tend to make the tramway exceedingly popular. In fact, while at Milan, a temporary interruption to the traffic caused by the relaying of part of the permanent way, which had been badly laid at first, caused quite a commotion among the people along the line, who complained bitterly of the want of their accustomed means of transport. Although he studied the local papers daily, and mixed very much with various classes, he did not during three months' stay at Milan come across a single complaint or objection against the use of steam on this and the other lines; but on the contrary, he found every one, from the highest authorities downwards, most anxious to see the system largely extended.

As regards financial results, the actual figures for this tramway are not available. It belongs to a Belgian company which is interested in other undertakings, and which has been unfortunate in its financial affairs, so that the returns to the shareholders are no criterion of the real results of the working of this particular line. It appears, however, from figures furnished by the director that the average train mile receipts are about 40d. per mile. The author calculates the train mileage as representing over the whole line an average of about five trains each way per day, or ten trains per day over each mile. As the average earnings per train mile are 3s. 4d., this gives the daily earnings per mile as £1 13s. 4d. or weekly £11 13s. 4d. The director informs him that the working expenses, including administration, &c., are 40 per cent. of the gross receipts; this would give a net receipt per mile per day of just £1, or £365 per annum. The writer estimates the actual cost of such a line, including stations, rolling stock, legal and engineering expenses, interest during construction, &c., at £3500 per mile. On this capital, therefore, the line in question must be earning over 10 per cent. The Milan-Gorgonzola Vaprio line is eighteen miles long. It was opened for passenger traffic in June, 1878; for goods traffic in November, 1878. It starts from a busy square or piazza just outside the Porta Venezia, and runs for about a mile and a-half along the road to Monza, the busiest and most frequented road out of Milan. For the above distance the Vaprio trains use the same rails as the horse tram-cars running to Monza. The line is double, and all up trains, whether drawn by steam or horses, use one line, while all down trains use the other. At Loreto the Vaprio line leaves the Monza road and proceeds along a provincial road to Gorgonzola and Vaprio. In the neighbourhood of Milan, and as far as Loreto, the permanent way is of the "Marsillon" type, that is a Vignoles rail of narrow base with a guard or counter rail, resembling a Vignoles rail split down the middle. The space between the two rails forms the groove for the flange. On the Vaprio line the two rails together weigh 50 lb. to the yard. This rail is also used within the precincts of villages passed though. Elsewhere the rail is an ordinary Vignoles rail weighing 36 lb. to the yard. In both cases the rail is supported by cross sleepers.

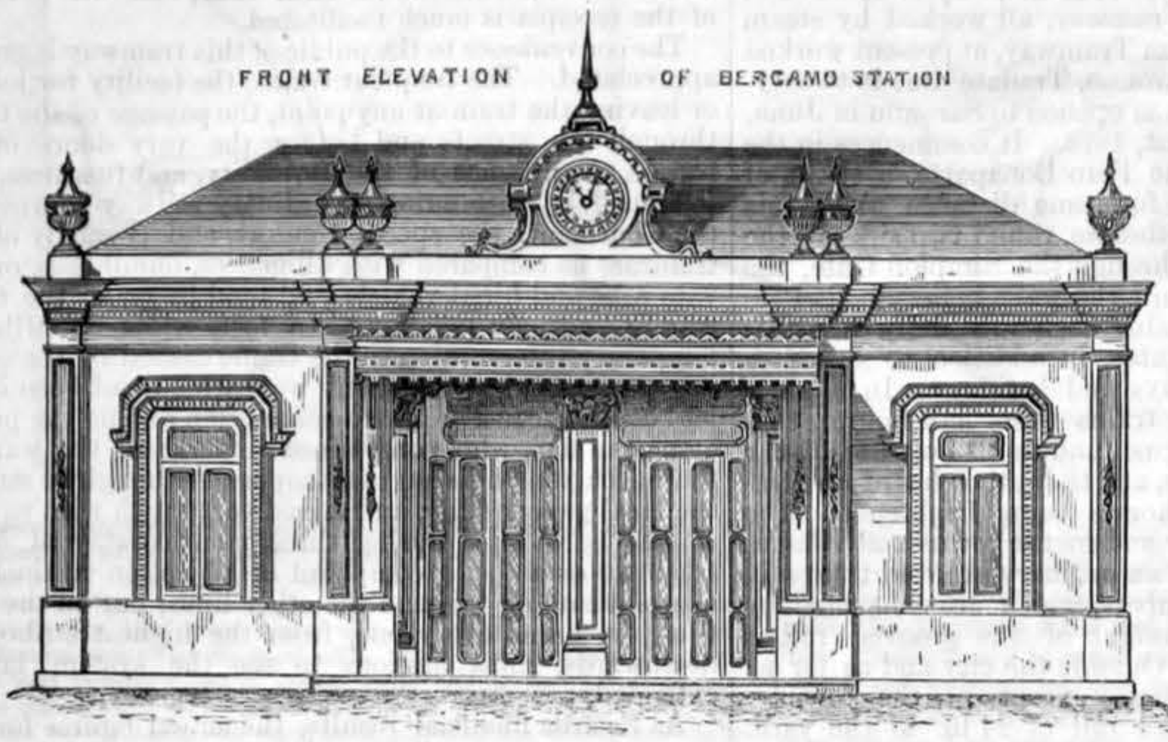
On the Vaprio line several types of engine have been tried—viz., (*a*), the Winterthur engine; (*b*), the Bamat (Elm Liga), Milan; (*c*), the Henschel engine, Cassel; (*d*), the Fox Walker engine, Bristol; (*e*), the Krauss engine, Munich; (*f*), the Baldwin engine, Philadelphia. Of these, the Winterthur engine is said to be the most economical, consuming 40 per cent. less coal than the others.* The Philadelphian engine having a vertical boiler was found to require more attention than others, and, moreover, was too wide for the road. It has been transferred to the Vercelli Trino line. The Herschel and Bamat engines are fitted with arrangements for condensing the steam. The other engines make no attempt to prevent the escape of steam into the air, but the Winterthur engine has an arrangement of double and triple conical tubes in the chimney, intended to break up the exhaust jet before it escapes into the air, and prevent the usual puffing noise. This answers well, and these engines are remarkably noiseless. In the case of this tramway there is an arrangement with the province, by which the Tramway Company pays three-fifths of the cost of maintaining the road surface. This cost varies from £48 to £75 per mile per annum. There are five side crossings in the eighteen miles, each sixty to eighty metres in length. The population along the line, exclusive of Milan, is about 95,000, or 3270 per kilometre, and 5277 per mile. The cost of construction of the eighteen miles is given as £40,000, or £2222 per mile, made up as follows:—Permanent way and laying, £1184; rolling stock, £595; buildings, stations, and sites, £366; fitting of workshops, furniture of offices, &c., £77; total, £2222. But subsequent additions have been made to the rolling stock, and moreover the above account does not appear to include the preliminary expenses, legal and engineering charges, administration, and other expenses during construction, &c., to which part of the difference between the above figure and my own estimate must be attributed. From Loreto to Gorgonzola the line, although alongside the road, is separated from it by the usual guard-stones ("paracarri"). Beyond Gorgonzola, the road being narrower, the rails are

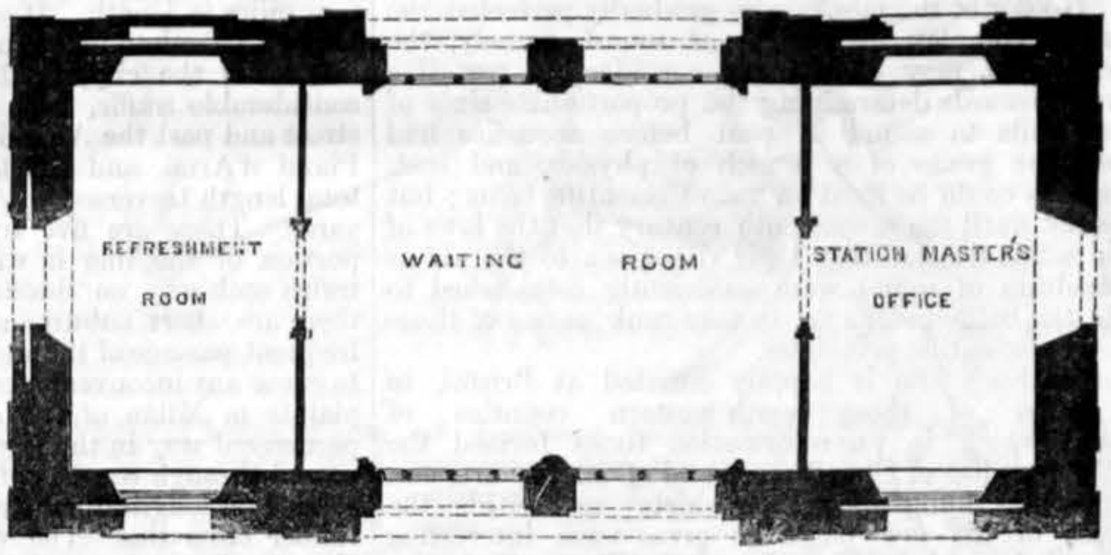
* This is the figure given me, but I suspect there is a mistake somewhere.—R. G. E.

# STATION, ENGINE SHEDS, AND CURVES, BERGAMO AND LODI TRAMWAY.

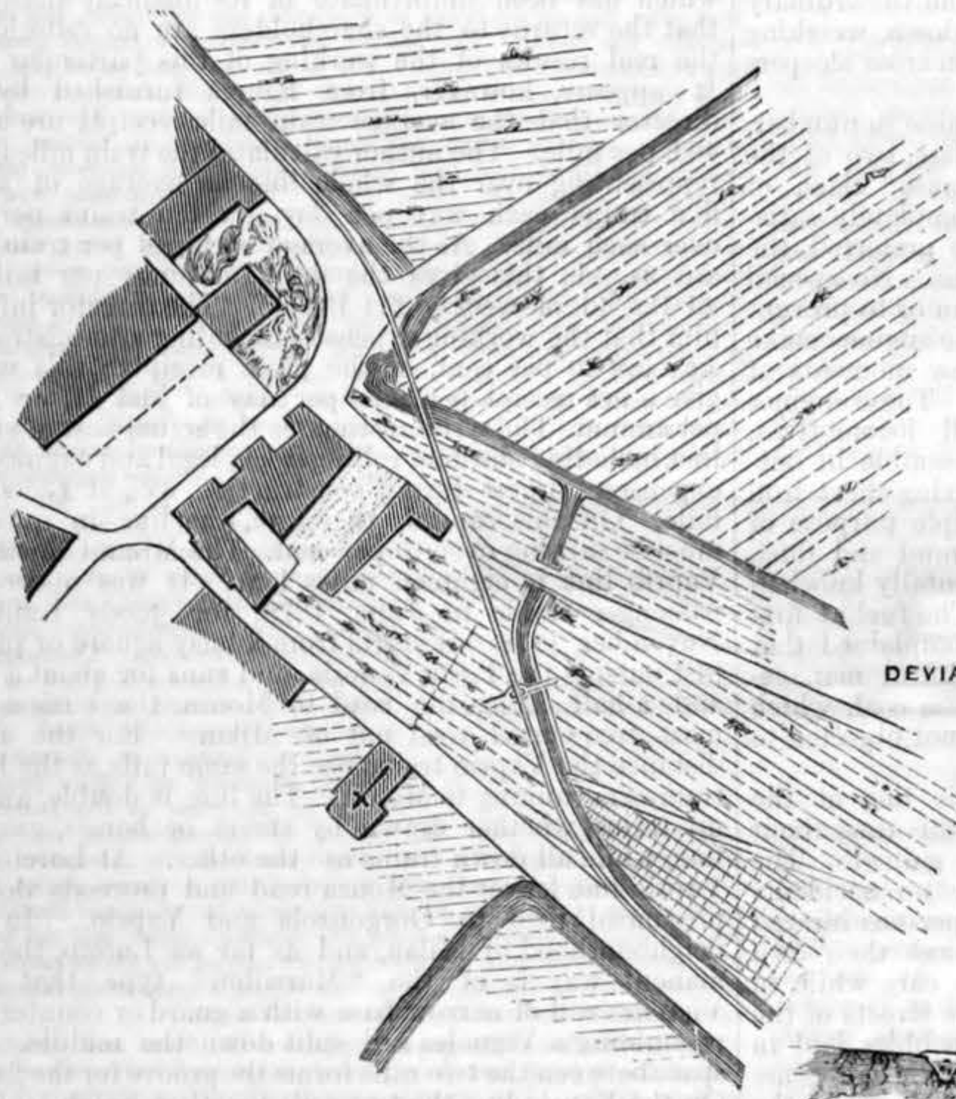
(*For description see page* 421.)

