

LITERATURE.

Das Bessemern in Oesterreich. Eine Zusammenstellung der in der Oesterreichischen Zeitschrift für Berg- und Hüttenwesen von Jahre 1856, bis zum Mai des Jahres 1865, erschienenen wichtigen Abhandlungen und Berichte über das Bessemer'sche Eisen und Stahl-fabrikations-Verfahren. Mit geschichtlichen Vorbermerkungen eingeleitet von OTTO FREIHERRN VON HINGENAU. Vienna: 1865. Manz.

[SECOND NOTICE.]

ALTHOUGH the title of this work would seem more especially to apply to "bessemerising" in Austria, four of its most important essays are drawn from Swedish sources, and give accounts of the history and progress of the process in Sweden. This is, however, perfectly justifiable when we remember the great influence exercised on the spreading of the process in Austria—indeed over the whole world—by its success in Sweden. Fortunate in the possession of such a distinguished and public-spirited writer and metallurgist as Professor Tunner, the ironmasters of Styria and Carinthia periodically received through his aid the best news on the subject. On this occasion we shall more especially confine our attention to these excellent Swedish papers, which may be regarded as forming the complement to the very valuable treatise by M. Boman on the Bessemer process in Sweden, which appeared in these columns about eight months ago. M. Boman, in fact, speaks more than once of M. Grill's experiences, and writings on the proceedings, at Edsken, where the first experiments in Sweden seem to have been conducted—no doubt, mainly at the expense of the enterprising and sagacious Swedish Ironmasters' Union. It will be of course noticed that these trials were made with stationary furnaces. This means for "bessemerising" is, indeed, known under the designation of the "Swedish method," in contradistinction to the use in England of the movable converter afterwards invented by Mr. Bessemer. The objections against the fixed furnace plan have been stated by the inventor to be "the impossibility of stopping the process without running out the metal; for if the blowing ceased for one instant the fluid metal would run into the tuyeres, and stop them up." The brick lining was also much sooner destroyed than the present ganister lining; and another inconvenience arose "from the danger and difficulty in tapping out the fluid malleable iron with a bar, after the manner of tapping an ordinary cupola furnace, for the blast had to be continued during the whole time the charge was running out of the vessel, in order to prevent the remaining portion from entering the tuyeres." Another difficulty arose while running the crude metal from the melting furnace, since it was necessary to turn on the blast before any metal was run into the vessel; the first portions so run in were, in consequence, partially decarbonised before the whole of the crude metal had left the melting furnace." In principle, however, the two methods must evidently correspond, and the adoption of the movable converter is rather a question of economy than of absolute necessity.

For the easy and full comprehension of a few of the technical points in these papers, one or two sketches are rather needed. Written for comparatively narrow circles, their authors assume that different minor points in the construction of the furnaces are known to the reader. It appears that the air tuyeres of the furnace at Edsken were at first set in two rows, one above another. It was found that the iron ores which gave the most satisfactory results with this arrangement—"at least as regards the possibility of producing a soft steel"—were those which contained most manganese, such as the ores of Dannemora, Vindtjern, Långvi, and Kräkånäs. For this reason about 69 Austrian lb., and afterwards 40 lb. were used for each charge of the blast furnace. But as the steel showed less tenacity in being worked, the Kräkånäs ore was afterwards left out of the charge; but the result of that was that for a long time no properly soft steel was produced. The blast used was not sufficiently powerful; an effect due either to the amount of air being *per se* insufficient, or that its being fed in from two rows of tuyeres was less efficient. The diameter of the six upper tuyeres with $\frac{3}{4}$ in. holes was certainly so chosen that a volume of air passed through them nearly equal to that flowing through the bottom tuyeres with holes $\frac{1}{2}$ in. in diameter. But, as the blast from the upper tuyeres had to pass by a much shorter road through the molten pig, a portion of its refining action got lost. There is every probability that this was indeed the case, and it may be considered as proved by the results which followed the following changes in the construction of the furnace:—"The upper row of tuyeres was lowered to the level of the bottom one—that is, two inches above the sole. The iron thus stood higher than previously above the tuyeres, which latter were all made to $\frac{3}{4}$ in. diameter." At the same time the roof of the furnace was set 19 in. lower, in order to obtain a more concentrated temperature in the narrowed capacity. Amongst other improvements made at about this time was the formation of a conical stopper of fire-brick, instead of the previously employed coating of clay for closing the hole in the wrought iron ladle. The whole could thus be better heated, causing the steel to run in a more lively way, leaving but an unimportant waste.

The blowing apparatus which, before the widening of the tuyeres, only made from 60 to 70 strokes per minute, had its speed raised to 80. "The period of blowing in was thus finished in from seven to ten minutes, though before those changes, it took from twelve to twenty minutes, and even to thirty minutes. The pressure of the blast, which previously rose to 12-14 lb. English pounds per inch, then fell with the increase of the tuyere openings, down to 6-8 lb." M. Grill observes that it would be difficult to accelerate the fining process by increasing the volume of the blast, as in this case the boiling of the mass would be too powerful; and for this reason its intensity is moderated at the beginning. With these changes it was not found necessary to try manganic ores, which previously gave

the greatest facilities to a good fining at a high temperature. Exact tests of the steel now produced showed that it was much superior to the previous work, not alone as regards softness, ease in melting, and tenacity, "but also as regards its freedom from slag and other impurities." The steel was also much easier to manipulate from its higher temperature and greater fluidity; "so that both furnace and ladle remained free from deposits, and in the castings produced there was seldom or never a bit of slag to be found when they were being worked up." From a table which is given, it would appear for every charge in the blast furnace about 16 centners were employed, from which, in addition to the "waste" pig in the blast furnace and the steel cross, 10 centners of pure castings were obtained. The daily produce was 37 $\frac{1}{2}$ centners.

In another report addressed to the *Jern-Kontoret* or Swedish Iron Masters' Union, in 1859, M. Grill enters more fully into the details of working up the metal. Amongst the points interesting in England may be noticed that even so long ago, "the steel produced at Edsken" was so hot and fluid that they could cast, in dry clay moulds, a number of railway crossings. It was also found that all "crop pieces," whether from the Bessemer furnace or from the hammer, "were excellent for re-melting in iron furnaces." "After being directly re-melted they afforded hard, tough, and good wrought iron." Workmen in whose hands Bessemer steel was placed greatly praised "the ease with which it could be worked, its resistance to repeated weldings and hardenings as also its strength." A wonderful instance is cited by M. Grill, in which a plate of white pig iron, 1 $\frac{1}{2}$ in. thick, was bored through with fourteen holes without the tool having to be ground, while it showed a sharp edge even after the last operation. Professor Tunner quotes, at the end of this paper, several passages from a letter he received about this time from a friend in Sweden. Amongst other matter we read the opinion, for which we have been able to cite so many strengthening circumstances, that the principal thing in this process is to work with much and with a powerful blast—in such wise, that the charge of about fifteen centners is finished in from seven to ten minutes. By this means the heat is concentrated, the mass more fluid, and the separation from the slag more complete. "It is not doubtful that locomotive tires can be cast which will only require to be somewhat hammered, or still better, rolled." Excellent axes are now already cast, and they only require to be sharpened. The manufacture of steel in pots in Sweden will now cease entirely, and every one is now convinced that the Bessemer process is "cheaper and more suitable."

In a later report from M. Grill we find it stated that experience has shown that "a Bessemer furnace can stand from thirty to thirty-six blowings with only slight repairs, and without requiring to be newly lined with bricks. The bricks made of the Höganäsclay (fire-clay from the lignite formation) have shown themselves to be sufficiently fire proof."

Any required hardness or softness in the steel could be obtained by stopping the process at the proper stage, which, as in England, can be easily judged by an examination of the peculiar changes in the flame. "Only with an untried pig iron, or when the tuyeres get partly stopped up, or when any uncommon disturbance in the course of the process takes place, does it happen that the intended quality of steel is not obtained." In spite of what is often repeated about "the uncertainty" in producing Bessemer steel, it was found in Sweden that "in bessemerising the hardness of the steel could be more easily determined than with most other steel making processes. It is evident that all the steel of the same blowing in is of the same hardness, which is at last accurately determined by an examination of the fracture."

We read further on that the forging of the steel castings is carried out at Högbe, under the direction of an English steelsmith, and that the English modes of working are adopted, in order to give a clean surface to the hammered steel. The main features of the working are, that the heavier castings, of 6 in. square and 30 in. in length, are taken down to 3 in. square in the course of about eight heats in the gas furnace, under a steam hammer weighing twenty centners, and giving fifty blows per minute. Castings of from 4 to 4 $\frac{1}{2}$ in. square, and of the same length, are worked in two heats, under a 8-centner hammer, driven by water power, down to about 2 in. square. The hammered-down material is then heated, covered with borax, in a "hollow fire," fed with coal. After being hammered out at the same heat to 1 $\frac{1}{2}$ in. square, one portion of the steel is ready for such purposes as coarse turning tools, borers, &c. After this forging the steel is examined, and scales and cracks on the surface are chipped out; the bars broken into lengths of about 18 in., and their fracture examined. The pieces are then hammered out under tail hammers, the smallest of which, driven by steam, makes 252 strokes per minute, with 6 $\frac{1}{2}$ in. stroke, and weighs about 320 Austrian pounds. Under the tail hammers, all the smaller dimensions are produced down to $\frac{1}{8}$ in. square.

In order to give in figures an idea of the immediate success in Sweden of the process, we may cite a table which we find here. From the 1st of November, 1858, to the 21st, 1859, were obtained from the castings successfully submitted to the steam, the welding, and at last to the smaller hammers:—

Steel of the first quality	30.35
" " railway steel	10.54
" "	40.89
Second quality	40.03
Waste and crop	9.05
Oxidisation (Abbrand.)	10.03
Total	100.00

Taking the "bessemerising" and the hammering together, the following are the products in percentages of the pig iron employed:—

Finished steel of the first and second quality	48.50
Steel crops	24.83
Pig crops	6.51
Oxidisation	20.16
Total	100.00

In England very good prices are obtained for the crop ends of rails and other work. They are largely used in Sheffield for melting up to ordinary cast steel. We find it here stated that, at any rate when M. Grill wrote, the steel crops only had a value rather higher than the pig iron. This may in fact be due to the almost complete supersession in Sweden of the old methods of making steel.

Professor Tunner does not hesitate to say that "according to the experiments which have been made in Sweden, and the many verbal and written opinions he has heard, Bessemer steel considerably surpasses the common Swedish steel, and is in general to be compared with the better qualities of English cast steel." He considers that it is on the same level as the best English welding cast steel; it only requires rather more attention in hardening, "as it takes the hardness at a much lower temperature, and just in this respect testifies to the many qualities originating in what the English call 'body.' It is possible that the boundaries of the appropriate heat may be looked upon as very narrow." It appears that such delicate work as razors, sword blades, steel mirrors, scissors, knives, and nippers for watchmakers, have long been made in Sweden of Bessemer steel—a very distinct proof of its admirable qualities.

We now come to the last essay of M. Grill which is inserted in the work before us. It may be remembered that in the translation of Boman's compendious work on "Bessemerising in Sweden," which we gave some time ago, he observes, under the heading of "the theory of the process":—"But little can here be said in addition to the explanation of the Bessemer process, given by M. Grill in the *Jern-Kontorets Annalen*." The following is a translation of this explanation, which we insert *in extenso*, as we consider it of importance, though well believing that much of the theory of the process has still to be worked out.

"The Bessemer process differs from any other method of fining in that:—1. No special fuel is required to melt, and to keep in a fluid state during the entire refining, the pig which is being operated upon.

"2. That the consumption of fining Frischschlacken slag and of oxidised iron is considerably less; and,

"3. That the fined product, iron or steel, still has sufficient fluidity to separate itself from the clay. That this is possible is due to the principle first discovered, or first applied, by Bessemer, that molten pig iron is not merely not cooled and solidified, when finely divided streams of compressed air are led through it, but rather remains liquid, and is fined to steel or iron, the temperature, at the same time, increasing to such a degree, that the metal operated upon remains in the fluid state.

"The suppositions [that the necessary temperature is herewith produced by a direct combustion of the carbon—of the plumbago—by means of the blast; that the temperature is thus produced and the fining thus effected—that, in fact, we have here an instance of true fining by means of blast—(*Windfrischen*)—is just as incorrect as the assertion that merely the iron is burnt instead of the ordinary combustible, and that thus the loss must be necessarily of such an amount as to be beyond the range of economical production.

"After an accurate study of the process, it is impossible to deny that an actual 'slag-fining' (*Schlackenfrischen*) takes place. A proof of this view is the comparative quietness of the fluid pig for several minutes before the boiling begins; further the boiling up itself; next its occasional occurrence in several repetitions, with intervals of quietude. Other proofs are the small amount of peroxide of iron in the slag produced, as also the colour of the flame, and lastly, the perceptibly increasing temperature after the cessation of the boiling.

"It is evidently not possible to assume that the blast has such an intense affinity to the carbon and silicium that it should attack these without oxidising the iron, which is present in much greater quantity. At this high temperature the metal is incessantly subjected to a stream of air at a pressure of two atmospheres, and therefore containing a double portion of the oxygen of the atmosphere. The iron must evidently be greatly tending to get oxidised; a fact which is evidenced by the fireworks-like sparks and the bright streams of fire which are thrown out of the furnace. It is only the question here what road is taken by the iron which is burnt in the furnace. The explanation is given in the slag, which is very poor in peroxide of iron, and the ferruginous contents of which are reduced by means of the coal and the silicium of the pig. The blast forced in contains, in round numbers, eighty volumes of nitrogen and twenty volumes of oxygen, the latter of which, as will be shown further on, is completely utilised in the process. In that stage, before the boiling up takes place, it must be assumed that the greatest portion of the oxygen is combined with the iron remaining in the fluid mass—the nitrogen principally escaping. For this reason the mass behaves comparatively quietly, as no development of gas takes place from itself. But when the boiling begins there also escapes, besides the eighty volumes of nitrogen, the twenty volumes of oxygen. By means of the combination with the carbon the latter is changed into forty volumes of carbonic oxide; and this last volume of gas is still increased by a volume at least equal in amount, as the oxygen which formerly remained behind in the iron is now also combined with carbon, and also escapes as carbonic oxide gas. If, for instance, eighty volumes of gas escape during the quieter stage of the process there escape at least twice as much, or 160 volumes of gas, within the same length of time, during the boiling stage. The violence—often almost explosive—with which the fining takes place is thus explained. The proportion of iron in the slag is reduced at the expense of the coal and silicium contained in the pig, and the reason of the slight proportion of oxide of iron in the slag can thus be accounted for. It is known how inconsiderable the amount of peroxide of iron can be in order that it may decarbonise iron during the boiling. In blast furnaces, if boiling slag has partly formed itself, the examples of this exist in great number. One cannot wonder that, under extremely favourable circumstances for this chemical process, the slag has not the appearance and ferruginous composition of ordinary finery slag. On the contrary, through the continual energetic reaction between itself and the pig, it gets poorer in iron, but richer in silica and several other bodies, drawn from the pig and the sides of the furnace.

"The occurrence of the boiling in several repetitions points to the fact that, in the interval, the oxygen of the blast remains behind in the slag by means of its combination with the iron. And after this latter has begun to get sufficiently free from iron to reduce the carbon in the pig, the mass is set violently boiling by means of the development, at portions of it, of carbonic oxide. This action lasts as long as either the slag has become too poor in oxide of iron, or that the greatest portion of carbon and silicium have been separated from the iron. The colour of the flame, which appears blue near the mouth of the furnace during the whole process, shows that the furnace is filled with carbonic oxide, which is formed by means of the action of the slag on the carbon contained in the pig iron.

"As the products of combustion always take up the heat developed in combustion, we thus find that the greatest heat remains behind during the combustion of the iron to peroxide. The carbonic oxide, on the contrary, formed by the oxidation of the carbon in the pig goes off at the temperature of the whole mass, and hence takes away a not inconsiderable portion of the heat. The greater portion of the heat freed at the beginning of the combustion of the iron gets, nevertheless, combined in the immediately following reduction of the oxidised iron. It is, therefore, probable that the heat produced before and during the regular fining is principally con-

* 90.08 Austrian lb. are equal to one English cwt. It is seen that an exact conversion of the foreign weights and measures is not needed here.

fining to that part which, by means of the combustion of the carbon contained in the pig is driven off in the form of carbonic oxide.

On the supposition, for which reasons will be given in the following, that 3 per cent. of the carbon in the pig are taken away, this quantity of carbon amounts, with each charge of 16 centners, to not quite 50 lb. a quantity which pretty nearly equals a *Vordernberger Fassel*, or 7½ cubic feet of soft charcoal. This not more than is necessary to counterbalance the cooling influence of the cold blast, of the furnace sides, &c. For this reason the temperature, during the process, does not appear to rise considerably before the fining process proper has come to an end. On the other hand, the temperature rises, after the fining is finished, to a bright white heat. This is due to no other cause than that the heat now produced by the combustion of the iron is not further bound up through the reduction. A small portion merely goes off with the gases, the volume of which, from the reasons given in the preceding, is, at the same time, considerably increased. This increase of temperature is noticeable at the tapping of the steel, as also more especially in the drops of iron thrown out, which are red during the whole time of the fining proper, and soon cool down. On the contrary, after the fining is finished they are at a white heat, and keep this temperature for a very long time.

According to a calculation by Herr Grill—conducted as accurately as possible from the data of Edsken—the volume of air per minute forced into the Bessemer furnace amounts to 947 Austrian cubic feet, or, during the whole eight minutes duration of the blowing in, 7,576 cubic feet. The quantity of atmospheric oxygen is determinable, according to the local relation of temperature and barometric pressure, at 12 lb. As the amount of pig iron was 1,743 lb., and as, in accordance with chemical researches, it may be taken that 3 per cent. of carbon and ½ per cent. of silicon were separated from the pig, 79 lb. of oxygen must have been absorbed. There thus only remains 42 lb. of the whole amount of oxygen, which quantity is capable of burning 147 lb. of iron to peroxide, or 8.4 per cent. of the whole pig. The entire loss can thus be calculated at $3 + 0.5 + 8.4 = 11.9$, or nearly 12 per cent.—which as has been, in fact, found to be the practical result.