FRONT ELEVATION OF BERGAMO STATION

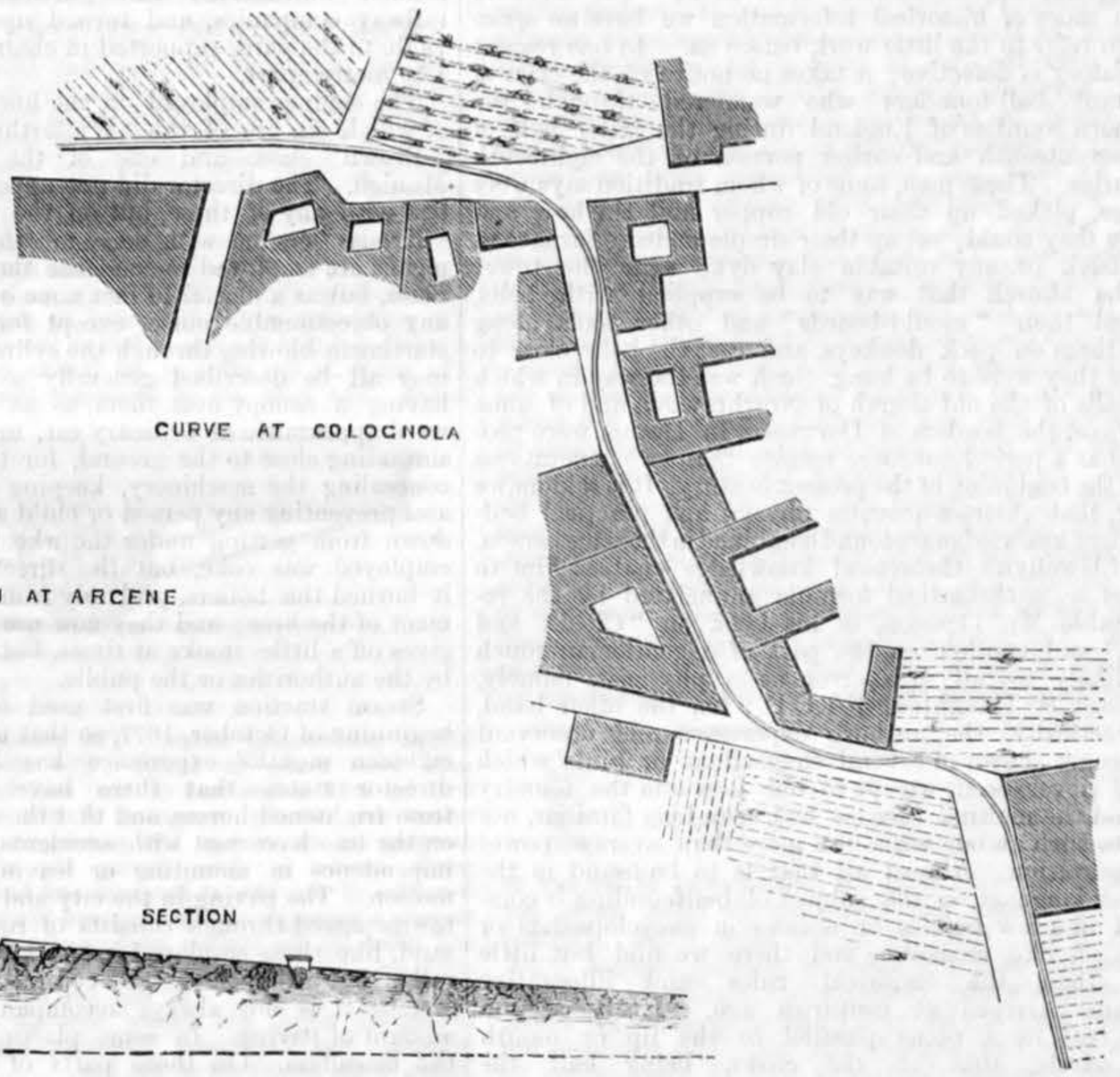





PLAN

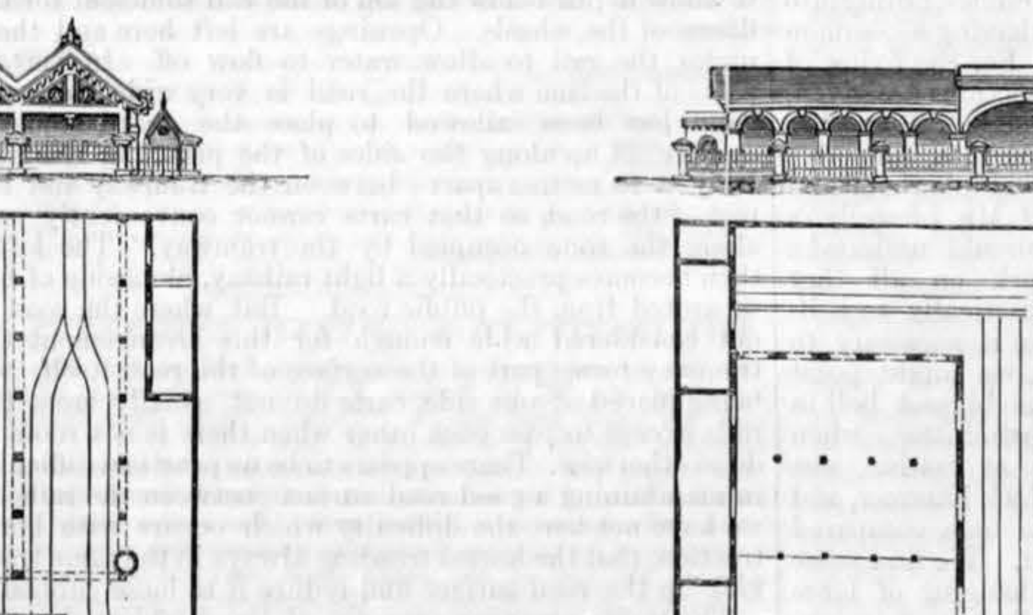


DEVIATION AT ARCENE



CURVE AT COLOGNOLA

SECTION

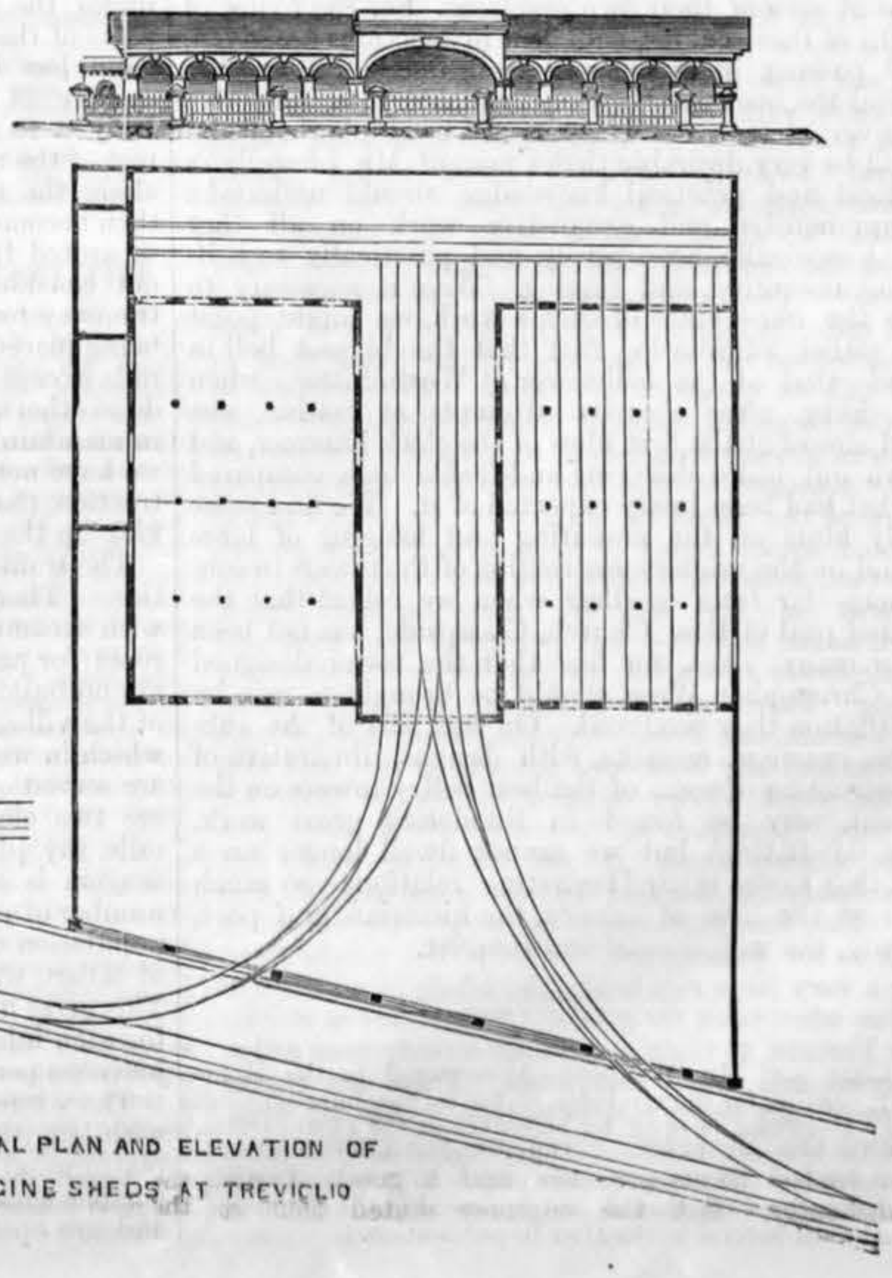




GENERAL PLAN AND ELEVATION OF ENGINE SHEDS AT BERGAMO

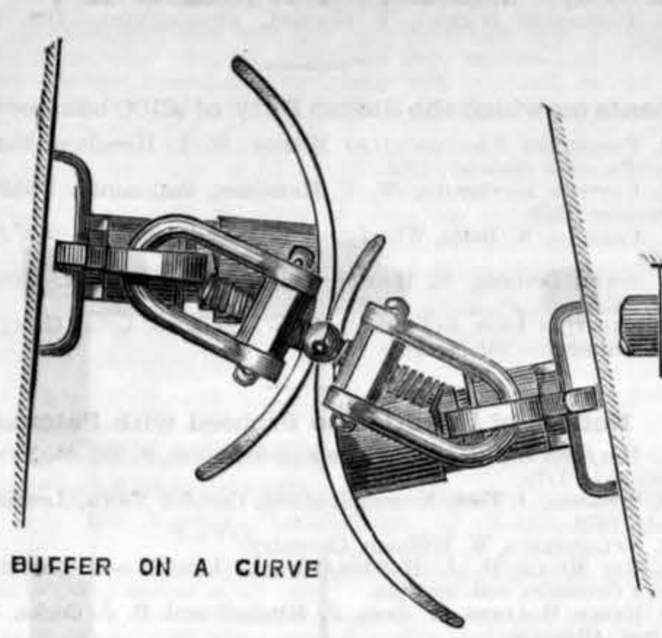
SCALE OF FEET

50 40 30 20 10 0 50 100 150

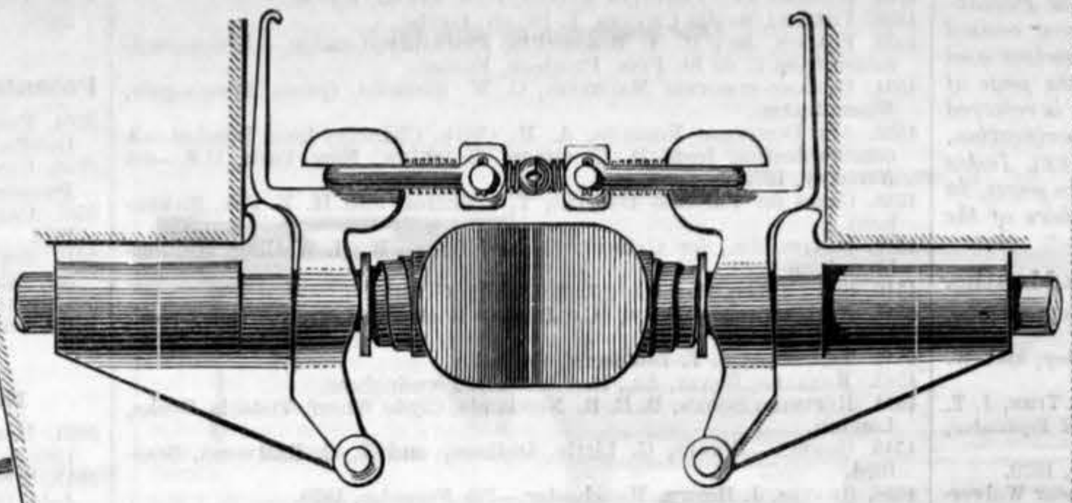


GENERAL PLAN AND ELEVATION OF ENGINE SHEDS AT TREVIGLIO

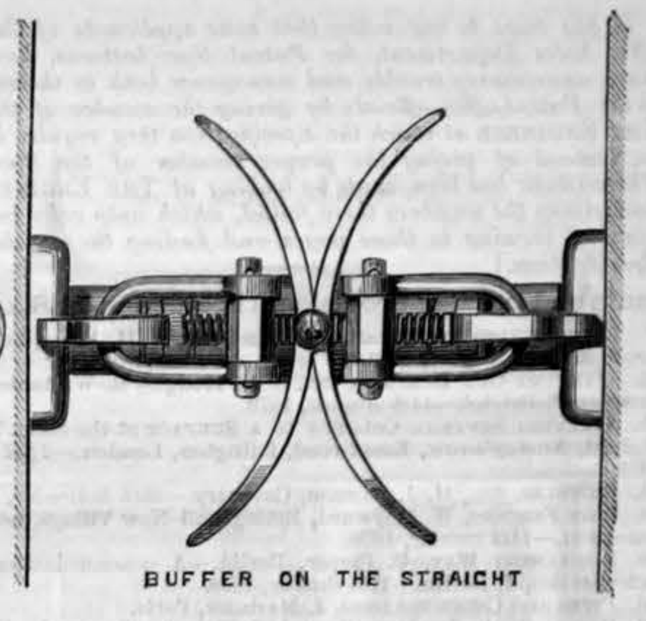
## SCREW COUPLINGS AND BUFFERS, BERGAMO AND LODI TRAMWAY.



BUFFER ON A CURVE



SIDE VIEW OF BUFFER



BUFFER ON THE STRAIGHT

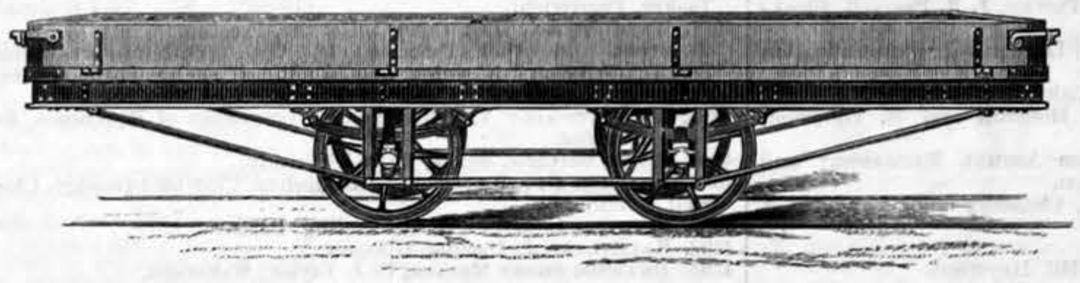
laid in the road itself, and freely traversed by the ordinary traffic, which, so far as my own observation and the testimony of the conductors enabled one to judge, does not damage the line. But it would be more prudent to give a greater depth of macadam over the cross sleepers, either by employing a deeper rail, or by using chairs to raise the rail slightly, as in wet weather there is danger of ruts being formed down to the timber sleepers, and, in any case, the depth of macadam over the sleepers is hardly sufficient to bind well. During the very severe weather of the past winter it was usual to clear out the grooves of the Marsillon section every morning by running a trolly over the line in front of an engine, the trolly having movable coulters fitted over each groove, which could be raised or depressed by the men on the trolly in passing through points, &c. These coulters served to clear out the half-frozen mud and snow, which would otherwise have caused slipping of the driving wheels. In ordinary weather this precaution is not required. The traffic arrangements resemble those on the Milan Saronno Tradate line, already described, except that in this line passengers are not supposed to enter or quit the train except at fixed points. There are seven intermediate stations, or rather stopping places—for there are no buildings or platforms—at which the trains always stop, and at certain other points are posts, at which the trains stop to take up or set down if required. In practice, however, the conductor, to oblige passengers, often stopped the train at other points also. The seven intermediate stations divide the line into eight "tracts," for each of which the fare is: First-class, 0·25f.; second-class, 0·15f.; and the passenger receives as many tickets as the number of "tracts" he desires to traverse. The goods traffic had only just been organised at the time of the writer's visit, and it was too soon to estimate the probable results. The tariff is as follows:—

| From Milan. Per 100 kilos.:— | To Gorgonzola. fr. | To Vaprio. fr. |
|---|---|---|
| Ordinary goods | 0·40 | 0·60 |
| Silk, textile fabrics, &c. | 0·70 | 0·90 |
| Parcels up to 3 kilos. each | 0·20 | 0·20 |
| Ditto, 3 to 10 kilos. each | 0·30 | 0·30 |

Charges for delivery from the terminus at Milan are as follows:—Packages not exceeding 20 kilos. each, per package, 0·20f.; ditto 20 to 100 kilos., 0·30f. Beyond 100 kilos., for each 100 kilos. or portion thereof, 0·20f. The first-class winter carriages are similar to ordinary tram cars; they are warmed by pipes from a tiny stove, fed with coke, from outside the car. The windows are fitted with Venetian shutters as well as glass sashes, to admit air while excluding sun. The second-class (winter) cars have a covered in central portion for sixteen persons and two end platforms, roofed over but otherwise open, for smokers. These platforms are supposed to have standing room for twelve men on each, bringing up the total capacity of the car to forty; but this is very close packing, and these platforms cannot hold more than eight persons each with comfort. The speed is nominally restricted to 15 kilos., or 9½ miles per hour; but trains on several occasions attained much higher speeds, once over eighteen miles per hour. The Vercelli Trino line is about twelve miles in length. It is laid in the ordinary road throughout, without any "paracarri." The permanent way consists of steel Vignoles rails, 36 lb. to the yard, spiked to oak cross sleepers, a second rail of the same section being used as a guard rail at crossings of streets. The engines in use are the Henschel, made at Cassel, costing £680; and the Baldwin, already mentioned, which cost a few pounds less. The managers of this line, who have had previous experience of the Henschel engine on the tramways at Cassel itself, spoke highly of it, as giving more power, with less fuel, than the Baldwin or other engines. The arrangement of the working parts appears good, being well boxed in below, and protected from dust and mud, while freely accessible to the driver for cleaning and oiling. There are five regular stopping places between Vercelli and Trino. At the time of the author's visit the line had only been open a month or two, and that during the worst winter weather known in Italy for twenty years. Nevertheless, the receipts from passengers only were already about £6 per mile per week, and would probably be doubled by the accession of fine weather. The line, however, is intended quite as much for goods as for passengers. Trino is the market and depôt for a very large rice trade, the whole of which will use the line when open for goods. An extension of this line from Vercelli to Gattinara, some twenty-four miles, is in progress, and nearly completed. There are curves on this line of only thirty metres radius—gauge 4ft. 8½in.—over which the Henschel engine, weighing seven tons, drew five loaded passenger cars and a goods truck without difficulty. But the engineer stated that it was intended to raise the minimum radius of curves to forty metres, except at crossings, where the minimum is twenty-five metres. The maximum gradient on this line is 2·7 per cent., or 1 in 37. They were running only three trains per day each way at the time of the author's visit, owing to the very bad weather, but the number has since, I believe, been increased. An illustration of the Henschel engine, with specimens of the summer and winter cars, will be found at page 416.

## THE BERGAMO AND LODI TRAMWAY.

IN our impression for November 14th we announced the opening of a tramway, worked by steam power, uniting Bergamo—a town about thirty miles from Milan—with Lodi, a town in Austrian-Italy. We now illustrate the line, and the rolling stock. The engines were constructed by Messrs. Henschel and Son, of Cassel. The principal dimensions are given below. The carriages are first, second, and third class, both closed and open at the sides, as shown by Figs. 1, 2, 3, and 4, the trucks for the transport of goods being illustrated by Fig. 5. These were made by a Milanese firm. The permanent way is illustrated at page 416. It will be remembered that the line is laid at the side of the high road. The gauge is the same as all Italian railways—viz., 1·445 metre. The rails are of Bessemer steel, and weigh 18·6



FIC.5

kilogs. per running metre. The accessories for fixing the rails were made in Italy. The sleepers are 2·30 by 0·17 by 0·12 metre, and of the best Lombardy oak. The trains are usually composed of four carriages, capable of carrying on an average 150 passengers each journey. The goods service is done during the night. At the extremities of the line at Bergamo and Lodi, and at Treviglio, there is a passenger station composed of a waiting-room, buffet, and office for the station master; also sheds for engines and carriages—see page 420—which occupy an area of about 3000 square metres. The line has a total length of about twenty-six miles, and passes through fifteen towns and villages. Sig. Ferdinand Pistorius, agricultural engineer, Milan, is the proprietor of the line.

The engine weighs 145 centners empty, and full, but without condensing water, 165 centners, and with this water 193 centners. The following are principal dimensions of the engines:—

| | Metres. |
|---|---|
| Cylinders, diameter | 0·20 |
| ,, stroke | 0·30 |
| Boiler, heating surface | 17·00 |
| ,, grate | 0·56 |
| Total length | 4·17 |
| ,, width | 2·20 |
| ,, height | 3·25 |
| Wheel base | 1·40 |
| Boiler pressure, atmospheres | 12·00 |

## THE INSTITUTION OF CIVIL ENGINEERS.

AT the second meeting of the session, held on the 18th of November, Mr. W. H. Barlow, F.R.S., vice-president, in the chair, the paper read was on "Tunnel Outlets from Storage Reservoirs," by Mr. C. J. Wood, M. Inst. C.E.

The subject was divided into the consideration of culverts in a direct line through an embankment, and tunnels round the end of the embankment as a distinct work. The author stated that the practice of laying pipes through an embankment, governed by valves at the foot of the outer slope was not satisfactory, first, because of the settlement of the earthwork; and secondly, because of the subsidence of the puddle, both of which were likely to damage the culvert and create leakage. In crossing the puddle trench, a stone or brickwork pillar had sometimes been used to remedy this difficulty with partial success, and in other cases, a "slip joint" had been made of the portion of the culvert crossing the trench, to allow a slight vertical movement. In consequence, however, of the uncertain settlement of the earthwork of the sides of the embankment, this movement might not be vertical. The advantages of a culvert through the embankment were speed, economy, and the building of the culvert in daylight; these culverts were frequently surrounded by a coating of concrete, which gave additional security. The study of culverts under high railway embankments was suggested, and the author believed it best to leave the bank, if possible, intact, by an alternative method—that of driving a tunnel round or under the end of the empankment in the solid rock as a separate work, the tunnel to be lined with stone, brick, or cast iron segments backed with concrete. The objections to this plan were stated to consist in the work having to be done in comparative darkness, in the possible displacement of the natural strata of the ground, producing a creep of water outside the tunnel, and in the difficulty of backing the crown of the arch satisfactorily. The expense was in favour of the culvert directly through the embankment; the tunnel, though more costly, was safer, as it was not in the most dangerous place. The draw-off valves, placed in earlier examples at the foot of the outside slope, which prevented necessary repairs, were now frequently at the bottom of a valve-pit built on the inside of the puddle trench in the embankment. These valve-pits were liable to get out of the perpendicular, and to prevent the valve rods working; also the water went half way through the bank in the inner culvert. The draw-off valve was sometimes placed at the foot of the inner slope; it had a sloping face and was worked by rods up the inside slope. The drawbacks were that stones were apt to settle, that there was great thrust on the valve-rods, that there was a want of access to the valve in case of accident, and that the least cleanly water was drawn off. A culvert terminating in a valve tower of masonry or iron was the best plan, the valves being in duplicate, one set inside, the other outside the tower. The author advocated the tunnel clear of the embankment and valve tower as the best and safest plan.

A high level supply was taken from the hills above Oxenhope, from Marywell Springs, and from Skipton district. The Stubden reservoir proving leaky had been abandoned in favour of a tunnel lined with cast iron plates backed with concrete, terminating in a cast iron valve tower. The embankment was cut down, the original culvert taken out, and the embankment was then made up solid in thin layers, the new tunnel being used to run water off during the reconstruction of the work. No leakage of any description had since been noticed, the valve-tower and tunnel being water-tight. The Leeming compensation reservoir for mill owners had been originally made with a circular culvert having a slip joint and iron shield where it crossed the puddle trench. This culvert was seriously fractured by the subsidence of the bank, which was mostly on a clay foundation, and it was considered unsafe to fill the reservoir. On the suggestion of Mr. Rawlinson, C.B., M. Inst. C.E., and of Mr. Binnie, on the latter taking charge of the Bradford Corporation Water Works, the old culvert was abandoned, and a new tunnel was substituted, similar to the one at Stubden. The original culvert was afterwards filled on the inside with concrete, and the reservoir was successfully filled with water, no leakage or disturbance having occurred up to the present time. In the case of the Leeshaw reservoir, which was in course of construction, on Mr. Rawlinson's inspection it was resolved to abandon the culvert already cracked, and to substitute a tunnel outlet and valve-tower of cast iron, similar to those at Leeming and Stubden; this had been successfully done, the reservoir filled, and the work had since proved most satisfactory. In two of the above cases the culverts were so damaged as to be a strong argument in favour of tunnel outlets distinct from the embankment.

The remainder of the paper explained the form and construction of the type of cast iron tunnel outlet and valve-tower used in these works. The tunnels were mostly driven through Yorkshire grit and shale; they were 8ft. 6in. high, 7ft. wide, and each tunnel had a fall of 1ft. in its length. The tunnel commenced at the bottom of a shaft, 13ft. or 14ft. deep inside the reservoirs, in which the lower part of the valve-tower, cased with concrete, was afterwards built. The valve-tower was composed of cast iron rings with socket joints, caulked with iron borings and salammoniac; on the top of the valve-tower, at the level of the top of the embankment, a house was built to protect the valves, and the tower was connected with the main land by a light wrought iron Warren girder bridge on stone piers. The tunnel starting from the bottom of the valve-tower was elliptical in form, made in rings, each ring being composed of four segments bolted together and surrounded by concrete; it extended in a V-shape under one end of the embankment, and was a distinct work; at the angle of the tunnel an air shaft was sunk, which was subsequently lined with cast iron rings, and formed a ventilating pipe. The supply pipes, 2ft. in diameter, extended through the tunnel, and were jointed at the tower to a vertical standpipe, at equal intervals on which branches were cast and sluice valves fixed. Connections to the pipes extended from the sluice valves through the sides of the tower, and were further protected on the outside by flap valves. Provision was also made for equalising the pressure on the flap valves, and for the expulsion of air when opening one of the flap valves. A wrought iron ladder extended up the tower, and at intervals there were grated floors so as to afford access to the valves and working parts. The connection of the bottom of the tower with the tunnel was made with a cast iron gland, to the face of which a wrought iron bulkhead was screwed, so as to make the valve-tower water-tight; the upper half of the bulkhead could be removed for entrance to that portion of the tunnel. These valve-towers had proved successful wherever erected. Mr. Binnie was the engineer for carrying out the works, the author being the resident engineer.

At the first meeting of the session, on the 11th of November, Mr. W. H. Barlow, vice-president in the chair, it was announced that the council had recently transferred Messrs. J. P. C. Anderson, T. A. Bulkley, R. Crawford, J. Jackson, J. T. Leather, R. K. MacBride, G. E. Ormiston, G. Palmer, F. F. Smith, J. Tate, F. A. Upcott, and A. F. Yarrow to the class of members; and had admitted Messrs. T. Adams, H. W. Anderson, J. T. P. Bassett, E. S. Baylis, H. C. Bowdage, T. Butler, A. H. Case, J. A. Dockray. F. H. Edminson, J. W. Fells, P. M. Gotto, P. Hammond, W. T. Holberton, J. H. Holmes. C. C. Horsley, A. J. Hudleston, H. J. Johnston, P. E. Keene, W. Kissack, J. B. Labatt, I. A. Lewin, R. McArthur, W. Maxwell, C. T. Merrick, G. E. N. Pauling, H. Roche, R. B. Rutherford, W. T. Skaife, J. R. Smith, P. Smith, J. S. B. Tarbotton, F. A. Target, G. R. Tyndall, and L. A. Wallace as students.

SOCIETY OF ENGINEERS.—At the last meeting of the Society of Engineers the following gentlemen were balloted for and duly elected:—As members, Mr. Alfred Penny and Mr. Thomas Rowland Jordan; associates, Mr. Charles Clauson and Mr. John Henry Buchan.

# THE PATENT JOURNAL.

*Condensed from the Journal of the Commissioners of Patents.*

*** *It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance both to themselves and to the Patent-office officials by giving the number of the page of* The Engineer *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* The Engineer *Index and giving the numbers there found, which only refer to pages, in place of turning to those pages and finding the numbers of the Specification.*]

## Grants and Dates of Provisional Protection for Six Months.

3137. Transmitting the Details of Plans, &c., W. H. Arber, Leytonstone, London.—*2nd August*, 1879.
3276. Stamping Out Leather, &c., S. H. Hodges, R. W. Ashley, and W. Grosvenor, Bristol.—*14th August*, 1879.
3805. Applying Several Colours to a Surface at the Same Time, J. T. Waight, Anstey's-row, Essex-road, Islington, London.—*22nd September*, 1879.
3934. Bicycles, &c., H. J. Lawson, Coventry.—*30th September*, 1879.
4150. Iron Fencing, W. Hayward, Ettingshall New Village, near Wolverhampton.—*14th October*, 1879.
4200. Permanent Way, C. Pieper, Berlin.—A communication from L. Schwartzkopff, Berlin.—*17th October*, 1879.
4266. Pipes and Cigar-holders, J. Marinier, Paris.
4269. Paper, W. A. Sommerville and W. Malcolm, Lasswade, N.B.
4271. Treating Wooden Casks, W. T. Doran, Belfast, Ireland.—*21st October*, 1879.
4285. Illuminating Frames for Exhibiting Advertisements in Carriages, &c., A. Laya, Paris.
4293. Drying Yarn, R Ecroyd, Lomeshaye, near Burnley.—*22nd October*, 1879.
4314. Fastening Boots and Shoes, H. T. Weston, Havelock-square, Sheffield.
4326. Stereotypers' Plates, W. Ward, Bradford.—*23rd October*, 1879.
4362. Cylinders for Breaking up Fibrous Materials, W. Tatham and W. T. Heap, Rochdale.
4366. Lamps, W. Lucke, Muelheim-on-the-Rhine, Germany.
4368. Mechanical Stoking Furnaces, J. Lockwood, Glasgow.
4370. Draw Gear of Railway Rolling Stock, J. Wallace, King-street, Wigan.
4372. Treatment of Malt, R. Prendergast, Sydney, New South Wales, and R. Free, Mistley.
4374. Cleaning the Bottoms of Ships while in Motion, S. Pitt, Sutton.—A communication from H. M. Jepsen, Flensburg, Prussia.
4376. Weaving, W. R. Lake, Southampton-buildings, London.—A communication from L. J. N. Rousseau, Lyons, France.—*27th October*, 1879.
4378. Metal Reservoir Pens, W. E. Wiley, Birmingham.
4380. Azimuth Compasses, A. Louttit, Tollington Park, London
4382. Compositions for Making Capsules, &c, H. Woodward and W. Boyd, Birmingham.
4384. Spinning, E. Pawson, Oxenhope, near Keighley.
4386. Stoppers for Casks, W. R. Lake, Southampton-buildings, London.—A communication from W. H. Stewart, Brooklyn, U.S.
4388. Effecting the Propulsion of Tramway Cars, &c., J. H. Johnson, Lincoln's-inn-fields, London.—A communication from C. Arson, Paris.
4390. Axles for Common Road Vehicles, A. M. Clark, Chancery-lane, London.—A communication from C. W. Ball and T. Davis, Macon, U.S.—*28th October*, 1879.
4392. Hydrants, I. Ross, Edinburgh.
4394. Explosive Compounds, L. T. O'Shea, Aughton, near Ormskirk, and C. T. Brooks, Liverpool.
4396. Moving Tram Cars by Gas Engine Power, J. R. Purssell, Blackfriars-road, London.
4398. Signal Buoys, H. J. Haddan, Strand, London.—A communication from E. E. Mann, Lawrence, U.S.
4400. Generating, &c., Electricity, W. R. Lake, Southampton-buildings, London.—A communication from E. I. Houston and E. Thomson, Philadelphia, U.S.
4402. Extracting Ammoniacal Salts from Animal Excrement and Urine, W. F. Nast, Portland-place, London.
4404. Electric Batteries, A. V. Newton, Chancery-lane, London.—A communication from F. Tommasi, Paris.
4406. Stoves, E. Townsend, Oldbury.
4408. Securing Stair or other Rods, C. T. Hill, Heywood.
4410. Ascertaining the Presence of Inflammable Gas in Mines, &c., W. Young, Belfast
4412. Valve for Single-acting Engines, R. Whitehead, Cork-street, London.
4414. Gas-burners, T. Heron, Manchester.
4420. Reducing Imperfectly or Semi-dissolved Substances to a Smooth State of Fluidity, A. O. Stopes, Colchester.—*29th October*, 1879.
4422. Thrashing Machines, W. Kaye, Hook Norton.
4426. Centre-second Stop Watches, W. Hirst, W. Hirst, and J. Hirst, Sheffield.
4428. Electrical Apparatus, E. G. Brewer, Chancery-lane, London.—A communication from E. A. Chambrier, Paris.
4430. Preservation with Sugar of Fruits and Peels, E. H. Hill, Commercial-road, London.
4432. Appliance for a Horse's Bridle, M. V. Bligh, Brighton.
4434. Condensing Waste Steam, W. Black and T. Hawthorn, Gateshead-on-Tyne.—*30th October*, 1879.
4436. Producing Aluminium Bronze, J. Webster, Edgbaston, near Birmingham.
4438. Pneumatic Elevators, F. H. F. Engel, Hamburg, Germany.—A communication from A. B. Hennicke and H. I. Goos, Hamburg, Germany.
4440. Telephones, J. H. Johnson, Lincoln's-inn-fields, London.—A communication from C. Ader, Paris.
4442. Corking Bottles, W. Oliver and J. C. Arrol, Edinburgh.
4444. Thumb Latches, W. Griffin, Birmingham.
4446. Treatment of Fishing and other Fabrics, T. Balls, Lowestoft.
4450. Classification of Letters, &c., W. Morgan-Brown, Southampton-buildings, London.—A communication from W. A. Amberg, Chicago, U.S.
4452. Lamps, E. Kauffmann, Red Lion-square, London.—*31st October*, 1879.
4454. Revolving Cannon and other Guns, B. B. Hotchkiss, Southampton-buildings, London.
4456. Protecting Telegraph Wires, J. T. King, Liverpool.—A communication from C. Linford, Pittsburgh, U.S.
4460. Buttons, &c., F. J. Barnes and E. Kirby, Birmingham.
4462. Husking or Hulling Coffee, J. C. Mewburn, Fleet-street, London.—A communication from J. E. Vassaux, Guatemala.
4464. Fencing, S. Bayliss, Wolverhampton.
4466. Cabs and Carriages, T. Greenhill, Alfred-place, Bedford-square, London.
4468. Spinning, E. Crossley, L. J. Crossley, and W. Sutcliffe, Halifax.
4470. Piers, &c., J. L. Clark and J. Standfield, Victoria-street, Westminster.—*1st November*, 1879.
4472. Digging the Earth, C. L. Lacarrière, Paris.
4476. Tin or Terne-plates, J. Jenkins, Clydach.
4478. Locks for Bracelets, A. W. Magerhans, New York.
4480. Turning of Three or More Sided Objects, G. W. von Nawrocki, Berlin.—A communication from J. Fangel and L. Weisse, Berlin.
4482. Road Locomotive Engines, D. Greig, Leeds, and T. Aveling, Rochester.—*3rd November*, 1879.
4483. Motive-power Engine, J. Graddon, Stanstead-road, Forest-hill.
4486. Screw-drivers, H. Simon, St. Peter's-square, Manchester.—A communication from P. Schneitler, Berlin.
4490. Ferro-phosphorus, F. C. Glaser, Berlin.—A communication from the Hoerder Bergwerks und Huetten-Verein, Hoerde, Westphalia, Prussia.
4492. Gas-holder Engines, J. Shaw, Scholes, Cleckheaton.
4494. Crushing, &c., Phosphates, &c., W. R. Lake, Southampton-buildings, London.—A communication from H. B. Dunham, New York.
4496. Boiling Starch-containing Matters, P. Jensen, Chancery-lane, London.—A communication from Count Sixtin de Sparre, Paris.
4500. Stoves Heated by Gas, &c., W. E. Griffith, Montpelier-road, Peckham, London.—*4th November*, 1879.
4502. Lubricating the Axles of Railway Carriages, &c., J. M. Johnston, Glasgow.
4504. Saving Life at Sea, J. McCarthy, Stoney-road, North Strand, Dublin.
4506. Digging and Shaping Peat, &c., H. Simon, St. Peter's-square, Manchester.—A communication from C. Schlickeysen, Berlin.
4508. Horseshoes, C. S. Tomlin, Westbourne-park, London.
4510. Doubling, Twisting, and Reeling Mechanism, C. Sipman, Kayes-walk, Nottingham.
4512. Working the Valves, &c., of Motive Power Engines, J. H. Kitson, Leeds.
4214. Water Meter, D. Johnston, Glasgow.
4516. Sawing Machinery, W. R. Lake, Southampton-buildings, London.—A communication from H. Young, New York, U.S.
4518. Grinding, &c., Machinery, J. B. Jackson, Sheffield.
4520. Rick Covers, T. Jones, Rowley Regis.
4522. Junctions for Wrought Iron Tubes, J. Bywater, Tipton.—*5th November*, 1879.
4524. Water-colour Printing Transfer Ink, D. Gestetner, New North-road, London.
4526. Effecting Locomotion, W. Exley, Otley.
4528. Raising, &c., Venetian Blinds, P. B. Elwell, Ryton.
4530. Travelling Jib Cranes, T. Dixon, Leeds.
4532. Flagon, &c., H. A. Bonneville, Piccadilly, London.—A communication from C. de St. Prix, Ploujean, France.
4534. Dynamo-electric Machines, C. W. Siemens, Queen Anne's-gate, Westminster.
4536. Air Injecting Nozzles, A. M. Clark, Chancery-lane, London.—A communication from D. C. Green, Brooklyn, New York, U.S.—*6th November*, 1879.
4538. Cases for Packing Bottles, T. Cookcroft and H. B. Fox, Birkenhead.
4539. Davits, &c., for Carrying Ships' Boats, W. H. Watling, Middlesbrough-on-Tees.
4540. Single Rail Railway, J. K. Collett, Cardiff.
4541. A Universal Vice, C. Junge, Rotherfield-street, Essex-road, London.
4542. Tricycles, I. T. Townsend, Coventry.
4543. Metallic Boxes, &c., R. Whitaker, Birmingham.
4544. Refining Sugar, B. E. R. Newlands, Clyde Wharf, Victoria Docks, London.
4545. Combing Fibres, G. Little, Oldham, and T. C. Eastwood, Bradford.
4546. Skates, J. Brown, Manchester.—*7th November*, 1879.
4547. Lamps, F. Wolff, Raadhusstraede, Copenhagen.—A communication from K. H. E. Höybye, Odense, Denmark.
4548. Printing Presses, H. P. Trueman and J. G. New, Birmingham.
4549. Insulated Electric Conductors, J. Bell, Southwark.
4550. Bottles, C. J. Wade and J. W. Dobson, Barnsley.
4551. Hot-air Stoves, A. Kohlhofer, Southampton-buildings, London.
4552. Washing Wool, H. Illingworth, Bradford.
4553. Controlling the Pressure of Steam, B. Malcolm, Belfast.
4554. Looms, J. Bywater, W. Spurr, T. Spivey, and R. Smith, Birstal, near Leeds.
4555. Electro-magnets, J. Bell and G. Scarlett, Liverpool.
4556. Twisting, &c., Yarns, G. Roper, Stockport.
4558. Dressing Combs, J. Hart, Handsworth.
4559. Castors for Furniture, J. S. Crowley, Manchester.
4560. Looms, H. Portway, Bradford.
4561. Cruets, &c., F. E. Lynde, Manchester.
4563. Effecting Interchange of Temperature in Fluids, J. H. Johnson, Lincoln's-inn-fields, London.—A communication from J. B. J. Mignon and S. H. Rouart, Paris.
4564. Steam Ramming Machines, W. R. Lake, Southampton-buildings, London.—A communication from S. Johnson, Philadelphia, U.S.—*8th November*, 1879.
4565. Lamps, F. T. Tyndall, Edinburgh.
4566. Couplings, &c., R. J. Lines, Northampton.
4567. Drawing, &c., Beers, Wines, &c., E. Bolton, Salford, near Manchester.
4568. Shutters, &c., R. Ott, Belfast.
4569. Oil Cans and Feeders, T. H. Price, Brasshouse-passage, Birmingham.
4570. Looms, C. Bedford, Birstal, and J. Pickering, Batley.
4571. Fastenings for Bracelets, W. Robinson, Birmingham.
4572. Telephonic Conductors, W. R. Lake, Southampton-buildings, London.—A communication from E. Holmes and E. T. Greenfield, Brooklyn, U.S.
4573. Electric Telegraph Apparatus, C. D. Abel, Southampton-buildings, London.—A communication from E. George, Berlin.
4574. Propeller for Ships, J. E. Liardet, Brakespears-road, Wickham-park, Brockley.
4575. Preparation of Plastic Material, W. R. Henshaw, Tunstall.—*10th November*, 1879.
4577. Regulating the Supply of Gas, T. Thorp, Whitefield, and R. Tasker, Prestwich.
4578. Washing, &c., Machines, C. Harvey, Preston.
4580. Steel and other Pens, C. D. Abel, Southampton-buildings, London.—A communication from E. Hammesfahr, Foche, Graefrath, Germany.
4584. Automatically Ventilating the Interiors of Buildings, &c., C. Ower, Dundee.
4586. Steam Boilers, &c., T. Dale, Kirkcaldy.
4588. Drawing Off Water, F. G. Underhay, Crawford-passage, Clerkenwell, London.
4590. Electric Lighting, G. P. Harding, Paris.
4592. Kalendars, J. Darling, Glasgow.
4594. Drawing Sheet Metals, F. J. Taylor, Wakefield.
4596. Regulators for Self-acting Variable Expansion, C. Kesseler, Mohren-strasse, Berlin.—A communication from A. Wever and F. Knüttel, Barmen, Germany.—*11th November*, 1879.
4598. Casting Metal Pipes, C. B. Palmer, R. E. B. Crompton, and J. Chambers, Stanton Ironworks, Nottingham.
4600. Wheels for Furniture Castors, J. Parry, Sale.
4604. Boots and Shoes, H. Ward, Derby.
4606. Bicycles, &c., G. Illston, Birmingham.
4608. Fastener for Driving Belts, &c., A. M. Clark, Chancery-lane, London.—A communication from A. Clunan and C. J. Warran, Brooklyn, U.S.—*12th November*, 1879.
4614. Raising, &c., Boats, J. Darby, Liverpool.
4616. Looms, T. A. Harrison, Lancaster.
4618. Chaff Cutters, A. McGregor, Leigh.
4620. Screw Gill Boxes, H. W. Whitehead, Leeds, and J. Stake, Huddersfield.
4622. Tube Pipes, J. T. Parlour, Fleet-street, London.
4624. Segment Wheels, J. Barbour, Belfast.
4628. Automatic Sewing Machines, W. R. Lake, Southampton-buildings, London.—A communication from T. Carmagnolle, Paris.
4630. Fire-grates, W. H. Warman, Bristol, and J. S. Bremner, Coalbrookdale.
4632. Dyeing Cotton Fabrics, J. Clare, Greenfield.
4634. Preserving Meat, &c., A. M. Clark, Chancery-lane, London.—A communication from Le Comte A. C. de Barbaran, Paris.—*13th November*, 1879.
4636. Lamps, D. M. Yeomans, Queen Victoria-street, London.—A communication from C. Bricogne, Paris.
4638. Sewing Machines, H. A. Dufrené, South-street, Finsbury, London.—A communication from J. R. V. de Castro, Porto, Portugal.
4640. Obtaining Motive Power from the Motion of Ships or Waves, H. J. Haddan, Strand, London.—A communication from G. Minisini, Turin, Italy.
4642. Pockets for Wearing Apparel, C. Levy, Manchester.
4644. Water Gauge Valves, F. H. F. Engel, Hamburg.—A communication from G. Leser, T. Leser and W. Leser, Hamburg.
4646. Mixing, &c., Meal and Flour Ingredients, J. L. Hancock, Cottrill-road, London.
4648. Registering the Number of Passengers in Tramcars, J. Wells, Coatham.
4650. Generation of Oxygen, &c., Gases, J. Rochford, Water-street, Liverpool.
4652. Treatment of Plants Suffering from Disease, A. Tyan, Kilburn, London.—*14th November*, 1879.

## Invention Protected for Six Months on the Deposit of Complete Specifications.

4711. Cutting Barbs on Fence Wire, A. M. Clark, Chancery-lane, London.—A communication from A. Cary, New York, U.S.—*19th November*, 1879.

## Patents on which the Stamp Duty of £50 has been Paid.

4562. Hollow Bossed Self-lubricating Wheel, R. Hadfield, Southampton-buildings, London.—*24th November*, 1876.
4573. Treatment of Vegetable Substances, C. Rands, Holloway.—*25th November*, 1876.
4577. Salts and Soaps, W. R. Lake, Southampton-buildings, London.—*25th November*, 1876.
4583. Fireplaces and Heat Generators, J. Dean, Oxford.—*27th November*, 1876.
4610. Looms for Weaving, J. Collins, Glasgow, N.B.—*29th November*, 1876.
4811. Studs, &c., J. C. W. Jeffreys, Tottenham-court-road, London.—*13th December*, 1876.
4587. Lamps, G. A. Ermen and E. Ermen, Eccles.—*27th November*, 1876.
4592. Peeling Barley, C. Pieper, Dresden, Saxony.—*27th November*, 1876.
4593. Feeding Steam Boilers, C. Pieper, Dresden, Saxony.—*27th November*, 1876.
4586. Preserving Meat, H. M. Whitehead, Fenchurch-street, London.—*27th November*, 1876.
4599. Roots, &c., J, Blakey, Leeds.—*28th November*, 1876.
4635. Spinning, &c., S. Brooks and G. Harrison, West Gorton, Manchester.—*30th November*, 1876.
4645. Making Up Printed Papers into the Form of Books, &c., W. Conquest, Tudor-street, London.—*30th November*, 1876.
4765. Electric Telephony, W. Morgan-Brown, Southampton-buildings, London.—*9th December*, 1876.
4797. Steam Boilers, H. S. Coleman, Chelmsford.—*12th December*, 1876.
4627. Tipping Cradles, W. G. Jackson, Saltburn-by-the-Sea.—*30th November*, 1876.
4628. Nut Blanks, J. H. Johnson, Lincoln's-inn-fields, London.—*30th November*, 1876.
4646. Screw Heads, F. C. Coxhead, Leadenhall-street, London, and R. Steers, Manor-road, Walworth.—*30th November*, 1876.
4652. Roofs, W. H. Kershaw, Widnes.—*1st December*, 1876.
4790. Threading Screws, T. Garnett, Birmingham.—*11th December*, 1876.

## Patents on which the Stamp Duty of £100 has been Paid.

3704. Producing Reciprocating Motion, W. T. Hamilton, Rathmines, Dublin.—*6th December*, 1872.
3756. Cutting Dovetails, W. T. Hamilton, Rathmines, Dublin.—*11th December*, 1872.
3587. Capsule, W. Betts, Wharf-road, City-road, London.—*28th November*, 1872.
3613. Steam Boilers, R. Hanson and J. Norton, Halifax.—*30th November*, 1872.
3642. Smelting Iron and Steel, C. W. Siemens, Great George-street, Westminster.—*3rd December* 1872.