This calculation shows clearly that:—

1. All the oxygen of the volume of air blown in has been utilised in the process.

2. That the oxygen of the air is not sufficient to oxidise more than ½ per cent. of silicon, 3 per cent. of carbon, and about 8 per cent. of iron; or a total of about 12 per cent. in weight of the pig.

3. That with this volume of air the boundary of the use of the atmospheric oxygen has not been exceeded.

4. That the carbon of the pig is not driven away in any other form than that of carbonic acid gas, which degree of oxidation is similarly reached in the so-called blast fining. (*Windfrischen*.)

5. It is also clear that the reason that the temperature of the air employed has such a great influence in the course of the fining process, is because an elevation of the temperature, and not of the pressure, is attended with a diminished supply of air into the furnace. It is hence seen how the experiment at Edsken, with hot air, was successful in giving better results as long as the steam engine driving the blast was not worked to a higher power.

6. Lastly, that the improved working, which was perceptible after the 18th of July, 1858, was mainly due to the increased amount of the blast, produced by the increased sections of all the tuyeres, openings, and blast apparatus, although the pressure was simultaneously diminished.

The general conclusions to be drawn from these experiments, carried out at Edsken with different ores, are that a freedom from every kind of impurity is an absolute requirement for producing a useful steel; and that, nevertheless, the red-shortness which is caused by the presence of sulphur may be so completely overcome by a careful roasting with gases, that a trace is neither to be found in the pig nor the steel, even with ores which are generally looked upon as leading to red-shortness. The presence of a small amount of manganese is very desirable, as much on account of the ease with which the fining takes place, as with respect to the malleability of the steel produced. Sulphur and manganese in the pig nevertheless cause a violent, inconvenient boiling, especially if the pig be very dark coloured (*stark halbrt.*)

Basic charges would appear, from several indications, to be more suitable than those rich in silica. It can be specially remarked of the Dannemora pig that it lets itself be well worked, though the blowing in is attended with a violent boiling action. The hardest numbers of the steel evolved over No. 1, lets itself be forged, and, "after being hammered from four inches down to two inches square, it nevertheless showed the texture peculiar to the pig, with a diagonal, crystalline radial arrangement."

In our next notice of the book before us we shall more especially direct attention to the progress of bessemerising in Austria itself.

A Record of the Progress of Modern Engineering for 1864. By WILLIAM HUMBER. London: Lockwood and Co.

The engineering annual before us fully maintains Mr. Humber's reputation as an author. It is, as it professes to be, a résumé of all the more interesting and important works lately completed in Great Britain; and containing, as it does, carefully executed drawings, with full working details, will be found a valuable accessory to the profession at large. The volume commences with a series of essays, on iron railway bridges, the coating of iron structures to prevent oxidation, economy of steam machinery; and on harbours, ports, and breakwaters; the latter section comprising an investigation of the several most important points to be embraced in designing harbours or improving the natural resources of ports.

The latter part of the letter-press consists of the description of the plates, which represent the greater part of the volume; and as the drawings and descriptions have, for the most part, been obtained from the engineers who designed the works, we presume that the fullest reliance may be placed on the accuracy of both. The works noticed are the Birkenhead docks, the Charing Cross station roof, the Digswell viaduct, and the Roberywood viaduct, on the Great Northern line; also the Clydach viaduct, and the river Ebbw viaduct, on the Merthyr, Tredegar, and Abergavenny Railway, the College Wood viaduct, Cornwall railway, Dublin winter palace, the London, Chatham, and Dover bridge at Blackfriars; and, finally, the Albert harbour at Greenock. In addition, the author gives a dissertation on metallic and general permanent way, which he illustrates by a sheet of engravings.

Tables of Tangential Angles and Multiples for Setting out Curves. By ALEXANDER BEAZELEY. London: Lockwood and Co.

The compiler of these tables does not lay any claim to originality as regards the method of calculating and setting out curves, for the system he employs was first published by Rankine, and has since been very generally adopted by civil engineers. The tables consist of

the tangential angles and their differences, for curves from 5 to 200 radius, and are applicable to whatever unit of measurement be used.

There are appended tables of multiples, intended to facilitate the calculation of fractional chords, which usually occur at beginning and end of curves. Each of these curve tables is printed on a small card, which, being placed on the theodolite, leaves the hands of the surveyor free to manipulate the instrument—no small advantage as regards rapidity of work. They are clearly printed, and compactly fitted into a small case for the pocket, an arrangement that will recommend them to all practical men.

VISITS TO THE PROVINCES.

MERTHYR, AND ITS IRONWORKS.

[CONCLUDED.]

The Cyfarthfa Works at the present time have a forge power, or power of producing puddled bar iron, equal to ten or twelve hundred tons per week, and there is sufficient mill power, when fully employed, to turn out from twelve to fourteen hundred tons in the same time. The coal used in all these operations is raised on the property close at hand, as already stated. A considerable quantity of native ironstone is likewise raised on the spot, and the importation of Cumberland and other ores into the ports of Cardiff Swansea, and Briton Ferry, for the use of these works, amounts to at least 50,000 tons a year. The limestone used as a flux in the blast furnaces is obtained from the north outcrop of the basin, the quarries being close to the works. The limestone, coal, and ironstone are brought to the furnaces by railways and tramroads. The number of horses employed on the whole establishment is 400, locomotives four, and the total number of men rather less than 5,000. On the whole the machinery at the works is of a substantial and somewhat old-fashioned description, water power being still used to a great extent. There are no less than five large water-wheels now at work in connection with the forges, several engines also being employed to drive trains of rolling mills.

Six schools in connection with the Cyfarthfa Works were established in 1856—three for boys and three for girls—the average attendance of children being now between 900 and 1,000. There are three head masters, three head mistresses, two assistant-mistresses, and twelve pupil teachers. The schools are all under Government inspection, and conducted under the British and Foreign system. The workmen contribute one halfpenny in the pound of their earnings towards the support of the schools, which are also assisted by a grant from Government, the remainder being paid by Mr. Crawshaw.

The late Mr. William Crawshaw, of Stoke Newington, was proprietor of the Cyfarthfa and Hirwain Ironworks for half a century. He died on the 11th of August, 1834, in the 52nd year of his age, and is buried beneath Hornsey Church, one of his grandsons, Mr. Alfred Crawshaw, late captain in the 17th Lancers, being buried in the neighbouring churchyard. At present the Cyfarthfa Works belong to Mr. William Crawshaw, of Caversham Park, Oxfordshire, his son, Mr. R. T. Crawshaw, residing at Cyfarthfa Castle, and acting as manager of the works. The chief cashier is Mr. William Jones.

Before closing this notice of the Cyfarthfa Works, it may be of interest to state that the rumours about their approaching sale, which a few weeks ago were extensively circulated in the Welsh newspapers, causing considerable excitement in the mining districts, originated in a very simple matter. Some correspondence was passing between Mr. R. T. Crawshaw and his father, the latter advocating the sale of the works to a company, because of the increasing competition in the iron trade, and the former wishing them to be retained and carried on as heretofore. It chanced that the fact of such correspondence taking place was mentioned to a gentleman who called in at the Cyfarthfa office, and he returned to Merthyr, announcing that the works were to be sold, consequently the news spread like wildfire over the district, and shortly appeared in the newspapers, having lost nothing in transmission.

The Plymouth Ironworks, to the south of Merthyr, on the Cardiff road, were founded by Mr. T. Bacon, son of the Mr. Anthony Bacon, the original owner of the Cyfarthfa property. Mr. Richard Hill, the descendant of a Cumberland family, had been for some years actively engaged in the Cyfarthfa Works, but in 1785 he bought the Plymouth Works of Mr. T. Bacon, who retained an improved rental on the terms of his own lease. The Plymouth Works took their name from Lord Plymouth, the owner of a great part of the ground on which they are situated, and the property has now passed into the hands of his successor, the Baroness Windsor, otherwise Lady Clive. The remainder of the land belongs to the Marquis of Bute, the legatees of the late Mr. Thomas Thomas, of Aber, the sons of the late Mr. Davies, of Mardy, Mr. Llewellyn, Mrs. Probyn, and Thomas Evans and Son.

The first proprietor of the works, Mr. R. Hill, before his death, took his eldest son into partnership with himself, and after the death of the father the works fell into the hands of the three sons, Richard, John, and Anthony. Mr. John Hill afterwards sold his share in the Plymouth Works to his brothers, and finally, in 1845, Mr. Anthony Hill became the sole proprietor, and retained the works till his death in 1862. In his will he made it almost binding upon his executors to sell the works as quickly as possible, and in September, 1863, they were bought by the present proprietors, the Plymouth Iron Company, in other words, Messrs. Fothergill, Hankey, and Bateman. The original lease of the more important part of the property expired on the 1st May, 1864, and the new leases from the different owners already mentioned are all for such periods that they will expire at the same time—in the year 1914. The executors appointed by the late Mr. Anthony Hill are Mr. A. T. Upton, of Austin Friars; Mr. R. Oliver Jones, chairman of the Glamorganshire Quarter Sessions; Mr. Charles W. Upton, barrister-at-law; Mr. John Bates, of Bristol; and Mr. David Joseph, of Ely Rise, near Cardiff. In Mr. A. Hill's time the business was carried on under the name of the Plymouth Forge Company, and the area of the property is about two square miles.

When Mr. Richard Hill took possession of the works in 1785 there was but one blast furnace, situated at the upper end of the property, within a mile of Merthyr—blown at first by a large smithy bellows, and afterwards by a rude machine, set in motion by water power. This furnace, which had been constantly burning for forty-five years from the beginning of the present century, was at the end of that period allowed to cool for repairs. At the lower part of the furnace a mass of burnt iron, seventy tons in weight, was found, and on the foundation stone the initials of the founder of the works, "T. B.," were seen deeply cut. Mr. Bacon also constructed a watercourse—in existence to this day—known as the Plymouth Feeder. This takes the water from the river Taff, in the centre of Merthyr, to the several wheels in the works, at three different levels, at a fall of 28ft., 27ft., and 24ft. respectively. After performing its work the water is restored to the Taff river, at a point three miles lower down than the point whence it was abstracted. A good supply of water is a

matter of vital importance to the Merthyr millowners, and special agreements, as well as clauses, in the Local Waterworks Act of Merthyr, regulate the supply to the large ironworks in the neighbourhood. The Plymouth Works however, were supplied with the waters of the Taff for motive power, under a lease of ninety-nine years from the Marquis of Bute, who has certain privileges over the waters of the river, to Lord Plymouth. The lease expired a year and a half ago, much to the surprise of many who knew not of the existence of such a lease; a fresh arrangement, however, was soon made.

In the year 1806 the quantity of iron made at the Plymouth Works was 3,952 tons. Mr. Richard Hill, who found but one furnace on the property, in the course of time erected two more, making three. In 1815 the three furnaces produced 7,800 tons of iron. In 1845, when Mr. Anthony Hill became sole proprietor, there were seven blast furnaces, each producing an average of 80 tons of iron per week. From 1845 the works rapidly rose in importance—for up to that date little but water and horse-power had been used, the introduction of steam power throughout the country telling severely against the Plymouth Works in consequence of this tardiness. At present the works consist of ten blast furnaces, blown by three blast engines and four water wheels. Near the furnaces are foundries where all the castings for the works are made. All the furnaces are still worked by cold blast, because, it is stated, "the cold blast, although more expensive and slower in action, is found to yield iron of better quality than is obtainable by the hot blast method, which has a greater power of utilising inferior metals."

Mr. Hill originated the idea of utilising refinery and forge cinders in the blast furnace, according to the following statement published in 1831:—"Messrs Hill and Co., of the Plymouth Works, near Merthyr, obtained a patent many years ago for the use of forge and refinery cinder, as a substitute for the mine in the furnace. It is an oxide of iron, with but little foreign matter, and therefore containing a great proportion of iron, frequently sixty or seventy per cent. It had not been generally used before for any purpose; for although it was known to contain a large proportion of iron, all attempts to smelt it effectively and economically had failed. It was thought to be so prejudicial to the working of a furnace, and the quality of the iron produced, as to render its extensive application impracticable. The effect it produced was to make the furnace burn, although a light burden was used. The tuyeres could not be kept strong; the cinder became black, and the iron of a very inferior quality, being entirely white and very thick in running out of the furnace. Under all these discouraging circumstances, it was thought that no substitution of forge or refinery cinder for mine could be advantageously made, and the cinder was consequently laid aside as worthless. The contrivance of Messrs. Hill and Co. consisted in mixing the cinder with argillaceous matter so as to form a more complete imitation of the ore in its natural state. A portion of the shale or clunch adhering to the natural ore when first raised was to be put into the furnace with every charge of cinder." The leaner material thus introduced into the furnace answered the expectations of Mr. Hill, and as the news spread all the ironmasters in the country began using their tons of waste cinder, from which they began making bad iron in large quantities, for experience has since shown that cinder can only be used sparingly and with care in the Welsh ironworks. It can be used more largely in Staffordshire.

At the northern end of the property a very old engine erected in the early days of the works, is still employed, working in dry weather three strokes per minute, and in wet weather six, raising 67 gallons at each stroke. Nearly the whole of the mineral property of the works is, however, drained by another large engine, which, with its shaft and pumps, commenced work thirteen years ago, having been erected at considerable expense. It is an 85-in. Cornish engine, having three lifts, working in a depth of 220 yards, at the rate of six strokes in wet weather, and three in dry, raising 134 gallons of water at each stroke.

The Plymouth Works now contain four forges and nine mills for the transformation of the pig iron into the various kinds of finished iron supplied by the company, viz., merchant bars, nail rods, and rails. The native clayband ironstone of the Plymouth Works yields about 28 per cent. of good iron, of great strength and tenacity, and this, mixed with the hematite imported, gives softer iron of superior average quality. In fact, the iron produced at these works has more than once proved its good qualities when subjected by the Government to severe tests; and the chain cable which saved the Great Eastern, and some smaller vessels which clung to her in the hurricane off Holyhead a few years ago, was made of Plymouth iron, manufactured into cable at the works of Messrs. Brown, Lennox, and Co., at Pontypridd. Shortly after railway communication was first established between Merthyr and the Midland districts in 1860, from 1,000 to 1,200 tons of iron per month were sent from Plymouth Works into Staffordshire to compete, as it did successfully, with the superior iron of that district.

The Plymouth Iron Company employ about 4,000 hands and 360 horses; they have also five locomotives constantly at work, and others spare. As regards schools, the Plymouth Works were practically without any ten years ago; but at that time Mr. Anthony Hill established boys', girls', and infants' schools, as well as some places of worship, all supported at his sole expense; and in his will he has perpetuated his support for all time. Throughout his proprietorship Mr. Hill was noted for benevolence, and in his will he left £40,000 in legacies to his agents, employes, incapacitated workmen, and workmen's widows.

The quantity of coal raised at Plymouth Works is about 285,000 tons per annum, of which 250,000 tons are used on the spot, and the remaining 35,000 tons exported. The quantity of native ore raised is about 40,000 tons per annum, and the other minerals used consist of ores brought from other districts. The yearly make of finished iron is 40,000 tons. Gas is economised from one furnace only, and used for the generation of steam for one blast engine. As already stated, the works have recently passed into the hands of Mr. Richard Fothergill and his partners, who use a greater quantity of coke, and consequently less raw coal, in the smelting. They have also recently erected eight new puddling furnaces, together with additional steam power, and two steam hammers. The speed of the blast engines has been accelerated; the mills also have been increased in power, the latter turning out bar iron from ½ in. diameter up to 6 in. square, the greater part of the make being used for chain and cable purposes. The quantity of coal raised and exported has been increased, the property has been enlarged by new adjacent purchases, and more locomotive power has been introduced. The latter fact necessitated the conversion of tram plates into rails, and the engines now run on the 2ft. 8in. and 4ft. 8in. gauges. A branch line from the works to the Vale of Neath main line has recently been completed, placing the establishment in direct communication with Swansea. Mr. Thos. H. Hosgood is the present engineer to the works, and for many of the facts here recorded we are indebted to Mr. S. W. Kelly, the metal broker, of Cardiff, who for a period of twenty-one years had held influential positions at these and other large Merthyr works.

The Penydarran Works alone remain to be noticed, and these took their name from an old farm house near Merthyr, which

occupied the place on which the works now stand. Three brothers of the name of Humphrey purchased Pendarran Farm of the owners, who had a lease upon the surface of some of the adjoining lands, while the Dowlais Company had a lease upon the coal beneath. After lengthy negotiation an arrangement as regards minerals, was made; the first blast furnace was built in 1782, another in 1796, and a third in 1811; about this time they also erected two rolling mills. By the year 1815 there were five furnaces, and the annual make of finished iron 7,800 tons; in 1845 there were seven furnaces in blast, the make of finished iron for the year being 25,600 tons. The Pendarran Works at this time were in the height of their glory, employing from 3,000 to 4,000 hands, and paying about £12,000 monthly in wages. The works passed by purchase into the hands of Messrs. Thompson and Forman, the London alderman and the capitalist, in 1830, and finally, at the death of the former, into the sole hands of Mr. William Forman. He carried on the works at considerable loss till 1860, when the mills were brought to a standstill, and the mineral property passed into the hands of the Dowlais Iron Company. In 1863 they were bought by Messrs. Davies, Williams, and Phillips, by whom they were again put in motion to the extent of one puddling forge and one rolling mill; a blast furnace also was lit just before they again changed hands. All the mineral property of the works being gone, the proprietors were obliged to buy coal of competing ironmasters, or import it from a distance at considerable delay and expense; consequently in a year or eighteen months advances were made both to the Dowlais Iron Company and Mr. Richard Fothergill, the latter purchasing the works. At present Pendarran Works are a picture of desolation, and at a complete standstill; but with the capital and energy of Mr. Fothergill the furnaces will doubtless soon be employed in smelting his excess of mineral produce.