## Notices of Intention to Proceed with Patents.

2924. Holding and Cleaning Bits and Stirrups, S. Elliott, Newbury.—*18th July*, 1879.
3015. Scissors, J. Foot, Eversholt-street, Camden Town, London.—*24th July*, 1879.
3027. Velocipedes, W. Hillman, Coventry.
3028. Gig Mills, H. J. Haddan, Strand, London.—A communication from Grosselin, sen. and jun.
3035. Cable Holders or Rims, J. Mitchell and D. J. Cocks, Gordon-street, Glasgow.
3037. Looms for Weaving, J. Bywater and C. Bedford, Birstal, near Leeds.
3044. Valve for Boats, J. Casey, Philpot-lane, London.
3045. Boring, &c., Rock and Stone, J. D. Brunton and F. H. J. Trier, Great George-street, Westminster, and A. H. Rapp, Paris.—*25th July*, 1879.
3047. Printing in Colours upon India-rubber, &c., W. G. White, Southampton-buildings, London.
3054. Elastic Webs for the Sides of Boots, &c., J. Astill, Leicester.—*26th July*, 1879.
3060. Pyrometers and Thermometers, A. Budenberg, Manchester.—A communication from A. Seyferth and C. F. Budenberg.
3061. Cake for Horses, &c., G. W. von Nawrocki, Berlin.—A communication from Alfred, Count of Salm.
3065. Screw and Lever Presses, T. Wrightson, Stockton-on-Tees, and J. H. Ladd, London.
3067. Screens for Stoves, A. Slater, Bristol.
3069. Enamelling Metal Castings, C. Kesseler, Berlin.—A communication from N. Henzel and L. Broz.—*28th July*, 1879.
3087. Pumping Engine, J. McInnes, Glasgow.
3089. Cleaning Safety Lamps, W. Ackroyd, jun., and W. Best, Morley, near Leeds.
3093 Compound Driving Lever, R. C. Ross, Manchester.
3100. Teaching Music, W. E. Gedge, Wellington-street, Strand, London.—A communication from M. A. Chassevant.
3101. Movable Stop for Fastening Folding Doors, A. Méritte, Rouen, France.—*30th July*, 1879.
3104. Extracting Moisture from Hops, J. Siddeley, Liverpool, and A. M. Dearn, Retford.
3105. "Dummys" for Profiling Machines, A. Muir, Manchester.
3108. Kilns for Burning Bricks, &c., G. W. von Nawrocki, Berlin.—A communication from R. Müller.
3113. Coupling Buffers, G. Turton, Westminster.—*31st July*, 1879.
3130. Preventing Waste in Spinning Frames, H. Ambler, Halifax.
3131. Chucking and Centreing of Pipes, T. Milburn and C. W. Haydon, Staleybridge.—*2nd August*, 1879.
3132. Finishing Zinc-coated Wire, A. M. Clark, Chancery-lane, London.—A communication from F. L. Sarmiento.—*5th August*, 1879.
3169. Cutting Veneers and Boards, A. M. Clark, Chancery-lane, London.—A communication from H. T. Bartlett and G. W. Read.—*6th August*, 1879.
3190. Iron and Steel, A. F. Gussander, Torsaker, Sweden—*8th August*, 1879.
3214. Combined Canteen, Water Bottle, and Cooking Apparatus, W. Harrington, Dublin.—*11th August*, 1879.
3231. Paper Barrels, &c., J. H. Darlington and C. E. Sedore, Brooklyn, U.S.
3235. Drying and Curing Hops, H. J. Haddan, Strand, London.—A communication from N. S. Hayes.
3240. Article of Food, J. W. Hayes, Upper Barnsbury-street, London.—*12th August*, 1879.
3315. Metallic Bedsteads, E. Peyton, Birmingham.—*16th August*, 1879.
3352. Metallic Boxes, C. R. E. Grubb, Knightrider-street, London.—*19th August*, 1879.
3438. Deep Sea Fishing or Trawling, J. W. de Caux, Great Yarmouth.—*26th August*, 1879.
3455. Galvanising Wire, &c., E. Fox, Castle-street, Sheffield.—*27th August*, 1879.
3519. Horse-collars, W. R. Lake, Southampton-buildings, London.—A communication from E. Fisher.—*2nd September*, 1879.
3624. Iron and Steel, H. C. Bull, Southampton-buildings, London.—*9th September*, 1879.
3629. Ships' Logs, A. M. Clark, Chancery-lane, London.—A communication from A. Gordon.—*10th September*, 1879.
3687. Supplying Fuel to Fires, &c., N. Macbeth, Bolton, and T. Beeley, Hyde Junction, Chester.—*15th September*, 1879.
3853. Stereotyping. W. P. Byles and G. Allen, Bradford.—*24th September*, 1879.
3900. Looms, O. Pickles, B. Smith, and C. Slater, Burnley.—*27th September*, 1879.
3973. Rolling Metallic Bars, &c., E. A. Brydges, Belle Alliance-strasse, Berlin.—A communication from the Menden and Schwerte "Eisenindustrie" Company, Schwerte, Germany.—*3rd October*, 1879.
3995. Glass Capsule, D. Grant, Water-lane, Queen Victoria-street, London.—*4th October*, 1879.
4038. Vinegar, C. Kesseler, Mohren-strasse, Berlin.—A communication from V. Michaelis.—*6th October*, 1879.
4078. Sulphate of Alumina, W. Chadwick, T. Chadwick, and J. Chadwick, Manchester, and J. W. Kynaston, Liverpool.—*9th October*, 1879.
4149. Valves, &c., J. Evans, Wolverhampton.
4153. Rails, &c., J. P. Spencer, North Shields, and R. Elsdon, Upper New-cross.—*14th October*, 1879.
4176. Ornamenting Metallic Surfaces, D. Littlehales, Birmingham.—*15th October*, 1879.
4264. Fulling Stocks, R. Kilburn, sen., Leeds.—*21st October*, 1879.
4292. Consolidating Fluid Steel, H. Sharp, Bolton-le-Moors.—*22nd October*, 1879.
4372. Treatment of Malt, R. Pendergast, Castlemaine Brewery, Sydney, New South Wales, and R. Free, Mistley.—*27th October*, 1879.
4380. Azimuth Compasses, A. Louttit, Tollington Park, London.—*28th October*, 1879.
4394. Explosive Compounds, L. T. O'Shae, Aughton, and C. T. Brooks, Liverpool.
4412. Valves for Single-acting Engines, R. Whitehead, Cork-street, London.—*29th October*, 1879.
4436. Producing Aluminium Bronze, J. Webster, Edgbaston, near Birmingham.
4450. Preservation of Letters, &c., W. Morgan-Brown, Southampton-buildings, London.—A communication from W. A. Amberg.—*31st October*, 1879.
4454. Revolving Cannon and other Guns, B. B. Hotchkiss, Southampton-buildings, London.—*1st November*, 1879.
4487. Cotton Cords, J. H. Openshaw, Bury.
4489. Cutting Grass and Grain, W. C. Manwaring, Banbury.—*4th November*, 1879.
4510. Doubling, &c., Mechanism, C. Sipman, Kaye's Walk, Nottingham.
4511. Umbrellas and Parasols, A. G. Brown, St. Thomas-street, Southwark.
4513. Preventing Overwinding of Cages in Mine Shafts, J. Hanson, T. Hudson, and E. Rowe, Darlington.—*5th November*, 1879.
4543. Metallic Boxes and Cases, &c., R. Whitaker, Birmingham.—*7th November*, 1879.
4547. Lamps, F. Wolff, Raadhusstraede, Copenhagen.—A communication from K. H. E. Höybye.
4561. Cruets, &c., F. G. Lyne, Manchester.—*8th November*, 1879.
4588. Drawing Off Water, F. G. Underhay, Crawford-passage, Clerkenwell, London.—*11th November*, 1879.
4598. Casting Metal Pipes or Tubes, C. B. Palmer, R. E. B. Crompton, and J. Chambers, Stanton Ironworks, near Nottingham.—*12th November*, 1879.
4652. Treatment of Plants, &c., A. Tyan, Kilburn, London.—*14th November*, 1879.
4666. Wire-rope Tramways, A. S. Halladie, San Francisco, U.S.—*15th November*, 1879.
4711. Cutting Barbs or Fence Wire, A. M. Clark, Chancery-lane, London.—A communication from A. Cary.—*19th November*, 1879.

All persons having an interest in opposing any one of such applications should leave particulars in writing of their objections to such application

at the office of the Commissioners of Patents within twenty-one days after date.

## List of Specifications published during the week ending November 29th, 1879.

1077, 6d.; 1296, 4d.; 1505, 6d.; 1520, 2d.; 1528, 6d.; 1553, 6d. 1567, 4d.; 1617, 6d.; 1620, 6d.; 1621, 6d.; 1629, 6d.; 1655, 2d.; 1656, 2d.; 1657, 2d.; 1659, 2d.; 1663, 4d.; 1664, 6d.; 1667, 2d.; 1672, 2d.; 1674, 2d.; 1677, 6d.; 1679, 2d.; 1680, 2d.; 1684, 6d.; 1685, 2d.; 1686, 4d.; 1687, 6d.; 1688, 2d.; 1691, 2d.; 1694, 2d.; 1698, 4d.; 1703, 4d.; 1705, 2d.; 1710, 2d.; 1711, 2d.; 1712, 2d.; 1717, 2d.; 1718, 2d.; 1719, 2d.; 1720, 2d.; 1724, 2d.; 1725, 2d.; 1727, 2d.; 1729, 2d.; 1731, 2d.; 1732, 6d.; 1733, 6d.; 1735, 2d.; 1736, 4d.; 1737, 4d.; 1740, 6d.; 1741, 2d.; 1742, 2d.; 1743, 6d.; 1745, 6d.; 1747, 6d.; 1757, 2d.; 1770, 4d.; 1905, 6d.; 1982, 6d.; 2961, 6d.; 3025, 6d.; 3255, 4d.

*** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

## ABSTRACTS OF SPECIFICATIONS.

*Prepared by ourselves expressly for* THE ENGINEER *at the office of Her Majesty's Commissioners of Patents.*

**1059.** OIL LAMPS, *H. Gardner.—Dated 18th March*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2d.

Two wicks are fitted at opposite angles in a burner, and are raised together by the same adjusting head or raising appliance. The oil reservoir has the filling hole at the side. A short chimney tube is fitted into the gallery of the burner, leaving a clearance between the top and the chimney proper or of the reflector.

**1290.** JOB PRINTING PRESSES, *H. P. Trueman and J. G. New.—Dated 1st April*, 1879. 6d.

The press has a horizontal bed to receive the forme, the ink plate being attached at an upward angle of 80 deg. at the back of the forme. On a vertical line from the centre of the bed is pivotted a rectangular frame, one end forming a handle, and the other carrying two or more inking rollers. The platten is hung over the bed and is carried to and from the types in exact parallelism by a system of grooves, which, after the impression is given, causes it to turn up to receive the paper to be printed. The impression is produced by toggle levers connected with the rectangular frame.

**1302.** TREATING EARTHY CLAYS FOR THE MANUFACTURE OF BRICKS, *R. Pickwell.—Dated 2nd April*, 1879. 4d.

The clay is mixed with sulphate of lime, sulphate of barytes, carbonate of barytes, and silica in such proportions as to produce any desired tint from red to white. The materials are placed in a casing provided with fixed cutters, within which revolves a shaft carrying arms arranged in a spiral, so that the materials in passing from one end of the casing to the other are thoroughly incorporated with the clay.

**1337.** MOUNTING AND OPERATING SCREW PROPELLERS, *H. R. Young.—Dated 4th April*, 1879.—(*Not proceeded with.*) 4d.

This consists in the employment of multiple gearing for the purpose of driving dual screw propellers.

**1348.** TOBACCO PIPE RACK, *J. J. Telfer.—Dated 4th April*, 1879. 4d.

An open frame of wire work of any suitable design contains an inner frame, a space being left between the two. The stem of the pipe is introduced into the meshes of the frame, and the bowl thus supported by the outer one, while the mouth is supported by the inner one.

**1372.** ROTARY LETTER PRESS PRINTING MACHINES, *G. Duncan and G. A. Wilson.—Dated 7th April*, 1879.—(*Void.*) 2d.

A web of paper is led to the printing cylinder which contains the type for printing both sides of the paper, and after receiving the impression on one side the web is severed, and the sheet led back to the cylinder to receive the impression on the other side.

**1399.** STEAM BOILERS, *J. G. Hughes.—Dated 8th April*, 1879. 6d.

As applied to a boiler with two internal furnace flues, the invention consists in turning the flues upwards at their rear ends, and then returning them to the front end of the boiler, where they are united to a single tube, which is carried backwards, and at its rear end passes through a feed-water cistern and thence is connected to a chimney. Water tubes extend across the flues, which may be corrugated so as to obtain an increased heating surface. Air is admitted to the furnaces through two cases arranged in relation to the fire doors, so as to be capable of being raised and lowered by guide rods, pulleys, and chains. These cases are open on the underside, and after the furnaces have been fired (which operation takes place alternately to the two furnaces) the case is brought down over its respective fire-door on to a plate provided with adjustable air openings communicating with the exterior.

**1400.** STEAM BOILER SIGNALLING APPARATUS, *J. H. Johnson.—Dated 8th April*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2d.

A steam whistle is connected to a float, which when the level of the water in the boiler falls below a certain level causes the whistle to be blown.

**1401** SOUNDING BOARDS OF PIANOFORTES. *A. M. Clark.—Dated 8th April*, 1879.—(*A communication.*)—(*Complete.*) 4d.

The board has a strip of wood or other vibration-conducting material abutting against and attached to its edge all round, and surrounded with a strip of rubber or other non-conductor of vibrations. The bridge extends at both ends to overlap the vibration-conducting rim.

**1403.** WATCH CASES, *A. M. Clark.—Dated 8th April*, 1879.—(*A communication.*) 6d.

The body of the case is formed in one seamless piece in the shape of a concave shell open in front to receive the movement, which is held in a sustaining ring hinged to the front edge of the case, so that when the bezel is removed the ring with the movement may be swung outwards. The bezel is screwed to the case and receives the glass. A removable stem cap fits tightly over the winding knob, so as to prevent the entrance of dust.

**1404.** REMOVABLE BOOK COVERS, *G. F. Redfern.—Dated 8th April*, 1879—(*A communication.*) 6d.

The outer sides of the cover have projecting eyes or staples, and the matter to be inserted within the cover is provided with grooved metal strips having transverse slots to receive the staples, so that when the outer covering is applied to the back and sides of the matter, the staples project through the slots and are secured by a longitudinal rod.

**1405.** LOADING, &c., THE CAGES OF COLLIERY AND OTHER HOISTS, *W. Barrowman.—Dated 9th April*, 1879. 6d.

The mechanism for raising and lowering the safety gate consists of a lever having its fulcrum on a support opposite the gate and gate guides, and so constructed that when the cage ascends above the pit mouth it will raise the lever and the safety gate. Safety stops are attached to the gate so as to project under the cage while it is being loaded or unloaded. Two sets of rails are employed, one inclined from the pit's mouth to carry away the loaded wagons, and the other inclined to the mouth to bring back the empty wagons.

**1406.** MANUFACTURE OF IRON, *J. Cooke.—Dated 9th April*, 1879. 2d.

Iron is produced in the ordinary manner, having ·030 to ·500 of carbon, ·040 to ·193 of silicon, ·087 to ·200 of sulphur, and ·200 to ·990 of manganese in combination with it. This metal is cut into small pieces and placed in a furnace, then surrounded by charcoal and subjected to one or more currents of atmospheric air.

**1407.** WEARING STUDS FOR BOOTS AND SHOES, *G. H. Ellis.—Dated 9th April*, 1879. 6d.

Round or other shaped open or box studs of metal are employed to fix into boots, and have the edges milled and the bottoms recessed. A short taper screw is fitted to the centre, and a series of teeth in a reverse direction to the screws are formed round the edge of each stud bottom, so that when the screw is tightened down upon the boot sole the teeth lock the stud and prevent it reversing or wearing loose. A disc of leather is fitted into the open or box parts of the studs.

**1408.** COMPRESSING, DELIVERING, AND REGULATING THE FLOW OF FLUIDS, &c., *G. W. Harvey and W. D. Seal.—Dated 9th April*, 1879. 6d.

The compressor consists of a vessel hung to a counterbalanced lever communicating with a water supply, and receiving water when elevated, such water compressing the air and forcing it from the vessel, and the water by its added weight causes the vessel to descend and in its movement operate valves, which cut off the supply, admit air and discharge the water previously received. A casing is provided with a chamber, channels, flexible diaphragm and pipe, and adjustable wedge, whereby the pressure of a fluid admitted to the casing is made the means of regulating the pressure at the discharge opening.

**1410.** PURIFYING GAS, *H. J. Haddan.—Dated 9th April*, 1879.—(*A communication.*) 4d.

Illuminating gas is purified by passing it mixed with air through animal charcoal, the absorption of illuminants being prevented by charging the black with a suitable correlative to such illuminants.

**1411.** GOVERNORS, *G. F. Redfern.—Dated 9th April*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2d.

A wheel with recesses in the inner part of the rim receives a set of springs, and a disc with recesses receives the other ends of the springs. The face of this disc, which is keyed to the shaft, acts as a bearing for lugs cast on the inner part of the wheel, and one of which receives the after wrist pin of the engine, all being slotted to receive bars which slide in a direction parallel to the shaft, and have a stud for rollers to run on, and engage in a cam groove.

**1412.** FASTENINGS FOR SECURING THE CORKS OR STOPPERS OF BOTTLES, *J. Shanks.—Dated 9th April*, 1879. 6d.

A band of metal with a tongue at one end and a slot in the other is bent round the neck of the bottle, and secured by passing the tongue through the slot and then bending it back. To this band is secured the end of a strip of metal, which then passes over the cork and is bent down to the other side, where it is again secured to the band.

**1413.** FIXING TUBES IN TUBE PLATES, *H. Koeltgen.—Dated 9th April*, 1879.—(*Not proceeded with.*) 2d.

The tubes project through the plates, the holes in which are larger than the circumference of the tubes, and are conical. A ferule of soft metal is driven into the space between the tube and the plate.

**1414.** SPRING FASTENINGS FOR GLOVES AND BOOTS AND SHOES, *J. Hinks and T. Hooper.—Dated 9th April*, 1879. 6d.

Two strips of metal are pivotted at one end, where one is formed with an excentric heel to bear upon a spring arm formed on the other strip. The strips are attached to the sides of the opening to be closed.

**1416.** RANGE FINDER, *F. Weldon.—Dated 9th April*, 1879. 6d.

Two reflectors, each adjusted to show an angle of 88 deg. 34 min. 3 sec., are fixed like those of an optical square, or may be formed of a reflecting prism, the faces of which are ground to show the same angle. The reflectors are secured in a case open on one side, and above each is an opening, through which objects in front of the observer are viewed direct.

**1417.** BENCH KNIVES OR HOLDFAST TOOLS, *H. Woodburne.—Dated 9th April*, 1879. 6d.

The tool has a bed plate with two pins which fit into grooves in the table or bench. The pins are serrated so as to hold firmly, and the holdfast lever is a metal bar bent at its outer end, and at its extremity formed with teeth.

**1418.** VENTILATING APPARATUS, *P. Jensen.—Dated 9th April*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2d.

The apparatus consists of a casing in which a fan is made to revolve by means of a helical spring. The casing has air inlet and outlet openings, and the fan draws the vitiated air through the former and out through the latter openings.

**1419.** LEAD AND CRAYON HOLDERS, *J. H. Johnson.—Dated 9th April*, 1879.—(*A communication.*) 6d.

A tube to receive the lead is formed with spring jaws at one end, and is capable of being moved longitudinally within an outer tube, so that the outside inclined surface of the jaws bearing against the end of outer tube will cause the lead or crayon to be nipped firmly.

**1420.** SETTING EYELETS OR STUDS IN LEATHER, *W. R. Lake.—Dated 9th April*, 1879.—(*A communication.*)—(*Complete.*) 6d.

The unflanged end of the eyelet is split into a series of divisions, which are turned over on the material and their edges pressed inwards upon the material. The tools to effect this consist of forming in the end of the clenching die or anvil a series of radial grooves with curved bottoms of uniform width and inclined sides, the inclined sides of one groove meeting the inclined side of the next groove at an acute angle, so as to form a cutting knife edge, each of which edges serves to split the end of the eyelet tube as the setting tools are brought together to clench the eyelet. In the upper end of the punch or male die a concave recess is formed of somewhat less diameter than the punch, that portion of the end of the latter outside the concave recess being so bevelled as to form an annular surface, slightly conical or inclined downward and outward, to first come in contact with the leather and be pressed into it as the punch is moved upward, and thus keep the punch from being sprung to one side and thrown out of line with the punch die.

**1421.** REDUCING AND PURIFYING ORES OR METALS FOR THE MANUFACTURE OF ORDNANCE, &c., *H. C. Bull, Lieut.-Col. W. Hope, and R. S. Ripley.—Dated 9th April*, 1879. 4d.

The process consists of reducing and purifying ores by means of heated gaseous blasts of defined chemical action passed through them, and which may be assisted by pulverised solid matter or vaporised liquids blown in with them; and for casting, pressing out flaws and blow-holes, and condensing or separating metals, alloys, and metalloids, or similar substances, by the agencies of gravity, centrifugal force, and abstraction of caloric.

**1422.** DUPLICATING OR COPYING ENGRAVED OR OTHER PLATES OR BLOCKS, &c., *W. R. Lake.—Dated 9th April*, 1879.—(*A communication.*) 4d.

This consists in the use of a cement composed of yellow oxide of lead (massicot) and glycerine for the rapid reproduction of engraved or raised surfaces, and for the reproduction of works of art.

**1423.** SAVING LIFE AT SEA, *A. Rolands.—Dated 9th April*, 1879.—(*Not proceeded with.*) 4d.

A raft is arranged on the deck of a vessel, so that should the latter sink, it will float off and afford a refuge for the crew. A cabin is formed on the raft, and above it is a deck through which water cannot penetrate.

**1424.** APPARATUS FOR WORKING WIRE ROPES, *W. H. Harfield.—Dated 9th April*, 1879. 6d.

To stop wire ropes a wedge with a groove on one side is employed, between which and a fixed groove block the rope passes. The other side of wedge moves on friction rollers kept in position by a lever jointed to the roller carriage, and one arm of which slides in a groove in the movable wedge, and the other arm moves in a groove in the fixed part or base of the stopper. The wedge piece is moved to nip the rope by a pinion working in a rack formed on the wedge.

**1426.** CASTING STEEL, *W. R. Lake.—Dated 9th April*, 1879.—(*A communication.*) 2d.

The processes of melting and pouring the steel into the ingot mould are similar to those heretofore practised, but instead of leaving the steel to shrink from the centre in cooling, a quantity of ignited charcoal is heaped over the top of the mould, so as to keep up the temperature, and cause the metal to flow in and fill up the centre as the shrinkage takes place in cooling.

**1427.** MINERS' SAFETY LAMPS, *W. Purdy.—Dated 11th April*, 1879. 6d.

Instead of a gauze cylinder a metal shell is placed above the glass of the lamp, such glass being longer than usual, and above it within the shell is a perforated metal rim with a perforated top, above which is a rim and plate of gauze, the whole secured by a screwed ferule. Above these parts the shell is perforated to allow the escape of heated air, and on top of the shell is an arched shed with a ring and swivel of usual construction. Below the glass is a gauze rim lining the neck of the gallery, which is drilled with holes, each inclining downwards from the outside to the inside, and below the neck is secured the reservoir and lamp.

**1428.** CHAFF CUTTERS, *R. Maynard.—Dated 10th April*, 1879.—(*Not proceeded with.*) 2d.

An endless chain or web is made to pass round the lower feed roller, and round a second roller placed in the rear, such web forming a casing for the lower feed roller, and by advancing the straw obviating the necessity of the feeder's hands being placed near the feed rollers.

**1429.** LOCOMOTIVE ENGINES, *J. Matthews.—Dated 10th April*, 1879. 6d.

Tramway and other locomotive engines are made with four coupled wheels placed inside the frame plates, and the whole of the driving mechanism is arranged outside the plates, and is covered with a close casing with doors for oiling. The exhaust steam is condensed by passing it into a closed box placed inside the water tank, and partly filled with water from the tank by an equilibrium valve. From the lower part of the box a pipe extends upwards and terminates in a nozzle at right angles to a second nozzle situated close to it, and communicating with the upper part of the box which is filled with steam. When steam issues from the latter pipe a jet of water is caused to issue from the former pipe and impinge on and condense the steam. A special coupling is described.

**1431.** CARDING WOOL, *J. Holden.—Dated 10th April*, 1879. 6d.

Five, six, or more opening card rollers are employed, and are arranged in two tiers, with one of the upper and then one of the lower acting on the fibre in succession. With each opening roller two working rollers are used, with or without strippers, with a bearing roller between the first, second, third, and fourth or more of the series. The opening rollers on which the fibres pass on the upper side require more room for the burrer than the others, and for this purpose are made of larger diameter, and in order to obtain more room for the two working rollers with their strippers each alternate opening roller is placed on a different level to its predecessor.

**1432.** SEWING MACHINE ATTACHMENT, *B. Hunt.—Dated 10th April*, 1879.—(*A communication.*) 6d.

This relates to an improved attachment, by which the needle has a lateral reciprocating motion imparted to it for the purpose of making lateral or zig-zag stitching. To the lower end of the needle bar is secured a block grooved to receive and guide a sliding plate, in the underside of which are openings to receive one or more needles. On the back of the plate are two lugs, between which projects a lower arm of a lever pivotted to a projection on the block. To the front of the head of the machine is secured a plate with an arm, from which projects a pin adapted to a curved slot formed near the upper end of a dog, the lower portion of which is made in the form of a pointed projection having inclined sides terminating at the top in shoulders. The upper end of the dog may have a projection thereon, or be in the shape of a blunt wedge for the action of a spring presser, which is adapted to a recessed stud secured to the arm of the plate.

**1433.** FURNACES, *E. Rowland and W. Varley.—Dated 10th April*, 1879. 6d.

The fire-bars are arranged in two sets, each alternate bar forming part of a separate set, and both being acted on by cams or cam shafts by rocking shafts fitted with suitable levers. The bridge is formed with an air passage communicating with the space below the grate, and opening into the space above the fire. In casting the fire-bars a metal chill is employed in conjunction with a sand mould.

**1434.** MACHINE FOR COVERING PILLS, *D. Cartner.—Dated 10th April*, 1879.—(*Not proceeded with.*) 2d.

The pills are placed in a spherical vessel mounted on the end of a shaft, which is caused to revolve. The sugar or other coating is placed in the vessel with the pills, and by the rotary motion the pills are coated.

**1435.** REAPING MACHINES, *E. G. C. Bomford.—Dated 10th April*, 1879. 6d.

The machine runs on two wheels, one at one side and the other near the middle, the latter serving to drive the machine. A circular fixed platform at the middle of the machine supports the cut grain. Four nearly vertical arms to bring and press the grain against the cutters are arranged in front or at one side of the machine, and are driven from the main shaft by a flange wheel and endless chain and worm wheel. The arms are either straight or curved to the radius of the rotating table, and their lower ends carry rollers which bear upon cams during the rotary motion of the shaft carrying them, so as to obtain the required depression as they are severally brought to act upon the grain. The top part of each arm slides on the other part, so that when it arrives at that portion of the machine between the divider and the rotation table the arm is lengthened and the grain cleared from that part of the machine. The knives or cutters are arranged around the periphery of a circular table which rotates slowly, the knives being operated from the main shaft by a crank and connecting link in the ordinary way. Over this table is the platform on which the corn falls and is carried forward to the binder by means of forks made to project through slots in the platform at the necessary intervals, and near the end of the platform is a deflector which turns the ears of grain towards the centre of the machine.

**1436.** SAFETY DRUM GUARDS FOR STEAM THRASHING MACHINES, *F. J. Hunt and G. H. Innes.—Dated 10th April*, 1879. 6d.

The drum guard consists of a slide and hood; the former is actuated by springs and arranged under the feed board, and rests on the top of the concave, being held back from covering the beaters by a lever and catch. The slide is released by the feed board or the hood being depressed when it slides out from under the feed board and covers the beaters.

**1437.** OPENER FOR BOTTLES CONTAINING AERATED WATER, *L. Rose.—Dated 10th April*, 1879.—(*Not proceeded with.*) 2d.

A short tube is fitted with a flange, to one side of which is attached a tube to close the mouth of the bottle without closing the first tube, and on the other side is a washer, so that when the tube is pressed down upon the stopper the washer will rest upon the lip of the bottle.

**1439.** DRYING FIBROUS SUBSTANCES, *L. Webster.—Dated 10th April*, 1879. 4d.

A close chamber heated by steam contains a series of chain pulleys, over which travel two endless chains. The hanks of yarn are stretched upon two cross bars extending across the chamber, and are attached at each end to the endless chains.

**1440.** SALT MILLS, *P. Moore.—Dated 10th April*, 1879.—(*Not proceeded with.*) 2d.

A cylinder is formed with serrations or projections on its surface and revolves with its axle. The salt is placed above the cylinder, and as it is ground falls into a box beneath.

**1441.** SHUTTLES, *W. Turner and E. Hoyle.—Dated 10th April*, 1879.—(*Not proceeded with.*) 2d.

At the end of the shuttle where the peg is usually fixed is placed a spindle provided with a collar at right angles to the axis of the spindle. On one end of the spindle is a spiral spring compressed between the collar and the body of the shuttle. The collar has two projections which fit into slots formed in the body of the shuttle, and the collar is shaped to fit the recessed portion of the shuttle and slide freely therein. At the front side of the collar is fixed a stay to the shuttles so that when the spindle is drawn back by the projections the groove in the flange of the bobbin passes on to the stay, and the end of the spindle at the front of the collar passes into the hole in the centre of the bobbin.

**1442.** INSTRUMENT FOR THE LINEAR MEASUREMENT OF DRAWINGS, *W. R. Lake.—Dated 10th April*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2d.

A wheel is connected with a system of gearing and with hands moving over dials, and denoting instantaneously the measurement of the line traversed.

**1443.** STEAM ENGINES FOR PUMPING, &c., *J. S. Stubbs.—Dated 10th April*, 1879. 8d.

A cylinder is formed with a pair of rotary three-way valves for admission and eduction of steam, which are operated from the piston crosshead by a rod and two quadrant cams. The exhaust steam is carried to a case fixed to the suction portion of the pump and admitted in a jet by means of a conoidal nozzle, thus creating a vacuum in the cylinder and heating the water to be pumped into the boiler. In place of a crosshead a circular piston slide is fitted to the piston rod and also to the connecting rod, such slide being fitted within an open cylinder which protects the moving parts. Belts are abolished for driving machinery, a wormed shaft, gearing with the main shaft and applied direct to the machinery, being substituted for such belts.

**1444.** PRODUCING PREPARATIONS OF ALUMINA, &c., *W. L. Wise.—Dated 10th April*, 1879.—(*A communication.*)—(*Not proceeded with.*) 4d.

According to one method lime or milk of lime is mixed with the alumina in the proportion of part alumina to one of lime. The mixture is dried and then heated. Several different methods are described for purifying the preparations of alumina after their employment in clarifying juices or fluids.

**1446.** PREVENTING AND EXTINGUISHING FIRES ON BOARD SHIP, &c., *A. J. Boult.—Dated 12th April*, 1879.—(*A communication.*)—(*Complete.*) 8d.

*This consists in drawing or forcing atmospheric air by means of a pump or equivalent mechanism, through a confined incandescent body or burning material to disunite the two elements that form and compose the air, and using both.

**1447.** CONTINUOUS BRAKES, *A. C. Boothby.—Dated 12th April*, 1879. 6d.

An electric current is applied direct to the brake blocks or to the brake shoes, so that when the current passes through the blocks, they being suspended near the wheels are attracted to and press upon the tires with a retarding force.

**1449.** APPLIANCES FOR DISCHARGING ORDNANCE, *J. Vavasseur.—Dated 12th April*, 1879.—(*Not proceeded with.*) 2d.

The charge is ignited at any desired point within its mass by means of electricity, without any vent or firing orifice being required.

**1450.** GAS ENGINES, *R. Hallewell.—Dated 12th April*, 1879. 8d.

This relates to high-pressure gas engines, and consists in providing such engines with passages and valves, which at suitable points in the outward strokes of the pistons permit of the flow of the gases from one side of each piston to the other, in order that the remaining pressure of the said gases shall aid in effecting the return strokes of the pistons.

**1451.** CLEANING WHEAT, &c., *J. Higginbottom and E. Hutchinson.—Dated 12th April*, 1879. 6d.

This consists of a series of discs or annular ledges either with or without vanes upon their upper or under surfaces, revolving inside a casing either solid or perforated, and upon which discs the grain is free to fall and lie till forced off by the centrifugal force into the narrow annular passage between the discs and the casing.

**1452.** PREPARING CLAY FOR BRICKS, &c, *J. Clayton.—Dated 12th April*, 1879.—(*Not proceeded with.*) 2d.

This relates to the arrangement and construction of a roller or rollers, on the periphery of which is placed a series of grooves or channels for the purpose of consolidating clay or like material in rolls, blocks, or slabs.

**1454.** LAMPS AND BURNERS, *G. Bray.—Dated 12th April*, 1879. 6d.

This refers to the causing of a column of air (other than what is required for the combustion and ventilating purposes) to flow vertically through the centre of street and other lamps.

**1455.** TRAMWAYS, *T. G. Hardie.—Dated 12th April*, 1879. 6d.

The rails and chairs are made in one piece and in long lengths. The rail may be made separate, and continuous chairs used, the two being secured together transversely by horizontal keys. The groove in the rail is vertical on the outside and bevelled on the inside so as to reduce the friction between the flange and rail. The points and crossings are secured to the rails by fishing provided on the crossing.

**1456.** APPARATUS OF CORK, &c., FOR OBTAINING BUOYANCY IN WATER, *H. R. Newton.—Dated 12th April*, 1879. 2d.

Slabs of cork are drilled with five holes through the centre longways, and as many of them as necessary are secured together by passing a double cord knotted and looped at one end through the centre hole of each slab, and bringing one of the cords up through the next hole on either side, knotting them together to form a long loop. Two sets thus formed are joined by a couple of ropes longer than the two sets together, and after passing them through the outer holes of each set they are knotted at each end so as not to run out.

**1457.** BREAKING DOUBLE TWISTS IN SPINNING, *A. C. Henderson.—Dated 15th April*, 1879.—(*A communication.*) 6d.

This apparatus consists of three principal parts, viz., First, a horizontal bar or rod bearing a number of loops or break twist dards so arranged on the bar as to occupy positions in the centres of the spaces between the threads. This rod or bar is parallel with the drawing and pressing rollers, and is in communication with a rack and pinion. Secondly, a horizontal bar placed in a plane perpendicular with the former, and bearing the rack. This bar slides in a guide of the frame of the loom, and is furnished with a triangle wedge or catch engaging in a block of the frame. Thirdly, a bar connected with the frame of the carriage at right angles with the second bar, and supplied with a platform bearing the spindle on which the spun thread is wound.

**1458.** Warming and Ventilating, *L. H. Hauber.—Dated 15th April*, 1879. 6*d*.

A number of stoves form a central heating apparatus with a heating chamber, the stoves being divided into series controlled separately, and each stove having controllable openings to admit air through a grid, such air when heated passing through flues and being distributed to the rooms to be heated.

**1459.** Dog Cart Seats, *R. Metcalf.—Dated 15th April*, 1879.—(*Not proceeded with.*) 2*d*.

The seat is mounted to slide to and fro to afford more accommodation for passengers and luggage and also to fold up so as to enable riders to get in and take their seats facing the horse without stepping over the back seat.

**1460.** Wick for Oil Lamps, *J. Freeman and A. E. Webb.—Dated 15th April*, 1879.—(*Not proceeded with.*) 2*d*.

Strips of asbestos are arranged within a casing of cotton, and drawn into a gauze wire exterior tube.

**1461.** Coats, *A. M. Clark.—Dated 15th April*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d*.

Besides the ordinary lining to the coat, an extra thicker lining is provided, which may be attached to the coat by hooks and eyes when the weather becomes very cold.

**1462.** Production of Glazed or Enamelled Materials, *J. H. Johnson.—Dated 15th April*, 1879.—(*A communication.*) 2*d*.

This consists in the employment, in the production of glazed or enamelled materials, of natural sandstones as a base for the coating of plain or decorated glaze or enamel.

**1463.** Swimming Apparatus, *E. G. Brewer.—Dated 15th April*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d*.

Blades hinged together are secured to the feet of the swimmer, so that when required they bear with the greatest surface on the water, and then fold over so as to present only a small surface for the return stroke.

**1464.** Embroidering, *C. A. Barlow.—Dated 16th April*, 1879.—(*A communication.*) 4*d*.

A rectangular frame is supported on bearings and counterbalanced by weights attached to cords passing over pulleys on a cross shaft. The frame supports bobbins containing silk or thread, and the frame is actuated by a crank and excentric. The silk is taken from the bobbins through two eyes and a steel guide, and is secured to the fabric to be embroidered by a few stitches. One eye can be moved to the right or left b a handle and rod to avoid touching the needle.

**1465.** Moulds for Stench Traps, &c., *J. H. and W. Sutcliffe.—Dated 15th April*, 1879.—(*Not proceeded with.*) 2*d*.

Gauge pins are used to ensure accurate relative positions of the cores, and at the mitres of the cores, are mitre or angle bits, which ensure full bore of pipe. The mould is hinged at one end and is turned into a nearly vertical position when running the lead in. A tool is employed consisting of a centre piece or mandril with an angle external cutter, which when rotated, pares the outer edge of pipe, or its inner edge according to the angle of the external.

**1466.** Looms, *J. Rollinson and J. Senior.—Dated 15th April*, 1879. 4*d*.

The needles are made in two parts with a recess in each to receive the jack, blade, or hook. A spiral spring is applied to one part, so as at all times to keep the needle and jack in close contact.

**1467.** Looms, *F. H. Coddington and J. Cocker.—Dated 15th April*, 1879.—(*Not proceeded with.*) 2*d*.

Fixed in a slot in the side of the shuttle box is a metal lever curved on each side its fulcrum, such curved parts projecting in the inside of the box, the outer ends being held by springs at the outside of the box. When the shuttle comes in contact with the first curve it depresses the same and moves the lever on its fulcrum, imparting to it a rocking motion and causing the second curve to project further until it is acted upon and depressed by the shuttle in its turn.

**1468.** Measuring and Weighing Grain, *W. Brierley.—Dated 15th April*, 1879.—(*A communication.*) 6*d*.

The scale consists of two beam arms and axles connecting them, centres being fitted to the axle, and in the same place with other centres fitted to the scale beam arms. When the weighing hopper is sufficiently charged the hopper descends and closes the inlet, the outlet to the weighing scale being opened at the same time, and the amount weighed being registered.

**1469.** Music and Duet Stool, *R. Dunworth.—Dated 16th April*, 1879.—(*Not proceeded with.*) 2*d*.

An oval or square ottoman has a stool in the centre, which can be raised to the ordinary height of a music stool, and when screwed down forms a duet ottoman.

**1470.** Mixing and Kneading, *E. Edwards.—Dated 16th April*, 1879.—(*Not proceeded with.*) 2*d*.

Over the mixing vessel rests a frame with arms to grip the upper edge of the vessel. A helical bar passes down through the frame and carries a crank handle at its upper end, the lower end revolving in a recess in the bottom of the vesssel.

**1471.** Preventing Horses from Gnawing Mangers, *J. Imray.—Dated 16th April*, 1879.—(*A communication.*) 4*d*.

This consists in the use of insulated electrical conductors so arranged on the edge of the manger that the horse in attempting to gnaw it completes a circuit and thereby receives a shock.

**1472.** Lace, *E. L. Devenière.—Dated 16th April*, 1879.—(*Complete.*) 2*d*.

This consists in the application in the manufacture of machine-made lace of two superposed "stumb" bars provided with either perforations or hooks, and working one and the same warp thread, the first of these bars regulating the movement of the latter between the apertures or hooks of the second and *vice versâ*.

**1473.** Looms, *E. Hindle.—Dated 16th April*, 1879.—(*Not proceeded with.*) 2*d*.

Two or more barrels and lattices are mounted and carried at suitable and equal distances apart by bearing plates or discs, the discs being carried by or working on a rod, which passes through the centre of same.

**1474.** Railways and Tramways, *J. Livesey.—Dated 16th April*, 1879.—(*Not proceeded with.*) 2*d*.

This relates to a means of securing rails to iron sleepers so as to dispense with detached or loose parts.

**1475.** Hoods and Reflectors for Fireplaces, *H. J. Haddan.—Dated 16th April*, 1879.—(*A communication.*)—(*Complete.*) 4*d*.

This consists of a frame having three parts hinged together and fitted with reflecting surfaces, whereby the heat may be thrown in any desired direction, the parts being secured in the required position. If the chimney smokes the apparatus is drawn outwards so as to form a hood, whereby a current of air is created sufficient to carry the smoke up the chimney.

**1476.** Telephones, &c., *H. J. Haddan.—Dated 16th April*, 1879.—(*A communication.*) 6*d*.

This relates to the combination of a telephone and a signalling apparatus in one instrument, and consists of one or more permanent magnets, which are used in common for the purpose of magnetising the cores of the telephone electro-magnets, and also to magnetise the cores of movable coils or electro-magnets used for the production of induced currents for signalling purposes.