The first locomotive ever constructed in Great Britain was made at Pendarran to carry the manufactured iron to a basin on the Glamorganshire canal, then nine miles distance. This engine was made by Messrs. Trevithick and Vivian in 1804; the boiler resembled that connected with the working model of a steam carriage constructed in 1784 by Mr. Murdoch, an engineer in the employ of Messrs. Boulton and Watt. This model is still preserved and was an object of considerable interest in the Exhibition of 1851. The boiler of the model had flat ends, but to increase the heating surface a flue was passed through it and back again, in the shape of the letter U; the lower part of the tube formed the furnace, and the upper part returned through the boiler into the chimney. In the place of the slide valve, not then invented, a four-way cock regulated the admission and escape of steam from the cylinder. On the axle of the crank a cog wheel was fixed, and by means of the usual gearing it communicated motion to the hind wheels, thus propelling the carriage. Trevithick's engine, much of which was suggested by this model, was the first practical application of high-pressure steam as a motive power. The first rails made in England or Wales were rolled at Pendarran.

The following tables show the changes that have taken place in the South Wales iron districts in a period of thirty-five years:—

TABLE OF BLAST FURNACES IN 1830.

	Furnaces in blast.	Furnaces out of blast.	Total.
Dowlais—Guest and Co.	9	3	12
Cyfarthfa—Crawshaw and Sons	9	0	9
Hirwaun	4	0	4
Plymouth—Hill and Co.	5	0	5
Pendarran—Thompson, Forman, and Co.	5	0	5
Romney and Bute Works	2	2	4
Sirhowey and Ebbw Vale Works—Harford, Davies, and Co.	6	1	7
Nantyglo—Bailey Brothers	7	0	7
Tredegar—Thompson, Forman, and Co.	5	0	5
Aberdare	3	3	6
Abersychan—British Iron Co.	3	2	5
Varteg Hill—Kenricks and Co.	5	0	5
Blaenafon—Hills and Wheeley	4	0	4
Beaufort—Kendal, Sevan, and Co.	3	1	4
Clydach—Frere and Co.	3	0	3
The Race—C. H. Leigh	1	2	3
Pentwyn—Hunt Brothers and Co.	2	0	2
Caerbrook Dale—Brewers	1	1	2
Blaenau—Jones and Co.	2	0	2
Yniscledwyn—Crane and Co.	2	0	2
Maesteg	2	0	2
Penthyrd y Ven—Reynolds and Co.	2	0	2
Vigors	1	0	1
Pentyrch—R. Blake more	1	0	1
Gadlys—Bryant	1	0	1
Ryddry	0	1	1
Cefn Crubur	1	0	1
Total	90	18	108

Some of the above works and their owners are no more known, and considerable changes have taken place in others, as shown by the following figures:—

TABLE OF BLAST FURNACES IN 1865.

	Furnaces in blast.	Furnaces out of blast.	Total.
Abernant—Abernant Iron Co.	0	3	3
Banwen—Llewellyn and Co.	0	2	2
Ystalyfera—Ystalyfera Iron Co.	6	5	11
Abercraze—J. Walters	0	1	1
Yniscledwyn—Yniscledwyn Iron Co.	1	5	6
Aberaman—Crawshaw Bailly	3	0	3
Aberdare—Fothergill and Co.	4	2	6
Abernant—Fothergill and Co.	2	0	2
Briton Ferry—Willett and Davey	2	0	2
Cwm Avon and Oakwood—Governor and Co. } of Copper Miners.	6	1	7
Cyfarthfa—William Crawshaw	11	0	11
Dowlais—The Dowlais Iron Co.	16	2	18
Llynvi Vale—Llynvi Vale Iron Co.	4	3	7
Gadlys—Gadlys Iron Co.	4	0	4
Pentyrch—T. W. Booker and Co.	2	0	2
Pendarran—R. Fothergill and Co.	0	7	7
Plymouth—R. Fothergill and Co.	10	1	11
Pontypridd—Francis Crawshaw	0	3	3
Tondu—John Brodgen and Sons	2	0	2
South Brecknockshire Ironworks (four com- } panies	10	7	17
Ebbw Vale Iron Co.	16	9	25
Blaenavon—Blaenavon Iron Co.	6	0	6
Levick and Simpson's Works	4	2	6
Other Monmouthshire Works	24	8	32
Total	133	61	194

WORTH IMITATING.—The New Bedford and Taunton Railroad has an arrangement for preventing brakemen being knocked off the tops of the cars by bridges while riding backward. About thirty rods distant from every bridge crossing is a bar or joist twenty feet above the track, from which a number of laths or similar small strips of wood are suspended by short cords, hanging within two or three feet of the car roofs. Persons standing on the cars cannot pass these sticks without striking some of them, and their attention is thus called to the fact that they are rapidly approaching a bridge.

SOUTH WALES INSTITUTE OF ENGINEERS.

(Concluded from page 323.)

A NEW MINING AND LAND SURVEYING THEODOLITE, WITH TRAVERSING STAND.

By Mr. H. D. HASKOLD.

This instrument, when intended for general underground work, has all its parts made much smaller than when made for land use, and the graduated plate or limb is made four inches in diameter, the vernier plate corresponding. One peculiarity in this instrument consists in its having a telescope fixed to each plate, one of which represents the zero of the plate carrying the vernier, and the other the zero of the lower or graduated plate, each having an independent motion. This object is effected by abandoning the old form of construction adopted, for the main axis, which worked concentrically in each other, and substituting in their places a single axis screwed to the underside of the lower plate, and, passing through the parallel or levelling plate, is screwed to the end of a ball in the socket joint. This main axis is constructed with an elongated hole or slot through its centre, in the sides of which a short transit axis is fixed, and into which a telescope is screwed, forming one piece with the axis. This hole or slot in the main axis is sufficiently elongated to allow a vertical motion being given to the telescope of about twenty degrees of elevation or depression, and a square perforation is made in one side of the main axis to receive a small square piece of brass, a little less than the perforation, and into this piece of brass one end of the telescope axis is inserted. There are four capstan headed screws let into the main axis, for the purpose of moving this piece of brass, and by slackening and tightening these screws the telescope and axis moves a little, and, consequently, the cross wires may be adjusted horizontally or vertically, to correspond with the optical axis of the upper telescope, when the zeroes of the plates are made to coincide. The lower telescope is held in position by a brass collar, which presses against the exterior side of the main axis, and is made tight by a screw passing into each end of the telescope axis. The upper plate fits close down on the top of the graduated plate, from which a strong short axis passes up through the centre of the upper plate, and enters a gun metal collar, screwed to the top of the upper limb, and gives an even and smooth motion to the plates; a small brass cap, fitted to the end of this axis, and a screw passes down to bolt all firmly together. Two receding microscopes are also attached to the upper plate axis by means of two radial bars, and travel just the length of the verniers. The upper, like the lower telescope, is constructed in two parts, and screwed into a transit axis, the extremities of which are turned beautifully true into cylindrical pivots, and which repose on short standards or supports. One end of the axis is perforated, which leads into the body of the telescope, and through which the cross hairs are illuminated by applying the light in a small lamp opposite the perforation in the axis; the lamp will remain in this position as long as required, being supported by a small circular brass projection, which is movable with the lamp. The graduated vertical arc reads to twenty seconds, and is screwed fast on one side of the transit axis, and, instead of being suspended under the centre of the telescope, as in the old form of theodolite, is fixed immediately inside one of the telescope supports, and in that position it can be read in less time than usual; and another advantage consists in its having on the same face as the degrees and minutes the difference of "hypotheneuse and base," which enables a man to obtain all these particulars at a single reading. A 4½-inch magnetic compass is fixed close on the top of the upper telescope by means of two milled screws, and is provided with a pair of plain folding sights, which may be used on any occasion without the telescope, or in a short distance underground, where the focus of the telescope glasses will not command. There are four screws fixed in short standards, adjusting the plain sights, to correspond with the line of collimation of the telescope. The telescope, vertical arc, magnetic compass, plain sights, and the spirit-bubble attached to the underside of the telescope, have all one common motion in a vertical plane movable on the transit axis. As this instrument is different to others, the adjustment must consequently be performed in a somewhat different way; this the writer described minutely, and then proceeded to say that it is intended by Messrs. Archbutt, the sole makers, to construct these instruments with two telescopes, and also with only one, or the upper telescope; and to meet all classes of purchasers it can be obtained divided, either on silver, gun metal, or brass (?) in the latter case the instrument is obtained at a cheaper cost, and is quite as efficient, and for underground work will stand more rough usage—which, by the way, a theodolite should never have; but for experienced surveyors and others, who know how to take care of the delicate graduations on the limb, by all means let it be divided on silver. Its advantages for colonial surveyings was next pointed out, and the writer's patented new portable kind of stand to expedite the settings out of the instrument over each station-mark described. Attached to the paper was a formula, by which persons will be able to determine from the angles what the magnetic bearings should be, and consequently, by comparing the bearings deduced numerically with those obtained mechanically, a satisfactory result may be obtained.

The chairman said the writer of the paper was not able to attend, but he understood there was a friend of his present who would answer any question which might be asked.

M. W. B. Brain said Mr. Haskold had made reference to him in respect to his plan for testing bearings, and if any gentleman had a question to ask upon the subject he would, if it lay in his power, answer him. With regard to the instrument he could only simply say that he had used it and found it the most efficient and correct he ever saw for underground purposes, and there was very little variation in the plates in consequence of not having been brought to zero. Now he begged to say that his system of testing bearings was not like Mr. Haskold's. They resembled each other in theory, but not so much in practice, for if the first bearing should be in error all the others reduced from it would be in error in proportion, and subject to a second reduction to put them right. He took every bearing as read from the needle, and deduct it if N.E. or S.W., and add it, if S.E. or N.W., to the angle. This gave him the angular difference between the magnetic and assumed angular meridian, and the majority of those bearings which make the same difference of meridians he took as true. By this means the true bearing of the first line or assumed angular meridian is ascertained. And then all the bearings in error can be put right from this tested line. He then proceeds with the subterranean survey in the same manner, and when tested unites it to the surface survey. And when a double proof of its accuracy is required, he placed the transit theodolite firmly in an inverted position over the top of a shaft, and after carefully levelling it applied a diagonal eye piece, and bisected two lamps, one on each side of the bottom shaft, in a direct line in centre of road from the bottom, and produced that line on the surface and united it to the surface survey, then went down the shaft and united it to subterranean survey, by this means the subterranean and surface survey can very easily be connected mathematically accurate without the aid of bearings, although he found the bearings useful as rough checks in surveys of considerable extent.

Mr. Brown: How many observations can you take in an hour?
Mr. Brain: Well, it would be difficult to take more than six observations with the theodolite.

A member: What is the weight of the instrument?
Mr. Brain: Its weight is not more than 13 lb., and I have used the instrument where the seams have only been twenty inches.

Mr. Bedlington said the difficulty was the largeness of the instrument, and the only advantage over the ordinary instrument was the telescope.

Mr. Brain said that, having a dialling on the top of the telescope, bearings could be taken very easily without any observation.

Mr. Bedlington observed that the legs would have to be spread out very much to get a compass at the top.

Mr. Brain replied that he used a short stand with the legs only one foot in length; they spread out very low.

Mr. Bedlington: Do you take observations on your knees?

Mr. Brain: You can't well stand up.
Mr. Bedlington thought they could, with ordinary care, make surveys with the ordinary compass.

A member: Was any bottom stone taken up in the 20in. seam?
Mr. Brain: Not any at all.

Mr. Bedlington: Do you think you can't make sufficient correctness with the ordinary compass?
Mr. Brain: I never could over bridge rails—wrought iron rail. I assume an angular meridian. I never take a magnetic meridian at all.

Mr. Brown: I think it must be admitted that for all practical purposes the miners' compass is sufficient. I think the fact of the theodolite being so heavy, and that it can only take six observations in the hour, must destroy all hopes of its being employed generally.

Mr. Brown then proceeded to show how, by striking out a line from the surface to the bottom of the pit, he did away with magnetic meridian.

Mr. Bedlington felt that they ought not to get into a discussion of theodolite against the compass, which he thought they were getting into through his fault.

The chairman thought the meeting would be in order in arguing the matter as between the theodolite and the compass, inasmuch as Mr. Haskold said the theodolite did for underground surveying.

Mr. Bedlington said it was, no doubt, a perfect instrument for surface purposes, but the difficulty was the using it for underground, and that had prevented it being used more extensively. Mr. Brain was right in saying that he could assume any meridian he liked and gain the surface underground. They would assume that as the basis; but it was usual to lay down magnetic meridian as a basis in all underground plans he knew of. If they did, they might start with a series of angles, but then they were liable to error in the first start from attraction of iron. Therefore, if they used angles instead of points of the compass they got a perfect survey.

Mr. Brain said he could not start with a magnetic meridian, but he assumed a meridian; such might do for surface survey, but it was not usual in collieries.

Mr. Brown begged to say that he always laid down magnetic meridian as well as his assumed meridian. If there was a survey of not much importance he should work by the compass, and he should not use the theodolite unless in work of great nicety.

A member: Have you ever seen the Hedley dial, which has both a compass and a theodolite, without the telescope; it will take angles without the needle, and at the same time take your bearings?
Mr. Brain: I have seen a drawing of them.

A member: Can you read from four or five minutes on the compass?
Mr. Brain: With the vernier you can.

After some further questions and answers, the chairman said he thought Mr. Brain had met fairly and manfully all the objections raised. It was not for him (the chairman) to say who had the best of the argument. Had any gentleman any more questions to ask or any objections to make?

Mr. Weeks: Have you any objection to a plumb line hung down by the side of a shaft?
Mr. Brain replied that he never used them because of their oscillation.

Mr. Monk said he had used Hedley's dials, and he had always found them work well. He had made many surveys, driven several stone drifts, and sunk pits, and therefore he considered Hedley's dial well adapted to underground purposes; taking the angles and needles conjointly, they could perform underground surveys more correctly.

Mr. Brown said he thought Mr. Brain's system more correct than any dial in taking a survey.

The chairman said Mr. Brain had acquitted himself very well in maintaining the usefulness of his friend's instrument.

THE CORNISH PUMPING ENGINE.

The chairman said the meeting had had the opportunity of seeing several drawings in relation to the Cornish pumping engine which had been kindly lent by Mr. Howe. Perhaps he might be allowed, on behalf of the Institute, to ask Mr. Howe to add to the obligation they owed him by writing a paper on the Cornish pumping engine, which was a subject of vital importance, more especially as the were about sinking deep shafts.

Mr. Howe said he would endeavour to comply with the request of the president.

THE LEINSTER COAL-FIELD.

The secretary read a paper on the Leinster coal-field, by Mr. J. M. Meadows.

On the proposition of the chairman, seconded by Mr. Brough, a vote of thanks was accorded to Mr. Meadows for his very interesting paper.

UNDERGROUND HAULAGE, PARTICULARLY WITH REFERENCE TO ENDLESS AND TAIL ROPES.

By Mr. GEORGE FOWLER.

The secretary having read the paper, the chairman said that as Mr. Fowler was present, although he lived a long distance off, he thought it would be only showing Mr. Fowler proper etiquette if they departed from their usual rule and discussed the paper then. He would ask Mr. Fowler if he had seen or knew anything of the clip drum. They found that instead of this system it was common in the North to fasten the rope two or three times round the pulleys.

Mr. Fowler said he did not. He knew where it worked on the surface for a short distance of about 200 or 300 yards. He had not seen it underground, or heard of it to a greater extent than from 1,000 to 2,000 yards.

The chairman: Because if you get the clip drum, instead of passing the rope round the pulleys, you would be able to work the rope much easier and with less wear. I have not seen it work, but it seems to answer well in steam ploughing for agricultural purposes.

Mr. Fowler pointed out the danger of damaging the ropes as the clip pieces came on them.

Mr. Brough said the endless rope was not much in use underground; it was the tail rope that was used.

The chairman said the writer of the paper had not made up his mind which was the best, and the subject was an open question; so far as his experience went he could not say which was the best.

Mr. Brough said the endless rope was one of endless difficulty. The tail rope was generally used in the North.

Mr. Fowler said that in his district they had two endless ropes, which answered very well. If an accident happened to a tail rope, by its breaking, the trains were delayed two or three hours; but with an endless rope, suppose a tub got off the rails, the train was stopped and the fault was rectified; or suppose the rope broke, the engine stopped at once, and the defect was easily and simply rectified.

The endless ropes could only be used when the sward was level. They had a line 2,000 yards long, and an inclined plane; the work was carried on by the same engine, one portion being worked with a single rope, and they found no difficulty in applying the two. They worked 400 or 500 tons per day by one engine with an endless rope.

Mr. Brough: That is not very much.

The chairman: It is rather a large amount of work.

Mr. Brough remarked that he knew of an iron endless rope which worked 1,500 tons. He should like to know what amount of deviation from a straight line they worked this endless rope.

Mr. Fowler said it could be worked to any curve they liked. He worked a curve of 90 degrees.

A member: You surely could not go round that.

Mr. Fowler: I could go round it easily.

Mr. Bedlington said he had seen a lot of those ropes; he had seen an endless rope on a level of 1,900 yards one way, and 1,700 yards in another direction, worked by the same engine very satisfactorily.