**1477.** Telephonic Apparatus, *H. J. Haddan.—Dated 16th April*, 1879.—(*A communication.*) 6*d*.

This consists, First, in the combination with a telephone of a condenser; Secondly, in connecting two or more wires of a telegraph line running in the same direction and using them as a conductor; Thirdly, in grounding the wire of a telephone circuit at one, two, or more intermediate points, and in the insertion in the said ground wires of a condenser.

**1478.** Treating the Refuse of Towns, *A. Fryer.—Dated 16th April*, 1879. 8*d*.

This refers to an apparatus for the reduction by fire of cinders and vegetable and animal refuse of the type known as "Fryer's destructor," and for the utilisation of the heat produced by such combustion.

**1479.** Weaving Carpets, &c., *J. and J. R. Lawson.—Dated 16th April*, 1879. 6*d*.

This consists in a system of weaving carpets, wherein the pile material is inserted like weft across longitudinal wires, and is looped over the wires by means of warp threads acting successively.

**1480.** Employing Heated Air in Drying and Baking, *S. C. Davidson.—Dated 16th April*, 1879. 6*d*.

The apparatus consists of a drying chamber, into which sieves or other suitable carriers for the materials to be dried or baked are inserted. Between the sieves and the base of the drying chamber is a self-emptying hopper, which guides any of the material falling through these sieves into a receiving tray underneath.

**1482.** Spinning, *J. Tatham.—Dated 16th April*, 1879. 6*d*.

In order to form a firm cop upon the bare spindle an upward or downward motion is imparted to the copping rail. When desired to keep the threads at a given angle in passing from the guide wires to the travellers, guide wires or rings are caused to move with the up and down motion of the copping rail. When the cops are full, the rail being near the top of the spindle, the cops are lifted a little way, leaving the parts of the spindle bare. The tubes to form a support for the spun material are split longitudinally to facilitate their adaptation to the spindles.

**1483.** Manufacture of Boots and Shoes, *J. H. Johnson.—Dated 16th April*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d*.

This relates to an apparatus for nailing the heels to boots and shoes.

**1484.** Evaporating Saccharine and other Liquids or Juices, *M. Gill.—Dated 16th April*, 1879.—(*A communication.*) 6*d*.

This consists in blowing or forcing, cold or heated, moist or dry air in currents below the surface of heated liquids or juices, for the purpose of rapid evaporation.

**1485.** Decorative Painting, &c., *F. C. Canier.—Dated 16th April*, 1879.—(*Not proceeded with.*) 2*d*.

This relates to a process of decorating in imitation of all kinds of wood, marble, stone, agate, &c., by a transfer process.

**1486.** Refining Petroleum, &c., *W. R. Lake.—Dated 16th April*, 1879.—(*A communication.*) 6*d*.

This invention comprises a peculiar construction and combination of parts, and has relation principally to the construction of the furnace top and sides, which consist of an arch with curved sides, and to its combination with internal and external air flues.

**1487.** Counter Supports for Boots and Shoes, *W. R. Lake.—Dated 16th April*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d*.

Two plates of metal, formed to fit the sides of the counter, are placed between the two layers of leather.

**1488.** Hydraulic Cranes, *C. R. Parkes.—Dated 16th April*, 1879. 4*d*.

This consists in the box or pedestal travelling on wheels, and instead of the crane post to which the jib is fixed being inside the pedestal, it is placed on the outside, and revolves in brackets, one being placed at the upper end of the pedestal, and one at the lower, and the jib is fastened to the crane post near this bracket. The cylinder for lifting may be fixed inside the pedestal on the opposite side, to serve as a counterweight to the weight of the jib and the goods being lifted.

**1489.** Railways, *W. L. Wise.—Dated 16th April*, 1879.—(*A communication.*)—(*Not proceeded with.*) 4*d*.

The rails are secured together by cross bars, each end of which embraces one of the rails

**1490.** Manufacture of Turkey Carpets, &c., *A. Hildebrandt.—Dated 17th April*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d*.

A warp is formed by placing small groups of threads at intervals, varying with the length of the pile required. Into this warp, weft of the colour and quality required to form the pile in the fabric is introduced in such order and succession as required by the pattern.

**1491.** Travelling Cranes and Traversers, *G. A. Newton.—Dated 17th April*, 1879. 4*d*.

This consists in the manufacture of cranes or traversers with a separate engine geared into and working the traversing motion independent of the winding engine, instead of having one engine to do both actions.

**1492.** Pianoforte Action, *W. A. Waddington.—Dated 17th April*, 1879.—(*Not proceeded with.*) 4*d*.

A portion of the finger keys gives motion by a sticker to the hammer in the usual way, and the key also actuates a pusher connected with the key at its lower end. The inclined upper end of pusher acts against an incline at the lower end of the damping lever, which is armed with felt, where it bears on the string and turns on a pivot carried by a double comb, which also carries the hammer pivots, and is fixed on the hammer rail.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

*(From our own Correspondent.*

The upward movement in iron, in iron-making requisites, and in products of iron, continues. Last week closed with a further rise in galvanised sheets of £1 per ton, making sheets of 24 w.g. £18 and £18 10s. per ton, according to make, delivered in London packed in felt. The week opened with a further rise also in coal to the extent of 1s. per ton, making Earl Dudley's furnace coal 10s., and his forge coal 9s. per ton.

These advances strengthened all other descriptions of iron and minerals. To-day—Thursday—in Birmingham, and yesterday in Wolverhampton merchants sought to place orders, but were seldom able to do so upon the terms which they stipulated. They desired to buy large lots of marked bars at the current quotation of £8; but makers would look at only small orders accompanied with specifications. No maker would book forward at even a good rise on current rates. For sheets of the latens gauge £12 10s. was freely offered if the maker would deliver in February. This would make doubles £11 and singles £9 10s.; but makers would not accept the terms. Most of the sheet firms, indeed, required yesterday's terms, which were a rise upon the week of 10s. per ton, and left the minimum quotation for singles at £9. At that rise only small orders would have been accepted. Consumers, however, hesitated to buy. There were only five sheet iron makers who would quote at all. Neither hoops nor strips were to be bought, and only few bars, or angles or rods. Common bars were unobtainable at less than a rise of £1 10s. upon the late minimum, and medium bars have risen to within 15s., and occasionally 10s., of the quotations of the marked bar firms.

Good boiler plates continue to sell at the rates set out under "Prices Current" on another page. Common plates are steadily rising. This week they are further strengthened by the higher quotation in the Middlesbrough market, and by the difficulty constructive engineers find in buying from the Cleveland district even at the enhanced prices.

The preparations for increasing the output of finished iron last reported continue. Such preparations are the more pushed forward because the majority of the firms have still to deliver large aggregate quantities at the late minimum prices. This is equally applicable to the makers of pig iron.

Few of these would to-day accept the prices which they would have taken last Thursday; and those who a few weeks ago were lamenting their accumulated stocks were to-day rejoicing that they still had "a few thousand tons left." Already local pigs which lately could not secure £2, are easy to sell at £3; and other kinds for which £2 17s. 6d. was taken, are difficult to get at £3 17s. 6d. Men who last Thursday, after previous negotiation, secured good hematite pigs at £4, could not later in the day get them under £4 5s., even on the rapid delivery terms appertaining to the £4 contract. This week the higher price was equally imperative. Furthermore, the high class irons of South Wales are this week dearer by 7s. 6d. per ton than they were a week ago. Tredegar pigs, for instance, have reached 87s. 6d. by three equal stages, a rise of half a crown having been declared on Friday, on Saturday, and on Monday. And the progress which this iron has shown from within £3, as an exceptional minimum, the makers through their agents warned consumers yesterday and to-day will continue till £5 and even £6 is reached. The Thorncliffe brand sold yesterday at 70s. best quality, delivered at stations. This was a rise of 5s. upon the fortnight. Northampton pigs are similarly advancing. By circular received in this district yesterday the Glendon brand was put up 2s. 6d. per ton, making No. 4 good forge quality £3 7s. 6d., and No. 3 foundry quality £3 10s. At this figure Glenden pigs were offered on 'Change to-day in small lots.

Among the pig-making firms who are getting into full activity again is that of Messrs. H. B. Whitehouse and Co., all of whose three furnaces are once more in blast, and whose pits are being re-opened throughout the estate.

There is no slackening in the rate of movement upwards which has lately distinguished the mineral market. It is this week difficult to get all the Ulverstone ore which consumers require even at £1 4s. per ton at the pits. The recent minimum was 9s., and "Blue Billy," which not long since was plentiful at 3s. 9d. per ton at Runcorn, was not to be got to-day at under £1 per ton in limited quantities.

All the colliery-owners in the ironmaking localities are following Earl Dudley's lead as to large coal, but they are not all imitating his lordship in advancing slack 6d. per ton. The divergence in this particular is due to the fact that most of the other firms put up their slack to that extent when they, like their more powerful neighbour, advanced furnace coal from 8s. to 9s. Lord Dudley's slack is now from 5s. to 6s., according to quality. All the colliers outside the Cannock Chase district have had their wages advanced by the rise in large coal quotations. That rise carries an advance in wages to the extent of 3d. "per day," or stint, as to the men working in the thick-coal seams, and 1½d. "per day" as to those working in the thin-coal seams. This advance makes the total rise in their wages by the lead which the Earl of Dudley has taken, 6d. and 3d. per day respectively.

Neither in prices nor in wages is the Cannock Chase district immediately affected by the earl's proceedings. Cannock Chase coal is unaltered in price. Nor is there any intention by the leading colliery-owners to quickly advance quotations. All the collieries open on the Chase keep in active work, and special trains daily take the coal to the South of England.

Throughout the ironmaking localities an under supply of coal will shortly be giving rise to some inconvenience.

The meeting of the blast furnace proprietors held here this afternoon was an influential one, and was presided over by Mr. J. P. Hunt, chairman of the Trade Board. It was unanimously decided to advance the wages of furnacemen 10 per cent., the advance to commence from Saturday next.

The ironmasters have now definitely determined to postpone the hearing of the men's claim for an advance until the arbitrator shall have returned home. The operatives contend that if an advance should be awarded it ought to date from the 18th of November, the day subsequent to the notice last handed in. But the masters seem to be of the opinion that it should date from the expiration of the month's notice. This difference of view, however, is not likely to lead to much difficulty.

An effort to increase the ranks of the union is being made by the ironworkers' agent in South Staffordshire. Reorganisation among the men is advocated as a necessity. It is proposed that, under the new scheme, 3d. per week should be paid into the union by each man when puddling is 7s. per ton, 4d. when 8s., 5d. when 9s., and so on. The rate of payment, it is proposed, shall be correspondingly decreased as wages decline. The forming of lodges at the several works is being determined upon.

The operative tin-plate workers have met and decided to strictly adhere to the notice which they have given for an advance of wages.

Hardwares continue to advance. By two successive alterations of equal amounts the wrought iron tube makers of Wednesbury and Walsall have lately declared prices up to the extent of a reduction in discounts of 10 per cent. There is a distinct rise this week in patent nails. Wire has advanced, brass ¼d., and copper ¼d. per lb.

Edge tool and hoe manufacturers are not oppressed with work, and many firms would gladly book more orders. This branch has not hitherto been much advantaged by the American revival, but that revival will, it is expected, make slightly less difficult the efforts of the manufacturers to meet the United States competition in the Australian markets; and it is encouraging some makers to believe that they can produce tools which, notwithstanding the heavy duty, can be sold in the Southern States of the Union below American manufacturers' prices.

The wrought nail trade is in a very depressed state, and it is feared, notwithstanding the advance in wages which has just been secured by the operatives, the coming winter will prove a severe and trying time for them. A difficulty with spike makers has now been arranged satisfactorily.

A notice for an advance in wages, which I last week intimated had been determined upon, has now been served upon all the colliery owners in North Staffordshire who reduced wages during the past year. The principal exception is the case of the Earl of Granville, who, it is stated, has not reduced wages since 1877.

## NOTES FROM LANCASHIRE.

*(From our own Correspondents.)*

It seems now to be generally conceded that the improvement in the iron trade is settled upon a thoroughly healthy basis. Makers of both raw and finished iron are very firm in their prices, and during the past week there has been very little underselling on the part of merchants and dealers, some of whom are experiencing considerable difficulty in covering the sales they have made. The cheap lots which were offering in the market a short time back have for the most part disappeared, and as it is becoming increasingly evident that not only are present rates being fully maintained, but that there is every probability of their advancing still further, those who have iron to sell are showing a disposition to hold.

There was a strong market at Manchester on Tuesday, and a good deal of iron has been sold during the week, with better prices generally being obtained. There have been a considerable number of inquiries for forward delivery, but these sellers will not entertain except at a considerable advance upon present rates, whilst for prompt delivery there is only a limited quantity of iron now offering. The demand for forge iron is much in excess of present supplies, the local rolling mills being now so full of work that they are all pressing for deliveries. For foundry qualities there is also more inquiry, the upward tendency of the market inducing consumers when they have secured an order, however small, to cover themselves at once.

Lancashire makers of pig iron, as I pointed out last week, have recently booked considerable quantities of iron, and they are now so fully sold, particularly in forge, for the next three or four months, that they do not care to take further orders for any large parcels at present, notwithstanding the advanced rates which can be obtained. Rather more than the advance announced last week is now being asked, and for delivery into Manchester No. 3 foundry is quoted at 56s. per ton less 2½ per cent., but orders for forge iron have been refused at this figure.

The local market for outside irons is also firmer, and of some brands there are now but very small quantities offering here at all. Lincolnshire and Derbyshire irons particularly are scarce, and those who have any lots to sell are asking prices which are practically prohibitive, 60s. 6d. to 62s. 6d. per ton less 2½ per cent. being quoted for foundry qualities delivered into the Manchester district. Of north-country iron a considerable quantity has been sold, and g.m.b.'s for prompt delivery equal to Manchester have been bought at from 52s. 6d. to 53s. 6d. per ton net cash, but for forward delivery 2s. to 3s. per ton above these figures is being asked.

For finished iron there is a very brisk inquiry, and there has been a good deal of business doing for shipment. Manufacturers, however, are now so fully sold—some of them having actual specifications in hand that will keep them going for the next three months—that fresh orders are difficult to place, and prices as a consequence are very stiff, £7 10s. per ton being now about the lowest figure at which Lancashire bars are quoted for delivery into the Manchester district. Hoops and sheets are also in good demand, with high prices asked by makers.

Machinists are gradually getting better off for work. At present it is chiefly in the shape of repairs, rendered necessary by mills being re-started, but a few orders for new machinery, such as looms, are also now being given out. Engineers, as I have pointed out in previous reports, are also better employed than they were, and some improvement is reported amongst founders.

I understand that the Wigan Rolling Mills, which were lately in liquidation, are to be re-started at the commencement of next year under new proprietorship.

In the coal trade there is generally a better tone, although the improvement is still only very gradual. The demand has not yet increased to the extent to cause any actual pressure for supplies to be generally felt, and many of the pits are still only working eight to nine days a fortnight. House fire classes of fuel are naturally moving off more freely, in consequence of the colder weather, and there is also a steady improvement in the demand from works for the common classes of round coal for steam and forge purposes, but burgy and slack are without material change. In prices there has been a stiffening up with the commencement of this month, those firms who did not advance in November having generally done so this month, and the average quotations at the pit are about as under:—Best Wigan Arley, 9s. to 9s. 6d.; inferior sorts, 7s. to 7s. 6d.; Pemberton four feet, 6s. 6d. to 7s.; common round coal, 5s. 6d. to 6s.; burgy, 3s. 9d. to 4s. 3d.; good slack, 2s. 9d. to 3s. 3d.; and common, 2s. to 2s. 6d. per ton.

For coke an improved demand is maintained with more firmness in prices.

The applications for an advance of wages which have been sent into the Lancashire colliery proprietors by their men expire this week, but from what I can hear there is not much probability of the matter being entertained, at least for the present.

The demand for hematite pig iron has improved, both on American, continental and home account, and as makers are not in a position to deliver much metal in respect to new orders, prices have had another advance, and now stand at 82s. 6d. per ton for all round qualities of Bessemer iron, 77s. 6d. per ton for No. 3 forge, and 75s. for Nos. 4 and 5, on trucks at makers' works. Iron ore stands at 20s. to 22s. per ton at the mines for blast qualities, and 21s. to 25s. for puddling descriptions. Steel has also advanced in value to a commensurate extent; but as makers are not able to accept contracts requiring early attention, the high quotations in the market do not mean very much. Shipbuilders, engineers, finished iron workers, and others in the general trade, are better furnished with work than of late. Iron ore is in large consumption, and is still difficult to buy. There is a stiffening tendency in coal and coke.

With a view of facilitating the transit of material to and from the docks at Workington a new seashore railway has been constructed, which will be found of great advantage.

It is reported that last week 25,000 tons of iron ore were sold in the Cleator district at 20s. per ton.

The Wyndham Company is now putting down a second shaft at its iron mines in Cumberland, anticipating a greater find of ore than it came across in its first sinking.

Mr. Stirling is opening out a new iron ore pit at Crossfield, in Cumberland.

One of the furnaces at Parton has been put in blast, and the other is being prepared. The works have been standing idle for some time.

It is anticipated the new docks at Maryport will cost £100,000. The Moresby Coal Company is contemplating sinking three more pits in Cumberland, one near Walk Mill, another at Castlerigg, and a third at Distington. It is also going to have a branch line of railway from the Walk Mill pit to Rowrah, so as to be in a position to supply the mining district there with coal.

The third new furnace belonging to Messrs. Bain and Co. was blown in at Harrington last week. The company intend to demolish the only old furnace now standing and erect one in its place.

## THE SHEFFIELD DISTRICT.

*(From our own Correspondent.)*

ALTHOUGH there is still great activity in the iron trade, and prices are fairly well maintained, I notice a tendency towards less firmness, and some mistrust. I anticipated some time ago that the remarkable reaction which then took place might be followed by a temporary lull, and that this change for the worse would not be of a very general character, and would, in all probability, be followed by a still greater briskness than had taken place at the time. I think we are on the eve of the temporary lull of which I spoke, but I am informed, in trustworthy quarters, that it will not be, to any extent, calculated to raise serious apprehensions of a reverse in trading activity. In fact, a revival is apparent throughout almost every branch of local industry, except the coal trade. Another significant fact is this—that the increased activity is not merely with America, or Russia, or Germany, but with almost all the markets of the world.

Sheets and plates for boilers and ships are still in very great demand at the advanced prices already noted. Light rods and bars are but sparingly inquired after.

The Parkgate Iron Company, Limited, report that they have obtained a large share of the increased orders in the market, and smelting furnaces, which have for a long time been disused are again in full blast. In rails there is still a very large business doing. Messrs. Chas. Cammell and Co. are actively employed on contracts for the Indian Government, and they have also heavy orders in hand for New South Wales. At other rail mills full time is being worked not only on orders for this country, but also for the Continent and the colonies. All kinds of railway materials, wheels, tires, axles, springs, &c., are freely inquired after.

Bessemer ingots are slowly rising in value, especially marked descriptions intended for the cutlery trades. The mills in the district have orders in hand which indicate that the improvement will be prolonged well into next spring. The annexed are a few quotations at the works;—Bessemer ingots, £6 10s. to £9; common cast, £9 to £10; spring steel, £10 to £12; better class, £12 10s. to £18s.; crucible steel, £20 and upward; Bessemer sheet, £12 to £16; common tool steel, £14 to £16; superior, £17 to £24; best specials, £45 to £60; fine rolled steels for clock springs, £60 to £70. Irons: Yorkshire, rolled, common, £7 to £8; best, £9 to £10 10s.; single sheets, £11 to £13.

The Lincolnshire Iron Smelting Company, Limited, which is of considerable interest to the trade in this district, held its eighth general meeting at Frodingham on Thursday. While they admit the severity of the depression in the iron trade until the end of September last, they now state that the turn for the better is very gratifying, and the directors are confident of making a good profit during the coming year.

Mr. E. Traw, trades union secretary, has sent out a circular to the ironworkers of Great Britain cautioning men not to emigrate to America with a view to work in the iron trade before they are satisfied there is work for them. He quotes a letter received from a leading ironworker's official in the United States, which says that a great number of English, Scotch, and Welsh ironworkers who have emigrated have not been able to obtain work. It is further stated that delusive hopes are held out to get British ironworkers to go to America, thereby having a surplus of labour, in order to keep down wages. Hundreds of workmen previously in the iron trade are reported to be waiting in America for an opportunity to obtain work.