In working an endless rope a man stood in front of the train, he just clipped the rope, and there was no occasion to have the tubs at all. If it was wished to get coal off at different stations he lets go the rope. In fact there was no difficulty whatever in working an endless chain rope. Then, again, there was the tail rope, which might be best in some cases. The advantage in the endless ropes was that they could work them to the utmost, because there was no danger if they

should happen to break. But on inclined planes there would be danger with a tail rope, as the train would run back if it got off the rails. The speaker then proceeded to point out how well the endless rope worked. They found one small engine working a length of chain 2,000 yards long, but it was very finely balanced. If the full tubs came down hill, empty tubs were going up; the fact was the chain was nicely balanced and carried on the tubs. They had only to put a train on the line of chain, the chain clipped, and it was taken up. He next pointed out how they worked at right angles, and mentioned that one engine worked two woods 10,436 yards in length. He thought it was the most admirable system he ever saw, and whatever the first outlay was, he considered there would be less expense in the long run, because of the small expense in renewing the rope.

Mr. Brough: Have you the power, the weight of the chain, and the quantity of power brought out?

Mr. Bedlington replied that the engine was a 12½ in. cylinder, with 30 lb. steam; the cost of the engine was 2s. 8d. per day, the quantity worked by it was 229 tons in about six or seven hours. They could calculate the weight of chain as the length of it was 10,436 yards, and its exact size was ½ in.

Mr. Brough: This is, indeed, a marvel in engineering. Do you attribute it all to balance? We really shall come to perpetual motion by and by.

Mr. Bedlington said it seemed to be done principally by balance. He would give the address of the colliery to any gentlemen who would like to see for themselves, and he had no doubt the agent would be glad to show them over the pit. In reply to a question Mr. Bedlington said they were straight lines, and when they wanted to go off at an angle they must use sheaves. In reply to the chairman he said that if the endless rope was applied to the South Wales district, they would be bound to have the coal on a level with the woodwork and to have iron trams.

The chairman said it would not be applicable to the present system, as the coal was too large.

In reply to a question Mr. Bedlington said, suppose in coming down a tub slipped, it would be blocked against the next.

Mr. Basset said the weight of the chain would keep the tubs from slipping off. He saw an endless rope on a slight incline, not more than half a mile long, at Manchester. The chain was very heavy and kept the tubs all in their proper places. He could not understand how they got away if they wanted to go into a right angles wood.

Mr. Bedlington explained this, but only a portion of his remarks were heard by the reporters.

Mr. Basset said he was at a meeting of the north of England engineers at Manchester, when a discussion took place about the endless and the tail rope; the arguments on both sides were so even that the question became a most difficult one, and the members appointed a committee of three or four to investigate the whole matter and report the result they arrived at. He hoped they should have another opportunity of still further discussing the matter.

Mr. Bedlington: It is evident, whether it be an endless rope or a tail rope, something more must be done in that way in Wales.

Mr. Basset: What kind of rope does Mr. Fowler suggest?

Mr. Fowler: Steel wire ropes.

The chairman said the discussion ought not to be closed, but Mr. Fowler ought to have an opportunity of hearing what Wales had to say; therefore it would be kept open till the next meeting, and in the meantime the paper would be printed, and gentlemen in and out of the district would get a good amount of information.

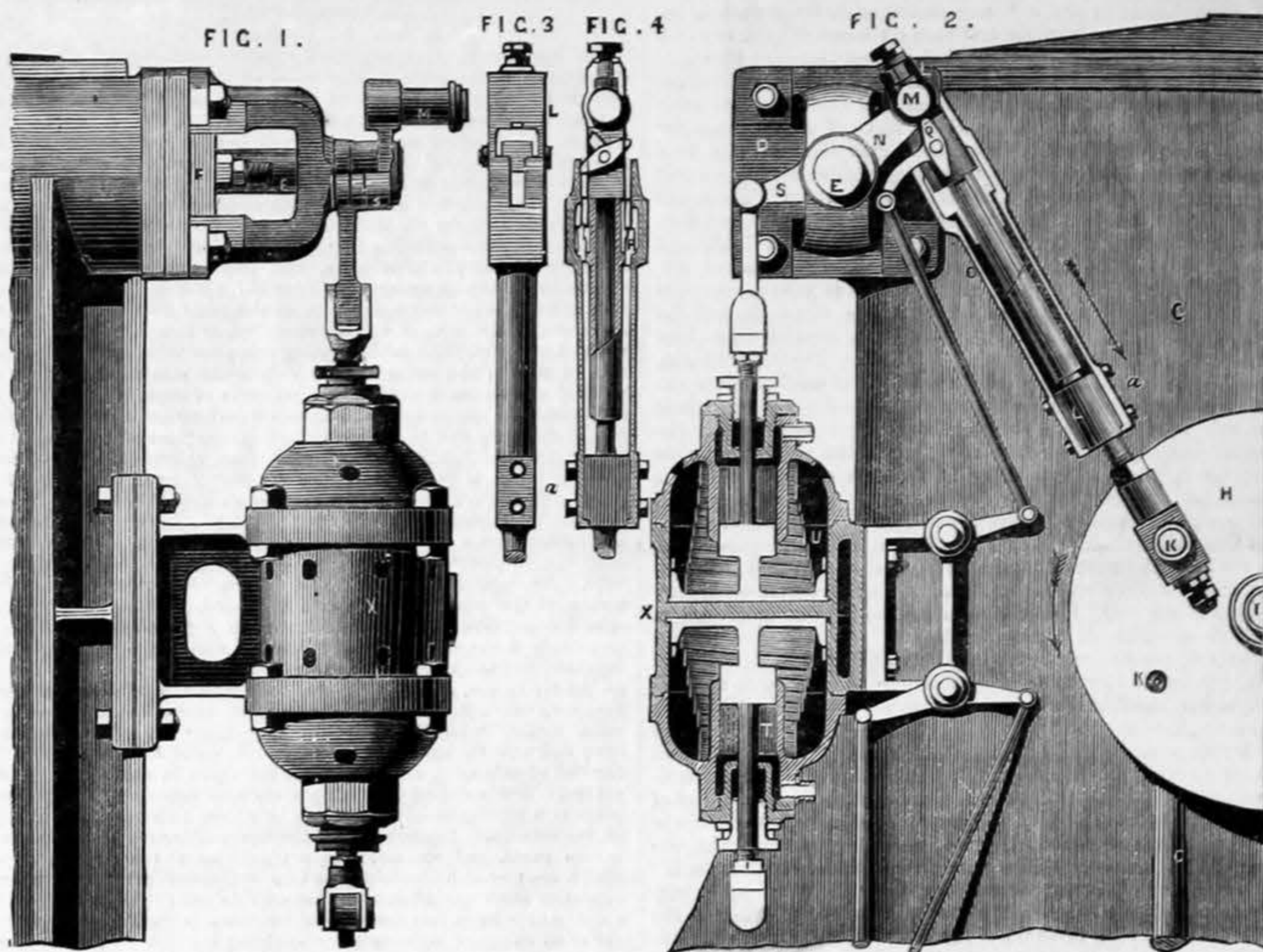
On the motion of Mr. Basset, seconded by Mr. Bedlington, a vote of thanks was passed to Mr. Fowler.

The chairman said he could not leave the chair a second time without thanking them heartily for their confidence, and he felt happy in being able to congratulate them on the success of the Institution, which he thought the first promoters hardly expected. They had to thank those gentlemen for the interest they have taken in the Institution, and he was glad they had selected one of the most worthy of them to succeed him in the chair. He now vacated in favour of Mr. Martin.

The members then adjourned to a splendid dinner served up by Mr. Hallen, in his well-known style. The viands, champagne, and dinner were of the first quality, and a very pleasant evening was spent under the presidency of Mr. Menelaus.

THE LORD CLYDE—The iron-cased screw steamship Lord Clyde, 24, was taken outside Plymouth Sound last week to make a trial of her engines, under the inspection of Capt. Edmonstone, C.B. Mr. Steil, assistant-engineer from Keyham Steam-yard; Mr. Dinnen, inspector of machinery afloat; and Mr. Saunders, second master shipwright, were present on the part of the Admiralty. Mr. Ravenhill represented the manufacturers of the engines. In consequence of bad weather she was only able to make two runs at the measured mile, but these, considering her peculiar construction, were very satisfactory. The Lord Clyde was built at Pembroke on the lines of Mr. Reed, Chief Constructor for the Navy. She is 280ft. long, 58ft. 9in. broad, and has a depth of hold of 20ft 9in.; her burden is 4,067 tons. Her engines are fitted with cylinders of very large diameter for the purpose of using the steam expansively, also with surface condensers, superheaters, and tubular boilers, having brass tubes 2½ in. outside diameter, and containing an aggregate heating surface of 19,000 square feet, with a grate surface of 700 square feet. There are nine boilers arranged in two groups, one of four pieces and the other of five, each group having a chimney 7ft. 1in. in diameter. The engines are capable of exerting an indicated power of 6,000 horses, being a multiple of 6 to 1 of their nominal power, and, as closely as their requirements would admit, are of the same style of double piston rod engine as those made by the same firm with ordinary condensers, which are well known both in the British and foreign navies. They are a pair of direct-acting horizontal engines, with double piston rods, having cylinders of 116in. diameter, with a stroke of 4ft. Each cylinder weighs upwards of thirty tons, and the crank shaft weighs twenty-five tons. The slide valves are placed vertically on the outside of the cylinders, and are worked directly by means of a solid link motion. The connecting rods are 9ft. 5in. long, being seven times the length of the crank. The air-pumps and the foot and delivering valves, which are of india-rubber, working on brass seats, can be easily examined and removed. The feed and bilge pumps, in brass, are fitted with india-rubber valves, and worked direct from the cross heads. Gridiron expansion valves are also applied, and are worked directly from the shaft by means of eccentrics and rods. The condensers are fitted on Hall's system, with vertical tubes, the end of every tube having a small stuffing-box and packing gland, both in the top and bottom tube plates of the condensers. The condensing water is circulated by means of two centrifugal pumps, one to each condenser, which are worked by a pair of independent donkey engines. In addition to the ordinary starting gear, steam cylinders are fitted to facilitate the handling of these large engines. The machinery is fitted with a four-bladed propeller fixed on the stern shaft. The cylinders are the greatest in diameter, and the engines, therefore, the largest that have yet been supplied to the British navy. The draught of water of the Lord Clyde was, forward 22ft. 4in., and aft 24ft. 10in. The vacuum in the condensers, forward 27in., aft 28in. Speed, first run, 4min. 26sec.; second, 4min. 26sec., equal to 13.533 knots per hour. The speed of the screw was 12.825, showing a negative slip of .708, or nearly three-quarters of a knot. Revolutions, first run, 55½ per minute; second, 56; indicated horse-power, 6,110; nominal, 1,000; propeller, four-bladed; diameter of screw, 23ft.; pitch, 22ft. 6in. Wind north-east, force one to two. The engineers feel confident that when the vessel can have the advantage of making the usual six runs under circumstances of certain slight modifications in the engines, that still better results will be obtained, and that a speed of fourteen knots will be realised. The speed of the Lord Clyde is, however, already in excess of any vessel of at all similar dimensions.

SPENCER'S REGULATING AND WORKING THE VALVES OF ENGINES.



THE immediate object of this invention, patented by Mr. J. F. Spencer, engineer, Newcastle, is to economise steam, air, or gas as motive power, by introducing into more general use distinct and separate admission valves and improved escapement gear, and with such valves and gear materially increasing the speed of piston.

Figs. 1 and 2 are front and side elevations of a part of a steam cylinder sufficient to show the improvements in valve referred to in this specification, and Figs. 3 and 4 are intended to show the improved escapement rod by itself; C is the cylinder of a steam engine, a portion only of which is shown, and such cylinder may be vertical, horizontal, or inclined, without impairing the usefulness of the improved valve gear; D is a portion of the valve chest, in which is one of the ordinary steam admission ports and a plain slide valve made to cover the port with sufficient lap to prevent leakage and to suit the action of the valve. The port and slide faces may be flat or curved according to the plan adopted to move the valve; in the engraving the port and valve faces are curved, the slide valve is worked by drivers on a weigh shaft E, passing through a stuffing box F; this weigh shaft E might give motion to any other kind of valve which requires little power to move it, but in the present illustration a valve, commonly called the Corlis valve, is supposed to be used; G is a rod worked by an eccentric or crank on the main crank shaft or on a supplementary shaft driven by the crank shaft, and the reciprocating motion of this rod causes the disc plate H to vibrate on a pin I. On the disc plate are four pins K, K, two of which only are shown, and one of these gives motion to the escapement rod L, which is attached by a pin M and lever N to the weigh shaft E, which gives motion to the slide for admitting steam to the cylinder. The escapement rod consists of two principal and distinct parts La and Lb, one of which, La, is always connected to the pin K on the disc plate H, and the other, Lb, to the pin M. O, O, are two steel spring clips bolted to that part of the escapement rod La which is attached to the pin K, and these spring clips are connected to that part of the escapement rod Lb which is attached to the pin M by the grip of the projecting edges of hardened steel P, P, P, P; Q is a lever, toe piece, or trigger working on the pin R, and connected by rods, &c., to an adjustable handle accessible to the engineer in charge. When the engine is started, and the escapement rod is in gear, as shown in the engraving, the motion of the disc plate and escapement rod in the direction of the arrows brings the trigger Q in contact with the insides of the spring clips O, O, and throws them out of gear, and the admission valve is instantly closed by the action of a spring or weights acting on the lever S and weigh shaft E; and the time when the clips are disengaged, and the admission valve is closed, can be varied at pleasure by the relative position of the trigger lever, which is held in any position at the pleasure of the engineer in charge, or the trigger may be connected to a governor to regulate the speed of the engines by varying the amount of the steam admitted to the engines. The two parts of the escapement rod before described are shown in the drawing as guided in the same line of motion by a guide rod and bush.

In Figs. 3 and 4 the escapement rod is shown disengaged, the steel spring clips being pressed outwards by the pressure of the toe or trigger, and allowing the parts La and Lb of the escapement rod to be separated by the closing action of the slide valve. Escapement valve gear such as used in pumping engines is so well known to engineers that any further description of the first part of the invention is considered unnecessary. Many modifications of detail may be made without affecting the invention of the double-clip escapement.

The second part of the invention requires no engraving to explain it, and is limited to cylinders working with slide valves only.

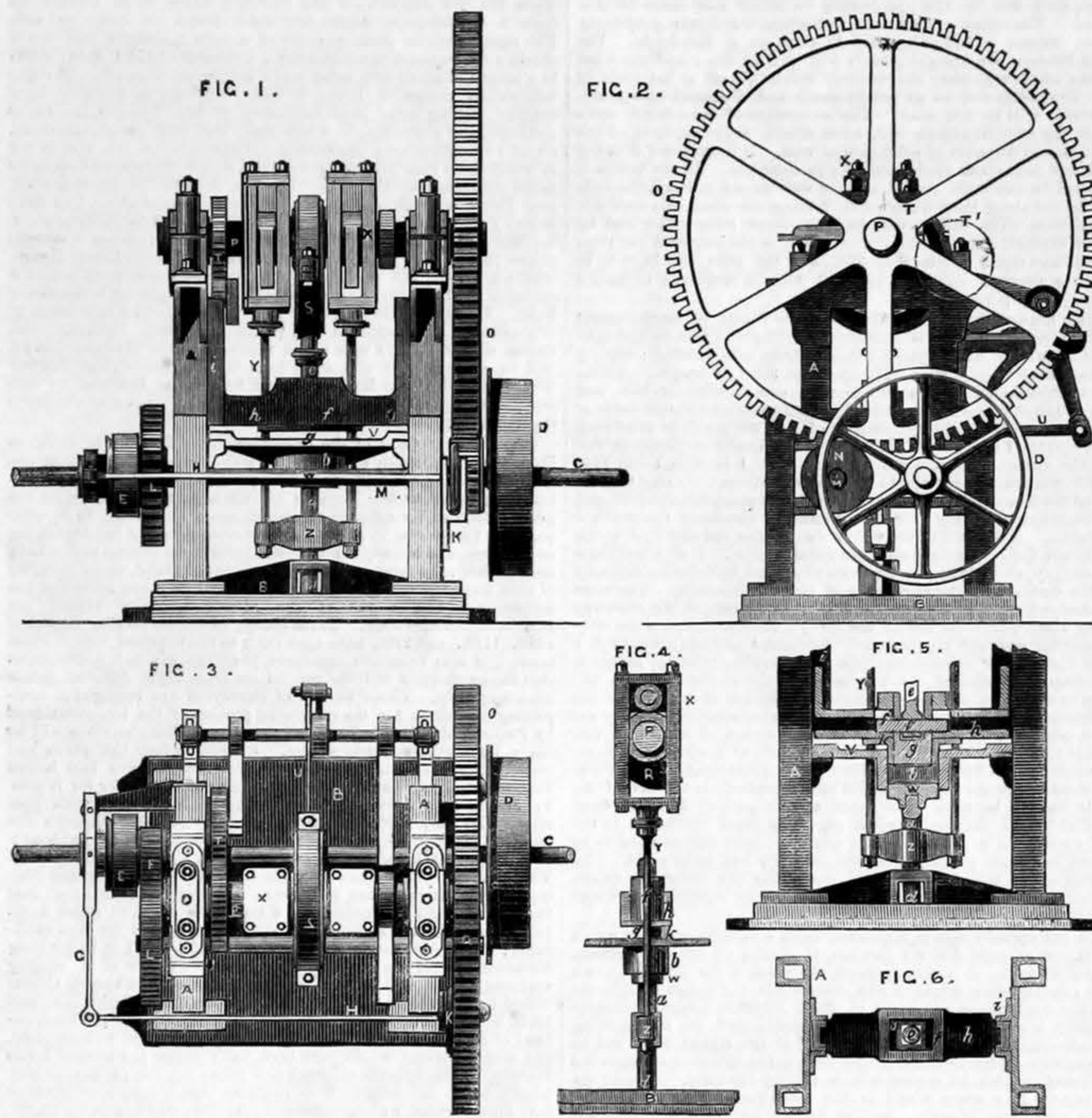
In explanation of the third, fourth, and fifth portions of the invention, the piston and cylinder in which the pressure of air, steam, gas, or water, is used to act on the lever S and close the admission valve is shown at T, and these cylinders (one to each admission valve) may be supplied with steam, air, &c., from any convenient source.