In the cutlery branch there is a good demand for India and Australia, and the Levant trade is just opening. South American markets are sending forward inquiries which will lead to business within two months.

Edge-tool and file houses report better advices from Canada, East Indies, and the States, and there are indications that stocks in New Zealand and Australia must be running low. The sudden advent of winter, and the keen frost of last week, has induced the skate makers to go largely into that branch, and as it is expected that we are about to have a severe winter, this trade will be exceedingly profitable and extensive. Last year the stocks were speedily cleared from the shelves, and the demand which suddenly sprang up could not be met.

In the coal trade there is no change for the better. Household sorts continue to be in demand for the London market and also for the Eastern counties. On the 1st inst. an advance took place in the prices, and the following are the present quotations:—Best branch coal, 14s. 6d.; Silkstone, 12s. 11d.; seconds, 9s. 7d.; nuts, 8s. 6d.; slack, 5s. 6d., showing an average advance during the past month of 13 per cent. A number of houses which for a month past have held these rates still adhere to them, and firms who have not quoted up to this estimate until now have adopted the terms above indicated.

The dispute in the coal trade at Birley—Sheffield Coal Company—still remains unsettled, but the masters are slowly filling up the places of the men with hands from Lancashire and other parts.

## THE NORTH OF ENGLAND.

*(From our own Correspondent.)*

THE trade of the Cleveland district generally has received an additional impetus during the last few days. Pig iron is in greater demand, and, consequent upon the fact that manufactured iron makers are able to obtain greatly enhanced prices in their department, they are willing to give increased rates for pig iron, and are anxious to buy at once. For immediate delivery No. 3 is selling at 44s. 6d. net cash, while contracts are being entered into for delivery over the first three months of next year at 47s. 6d. Forge iron is in great request, and makers were able to sell at 45s. 6d. delivery next year. Messrs. Connal and Co.'s Middlesbrough stores now contain 95,250 tons, and they are receiving from 300 to 500 tons daily.

The North-Eastern traffic returns last week showed a general increase of £2369. There was a decrease of £1174 on cattle and merchandise traffic, but an increase of £2864 on mineral traffic, and increases on the passenger and dock dues departments.

It is stated that the Norton furnaces, six in number, will shortly be put into blast. They have been out of blast for three years. Mr. Williams is superintending the renovation of the Linthorpe furnaces, which will probably be ready for blowing in by the spring of next year.

The enginemen and mechanics employed at and about the Cleveland mines held a meeting on Saturday last at Saltburn, to consider the offer of the mineowners in response to their application for an advance of wages. The enginemen sought an advance of 15 per cent., but after discussion reduced the demand to 10 per cent. The mineowners offered the same terms as they have accorded to miners paid datal wages, namely, 8 per cent. on a sliding scale. This the enginemen and mechanics refused to accept, and declined any terms that did not include a readjustment of hours. The matter is at present no further advanced.

The coal trade presents features of briskness. The first examination of the owners' books by accountants under the sliding scale arrangement has been made. The result is that wages will remain unaltered for the present. Prices are now beginning to advance. The prospect of manufactured ironworks starting early next year is giving a decided impetus to sales. Coke is also in good demand and is rising in price.

The manufactured iron trade continues to improve. On Monday night Messrs. Dorman, Long, and Co., who have leased the Britannia Ironworks to carry on in connection with their own --the West Marsh—lit up twenty puddling furnaces. They intend shortly to increase that number, and in all probability by Christmas will have nearly sixty working. The Moor Ironworks at Stockton are being prepared for re-starting.

The works of the late company of Messrs. Jones Bros., Limited, are being carried on with energy by the liquidator pending the re-construction of the company.

The large concern of Messrs. Hopkins, Gilkes, and Co., Limited, in liquidation, is likely to be re-constructed. I understand the liquidator has under consideration a scheme for re-construction which will probably end in the fine works of the company being made available for the production and manufacture of iron again within a few months.

The iron shipbuilding trade is brisk, and apart from the severe frosty weather which is now being experienced, and which has partially stopped work in some of the yards, the employment of labour is very greatly increased.

The engineering trades are beginning to experience the beneficial change which appears to have gone through the various branches of the iron trade, and are receiving orders and inquiries on a much larger scale than could have been anticipated a few weeks since. At some of the works additional hands have been set on.

Messrs. Smith and Stoker will commence working at their large new foundry on Monday. They have plenty of orders on their books.

The Rosedale and Ferryhill works and the Loftus Iron Company's Works are in the market. The present is deemed to be a favourable time for disposing of them.

The Witton Park puddling furnaces of Messrs. Bolckow, Vaughan and Co., are working briskly. On Saturday last they were compelled to apply to Middlesbrough for about 125 puddlers and underhands.

The returns of the Cleveland Ironmasters' Association for the month of November have just been issued. They do not show such a favourable state of affairs as the returns of the past two months, but taking into account all circumstances, they bear out the belief in a permanent revival of this branch of the iron trade. The total make of iron during the month was 169,358 tons, as compared with 164,084 tons in October, an increase of 5274 tons; there is an increase in makers' stocks of 2349 tons, an increase in public stores of 8455 tons. Warrant stores are assuming great proportions. They now hold 172,536 tons of total stocks, which amount to 282,487 tons. There are now 93 furnaces in blast out of 105 built; the number of furnaces in blast exactly tallies in the November, 1878. Shipments to foreign ports show an increase of 11,031 tons upon those in November last year, and coastwise an increase of 1547 tons. They are, however over 30,000 tons less than in October last.

## NOTES FROM SCOTLAND.

*(From our own Correspondent.)*

THE pig iron market has been very animated in the course of the past week, with a large business at advanced prices. Although the shipments of pigs abroad are about 1500 tons less than in the preceding week's return, the demand on American account is again better, and it is understood that a number of good orders have been secured for forward delivery. The great activity in the various departments of the iron trade has also tended to strengthen the pig iron market. During the past week a very large delivery of pigs into store took place, and Messrs. Connal and Co. have now under their charge upwards of 390,000 tons. At the ironworks the furnaces to the number of ninety-nine are all kept busy.

Business was done in the warrant market on Friday morning at from 59s. 7½d. to 58s. 10d. cash, and 60s. for fourteen days and one month, the afternoon's transactions being at from 59s. 7½d. to 59s. 10½d. cash, and 60s. to 60s. 1½d. one month. On Monday the market was very strong all day, and a large business was done in the forenoon at 60s. 6d. to 61s. cash, and in the afternoon at 60s. 10½d. to 61s. prompt. The market was less animated on Tuesday, when transactions took place at from 61s. cash, and 61s. 4½d. one month to 60s. 3d. cash and 60s. 7½d. one month. The market was flat all day on Wednesday at about 59s. cash. The feeling was comparatively flat to-day at 58s. 7½d. one month and 58s. 4d. cash.

The inquiry for makers' iron has been good, and prices are all advanced, the increase ranging from 2s. to 4s. per ton.

For all kinds of malleable iron the demand continues very heavy, and the result has been a general advance this week of 10s. per ton. Bars now sell at £7 10s., and nail rods at the same figure per ton. The plate mills are likewise exceedingly busy, and the manufactured iron trade through all its branches is experiencing the effects of the revival.

There is little improvement in the coal trade as regards the West of Scotland. The severe weather has induced a better demand for home consumption, but the shipping trade is in a very unsatisfactory condition. This state of matters is largely due to the effect of the wages disputes. In the Eastern mining counties, and especially in Fifeshire, there is much more activity in the trade, and the complaint is that ships can not be got away from some of the ports quickly enough. The explanation of the activity here is that the miners' wages have not been advanced, and the coalmasters are therefore in a position to sell at lower quotations than in the West.

The ironmasters have now put into force their reduction of 6d. per day in the wages of the miners in their employment, but the colliery-owners, who supply the open market, have deferred enforcing the latest or third reduction of 6d. for a few days, in order to give the society an opportunity of removing the "blocks" from the works which are ballotted out. It is probable that this will be done. The miners now appear to realise that their demands were exorbitant, and they have voted by a majority a resolution to the effect that the strikes shall end, and that a change should be made in the constitution of the central board, who have been carrying out the opposition against the employers.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

A CARDIFF shipper tells me that he has never known such a peculiar condition of trade as that which now obtains. Buyers are eager, and a great deal more business could be done, but sellers are very cautious, and nothing beyond three months is regarded with favour unless some small advance is noted. The prospects of that advance are getting more defined and hopeful. Both in South Wales and the Forest of Dean prices of house coal are gone up, in many cases 1s. per ton. Coke, too, is from 2s. to 2s. 6d. per ton higher, and makers have sold all their make for the remainder of the year at the advanced price, that is excepting a few who were incautious enough to conclude contracts some time ago at the minimum price. These movements may be taken as the forerunner of an advance in steam coal as soon as the make of iron has necessitated a fair increase in the consumption of coal.

The exports of coal from Cardiff now exceed those of Newcastle, the foreign exports during October being 60,000 tons more than the northern port. In the month of October the returns just completed show that Cardiff sent 364,385 tons of coal, 12,000 tons of iron, 2804 tons of coke, and 9407 tons of patent fuel. It may be fairly expected that the two first items will be greatly increased. The large collieries now opened out have not been worked with anything like spirit, in consequence of business arrangements being incomplete. When all are in steady working we shall in all probability see 400,000 tons a month shipped from Cardiff alone.

The exports of iron are gratifying. Upwards of 5000 tons were sent away last week from all Wales, and out of this Newport has sent 2400. Singularly enough the total manufactured iron sent out was equalled by the total Spanish ore received. Those who bought largely and stocked in the dull times, such as the Dowlais and Rhymney, are now receiving the benefit of their foresight, for it is difficult to get a cargo even at 17s. 9d., the last quotation. This is an advance of 2s. 9d., for prior to the movement in the iron trade it was possible to buy for 15s.

A gentleman from Quebec visiting Cardiff states that the American agents in London were too sharp for English and Welsh ironmasters. In one inquiry, he said, before the British public knew what was coming, they had bought to the extent of 500,000 tons rails, pigs, and bars. The result of this is that it will be some time before the flush of trade will result in general benefit.

Swansea is putting out its best powers in tin-plate. I saw the make last week at one of the principal works in the Tawe Valley, branching from Swansea, and was told the make for months was sold at an advance of 9s. per box over the old quotations of 15s. ordinary coke. The ruling price is from 22s. to 24s. 6d. ordinary coke, best commands 28s. There are thirteen tin-plate works in the neighbourhood of Swansea and all well filled with orders. Swansea has been successful, too, I find, in getting a leading steamship company to use anthracite—the Royal Mail Steamship Company. The report of this is favourable, and quantities are now being sent to Southampton.

Newport continues to keep up a good average of coal exports, that of last week being 24,000 tons; and its coastwise shipments are very good.

Messrs. Cory and Co. have purchased a new steamer for Cardiff.

The masters and men have had another meeting at Cardiff on the subject of an improvement in wages, but with no alteration of result from the previous meetings. If colliers would consent to the adoption of a sliding scale some benefit might result. As it is, masters have no incentive to push up prices, as the action of the men would neutralise their efforts, or render them unproductive.

Some of the mills and forges at Booker's Works were started this week. The furnaces will be put in blast as soon as there is a sufficient accumulation of material. For the present I note that there is ample pig iron on the banks to keep the mill busy.

Cyfarthfa is pushing on briskly, and shipped a second cargo of rails this week.

KING'S COLLEGE ENGINEERING SOCIETY.—At an ordinary meeting of the above Society, held on Friday, November 28th, 1879, a paper on "Lathes and Turning," by Mr. S. E. Blackburn, S.I.C.E., hon. sec. to the Society, was read, Professor Shelley, H.I.M.E., &c., in the chair. The author began by describing some of the woods used in turning, after which he gave an account of the lathe from the remotest to the present date—the chucks used for both metal and wood turning—dwelling on those chucks and cutting frames used in ornamental turning. Both the hand-tools and slide rest tools were next described—the points which should be attended to when using them—also the different methods for supporting the latter. Mr. Blackburn then described the methods of centreing circular work, viz., the ordinary, Mr. Kilburn's, and Mr. Hales' methods. He then showed how the driving bands should be joined, and concluded by giving an account of the screw-cutting lathe, describing Sir J. Whitworth's screw-cutting lathe, and giving the rule for finding the diameters of change wheels, at the same time describing the system. After the reading of the paper, Professor Shelley passed a vote of thanks to Mr. Blackburn for his paper, and made a few remarks. The meeting adjourned at 5.15 p.m., after a vote of thanks being passed to Professor Shelley for having so kindly taken the chair.

WATERWORKS IN AUSTRALIA.—The following return to the order of Mr. Simms, giving information as to the total expenditure and the annual cost of maintenance, with other particulars in connection with the old and new reservoirs, was laid on the table of the House of Assembly on Tuesday, October 7th:—(1) The total expenditure on the Hope Valley Reservoir has been £163,000, and on the Thorndon Park Reservoir £57,700. (2) On September 27th, of the present year, the former reservoir contained 32ft. 4in. of water. (3) The Government do not propose to complete the new reservoir by properly claying and otherwise repairing it. (4) By the end of February next reservoirs will be ready for use at North Adelaide, Magill, Burnside, and Mitcham. (5) The annual amount received on account of the Adelaide Waterworks was £22,125 17s. 7d.; Suburban ditto, £14,001 15s. 7d.; Port ditto, £2881 8s. 7d.; Glenelg ditto, £1532 14s. 5d. (6) The receipts for the year 1879-80 amounted to £40,541 16s. 2d., and the expenditure to £23,387 4s. 4d., making the total net receipts £17,154 11s. 10d. The interest paid during the year was £23,914 18s. 8d., making a total amount paid on account of interest above receipts of £6760 6s. 10d. (7) and (8) The cost of collection was £1985, and of management and other incidental expenses, £21,402 4s. 4d. (9) The smallest quantity of water stored in the Hope Valley Reservoir during 1878-9 was 9,000,000 gallons on April 28th, 1879, and at Thorndon Park Reservoir 60,750,000 gallons, on May 2nd of the same year. (10) The quantity of water stored in the Hope Valley Reservoir was, on September 29th, 1879, 264,500,000 gallons, and in that of Thorndon Park, 125,450,000 gallons.

# PRICES CURRENT OF IRON AND STEEL.

The following prices are corrected up to last night, but it should be borne in mind that in many cases makers are prepared to quote different terms for special contracts. It is obviously impossible to specify these cases and terms, or to give more than the market quotations and makers prices. Readers should also refer to our correspondents' letters.

In almost all markets prices are advancing, and the following prices are subject to immediate change.

## PIG IRON AND PUDDLED BARS.

| | £ s. d. |
|---|---|
| **Scotland—** | |
| G.m.b.—No. 1 | 3 2 0 |
| No. 3 | 2 19 0 |
| Gartsherrie—No. 1 | 3 5 6 |
| No. 3 | 3 1 0 |
| Coltness—No. 1 | 3 9 0 |
| No. 2 | 3 1 6 |
| Summerlee—No. 1 | 3 5 0 |
| No. 3 | 2 19 6 |
| Langloan—No. 1 | 3 5 0 |
| No. 3 | 2 19 6 |
| Carnbroe—No. 1 | 3 5 0 |
| No. 3 | 2 19 6 |
| Monkland—No. 1 | 3 2 0 |
| No. 3 | 2 19 9 |
| Chapelhall—No. 1 | 3 2 0 |
| No. 3 | 0 0 0 |
| Clyde—No. 1 | 3 2 6 |
| No. 3 | 2 12 6 |
| The above at Glasgow, deliverable alongside. | |
| Govan—No. 1 | 3 2 0 |
| No. 3 | 2 19 0 |
| At Broomielaw. | |
| Calder—No. 1 | 3 5 0 |
| No. 3 | 3 0 0 |
| At Port Dundas. | |
| Glengarnock—No. 1 | 3 5 0 |
| No. 3 | 2 19 0 |
| Eglinton—No. 1 | 3 2 0 |
| No. 3 | 2 17 6 |
| Dalmellington—No. 1 | 3 2 0 |
| No. 3 | 2 17 6 |
| At Ardrossan. | |
| Carron—No. 1 | 3 2 6 |
| Do., specially selected | 3 5 0 |
| No. 3 | 3 0 0 |
| At Grangemouth. | |
| Shotts—No. 1 | 3 5 0 |
| No. 3 | 3 0 0 |
| At Leith. | |
| **Cleveland**—Prices at works— | |
| No. 1 | 2 12 6 |
| No. 2 | 2 10 0 |
| No. 3 | 2 7 6 |
| No. 4, foundry | 2 4 6 |
| No. 4, forge | 2 5 0 |
| Mottled | 2 2 6 |
| White | 2 2 6 |
| Thornaby, No. 3 | 2 12 6 |

**Monmouthshire**—Tredegar No. 3 tin-plate pig iron, 60s. 0d. at works, less 2½ per cent. discount.

„ Tredegar No. 3 foundry pig iron, 50s. 0d. do.

| | £ s. d. | £ s. d. |
|---|---|---|
| **Wales**—No. 2, f.o.b., Newport | 2 15 0 to | 0 0 0 |
| Forge, at works | 2 15 0 to | 3 0 0 |
| 40s. per ton for rail quality. | | |
| Common pig, at works | 2 15 0 to | 0 0 0 |
| **Derbyshire**—No. 1, at Sheffield | 2 4 0 to | 2 6 0 |
| No. 3 | 2 0 0 to | 2 4 0 |
| **Lancashire**, delivered in Manchester—No. 3 | 2 16 0 to | 0 0 0 |
| „ „ „ „ No. 4 | 2 16 0 to | 0 0 0 |
| K. H. Messelmoun | 5 0 0 to | 0 0 0 |

Messrs. Whitwell and Co.'s Stockton net prices (on trucks) are—"Thornaby" No. 4 forge, £3 10s. 0d.; 'B Thornaby," £3 15s. 0d. net. Thornaby hematite (Bessemer), £4 5s. 0d.

| | £ s. d. |
|---|---|
| **Hematite**, at works, 2½ dis. for prompt cash. | |
| Millom "Bessemer"—No. 1 | 3 10 0 |
| No. 2 | 3 7 6 |
| No. 3 | 3 5 0 |
| Ordinary No. 3 | 3 5 0 |
| No. 4 | 3 4 0 |
| No. 5 | 0 0 0 |
| Mottled | 3 0 0 |
| White | 3 0 0 |
| Maryport Hematite—No. 1 | 3 10 0 |
| No. 2 | 3 7 6 |
| No. 3 | 3 5 0 |
| No. 4 | 3 5 0 |
| No. 5 | 3 5 0 |
| Mottled and white | 3 5 0 |
| "Bessemer"—No. 1 | 2 12 6 |
| No. 2 | 2 10 0 |
| No. 3 | 2 7 6 |

### Puddled Bar—

| | £ s. d. | £ s. d. |
|---|---|---|
| **Wales**—Rail quality, at works | £4 0 0 to | 5 0 0 |
| **Cleveland**, delivered | 3 15 0 to | 3 17 6 |
| **Fox, Head, and Co.**, 16in., plate quality, per ton | 4 10 0 to | 0 0 0 |
| **Lancashire**—Pearson and Knowles Coal and Iron Co. | 5 10 0 to | 6 0 0 |
| **Glasgow**, f.o.b. | 7 0 0 to | 7 10 0 |

## MANUFACTURED IRON.

### Ship Plates—

| | £ s. d. |
|---|---|
| **Pearson & Knowles Co.**, best, 2½ dis. for cash | 8 10 0 |
| **Glasgow**, f.o.b. | £7 10 0 to 8 0 0 |
| **Wales**—At works, net | 7 5 0 to 0 0 0 |
| **Fox, Head, & Co.**, at works, cash less 2½— | |
| Ship or bridge plates (A) | 8 0 0 |
| Mast plates (A/MAST) | 8 10 0 |
| Best | 8 10 0 |
| Best best | 9 0 0 |
| Superior do. (AA/MAST) | 9 10 0 |
| Best best best | 11 0 0 |

### Boiler Plates—

| | £ s. d. |
|---|---|
| **Welsh** | 6 5 0 to 0 0 0 |
| **Pearson and Knowles**, to 5 cwt. each plate | 9 10 0 to 0 0 0 |
| Do. best best | 10 10 0 to 0 0 0 |
| Do. treble best | 12 10 0 to 0 0 0 |
| Sheffield | £10 5 0 to 12 10 0 |

2½ per cent. discount for cash. The Pearson and Knowles Co.'s prices of finished iron include delivery at station in Liverpool, Manchester, or Warrington, in lots of not less than 2 tons, or free alongside at Liverpool in lots of 10 tons and upwards.

**Bowling and Low Moor**—
Terms in each case 2½ dis. for cash in payment of monthly accounts, or 1½ per cent. dis. for cash in lieu of three months' bill. The Low Moor Co. and the Bowling Iron Co., Limited, deliver in London at 10s.; Liverpool, 7s. 6d.; and Hull, 5s. per ton extra.

| | £ s. d. |
|---|---|
| Under 2½ cwt. each | per cwt. 1 2 0 |
| 2½ cwt. and under 3 cwt. | 1 3 0 |
| 3 cwt. „ 3½ cwt. | 1 5 0 |
| 3½ cwt. „ 4 cwt. | 1 7 0 |
| 4 cwt. „ 5 cwt. | 1 10 0 |
| 5 cwt. „ 6 cwt. | 1 13 0 |
| 6 cwt. „ 7 cwt. | 1 16 0 |
| 7 cwt. and upwards | 1 19 0 |

Plates exceeding 6ft. wide, 2s. per cwt. extra. All plates differing from a square form or regular taper, or when over 20 per cent. is cut away, extra per cwt. 3s.

"Bowling" weldless hoops, for strengthening boiler flues, £1 14s. per cwt.

**Taylor Bros.'** boiler plates 6d. per cwt. less; their terms as Low Moor.

| | £ s. d. |
|---|---|
| "Monmoor" (E. T. Wright and Sons). Best, to 5 cwt., to 4ft. 6in. wide, and to 32 superficial feet, per ton at works | 9 10 0 |
| Best best | 10 10 0 |
| Best best best, to 4 cwt. | 12 10 0 |
| Special, to 3 cwt. | 16 0 0 |
| Usual extras for overweight, sketches, &c. | |
| **Barrows and Sons**— | |
| B.B.H. Bloomfield plates | 10 0 0 |
| „ Best plates | 11 0 0 |
| „ Best best plates | 12 0 0 |
| **Fox, Head, and Co.**, at works, cash less 2½— | |
| Boiler shell plates, best boiler | 9 0 0 |
| Flanging plates, best best boiler | 10 0 0 |
| Do., special quality, best best best boiler | 11 0 0 |
| **Glasgow**, f.o.b. | £8 0s. to 8 10 0 |

### Angle Iron—

| | £ s. d. |
|---|---|
| **Bowling and Low Moor**, terms as above. | per cwt. |
| L and T iron, not exceeding ten united inches | 1 2 0 |
| For each additional nch extra per cwt., 1s. | |
| **Barrows and Sons**— | |
| B.B.H. best angle iron, at works | 10 0 0 |
| **Pearson and Knowles**—less 2½ per cent. for cash— from 1 by 1 by ¼ to 3½ by 3½, per ton | 9 10 0 |
| Best boiler do., per ton | 9 0 0 |

| | £ s. d. |
|---|---|
| **Whitwell and Co.**, less 2½ discount, per ton | 7 10 0 |
| Best | 8 0 0 |
| Best best boiler | 9 0 0 |
| "Monmoor," at the works, up to eight united inches | 8 5 0 |
| Best do. | 9 5 0 |
| Best best do. | 10 5 0 |
| T-iron, as above, 10s. extra. | |
| Angle and T bars, 8in. to 9in., 10s. extra. | |
| „ „ 9in. to 10in., 20s. extra. | |
| **Round Oak**— | |
| Ordinary | 9 2 6 |
| Best | 10 10 0 |
| Double best | 12 0 0 |
| Treble best | 14 0 0 |
| **Cleveland** | £7 0s. to 7 10 0 |
| **Welsh**—"Best best" angles from 1½×1½×5-16 to 3in. | 6 10 0 |
| Also T-iron, f.o.b. less 2½ and 1 per cent. | |
| **Glasgow**, f.o.b. | £7 0s. to 7 10 0 |
| **Aberdare** | 7 0 to 8 0 0 |

### Bar Iron—

**Low Moor and Bowling**, terms as for plates, &c.—

| | Per cwt. £ s. d. |
|---|---|
| Flat, round, or square, to 3½ cwt. | 0 19 0 |
| Do., 3½ to 5 cwt. | 1 0 0 |
| Do., 5 cwt. and upwards | 1 2 0 |
| Flats—1½in. by ⅜in. and upwards | 0 19 0 |
| „ under ⅜in. thick to ¼in. | 1 0 0 |
| „ under ¼in. to ⅛in. | 1 1 0 |
| „ under ⅛in. | 1 4 0 |
| For each ¼in. less than 1½in. wide, extra, 10s. per ton. | |
| Squares—½in. and upwards | 0 19 0 |
| „ 7-16in. | 1 1 0 |
| „ ⅜in. and 5-16in. | 1 3 0 |
| „ ¼in. | 1 5 0 |
| Rounds—⅜in. and upwards | 0 19 0 |
| „ 9-16in. and ½in. | 1 1 0 |
| „ 7-16in. and ⅜in. | 1 3 0 |
| „ 5-16in. | 1 5 0 |
| „ ¼in. | 1 7 0 |
| Rivet, prices as above. Chain iron, 2s.; and best bars and rods, extra 3s. per cwt. | |

| | £ s. d. |
|---|---|
| **"Monmoor Crown"** (E. T. Wright and Sons), at the works, per ton— | |
| Bars, ½in. to 3in. round and square, or to 6in. flat | 7 15 0 |
| Best „ „ „ „ „ | 8 15 0 |
| Best best „ „ „ „ „ | 9 15 0 |
| Rivet iron, usual sizes | 9 10 0 |
| Best best | 10 10 0 |
| **Barrows and Sons**, at works, per ton short— | |
| B.B.H. bars | 8 0 0 |
| **Round Oak, Dudley**, per ton— | |
| Ordinary bars | 8 12 6 |
| Single best | 10 0 0 |
| Double best | 11 10 0 |
| Treble best | 13 10 0 |
| Rivet, treble best | 14 10 0 |

### Merchant Bars—

| | £ s. d. |
|---|---|
| **Whitwell and Co.**, f o.b. works (2½ dis. for cash), per ton— | |
| Crown quality | 7 10 0 |
| Best | 8 0 0 |
| Ship rivet iron | 8 10 0 |
| Crown quality, "Thornaby" | 9 0 0 |
| Best | 10 0 0 |
| Best best | 10 0 0 |
| Detail specifications from warehouse 10s. per ton extra. | |
| Common Welsh bars, £5 f.o.b. South Wales ports, net cash. | |
| Best, £5 15s. to £6 5s. | |
| **The Pearson and Knowles Co.**— | |
| Flats, from 1in. to 6in. wide by ¼in. thick and upwards | 7 0 0 |
| Rounds and squares, from ½in. to 3in. | 7 0 0 |
| Best, 10s.; best best, 30s.; treble best, 60s. per ton extra. | |

### Sheet—

| | £ s. d. |
|---|---|
| "Monmoor" (E. T. Wright and Sons), to 8ft. by 3ft. 20 w.g., per ton at works | 9 0 0 |
| Best | 10 0 0 |
| Best best | 11 0 0 |
| **Barrows and Sons**— | |
| B.B.H. sheets | 10 0 0 |
| „ best do. | 11 10 0 |
| „ best best do. | 12 10 0 |
| E. P. and W. Baldwin, per ton, at works— | |
| Brand "Severn," singles to 20 w.g., usual sizes | 0 0 0 |
| „ "Baldwin-Wilden" B | 0 0 0 |
| „ „ „ B B | 0 0 0 |
| „ „ „ B B B | 0 0 0 |
| „ „ „ B charcoal | 0 0 0 |
| „ „ „ E B charcoal | 0 0 0 |
| Doubles 21 to 24 w.g., 30s.; and trebles 25 to 27 w.g., 60s. per ton extra. Terms as usual. | |
| "E P and W B" best charcoal I C | per box 0 0 0 |
| "Wilden" I C | 0 0 0 |
| "Unicorn" charcoal I C | 0 0 0 |
| "Arley" ♔ tin | 0 0 0 |
| "Stour" coke tin | 0 0 0 |
| **Joseph Tinn, C.E.**, Ashton Iron Rolling Mills, Bristol— | |
| Export quality, singles, London | 0 0 0 |
| Galvanising and corrugating sheets, do. | 0 0 0 |
| Working up sheets for kegs and drums | 0 0 0 |
| Mild quality steel sheets | 0 0 0 |
| Special quality do. | 0 0 0 |
| Doubles and lattens usual extras. | |

**Wales**—Treforest Tin-plate Works—
Coked tin, at Cardiff, 25s. in London.

| | £ s. d. |
|---|---|
| Lydney—Charcoal tin, I C | £0 0 0 to 0 0 0 |
| Terne | 0 0 0 to 0 0 0 |
| Coke tin | 0 0 0 to 0 0 0 |
| Swansea | 0 0 0 to 0 0 0 |
| Gadly's Aberdare coke | 1 2 0 to 1 4 6 |
| Best charcoal | 1 8 0 to 0 0 0 |
| Morriston, at works, coke | 0 0 0 to 0 0 0 |

| | £ s. d. |
|---|---|
| **The Pearson and Knowles Co.**— | |
| Singles, from 1 to 20 B.W.G., and 12in. to 36in. wide | 9 10 0 |
| Best and best for galvanising, 10s. per ton extra; best best, 30s. | |
| **Crowther Bros.** and Co.— | |
| **Tin Sheets**—"Lion & Crown," Kidderminster— | |
| Coke, annealed | Singles, per cwt. 31 0 0 |
| Charcoal do. | „ 36 0 0 |
| Best charcoal do. | „ 38 0 0 |
| Doubles to 24 w.g., 1s. 6d., and lattens to 26 w.g., 3s. per cwt. extra. | |

### Patent Coated Sheets—

| | £ s. d. |
|---|---|
| No. 3 lead | Singles, per cwt. 0 18 0 |
| B terne | „ „ 1 3 0 |
| Charcoal terne | „ „ 1 6 0 |
| Doubles to 24 g., 1s. 6d. Lattens to 26 w.g., 3s. per cwt. extra at works, less 2½ per cent. discount. | |

**Wire**—Rylands Brothers, Limited, Warrington—

Best (W) Annealed drawn fencing wire, per ton—

| £10 5s. | £10 15s. | £11 5s. | £11 15s. | £12 15s. |
|---|---|---|---|---|
| Nos. 6 | 7 | 8 | 9 | 10 |

Delivered free alongside ship Liverpool, 2½ per cent.

| | £ s. d. |
|---|---|
| **Nail Rods**—Glasgow, f.o.b. | 7 10 to 0 0 |
| Cleveland | 5 0 to 5 10 |

**Hoops and Strips**—Pearson and Knowles—
Ordinary sizes and gauges, up to 5in. wide 8 10 0
Best, 10s.; best best, 30s. per ton extra.

| | £ s. d. |
|---|---|
| **Round Oak**— | |
| Ordinary, not less than 19 w.g. | 9 2 6 |
| Treble best | 14 0 0 |
| **Rails**—Glasgow, f.o.b. | 5 10 0 to 6 10 0 |
| Cleveland—Heavy rails | 4 2 6 to 4 10 0 |
| Light do. | 4 10 0 to 5 5 0 |
| Wales—Tredegar Iron Company f.o.b. Newport. | 5 10 0 to 6 0 0 |

Ordinary quality of iron rails above 50 lb. per yard in 250 ton lots, £5 15s. 0d. per ton f.o.b. Newport, net cash.
For colliery sidings, works, £3 15s. to £4 7s. 6d. per ton.

| | £ s. d. |
|---|---|
| Colliery bridge rails, in 10-ton lots, net cash | £5 5 0 |
| Fishplates, at works, any section | 5 7/6 to 6 0 |
| Old and D H flange rails, at works | 2 10 to 3 5 |

| | £ s. d. |
|---|---|
| **Railway Chairs**—Glasgow, f.o.b. | 3 10 to 4 0 |
| **Pipes**—Glasgow, f.o.b. | 4 10 to 5 0 |

### STEEL.

| | £ s. d. | £ s. d. |
|---|---|---|
| **Sheffield**—At works— | | |
| Spring steel | 9 5 0 to | 18 0 0 |
| Ordinary cast rods | 14 7 6 to | 21 0 0 |
| Fair average steel | 24 0 0 to | 32 0 0 |
| Sheet, crucible | 20 0 0 to | 60 0 0 |
| Sheets, Bessemer | 12 10 0 to | 16 10 0 |
| Second-class tool | 30 0 0 to | 45 0 0 |
| Best special steels | 48 0 0 to | 75 0 0 |
| R. Mushet's special tool steel | 140 0 0 to | 224 0 0 |
| Fine rolled, for clock springs, &c. | 60 0 0 to | 70 0 0 |
| Rails—Siemens, at works | 0 0 0 to | 0 0 0 |
| Bessemer, ordinary, at works | 4 9 0 to | 5 10 0 |
| Do. superior | 6 0 0 to | 6 10 0 |
| **Wales**— | | |
| Rails, f.o.b, Cardiff or Newport | 5 15 0 to | 6 0 0 |
| Rails, at works, Bessemer | 5 15 0 to | 6 0 0 |
| Heavy | 5 15 0 to | 6 0 0 |
| Slightly defective, Cardiff or Newport | 5 0 0 to | 0 0 0 |
| Steel colliery bridge rail, works | 0 0 0 to | 0 0 0 |
| **Middlesbrough**— | | |
| Steel rails | 4 17 6 to | 5 0 0 |

## MISCELLANEOUS METALS.

| | £ s. d. | £ s. d. |
|---|---|---|
| **Copper**—Chili bars per ton | 66 5 0 to | 66 15 0 |
| British cake and ingots | 70 0 0 to | 72 0 0 |
| Best selected | 72 10 0 to | 73 10 0 |
| British sheets, strong | 76 0 0 to | 78 0 0 |
| **Tin**—Straits | 94 10 0 to | 95 10 0 |
| British blocks | 95 0 0 to | 97 0 0 |
| „ bars | 97 0 0 to | 98 0 0 |
| „ refined, in blocks | 99 0 0 to | 100 0 0 |
| **Lead**—English pig | 18 0 0 to | 00 0 0 |
| Spanish do. | 17 0 0 to | 17 7 6 |
| Sheet | 17 15 0 to | 18 0 0 |
| **Spelter**—Silesian | 19 10 0 to | 19 15 0 |
| English | 00 0 0 to | 00 0 0 |
| **Zinc**—English sheet | 24 0 0 to | 24 15 0 |
| **Quicksilver** per bottle | 7 0 0 to | 7 5 0 |
| **Phosphor Bronze**—per ton— | | |
| Bearing metal XI | 110 0 0 to | 00 0 0 |
| Other alloys | 115 0 0 to | 130 0 0 |

Best refined grain nickel, per lb., less 2½ monthly account, 3s.; square nickel, per lb., 2s. 10d.; inferior qualities, per lb., 2s. 6d. min.

## COAL, COKE, OIL, &c.

| | £ s. d. £ s. d. |
|---|---|
| **Coke**— | |
| Cleveland, at ovens | 0 9 6—0 0 |
| Derbyshire | 0 10 6—0 14 0 |
| Sheffield | 0 14 0—0 16 0 |
| Tredegar | 0 9 6—0 0 0 |
| Wales—Rhondda | 0 11 0—0 12 0 |
| **Coals**, best, per ton— | |
| South Durham | 0 6 0—0 11 0 |
| Derbyshire— | |
| Best, at pits | 0 8 0—0 11 0 |
| Converting | 0 7 6—0 9 0 |
| Slack | 0 3 3—0 6 0 |
| South Yorkshire—At the pits— | |
| Branch | 0 12 0—0 14 9 |
| Silkstone, house | 0 11 0—0 13 0 |
| Converting | 0 9 0—0 11 0 |
| Steam coal* | 0 5 11—0 6 6 |
| Slack† | 0 3 0—0 5 6 |
| Wales, through | 0 5 6—0 6 0 |
| Steam, less 2½ | 0 5 6—0 7 0 |
| House, at port | 0 6 6—0 8 3 |
| Small steam | 0 1 6—0 2 6 |

| | £ s. d. £ s. d. |
|---|---|
| Glasgow—Per cwt., f.o.b.— | |
| Ell coal, per ton | 0 7 6—0 7 9 |
| Main | 0 7 6—0 7 9 |
| Splint | 0 8 6—0 8 9 |
| Smithy | 0 11 6—0 12 6 |
| Lancashire—Wigan pit prices— | |
| Arley | 0 9 0—0 9 6 |
| Pemberton 4ft. | 0 6 6—0 7 0 |
| Forge coal | 0 5 6—0 6 0 |
| Burgy | 0 3 9—0 4 3 |
| Slack | 0 2 6—0 3 3 |
| **Oils**, tun— | |
| Lard oil | 42 0 0—44 0 0 |
| Linseed | 28 6 0—29 0 0 |
| Palm nut | 36 10 0—0 0 0 |
| Rangoon engn., gal. | 0 0 0—0 0 0 |
| Rapeseed, brown | 29 15 0—0 0 0 |
| „ Engl. pale | 30 0 0—31 0 0 |
| Petroleum, refin'd (per gal.) | 0 0 7½ 00 0 0 |
| **Tallow**, old, P.Y.C. | 43 0 0—00 0 0 |
| „ new „ | 45 0 0—00 0 0 |

* Supplied to railway companies and large works. † In many cases it is not brought out of the pits.

## PRICES CURRENT OF TIMBER.

| | £ s. | £ s. |
|---|---|---|
| Teak, load | 9 10 | 10 10 |
| Quebec pine, red | 3 0 | 4 5 |
| yellow | 3 5 | 5 0 |
| pitch | 3 2/6 | 5 0 |
| Oak | 4 10 | 5 5 |
| Birch | 3 10 | 4 10 |
| Elm | 3 10 | 4 15 |
| Ash | 3 5 | 4 5 |
| Dantsic & Memel. oak | 3 10 | 5 0 |
| Fir | 2 5 | 4 10 |
| „ undersized | 1 10 | 2 0 |
| „ Riga | 3 10 | 4 0 |
| „ Swedish | 1 10 | 2 5 |
| Wainscot, Riga, log | 2 10 | 6 0 |
| Masts, Quebec red pine | 4 0 | 5 0 |
| Kowrie, load | 7 0 | 8 0 |
| Oregon | 5 0 | 7 10 |
| Lath, Dantsic, fathom | 4 0 | 5 10 |
| St. Petersburg | 6 0 | 7 0 |
| **Deals**, per C, 12ft. by 3 by 9in.:— | | |
| Quebec, pine 1st | 13 0 | 23 10 |
| „ 2nd | 9 0 | 14 0 |
| „ 3rd | 7 0 | 9 0 |
| Canada, spruce 1st | 10 0 | 12 0 |
| 3rd and 2nd | 6 10 | 8 0 |
| New Brunswick | 6 0 | 7 10 |
| Archangel | 9 0 | 16 0 |
| St. Petersburg | 12 0 | 14 0 |
| Finland | 7 10 | 9 0 |
| Wyburg | 8 10 | 9 10 |

| | £ s. | £ s. |
|---|---|---|
| Christiania | 0 0 | 0 0 |
| Other Norway | 0 0 | 0 0 |
| Battens, all sorts | 5 0 | 7 10 |
| **Flooring** bds. sq. of 1in. | s. d. | s. d. |
| First yellow | 10 0 | 13 0 |
| „ white | 8 6 | 9 0 |
| Second quality | 7 0 | 9 0 |
| **Staves**, p. standard M. | £ s. | £ s. |
| Quebec, pipe | 55 0 | 60 0 |
| Puncheon | 15 0 | 16 0 |
| Baltic, crown pipe | 170 0 | 175 0 |
| Brack | 120 0 | 130 0 |
| **Hard Woods**: | | |
| Box, Turkey, p. ton | 6 0 | 20 0 |
| | s. d. | s. d. |
| Cedar, Cuba, sup. ft. | 0 4 | 0 4¾ |
| Honduras, &c. | 0 4 | 0 4½ |
| | £ s. | £ s. |
| Ebony, Ceylon, ton | 5 5 | 17 10 |
| Zanzibar, &c. | 4 0 | 9 0 |
| Lignum Vitæ | 5 0 | 10 0 |
| Mahogany, Cuba, superficial foot. | s. d. | s. d. |
| | 0 6 | 0 8 |
| St. Domingo, car. average | 0 6½ | 0 9 |
| Mexican, do. | 0 4 | 0 4½ |
| Tobasco, do. | 0 4½ | 0 5 |
| Honduras, do. | 0 4 | 0 5½ |
| Walnut, Italian | 0 4 | 0 5 |
| Satin, St. Domingo, foot | 0 7 | 1 0 |

# CONTENTS.

The Engineer, December 5th, 1879.