To illustrate the improvements in the springs and air pistons for effecting certainly, and yet gently, the closing of the admission valves, a volute or spiral spring is shown at U, U; W is the air piston, X is the central chamber described in the fifth part of the invention, and Y is the central diaphragm.

DETECTION OF FIRE-DAMP IN COLLIERIES.—In connection with colliery operations, there is nothing which requires such continuous attention as the ventilation, and it cannot be doubted that, even when the utmost skill is brought to bear, the prevention of accumulations of fire-damp is practically impossible; it is, therefore, of paramount importance that a ready and infallible means of detecting the presence of the destructive gas should be at the disposal of those responsible for the safety of the mine, and that a means should be provided of giving light to the collier in workings wherein the air, although not so pure as at surface, is not sufficiently contaminated to be dangerous to human life. Until the beginning of the present century the sole means of ascertaining that the fire-damp existed to a dangerous extent was by the actual ignition of the entire mass,

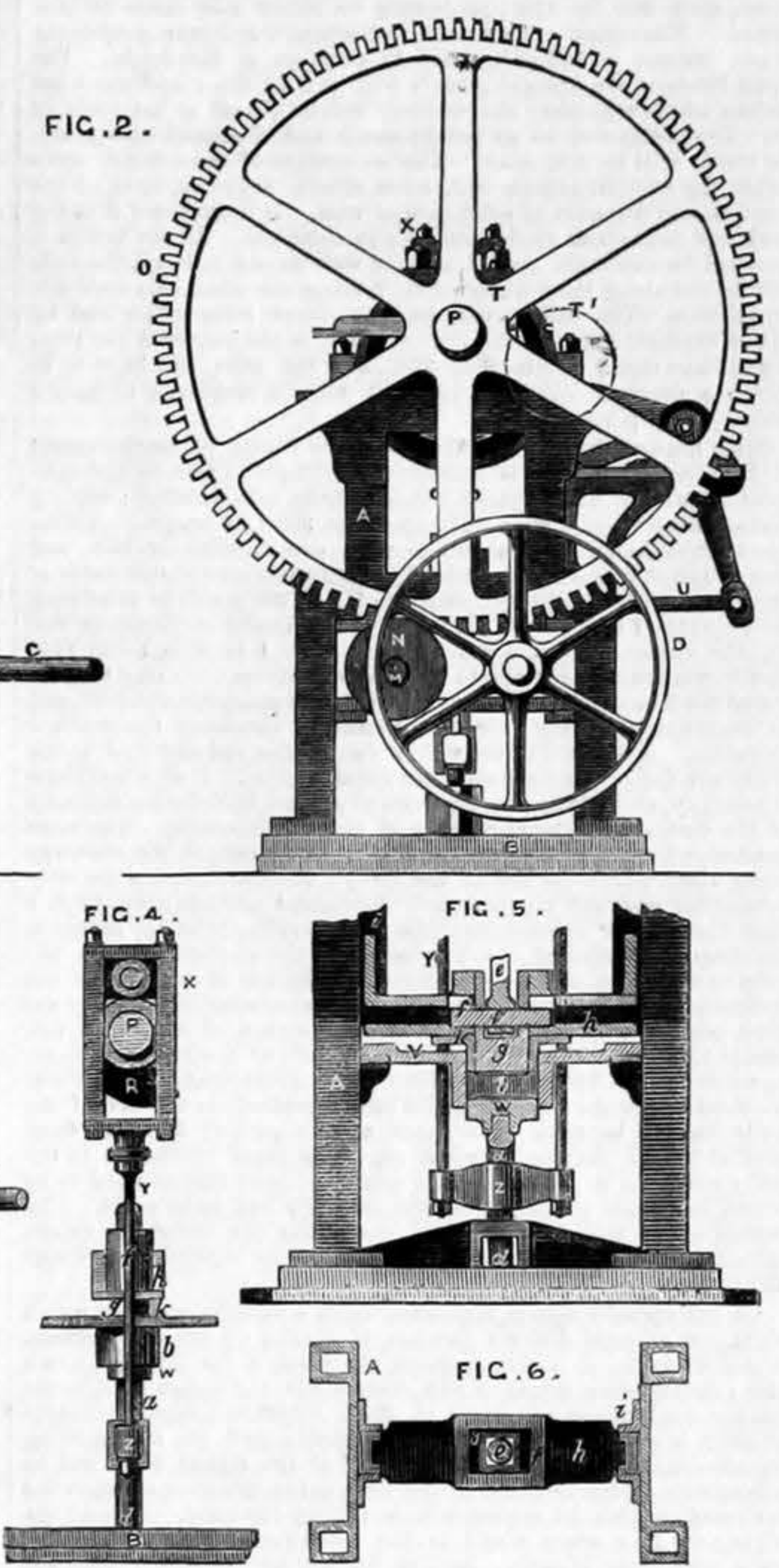
while the dim light of the steel-mill was the only one with which a dangerous atmosphere could be entered, and even with this there was the danger of the sparks inflaming the gas. In 1812 the inefficiency of the then existing arrangements was made painfully apparent by the Felling Colliery explosion, the fact of a pit judiciously worked and, as was supposed, adequately ventilated, being subjected to so extensive a calamity as to cause the sacrifice of three-fourths of the large staff of workmen employed, leading to the most earnest efforts to devise a remedy. The first lamp capable of burning in an explosive atmosphere without communicating flame to the gas was devised by Dr. Clanny, of Sunderland, and consisted of an arrangement for blowing through water the air to support combustion, and for permitting the escape of the heated air through the same medium. This arrangement being necessarily somewhat complicated, efforts were made to discover a more simple one, which led to the introduction of the safety-lamps now generally in use. The fact that burning gases would not pass through tubes below a certain diameter was first noticed by Tennant, in his "Researches on Flame," and the knowledge thus acquired was practically applied to the production of safety-lamps by Stephenson and Davy. As the equivalent of minute tubes, the employment of fine wire gauze not unobviously presented itself, and the success which attended the substitution is attested by the fact that wire gauze lamps are the only safety-lamps which have been employed in collieries during the past half century; their safety and efficiency when constructed with ordinary skill being, so far as an illuminator is concerned, all that need be desired; although Mr. J. J. Atkinson, in his report for this year, gives two cases of explosions through the gauze of perfectly constructed safety-lamps. But the safety-lamp has proved of even greater value for detecting the presence of fire-damp than for enabling the collier to work in dangerous air, the facility afforded for igniting the gas enclosed within a limited and protected area instead of inflaming the entire mass having enabled important tests to be made, which would otherwise have been impracticable. Another step has now been made in connection with the subject of fire damp by the introduction of the simple and highly sensitive indicator devised by Mr. G. F. Ansell, of the Royal Mint. As in the case of the safety-lamp, Ansell's fire-damp indicator is the practical application of a natural law previously eliminated by Mr. Thomas Graham, F.R.S., the Master of the Mint; this law may be popularly explained somewhat thus—when two different gases, as atmospheric air and fire-damp, for example, are brought into contact with each other they have a tendency to mix, and whilst this mixture is taking place the atoms of each gas travel at a speed peculiar to that gas, which speed remains the same under all circumstances. Another peculiarity is that the speed of a gas remains the same whether it is passing into space or into another gas, and whether it is passing through a porous substance or is perfectly free. Mr. Ansell practically applies these facts to the detection of fire damp, and since his indicator enables the exact percentage of the deleterious gas to be ascertained, the application is of the utmost importance. It fortunately happens that a light gas, like fire-damp, travels much faster than heavy ones, like atmospheric air; and as Mr. Ansell's indicator is filled with the atmospheric air, it is obvious that when it is taken into an explosive atmosphere the fire-damp will enter the indicator faster than the atmospheric air escapes; consequently, the contents of the indicator being increased, it is easy to apply such increase to the moving of a lever, by which, as Mr. Ansell expresses it, he obtains "a motive power, by which he can telegraph to a distance (as well as give an audible signal at the actual seat of danger) the locality in which fire-damp exists." Upon the first mention of Mr. Ansell's apparatus, a question was raised as to whether the index, having once indicated the presence of fire-damp, would return to its normal position ready to indicate afresh; and as, from some misconception of the point raised, the question was not distinctly answered in the affirmative, many have given no further attention to the invention, upon the supposition that it was merely an ingenious scientific toy, unfit for practical use. So far from there being any grounds for these conclusions, it is a fact that practically Ansell's fire-damp indicator distinctly shows the percentage of fire-damp present in every level passed through, and in every working place visited, no matter how great the variation in the places successively tested. The misconception appears to have arisen from Mr. Ansell's having replied upon strict chemical facts, which the practical man would regard as unimportant. Assuming the indicator to be taken into an atmosphere containing (say) 8 per cent. of fire damp, that percentage would be at once indicated; if it were then taken into 6 per cent., the indication of 6 per cent. would be equally rapid, and so on for any other percentage. This is all that colliery owners require, and there can be no doubt that the adoption of the instrument will be so general as to prove that since the discovery of the safety-lamp no more important instrument than this has been placed at their disposal. The fact that in either of the mixtures mentioned the index of the indicator would return to zero after being some time in the gas, is one of no more interest to the practical man than the fact that flame may, under certain circumstances, be drawn through the Davy lamp. The indicator is instantaneous in its action, and reliable in its results, and is, therefore, entitled to be universally adopted.—Mining Journal.

CHAMBERLAIN'S MODE OF MANUFACTURING COMPRESSED BRICKS.



This invention, patented by Humphrey Chamberlain, engineer, Wakefield, relates to a peculiar construction and arrangement of machinery or apparatus for the manufacture of compressed bricks from what is known as "granulated clay," whereby two, three, or more distinct and separate pressures are applied to the clay at each revolution of the main shaft.

Fig. 1 in the accompanying engraving represents a front elevation of the improved brick-making machine; Fig. 2 is a corresponding end elevation of the same; Fig. 3 is a plan corresponding to Fig. 1; Fig. 4 is a detail side elevation of the plungers or pistons, and the cams for working the same; and Figs. 5 and 6 represent respectively a detail sectional elevation and plan of the pistons or plungers, and parts in immediate connection therewith. A is the main framing of the machine, which is bolted to any suitable bed or foundation B, and carries the first motion or main driving shaft C. This shaft is provided with the usual driving pulley D, and with a friction clutch E, which engages with the spur pinion F loose upon the shaft. The clutch is thrown in or out of gear by means of a lever G and rod H, the latter having a screw thread formed upon it, and being worked by an internal screw thread in the boss of the hand wheel I, carried by the double bracket K, which is bolted to the side of the main framing. The pinion F gears into a spur wheel L fast on the second motion shaft M, which carries a pinion N at its opposite end in gear with the large spur wheel O, keyed on to one end of the cam shaft P. This shaft is supported in suitable bearings Q bolted to the top of the standards A, and carries the two cams R, R, for working the upper pistons, as shown clearly in Fig. 4, as well as the eccentric S for working the lower piston, as hereinafter more fully explained. T, T', are spur wheels for actuating the self-acting feeder U, but as this feeder is well known, and forms no part of this invention, no further reference to it is necessary; V is a fixed table bolted to legs on the inner sides of the standards, and having one or more moulds or chambers formed therein, which are supplied with the granulated clay from a hopper, not shown, by means of the well-known self-acting feeder; W is a piston or plunger which forms the bottom of each mould, and which receives a rising and falling motion from a pair of snail cams R (Fig. 4) keyed on to the overhead shaft P. These cams each revolve within a frame X, to the lower end of which is connected the rod Y secured by a nut to each extremity of a cross-head Z keyed on to the piston rod a. The upper end of this rod carries the piston W (Fig. 5) working inside the moulding box or chamber b, and its lower end when down rests upon a packing piece d on the bed plate or foundation B; S is an eccentric keyed on the shaft P between the snail cams R, the rod e of which is connected by a long cross-pin f with the upper piston or plunger g working inside the main beam h which slides up and down in vertical guides i, i. The piston or plunger g serves to form the "panel" or indentation of the brick when a solid brick is to be produced, or to form the perforations by being provided with suitable pins when perforated bricks are required; k is the hollow piston or plunger, which is connected to the main beam h, and fits accurately into the mould b, the piston g, working through the centre of this hollow piston, as shown in Fig. 5. The cross pin f works in vertical slots in the main beam h, so that it can move to a certain extent up or down without imparting motion to the beam h. Both the upper pistons g and k with the beam h being elevated, "granulated" clay is fed into the mould either in a dry or slightly damp state, the lower piston W being at that time in its lowest position. The beam h, with its hollow piston k, then commences to descend, the piston k resting upon the clay in the mould, while at the same time the lower piston W rises, and by compressing the clay against the upper pistons expels a considerable portion of the air from the particles of clay. While this operation is going on the inner or "panel" piston g continues to descend slightly, the main beam h and hollow piston k remaining at rest. The amount of this descent of the piston g depends, of course, upon the length of the slots in which its pin f works, and so soon as the pin f arrives at the bottom of such slots, the beam h and hollow piston k will be carried down still further into the mould. In the meantime the bottom piston W has dropped sufficiently to find a firm rest or support upon the packing underneath the lower end of its rod, and thus, as the upper pistons descend, they will force the partially compressed brick downwards to the bottom of the mould, and as the bottom piston has by this time obtained a solid bearing, the final pressure is given to the



clay by the action of the eccentric on the upper pistons as it passes its centre. The "panel" piston g then commences to rise, and so soon as the connecting pin f reaches the top of its slots f', it carries up with it the main beam h and the hollow piston k clear of the mould. The bottom piston in the meantime rises until its surface is flush with the table, thereby expelling the compressed brick from the mould, which is then pushed away by the advance of the self-acting feeder when bringing the next supply of clay, the piston W descending again to the bottom of the mould in readiness to receive the next charge when the operations are repeated.

DUMAS' LAMP FOR THE USE OF MINES.

By M. BREGUET.*

THE apparatus called Dumas' lamp utilises the light produced in a vacuum by the passage of currents of induction; it consists, then, in a necessary manner, of a battery, an induction apparatus, and a vacuum tube, called a Geissler tube, from the German manufacturer who made the first.

The battery furnishes a quantity current; this inducing current produces in the induction apparatus an induced current or one of tension; and, finally, this induced current, traversing the vacuum tube, produces there a light sufficient for conducting one in darkness for reading characters traced on paper, or even divisions engraved on an instrument for working in a mine.

The battery is of two liquids; in the interior of the porous cell is a piece of carbon, which forms the positive pole of the battery, and which is immersed in water, acidulated with sulphuric acid, marking 16 deg. on the hydrometer (for acids), to which is added pulverised red bichromate of potash. At the exterior of the porous cell is a cylinder of amalgamated zinc, forming the negative electrode of the battery, immersed in a solution of sulphuric acid to 6 deg. of the hydrometer. The cylinder of zinc has a diameter but little different from the porous cell, so that the distance between the electrodes should be as little as possible, and, consequently, that the resistance is as small as possible. The exterior case of the battery is a bag of india-rubber, at the bottom of which is placed a round piece of amalgamated zinc, which increases the surface of the negative electrode, and serves as well to support the india-rubber bag, as to protect the porous cell against any shock or shake.

The upper part of the battery is closed in a manner completely hermetic by a plate of hardened india-rubber, kept in its place by screws. Two small tubes of india-rubber, communicating one with the interior and the other with the exterior of the porous cell, give exit to the gases which are formed by the working of the battery.

The battery thus composed can give a constant light during twelve hours at the least; but if it is not kept at work, it is preserved much longer, and can give light at the end of a week.

The expense of maintenance of this battery may be valued at one cent. per hour of effective working, or 1d. for a day of ten hours; and this expense being the only one which the use of the Dumas lamp requires, it is seen that this apparatus costs less than a Davy lamp.

The inductive apparatus does not differ essentially from apparatus of this sort employed in laboratories.

Around a centre, composed of iron wires well annealed, are wound two layers of a primary wire, called the "inductor," of a sufficiently large diameter, through which passes the battery current. Around this "inductor" is wound the induced wire, of which the diameter is much less, and of which the spires and the different layers are insulated one from the other with the greatest care. The induction circuit is provided with an automatic trembler, which interrupts the induction current, and re-establishes it with great rapidity.

The two extremities of the induction wire are placed in communication with the two metallic faces of a Fizeau condenser, the action of which upon the luminous effects of the induction apparatus is very important. To each of the making or breaking of the induction current corresponds an induced current of the fine wire of the coil, and sent into the luminous tube.

The luminous tube is a tube of glass in which a vacuum has been

made after having filled it with azote or nitrogen, so that it still contains very rarefied azote. This tube is sealed to the lamp, so that it preserves its vacuum indefinitely. It shows a central chamber in which are placed two rather fine tubes, one of which has circulations spread out in the same plane, which have the effect of multiplying the lighting surface, and of consequently augmenting the light.

These fine tubes are made of glass or uranium, whose fluorescent properties render more constant the light from the current of induction, which, in fact, is intermittent, although it is impossible for the eye to distinguish the intermittence. This vacuum tube, which already is of a sufficiently great thickness, is protected by a very thick exterior tube, the solidity of which is very great. The exterior tube can be surrounded with a special reflector, half cylindrical, which throws the light forward that would otherwise be lost.

A turning commutator placed above the battery allows one to close or open the induction circuit, and, consequently, to make the light appear or disappear. The battery and induction apparatus are enclosed in a box of leather and in wood, furnished with a cover closed with screws with hardened india-rubber nuts. The commutator alone projects a nut or button in hardened india-rubber above the before-mentioned cover.

The box is supplied with a leather band, which enables the apparatus to be carried in a shoulder belt. The tube is attached to this box by conductors, seventy-five centimetres in length, carefully insulated with cotters, first a tube of india-rubber, then a second tube of india-rubber sufficiently thick, which gives a great resistance and a certain thickness to these cords. By aid of these conductors the tube held in the hand can be passed by the bearer all round him, while the box which furnishes the current rests immovable on his back, or on any support whatever.

For facility of transport the tube has also a place made on the side of the box, in which it is sustained by leather bands of such a sort that even in this position it can lighten the path of the person who carries the instrument, especially if he is supplied with the reflector of which we have spoken. In the box itself the wires which place in communication the battery and the induction apparatus, are insulated with the same care as the external conductors, terminating in the luminous tube; finally the induction apparatus enclosed in a small wooden box is placed in a double envelope of sufficiently thick india-rubber.

All these envelopes have the accessory advantage of decreasing the shocks the apparatus might receive; but their principal object is to prevent an electric spark from passing between the conductors, and firing the explosive mixture of gas in which the apparatus might be placed, which would produce the greatest danger. Everybody who sees the Dumas lamp perceives at first sight that this danger is completely averted.

It is known that in mines it frequently happens that the gases which escape from the sides form, with the air, explosive mixtures. The introduction of an ordinary light in a mine where these phenomena are produced might cause the most frightful accidents, in producing the explosion of the gaseous mixtures of which we have just spoken. It is under these circumstances that the use of safety lamps becomes necessary.

Amongst the most used and most useful of the safety lamps is that of Davy, which might be taken as a type. The Davy lamp has several great defects—first, it may be opened by the workman who carries it, and who, when wishing to obtain a more brilliant light, would let it burn without the surrounding protection of metallic net; it might be extinguished if, as is often the case, water should fall upon it from the roof of the gallery; placed in an impure atmosphere it fails and sometimes suddenly goes out, leaving the workmen without light. Moreover, in cases where light is necessary in order to prevent danger, it may happen that one has men to save—urgent works to execute in an atmosphere where life is possible at least for a short time, and where the Davy lamp cannot burn. In such cases the Dumas lamp would be often of an inappreciable value, for it burns as well in a gas absolutely unfit for combustion and for respiration, under water, and in all the conditions where ordinary combustion lamps are either dangerous or unable to give light.

It will be remarked that there is no possibility of explosion of inflammable gases from the spark of induction, for it only passes in vacuum (at least from the distance where the two platinum points are placed, which are sealed at the two ends of the vacuum tube); and if by accident the vacuum tube should be broken the air would enter the vacuum and immediately all light and all passage of electricity would cease.

It is known that electric currents have been used for a long time to explode powder and to blast mines. Such has been up to this time the only industrial application of the induction apparatus. The Dumas lamp offers two means of arriving at this result. The first consists in employing the intermediary of the induction apparatus; one has only to suppress the communication between the induced wire and the luminous tube, and to attach it to the insulated metallic conductors which are attached to a Stateham or Abel fuse, in which two metallic points, placed at a short distance from each other, and surrounded with sulphuret of copper, and of a small quantity of fulminate of mercury, then ordinary powder, letting escape the spark of induction and lighting the powder.

The second means employs directly the battery; it is sufficient to send the current of the battery in a fuse specially composed as follows:—A very small platinum wire, attached to the ends of two wires which come from the battery; this platinum wire is surrounded with gun cotton first and ordinary gunpowder afterwards, enclosed and held in a small gutta-percha bag. When the current passes this the platinum wire reddens and ignites the gun cotton, which sets fire to the gunpowder used in the mine. This second means is, according to M. Dumas, the surest and most convenient.

A CHINESE NEWSPAPER.—A novelty is announced, *The Flying Dragon*, a journal to be printed in London, from Chinese type imported for the purpose, but to be circulated in the empires of China and Japan. Mr. Summers, the Professor of the Chinese Language at King's College, is to be the editor. It is to contain a concise summary of European news, and descriptions, with illustrations when necessary, of European inventions and manufactures, for the sale of which, in Japan especially, a wide field no doubt exists. This "Dragon" is to make an appearance once a month, in time for the Overland mail, and it will offer to our enterprising traders an opportunity to advertise their novelties in Eastern Asia. We presume Mr. Summers is prepared to translate the advertisements into Chinese.

ISLE OF THANET STEAM FLOUR MILLS.—(From a Correspondent)—The first annual general meeting of the shareholders of this company was held at the mills, Ramsgate, on the 7th inst., when the following report was laid before the meeting:—"The directors have in great pleasure in meeting the shareholders on this occasion, and in being able to report satisfactorily on the completion of the undertaking. No trading having yet been carried on, the directors have only to present to the shareholders a statement of the receipts and expenditure on capital account; and they can assure them, in carrying out the scheme, their principal object has been to get a first-class building and first-class machinery, with due regard to economy, and this they feel assured has been done. The accounts have been duly audited, and are now forwarded for the inspection of the shareholders. Share certificates have been prepared, and may be obtained by application to the bankers of the company." The statement of accounts which was appended was sufficiently satisfactory. The mill has been designed by W. F. Pugin, and we need hardly say that he has imparted a peculiar originality to the architectural features not often met with in buildings of this kind. The mill at present contains but six pairs of stones, driven by a 30-horse high and low pressure double cylinder engine. It is contemplated to add to their number. They are fitted up with Bovill's patent blowing apparatus, and the "silent feed." The machinery and fittings have been turned out from first to last by Messrs. Whitmore, of Wickham Market, and the arrangements throughout reflect much credit on that firm.

* Read before the Manchester Geological Society.

NOTES FROM NEW SOUTH WALES.

The formidable difficulties in the way of forming a railway between Penrith and Bathurst, must be patent to all who have travelled westwards in New South Wales. It was for a long time believed that the steepness of what are known as the Blue Mountains presented insuperable obstacles to the construction of a locomotive line. Not to dwell on the often-quoted assertion of Mr. Wentworth—that bullock drays were the proper mode of conveyance for the colony—even so late as 1857, Captain Hawkins, of the Royal Engineers, in a report which may be seen amongst the parliamentary papers, expressed his conviction that no direct line between Sydney and Bathurst for either a railroad or a tramway could be obtained. This opinion did not, however, satisfy the residents in the western districts, who, realising very keenly, as every traveller on the heavy mountain road must do, not only the personal discomforts of the journey, but also the direct loss which the slow mode of transit occasioned, brought sufficient influence to bear on the Legislature to make the construction of a line to Bathurst a necessary part of the system of railway extension. It was towards the end of 1857 that Mr. Barton was directed to examine the country with a view to determine the best line for a railway, and shortly after took charge, for that purpose, of a party of sappers and miners. A very elaborate and careful exploration of the country between the Nepean and Bathurst was made, extending over three or four years, in the course of which several lines were surveyed and levels taken, but were afterwards for various reasons abandoned. For months together the party were engaged either in following up the various tributaries of the Nepean or in examining all the spurs and gullies of the leading ranges. It need scarcely be stated that the broken nature of the country, the suddenness and the length of the descents, rendered the discovery of a practicable line a task of extreme difficulty. One of the lines surveyed was that from Richmond to Hartley, by following the Grose Valley, and which, if it had been practicable, would have been shorter by nine miles than the mountain line—reckoning from the Nepean. Very good gradients were obtained along the greater part of the line; but it was found that the head of the valley of the Grose was so much lower than that of the Lett, that, even with a gradient of 1 in 30, between three and four miles of tunnelling would have been required. The enormous expense of such a line, together with the difficulty of access, was the cause of its being abandoned. A line, corresponding in many respects with that now adopted, was laid before the Colonial Parliament in October, 1860. It followed the mountain road for about forty miles, but in order to reach Hartley it descended, at the rate of 1 in 62, along the sides of one of the spurs of Mount York (passing near a recently discovered kerosene mine, then doubling back and crossing itself through a tunnel; the detour, which had the form of a narrow loop, included seven long tunnels and six large viaducts. There were to have been throughout the line no less than seventeen tunnels, of the aggregate length of five and a half miles, besides many other very heavy works. The steepest gradient was to have been 1 in 40, and the sharpest curve ten chains radius. The estimated cost of carrying out this line was £26,000 per mile; and, probably from the belief that Parliament would not sanction so expensive a line, its adoption was not proposed. Economical considerations prevailed, and it was determined that, on the western line, not more than £10,000 per mile should be expended. In order to bring the cost within that sum, it was necessary to adopt much steeper gradients and sharper curves than those on the existing lines, and the maximum gradient was fixed at 1 in 30, and the sharpest curve at eight chains radius. It was under these conditions that Mr. Barton selected the present line, the cost of which, it is stated, will not exceed £10,000 per mile.

In an inspection of the works on the Great Western extension, starting from the terminus of the existing line at Penrith, notice is first attracted by the piers for the tubular girder bridge across the Nepean, a river about 600ft. in width. These piers of masonry rise more than 40ft. above the water level, their great height, semi-circular ends, and projecting tops giving them a tower-like appearance. Some astonishment may be expressed at the size and massiveness of the pillars, looking at the low and quiet stream that flows between them; but the enormous volume and the violence of the current on the occasion of a flood rendered it necessary that the structure should be of proportionate strength and height. During a recent flood the Nepean rose 37ft. above its usual level. The rapid progress that has been made with the erection of the piers since they were taken in hand in October, 1864, by Mr. Watkins, testifies to the skillful and energetic manner in which the work has been carried on, under the management of Mr. Morgan, who is associated with Mr. Watkins in the contract. The progress is at the same time due to favourable weather, while a former contractor for the masonry had his apparatus several times carried away or destroyed, involving a loss of £6,000.

In order to give an idea of the size of the structure, it may be mentioned that the two centre piers measure 58ft. by 17ft. 6in. at the foundation, battering upwards at the ends 1 in 15, and at the sides 1 in 20, and that their extreme height is 59ft. The piers are 186ft. apart; the two in the bank at either end are a little larger than the intermediate ones. With the view of economising the masonry, five longitudinal apertures, each about 6ft. by 4ft., have been left; they are filled with concrete, and are covered in half way with a ceiling course. A large amount of preliminary work had to be done before the foundations of the piers could be laid. Divers were sent down to clear away the gravel from the bed of the river to receive the sills into which the piles for the cofferdams were driven. The sills had to be firmly bedded in the shale, and the sheeting to be closely driven into the sills; yet, in spite of these precautions, the water would continually boil up from below, and had to be pumped out. The shale was excavated for a depth of about 18in. to receive the foundations of the piers, which are about 16ft. below the ordinary water level. The shale was so hard that the tools used in the excavation were continually being blunted; and on borings being made, it was found to be more than 11ft. in depth. Immediately within the cofferdam bays of piles were driven, and upon these staging was fixed around the piers, to support the traveller and jenny which have been employed in lifting the stones from the punts and depositing them in their places. The sandstone used for the piers was obtained from a quarry near the top of Lapstone Hill, a distance of three and a half miles, and was brought down by drays in loads of from four to five tons. There were about sixty men and ten cranes employed at the quarry. At the masons' yard, which is close to the bridge works, a large traveller, running on rails 35ft. apart, lifted the blocks of stone on being dressed to the required sizes, and deposited them on a trolley upon which they were taken down to a crane fixed on the wharf, and deposited in punts which conveyed them to either of the piers. A rope was carried across the river, by means of which the punts were drawn from the wharf to the piers. The courses are 15in. in thickness; the weight of the stones average from two to three tons, but some of the blocks of the dental course weigh from five to six tons; the stones are rock faced and are set in concrete. A simple contrivance has been used for the direction of the masons in dressing the stones. There was an exact model of each of the piers, consisting of a succession of wooden slabs marked so as to show the joints and interstices; each slab represented a course of the masonry, and they are given out one by one as guides for the size of the blocks. During the time that the foundations were being laid the works were being carried on night and day.

The piers being finished, a commencement has been made with the fixing of the tubular iron girders. This portion of the work has been contracted for by Sir M. Peto and Co. The whole of the plates and bolts have arrived, and they are now being deposited on the adjacent ground. Five or six bays of temporary staging will have to be erected between the piers to support the ironwork while the rivetting is in progress. As at the Menangle Bridge, there will be two upright parallel tubular girders with cross girders between at

the bottom. Each division of the upright girders will consist of a compartment 10ft. by 2ft. 3in., the vertical side plates varying from a quarter to half inch thickness; above and below will be double boxes, each 3ft. by 18in., projecting on either side three or four inches. The cross girders will rest upon the lower projecting boxes, instead of being fastened to them as at Menangle. The width between the upright girders will be 25ft. 6in.; and the cross girders which will carry the roadway will be placed at intervals of 3ft. The plates will be united by angle and T-shaped pieces, and the rivets will be 5in. apart. The succession of iron boxes composing the upright girders will, when rivetted together, have all the strength and firmness of solid bars of iron. It is expected that the work will take about twelve months to complete. As the bridge is intended for the main road traffic as well as the railway, the rails will be laid along the northern side, leaving the other side available for vehicles. The bridge will be approached from either end by timber viaducts; that on the Emu side will be the longer of the two; it will have eight openings of 26ft., and the piles will have to be driven a depth of 75ft., for which it will be necessary to have a second tier of piles.

Some heavy works are required on Emu Plains before the ascent of the Blue Mountains is commenced. There is first an embankment containing 44,718 yards obtained from side cuttings; beyond that a timber viaduct with 12ft. openings 900ft. in length. After a short embankment, and a bridge with one opening of 26ft., and four of 21ft., there is a long embankment containing 190,000 yards of earth, and commencing the incline of 1 in 30, which is continued for a length of two miles. So steep is the ascent of Lapstone Hill by the road—the gradients ranging from 1 in 8 to 1 in 14—that it was found necessary to make a wide detour, to carry the line round the face of the mountain and across the precipitous gullies, and to introduce a "zigzag," for the purpose of obtaining the required elevation. A stone viaduct which carries the railway line across Knapsack Gully was finished a few months since. It is a fine piece of masonry, and admiration has been expressed both for the boldness of the design and the excellence of the workmanship. The most noticeable feature of the structure is its great height, the roadway being 120ft. above the bed of the gully; though the piers are very substantial and well proportioned, their great altitude gives them a light and slender appearance. Another peculiarity of the bridge is the steep inclination of the top, being on the gradient of 1 in 36; even as seen from the Penrith station, a distance of four miles, the inclination is very perceptible. The opposite sides of the gully are 388ft. apart; there are five semi-circular arches of 50ft. span and two of 25ft. span; the piers are 36ft. by 20ft. at the base, and taper upwards to 15ft. by 9ft. 6in. at the top. A great deal of labour was required before the masonry could be commenced, as the bed of the gully had to be filled in a depth, on one part, of 30ft., to form ground for the masons to work on. The stone obtainable in the gully not being fit for the work, a quarry at some distance had to be found, and roads to connect it with the gully had to be made. The details of the work were carried out under the immediate superintendence of Mr. Watkins. The cost of the structure was about £22,000.

On the opposite side of Knapsack Gully a contrivance known as a zigzag is adopted for the purpose of getting up the steep ascent. About a quarter of a mile beyond the viaduct the line comes to a stop; another line meets it at a sharp angle and comes back to the head of the gully at a distance of 120ft. from the bridge; a height of 135ft. is gained in a length of about half a mile, the zigzag being on a gradient of 1 in 33. At each end of the zigzag there will be a reversing station to allow of the train being shunted, as upon the intermediate line the engine will be behind the train. Beyond the zigzag the line winds round to the southward, and comes on the main road near Wascoe's Inn, at the top of Lapstone Hill; the height here above the plains is 550ft., the plains being 86ft. above the sea. From this point until reaching Blackheath the line keeps within a short distance of the main road, now on one side then on the other, avoiding the steep ascents and descents of the road by alternate cuttings and embankments. The line being taken over a succession of rapid undulations the earthworks are necessarily very heavy; one of the cuttings is eleven chains in length, and 51ft. in depth; another is eight chains in length, and 48ft. in depth; one embankment contains upwards of 63,000 yards, and another nearly 54,000 yards; one cutting is forty-six chains in length, and contains 51,200 yards, the deepest part being more than 50ft. A considerable portion of the excavation has been through sandstone rock, all of which had to be blasted; so compact is the material in some of the cuttings that the sides stand safely at a slope of one-eighth to one. At two or three places tunnels are carried under the road, to avoid the necessity for bridges; owing to the density of the rock no lining is required. There are a number of level crossings; the gates will probably be kept by the men engaged in the repairs of the permanent way. All along the line there is a steady rise, frequently at a gradient of 1 in 33. At the Valley the line is 1,069ft. above the level of the sea; at Cox's Downfall it is 1,462ft.; at Ellison's Tollbar, 1,728ft.; at Eighteen-mile Hollow, 2,050ft.; at the Blue Mountain Inn, 2,398ft.; at King's Table Land, 2,865ft.; and at Blackheath, 3,255ft. This latter is the highest level to which the railway is taken between Penrith and Hartley. The elevation gained between Emu Plains and Blackheath, a distance of thirty-eight miles, is 3,439ft., giving an average gradient of 1 in 58; but the average gradient from Emu Plains to King's Table Land is only 1 in 48.

With regard to the line from Emu to Blackheath, nearly the whole of the formation is now finished. Four or five of the heaviest cuttings about the middle of the line are still in hand, some lengths of fencing have to be done, and the banks require to be trimmed; but in three months, at the furthest, all the works will be completed. The line was divided into three contracts, the first and the third of which are being carried out by Mr. Watkins, and the intermediate one by Messrs. Duxbury and Kerr. A few weeks since tenders were advertised for laying the permanent way, but the contractors whose tender was the lowest failed to comply with the conditions, and fresh tenders were invited. In consequence, it is understood, of the second series of tenders being considered too high, it has been determined to call for tenders a third time. After leaving Blackheath the line descends at the rate of 1 in 55 to the Soldier's Pinch, whence it rises with a gradient of 1 in 66 to Shepherd's Tollbar. Near this place the line parts from the main road, and will only once cross it until it reaches Bathurst. The chief reason for this deviation is to avoid the steep descent into the Hartley Valley, and, consequently, the steep ascent of the range beyond. The Hartley Valley is only 2,286ft. above the sea; by taking the railway through Lithgow Valley, which is 2,975ft. above the sea, the descent, and the subsequent ascent, of 689ft. is saved. The road along the celebrated Victoria Pass, constructed by the late Sir Thomas Mitchell, is extremely steep; for a length of 80ft. the incline is 1 in 6, and the ruling gradient is 1 in 8. Instead of following that road the line diverges to the northward upon the Darling's Causeway Range. There is an easy descent for some distance, and then an ascent, until a higher level than that at Blackheath is reached. The line here comes upon the track known as Bell's line of road, and following generally the range between the Colo and Lett rivers, on which that line was taken, descends at a gradient of 1 in 50 to Dargan's Creek, the chief tributary of the river Lett. Thence the line rises at the rate of 1 in 33 for a length of a mile and a-half towards the Clarence Range, which is a continuation of Hassan's Walls. Through this mountain there is to be a through sandstone tunnel 539 yards in length, exclusive of the cuttings at either end. Here the greatest height is reached on any part of the line between Sydney and Bathurst, the level being 3,656ft. above the sea, and the top of the mountain being 3,753ft. above the sea. This is stated to be by far the highest level attained by any railway in the world; this line containing a greater length of steep gradients and sharp curves than any other. Beyond the tunnel the line commences the descent into Lithgow Valley. In order to reach a lower level another zigzag is resorted to, of much greater length than that at Lapstone Hill; the line retraverses the face of the spur, descending

along the zigzag at the rate of 1 in 42. The rocky spur along which the zigzag will be taken is extremely abrupt and craggy. Two tunnels, of 59ft. and 76ft., will have to be excavated; and retaining walls for the support of the line will have to be carried up from a considerable depth—at some places of 30ft. or 40ft. The zigzag will be three-quarters of a mile in length, and it will obtain a difference of level of 220ft.; a descent of 574ft. being made in a length of about two miles and a half direct distance. The line follows the course of Lithgow Valley through a tolerably level country, taking some land belonging to Mr. Thomas Brown, at Eskbank, and proceeding to where Bell's line joins the Mudgee-road, about two miles from Bowenfels. Here will be the station for Bowenfels, on land belonging to Mr. Andrew Brown, and opposite to his residence at Coerwul. The line crosses the Mudgee-road, near Farmer's Creek, and thence rises at the rate of about 1 in 40 to Brown's Gap, and proceeds parallel with the road to Morangaro, at the Middle River, the residence of Mr. C. Sidney; thence it ascends at the rate of 1 in 40 to the summit of the Middle River Range, where a tunnel, 216 yards in length, will be made, from which it descends to Cox's River at the rate of 1 in 40, making a descent of 300ft. The end of the line is at Piper's Flat, about a mile north of Wallerawang, the residence and property of Mrs. Walker. The station will be about a mile to the westward of the Mudgee-road; it will be a distance of nine miles from the Western-road at Meadow Flat, nine miles from Bowenfels, and forty miles Bathurst by railway, and sixty miles from Mudgee. Meadow Flat is about twenty-one miles from Bathurst.

Plans and sections of the extension from Blackheath as far as Piper's Flat, a length of thirty-one miles, were sanctioned by the Colonial Parliament in August, 1864; and in November, 1864, a contract was taken by Mr. Watkins for the formation and also for the permanent way for a length of sixteen and a half miles, to be completed in two years. The works were commenced at the beginning of the year, and already more than 140,000 yards of excavation have been shifted; the formation is considerably advanced, and a quantity of rock from the cuttings has been stacked in preparation for the ballasting. The works at the Mount Clarence tunnel are also in active operation. Three shafts, of the respective depths of 128ft., 117ft., and 97ft., have been sunk to the required level. From these, and also from the entrances, headings are being driven, so that the excavation will be carried on from eight different points simultaneously. Three parties of surveyors are engaged in completing the levels for the remaining portion of the line sanctioned by Parliament, and it is expected that the working sections will be ready for tendering this winter. Shortly before the plans and sections for the extension beyond Blackheath were laid before Parliament, a representation was made to the Minister for Works by Mr. George Jarvis, of Hartley, that a better line than that selected by Mr. Barton could be obtained by going through the town of Hartley. The line proposed descended the range about a mile from Blackheath, and passed round the south of Mount Victoria. Mr. Barton having made a survey of the proposed line, reported that it presented insuperable engineering difficulties; that tunnelling would be required for 4,100 linear yards, of which 3,566 yards would be through granite, and the remainder through sandstone; that impracticable gradients of 1 in 12½, and 1 in 8½ for long distances, would be necessary, besides a number of lengthy viaducts, one of which, over the tributaries of Blackheath Creek, would be 600ft. long and 220ft. high, and another 800ft. long and 100ft. high. The greatest obstacle presented was the fall from the head of Blackheath Creek down to a valley that had to be crossed, and where the line would have been 500ft. below the level of Little Hartley. Although the contract now taken for the permanent way terminates at Blackheath, it is probable that a length of three or four miles beyond will be included in the line when open for traffic, a site having been selected for a station at the most convenient distance from Hartley. To sum up the works on the four contracts now in hand we may state, that the excavation on No. 1 amounts to 462,000 yards; on No. 2, to 329,000 yards; on No. 3, to 350,000 yards; and on No. 4, to 470,000 yards, making a total of 1,611,000. From Piper's Flat the line will ascend the main Dividing Range, which it will cross about two miles north of the township of Rydal, also crossing the Western-road near Solitary Creek. It will then follow the valley of this creek as far as the Fish River, at first southward to Sodwalls, and thence in a westerly direction. Keeping on the north side of the Fish River, it will pass round Tarana Mountain on to Dirty Swamp, a continuation of Frying Pan Creek; thence it will go through Tyndale's Hollow, about two miles north of the township of O'Connell, and about four miles south of the Green Swamp, which is close to the Glanmire diggings. The remaining course of the line will be through the township of Raglan, and thence through Kelso to Bathurst, crossing the Macquarie River, a little higher up than the Denison Bridge. The station will probably be between Russell and Piper streets, within a short distance of the centre of the town. The site stated to have been selected by Sir William Denison as the most suitable for a station was the reserve known as the Ordnance Ground; but, besides other objections to that site, in the event of the railway being continued further, it would have to be taken through the centre of the town, for which some of the most valuable land and buildings would have to be bought. From the survey at present made of this line it is not expected that the works will be so heavy as upon some of the other lines. On the western side of the Dividing Range granite is met with, but it is not known to what extent the cuttings will be through that material. A number of bridges of various sizes will be required to carry the line over Solitary Creek, which will be crossed about sixteen times in a length of nine miles; the largest of these bridges will be about 100ft. in length. The gradients will, for the most part, be easy; the line will ascend the Main Range at a gradient of 1 in 91; then it will descend at 1 in 100, 1 in 50, and 1 in 87. The worst gradient on the line will be 1 in 33 for a length of a mile and a quarter, crossing the range between Dirty Swamp and Tyndale's Hollow; and there will be a descending gradient of 1 in 40 to Bathurst Plains. This portion of the line, although having very easy gradients and light work, is necessarily rendered tortuous by the roughness of the country through which it passes. The distance of Bathurst from Sydney by railway will be about 143 miles, being twenty-two miles longer than by the road. It would be useless to speculate as to when the line will be completed to Bathurst; but there is some probability of its being opened for traffic as far as what will be called the Hartley station, about forty-one miles from Penrith and seventy-five miles from Sydney, early in 1867.

JOINT-STOCK COMPANY LAW.—THE LONDON ENGINEERING COMPANY V. OGLE.—It has become a very interesting question to many, what makes a man a member of a joint stock company, and whether he may not at his own option strip himself of that character, and repudiate further liability by resigning or withdrawing, and by forfeiting all the money he may have paid in the shape of deposit on application and allotment. That was the question raised in the above action. Mr. Ogle, the defendant, had applied for shares in the company in the usual form, and in due course received a letter of allotment, on which he paid a deposit of £125. Mr. Ogle afterwards changed his mind, and became anxious to relinquish the shares and to withdraw from the company, forfeiting the amount he had paid by way of deposit. The company, however, were unwilling to part with him, and therefore they placed his name upon their register of shareholders as a member of the company, and now sued him for calls made upon him in that capacity. The action was tried in the Court of Queen's Bench before the Lord Chief Justice, the defendant's counsel contending that he had been improperly placed upon the register because he had not signed the memorandum of association. The Lord Chief Justice, however, thought that the words of the Act of Parliament were clear and precise, and a verdict passed for the plaintiffs, subject to the point of law whether, under the circumstances, the statute made the defendant a member of the company.—*Money Market Review.*

LETTERS TO THE EDITOR.

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

PROFESSIONAL QUALIFICATION.

SIR,—I am glad to see from your editorial of the 17th inst., that you have at last taken up the baton in favour of a professional test of qualification for the important duties of an engineer, and as your sentiments so closely coincide with my own (as evidenced by a letter you were kind enough to insert in your journal of June 9th), you will perhaps accord me a few lines of supplementary remark to your able article.

As you justly state, it becomes a matter of extreme difficulty to decide where "qualification ends and quackery begins," therefore the immediate adoption of any arbitrary standard (whereby to attest or annul the assumed position of any man) would be doing an injury to those who are at present practising, but whose efficiency would be found considerably below par; and as these form a goodly proportion of the so-called "professional men" of the day, it must necessarily be a work of time to bring this much-to-be-desired "diploma" system into operation.

I would therefore suggest, as a preliminary step, that yourself and other engineers of known scientific attainment, constitute a board of examiners, and that young engineers be invited to offer themselves for examination—to receive as the result certificates of the first, second, or third grade; the senior wrangler in each subject being admitted as member of one or other of the institutes.

At some future period it would be possible to obtain a charter of incorporation, and these candidates might henceforth take rank as Masters, Bachelors, or Passees of Engineering, and might be initiated as M.C.E. or M.M.E., B.C.E. or M.E., C.E. or M.E.

Of course the board would be best qualified to judge respecting the attainments required for each grade; but I should suggest similar papers to those given to candidates for the engineers' department of the Indian Civil Service or the Naval Engineers, with, however, a more fully developed practical bearing.

For the C. or M.E., I should consider the following course sufficient:—Arithmetic and mensuration, algebra, inclusive of quadratic equations, plane and spherical trigonometry, and the first six and part of the eleventh and twelfth books of Euclid, mechanical philosophy, and its practical applications. The professional part to embrace designing, drawing, estimating, and surveying, with an outline of professional jurisprudence of works and services; these latter papers to be extensive in application, and framed, of course, to suit the civil or mechanical tendency of the candidate.

For the Bachelor test I should suggest a further excellence in the above, and include conic sections, and the differential and integral calculus. The Master's certificate would be obtained by a refinement upon the preceding, and acquaintance with the writings of ancient and modern authors.

This scheme may by some be thought visionary, but I feel confident that the course roughly sketched could be easily overcome by any one desirous of so doing, and we should ultimately raise our profession to a position more in accordance with its varied requirements.

Your scheme of pupilage also presents some features worthy of notice, but I should go further back, and observe that our ordinary school tuition has not kept pace with the advancement of the age; as example, who is not aware that a boy's arithmetic days are spent in calculating the tare and tret of tea, sugar, and treacle, or in finding the value of so many yards of tape or broadcloth? Again, in mensuration or surveying, he meets with a most happy combination of triangular, square, or circular fields, and can determine with accuracy the distance of the moon, or between two ambiguous points A and B, by conjuring with a table of logarithms; but as far as application to obtain any measurement of the school yard or common hard by, or the recognition of a theodolite, and its adaptations for finding the height of the parish steeple, in these he is quite at fault. Let us next follow him to the drawing lesson; he there learns to portray the likeness of some piece of mechanism on another paper, generally by the enlargement and exaggeration of its proportions; and after outlining this effigy with a decoction of ink and water, he elaborates the whole by a display of water colours; but as far as knowing which is bolt, nut, or washer, neck or coupling, one term may be substituted for another without injury to his preconceptions.

Here, then, I consider, lies the strongest argument for the establishment of a school such as you recommend, viz., for the study of "Practical Engineering."

As I have already taken up too much of your time and space, I shall not endeavour to describe the entrance of the above school-boy into the office or workshop, where he is instructed into the mysteries of mixing ink (a good black and not too thin) and colours, tracing and running errands; or into the unsuitableness of leaden punches, and bevelled or left-handed squares, &c. Suffice it to say, that at the expiry of his apprenticeship—unless he applies himself manfully out of working hours—he is competent to obtain the sum of one guinea per week, or he appears in your prints offering himself as an improver, salary no object.

Now I contest that this low ebb could, in most instances, be avoided by adopting proper modes of instruction, and by the young man knowing that without passing a thorough examination he will be unable to obtain a license to practice, thereby improving the intellectual status of our rising members.

I enclose my card, and (if you can obtain the names of gentlemen willing to undergo the onerous duties of examiners) whatever lies in my power for the advancement of this object shall be willingly rendered.

Oldham, Nov. 21, 1865.

T. M.

INVENTORS' RIGHTS.

SIR,—If the Lord Chancellor's decision, of which I enclose report extracted from the *Times* of the 4th inst., in the case of Mather v. Green be not reversed, it follows that a joint patentee (though the sole inventor) has no claim upon his wealthy partner to profits arising out of articles manufactured and sold under a joint patent, unless a special contract has been made to that effect.

Very much has been said of late about the injustice of our patent laws, the management of the funds arising from the sale of letters patent, and the difficulties inventors have to contend against in securing their interests. Much remains to be said and more to be done on these subjects, but nothing hitherto has occurred of such importance to the inventors of this country as the judgment given in the above case, and as I said before, unless the same be reversed, then a new era on this subject is inaugurated.

By that decision no inventor henceforth must trust to his co-patentee's honour or partnership, as heretofore, but must have a special contract that certain profits shall be paid to him as his share in the interest to be derived from any joint patent; otherwise, he will have to look on patiently, perhaps starve, and it may be die, while his opulent partner grows richer out of the returns from the patent secured in their joint names.

The doctrines hitherto acted upon must pass away, all mutual interests now existing may be severed at any moment; no joint patentee will be entitled to a share in the profits arising from a joint patent (unless by special contract); and any joint patentee may now manufacture in his own name irrespective of his co-partner or co-partners, destroying or reversing all existing interests.

The inventive faculties existing in the artisan's mind of this country will be checked for lack of confidence. What can be done in this matter? Should not all those whose interests are affected by this judgment consider the case as their own?

Subsequent inventors should take knowledge of this important judgment—should secure patents in their own names, and not give up their rights to others, except by special contract, setting forth the amount to be paid to them by their co-patentee, who may be a

wealthy manufacturer. I trust this subject will receive due consideration in your columns. A PATENTEE.
Leeds, November 20th, 1865.

COURT OF CHANCERY, LINCOLN'S-INN, NOV. 4.

(Before the LORD CHANCELLOR.)

MATHER v. GREEN.

This appeal from a decision of the Master of the Rolls was argued before the long vacation, and stood over for judgment. It appeared from the case that the defendant, Thomas Green, had carried on business at Leeds as a manufacturing engineer, and was a maker in particular of lawn-mowing machines and rollers; and also had a retail shop in Victoria-street, Holborn, which was managed by his son, Willoughby Green. In the latter part of the year 1861 Willoughby Green joined his father at Leeds as partner, when the London business was carried on by the plaintiff down to the year 1863. Letters patent had been obtained in the joint names of the defendants and the plaintiff for improvements in the construction of lawn-mowing machines, &c., and the defendants had been in the habit of granting licenses and receiving royalties on the sale of the machines. In 1863 differences arose between the parties, when the plaintiff filed his bill for an account, claiming, as partner, a share in the royalties received by the defendants, and insisting upon his right to the profits of the London business, which, he alleged, was his own, although carried on in the name of the defendants. The defendants contended that he was merely their managing agent. The evidence and correspondence extended to a considerable length, and the Master of the Rolls, although negating the claim of the plaintiff to be a partner, made a decree in his favour as to a share in the royalties and commission, and directed an account to be taken. Mr. Southgate and Mr. Kingdon appeared for the plaintiff; Mr. Selwyn and Mr. Phear for the defendants. The Lord Chancellor this morning delivered judgment, and, after carefully reviewing the evidence and the correspondence, said that with respect to the first part of the case, namely, the claim of the plaintiff to a share in the royalties, he thought the evidence was not sufficient to rebut the assertion that the plaintiff was jointly interested with the defendants in the letters patent. This interest, however, could not confer upon him a right to claim a share in the profits made by his co-patentees, unless there was a special contract to that effect. The right under letters patent was to exclude all the world from the benefit derived from them except the grantees of the patent; but there was nothing in the law to restrict any of the joint patentees from such benefit. This could only be done by special contract, and, therefore, as none such existed in the present case, the claim of the plaintiff on this ground must be rejected, and the decree of the Master of the Rolls reversed. With respect to the second part of the case, the claim of the plaintiff to the profits of the London business, he, the Lord Chancellor, was of opinion that the evidence proved that the plaintiff was only the managing agent for the defendants, and he had consequently wholly failed in establishing any title for relief. The bill must be dismissed with costs.

COMPRESSED MOIST HOT AIR ENGINE FOR MARINE PURPOSES.

SIR,—On Saturday last a trial of a boat propelled by a light portable moist air engine came off on the Thames at Lambeth. The boat into which the engine was placed (without any fitting or alteration of the boat) is 22ft. 6in. long by about 5ft. 6in. beam, and 2ft. deep, and is capable of seating from fifteen to twenty persons. The boat is an iron one, built on the Lake of Geneva, by M. Chillon, and was sent over to the first International Exhibition, and previously to the robbery—which it seems is common to all premises on the Thames—had a handsome appearance. The engine has one cylinder, 4in. diameter and 12in. stroke, driving a pair of light paddle-wheels, 3ft. diameter, about eighty revolutions per minute. The power of the engine is about 1-horse power nominal, and the weight of the boiler and engine is about 300 lb. The maximum speed attained through the water was six miles an hour, but the average speed was about five miles. The consumption of fuel in three hours' work was a peck of gas coke, which cost retail 1½d., and 4 lb. of coals, 1d.; total cost for three hours, 2½d. As the boat is capable of carrying 1½ tons of coal, it would be equal to a voyage, in smooth still water, of between 3,000 and 4,000 miles without further fuel. The reason of the extraordinary economy of fuel arises from the use of the latent heat of the steam as motive power, but which, as I pointed out in a former communication, is wasted in all steam engines. The engine, when not required for the boat, is easily lifted out (and in my case is absolutely necessary, or it would be all stolen), and may be used either as a light road engine, or as a fixed engine of 1-horse power, working for less than 1d. an hour for fuel. It seems extraordinary that the present steam engines should continue to be used in steam vessels, entailing, as they do, a clear loss of half the fuel and two-thirds the space occupied by the engine.

Several omnibus proprietors would have been willing to start omnibuses on my plan, but are deterred from the fear of infringing the letter of that absurd legislative enactment requiring a red flag and stoppage, and a speed of not more than two miles an hour. I suppose the originator, having seen a noisy agricultural engine at work, concluded that all engines must be of the same description, and require three persons to manage them. My little locomotive is easily controlled by a child eight years of age, and makes less noise than a cab, and no smoke. Our boasted liberty does not bear comparison with the absence of it, as we are told is the case in France, but where, nevertheless, locomotives are allowed to run on the common roads without those ridiculous restrictions.

November 21, 1865.

J. PARKER.

MECHANICAL INDUSTRY IN BELGIUM.—(From our Correspondent.)—The Belgium General Company for the Construction of Machinery and Railway Plant has just issued its report for 1864-5. The directors announce a loss during the year of £1,291, and account for this adverse result by stating that during a great part of the year orders for railway plant have been suspended in countries supplying their wants in Belgium. The directors have endeavoured to maintain activity in the company's works by obtaining contracts for the Belgian state lines, but they found the prices at which work is given out not very remunerative. While the prices obtained for the company's manufactured products have been thus falling, the price of labour has risen to a point exceeding all estimates and calculations hitherto formed on the subject.

THE HULL DOCKS.—A good deal of talk of late with reference to the Hull docks, and the Parliamentary notices have been given on the subject. The most important of these is an application on the part of the Hull corporation for the dissolution and winding up of the Dock company, the vesting of the docks in the hands of public trustees or commissioners, and for power to the corporation to guarantee dock stock, &c., by a charge on the borough fund. The Dock Company seek authority to enlarge and deepen the West dock, so as to take in Messrs. Earles' cement works; to construct a bridge over the railway near Belle Vue-terrace, from the quay of the West dock; and to raise additional share and loan capital. Both the Dock Company and corporation apply for an extension of the time limited by the Dock Act of 1861. Powers are solicited to take in a portion of the foreshore of the River Humber between Sunk Island and Spurn. With regards to business matters at Leeds, we may note that the iron and machine trades are in a satisfactory position, being fully employed in the execution of orders. With regard to the South Yorkshire coal trade, it may be noted that there still continues to be a large tonnage to the metropolis, and the country markets from this district, as well as from Derbyshire. The price of house coal for London has a tendency downwards, but for other descriptions full rates are readily obtained. The steam coal trade is brisk for both Hull and Grimsby. At the latter port there is a large number of vessels, and which will take out coals probably to the Baltic ports. The steam coal trade at Newcastle and other northern ports being slack, colliery owners are ready to execute any orders that may come to hand. For Sheffield and the iron districts in this locality, a large quantity of coal is taken, and there is a fair inquiry for Lincolnshire. For coke there is a good demand, for both Staffordshire and Lincolnshire. The masters in almost all cases have intimated their intention not to pay the 10 per cent. advance; and with the refusal before them the delegates representing the workmen met during the past week at Wombwell, to arrange what course must be taken, and when the strike, which will eventually take place, shall commence.

NOTES AND MEMORANDA.

SIPHONS were used in Egypt at least as early as 1450 B.C. RALPH HAGE and Peter Bawde were the first to make articles of cast iron in England.

The tenacity of silver is to that of gold and platinum as the numbers 19, 15, and 26½.

The time required for the light of the sun to travel to the earth is 8 min. 18 sec.

The smallest visual angle is 30 sec., and its size on the retina the 8,000th of an inch.

ROLLING or "milling" lead was invented by Thos. Hale, in 1670, about which time the first mill was erected at Deptford.

It was not until the sixteenth century that the present mode of coating the backs of mirrors with quicksilver and tinfoil was introduced.

The origin of the clepsydra or water clock is unknown, but it is known that the Britons used it previous to the conquest by Julius Cæsar.

The Dutch, on visiting the Japanese, found the baths of these people supplied with cold and warm water by means of pipes and copper taps.

In one of the apartments of a villa discovered at Pompeii there was a large bow window in which the glass used was set in lead like a modern casement.

COPPER and lead have recently been detected in human flesh, the intestines of animals and poultry, &c., and even in the bodies of crustacea and snails.

The first person who is known to have raised water by means of the hydraulic ram was Mr. Whitehurst, a watchmaker, of Derby. He erected one in 1772.

The aggregate weight of the atmosphere has been calculated at upwards of 77 billions of tons, being equivalent to a solid globe of lead sixty miles in diameter.

An object in motion will appear to be at rest when its motion in a second is to its distance as 1 is to 1,400.

PLINY states that the Greeks imported red cinnabar from Almada 700 years before the Christian era; and that Rome, in his time, annually received 700,000 lb. from the same mine.

ABOUT 1643 a Fleming named Kepler established the first dye-house for scarlet in England, at Bow, near London; and on that account the colour was called at first the Bow dye.

Up to the year 1860, no less than fifty wells had been sunk in the Great Sahara desert by the French. The total quantity of water given by these wells amounts to 7,920,000 gallons per day.

In 1582 the first pumping machines ever used in England were set up by Peter Maurice, a German engineer, for the supply of the City with Thames water. By means of these machines water was raised to a height of 120ft.

The repeal of the paper duties has been highly beneficial to the paper-makers of Belgium. From four or five paper-mills the number has increased to more than forty, producing more than 20,000 tons of paper annually.

WATER deprived of the air naturally contained in it may be heated to 100 deg. Fahrenheit beyond the boiling point. It then frequently happens that the steam is suddenly disengaged, and an explosion is the consequence.

In 1851-2 the cotton harvest in Algeria amounted to 4,500 kilogrammes, and in 1864-5 to 900,000 kilogrammes. The greatest increase in the harvest was in last year, that of the previous year only having amounted to 365,000 kilogrammes.

A MIXTURE of clay and glycerine has recently been tried for modelling purposes, and has been found to answer well, and to retain its plasticity for a lengthened period at all temperatures. The clay must be well dried before it is mixed with the glycerine.

The gross receipts of all the French railways for the first nine months of the present year, for both the old and new networks, amount to £16,419,384, showing an increase, as compared with the same period of last year, of nearly £900,000.

In 1543 a naval officer, under Charles V., is said to have propelled a ship of two hundred tons, by steam, in the harbour of Barcelona. No account of this machinery is extant, except that he had a large copper boiler, and that paddle wheels were suspended over the sides of the vessel.

In 1678 engines were constructed by Hautefeuille and Huyghens, which derived their motion from the explosion of small charges of gunpowder within their cylinders. In the same year Hautefeuille proposed the alternate evolution and condensation of the vapour of alcohol in such a manner that none should be wasted.

As early as 1236 the corporation of London commenced to lay a six inch leaden pipe from some springs at Tyburn. This is supposed to have been the first attempt to convey water to the City through pipes, and fifty years elapsed before the work was completed. The pipes were formed of sheet lead and joined at the seams.

The theory of transfusion of blood as a cure for various diseases is now receiving considerable attention. It has been found that life may be sustained for some time, without taking food, by means of transfusion of blood. It is also suggested as a certain cure for consumption, if the operation be performed in the early stage.

M. CHEVREUL, of Paris, has discovered a plan by which ancient stained glass may be perfectly renovated. The glass is removed from its setting, and immersed for several days in a solution of carbonate of soda, of a specific gravity of 1.068. It is then washed and dipped for a few hours in a solution of hydrochloric acid of a specific gravity of 1.080.

In forty years, from 1790 to 1830, Mexico produced, according to the *Mining Journal*, £6,486,453 worth of gold, and £139,818,032 of silver. Chili, £2,768,488 of gold, and £1,822,924 of silver. Buenos Ayres, £4,024,895 of gold, and £27,182,673 of silver. Russia, £3,703,743 of gold, and £1,502,981 of silver. Total, 1850 millions sterling, or 47 millions per annum.

HUMBOLDT stated that guano is deposited in layers of 50ft. to 60ft. thick on the granite of many of the South Sea islands of the coast of Peru. During three hundred years the layer of guano deposited is only a few lines in thickness. This shows how great must have been the number of birds, and how many centuries must have elapsed to form the present guano beds.

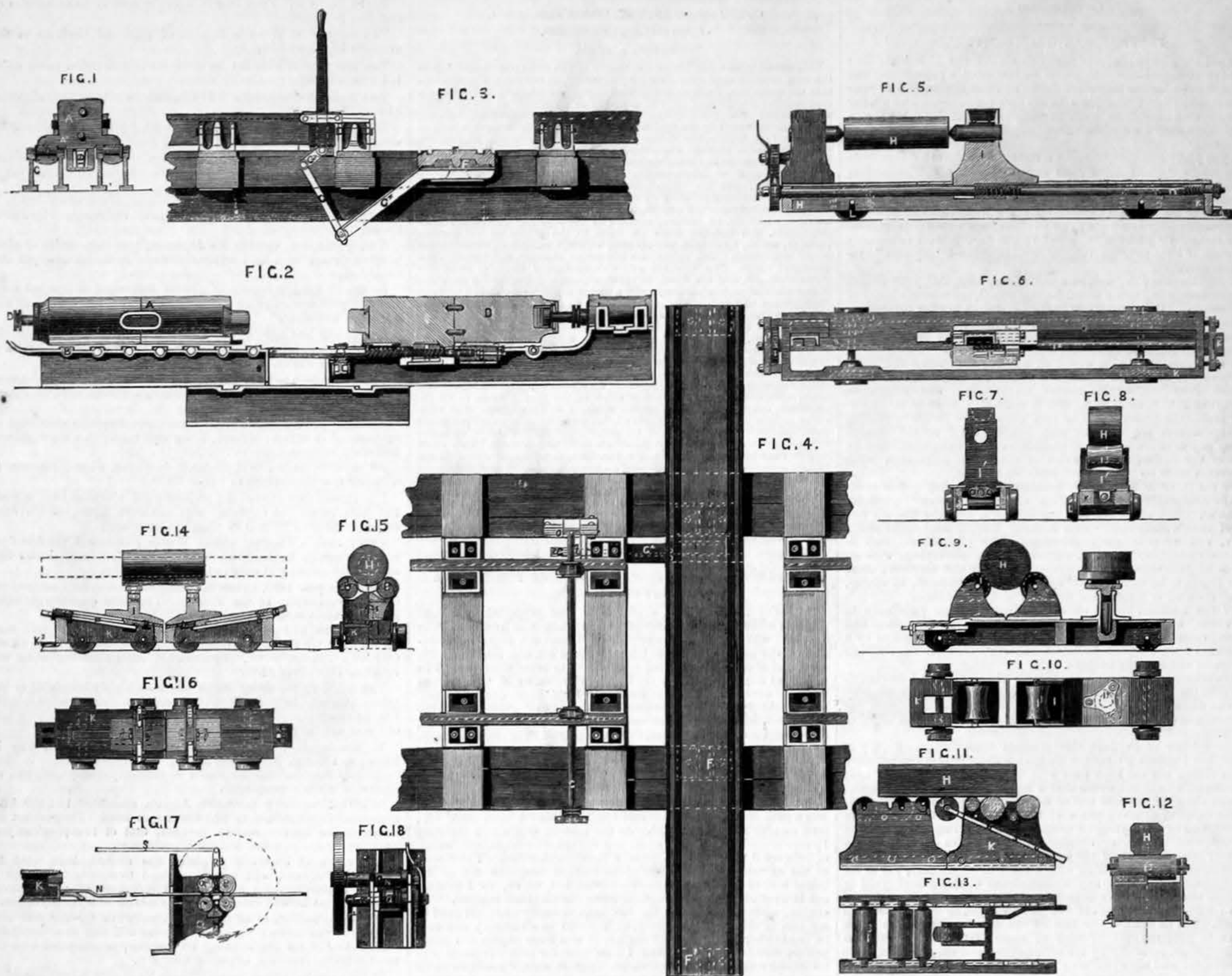
The number of locomotives on the railways of Great Britain, at the close of 1864, was 7,203; while at the close of 1863 it was only 6,643. To the increase of 560 here disclosed, England and Wales contributed 361; Scotland, 168; and Ireland, 31. At the close of last year English and Welsh railways had 5,708 locomotives between them; Scotch railways, 1,072; and Irish railways, 423.

LEADEN pipes were used by Archimedes to distribute water by engines in the large ship built for Hiero. The first improvement on the ancient mode of making leaden pipes was matured in England in 1539. It consisted in casting them complete in short lengths, in moulds placed in a perpendicular position. After a number were cast, they were united in a separate mould by pouring hot metal over the ends until they ran together.

SILVER was formerly found in such quantities in Spain that according to Pliny, Hannibal extracted a daily quantity equal in value to £300, from a mine worked by him near Cartagena. Cato delivered into the treasury 25,000 lb. of silver in bars, and 120,000 in money, besides 400 lb. of gold, all of which he accumulated in Spain. Helvetius, who was only governor of Andalusia, delivered 37,000 lb. of silver in coin, and 40,000 lb. in bars.

The use of paddle wheels for the propulsion of boats dates from a very early period. Roman galleys were occasionally moved by them, and Robertus Valturius, in his *De Re Militari*, Verona, 1472, gives a figure of a galley with five wheels in each side. An old English writer mentions them in 1578; and in 1682 a horse tow-boat with paddle wheels was used at Chatham. In the case of the Roman galleys, oxen were used to move the paddle wheels.

RAMSBOTTOM'S IMPROVEMENTS IN STEAM HAMMERS.



This invention, patented by Mr. J. Ramsbottom, engineer, Crewe, consists, first, in supporting the hammer blocks of duplex steam hammers upon rollers mounted in fixed bearings.

The second part of the invention relates to the apparatus required for supporting and moving the articles to be hammered, and it consists in supporting the rails upon which the truck for the ingot travels on a rocking frame or platform, or in traversing the said rails laterally for the purpose of keeping the article to be hammered midway between the hammer heads, so that both sides of the article may be struck simultaneously.

Also, in supporting the ingots or other articles to be hammered in centres fixed to headstocks, one or both of which is or are movable, to provide for the elongation of the article; or the article, particularly when of cast steel, may be provided with pivots or gudgeons at the ends, and supported in V bearings, or on anti-friction rollers on separate trucks, the distance between which is at liberty to increase as the article becomes elongated by the hammering. The V bearings, or anti-friction rollers, can be raised by screws or inclined planes, to keep the article, as regards the vertical position, in line with the centre of the hammer blocks.

And, thirdly, in applying steam or other power for giving motion to the trucks supporting the article to be hammered. This may be effected by the direct application of steam or water pressure to a piston or ram connected to the truck; or the truck may be moved by rack and pinion, or by a screw, or by rollers acting on a friction bar, or by other suitable combinations of machinery, the object being to economise manual labour. When the articles are not of sufficient weight to require steam or other power for moving the trucks, they may be moved by a hand winch, either stationary or attached to the truck.

Fig. 1 is a transverse section, and Fig. 2 a side elevation of a duplex steam hammer constructed in the manner described in a previous specification, No. 924, 1862, to which the present improvements are applied. *a, a*, are the hammer blocks, furnished with side flanges *a'*, supported on the rollers *b, b*, which when the hammer blocks are moved to and fro by the direct action of the steam in the cylinders *d* (only one is shown), rotate in the bearings cast in or fixed to the bed plates *c, c*. The piston rods of the steam cylinders are connected to the hammer blocks with an elastic packing, and the simultaneous action of the hammer blocks is insured by the right and left-handed screws.

Fig. 3 is an elevation, and Fig. 4 is a plan, of that improved apparatus for keeping the ingot or other article midway between the hammer heads of duplex steam hammers. *f* is a table or platform cast with rails for supporting the truck with the ingot or other article to be hammered; this platform is supported on chairs, and is at liberty to rock in them. The shaft *g* is furnished with the handle *g'*, and to it is fixed the lever *g''*, connected by the link *g'''* to the lever *g'''*, which is secured to the underside of the platform *f*. By this arrangement the attendant, by moving the lever *g'*, can cause the truck to tilt over in either direction, and thus keep the ingot midway between the hammer faces; or, instead of making the truck to tilt over, as above described, the truck, with the ingot or article to be hammered, may be supported on rails capable of being moved laterally.

Fig. 5 is a side elevation, Fig. 6 a plan, and Fig. 7 an end view of a truck for supporting steel ingots or other articles while they are being hammered by duplex steam hammers. *k* is the body of the truck, connected by cross beams, and supported on the wheels *l*, which run on the rails of the platform *f* (see Figs. 3 and 4), or on cross rails fixed to the floor of the forge. To one end of the truck is fixed a headstock *i*, and the headstock *i'* is capable of adjustment by means of a screw, which is turned round when required by handles and spur wheels. To the headstocks are fixed

centres, between which the ingots or shaft *h* is supported. The nut of the screw is connected to the headstock *i'* by two bolts, and a spring is placed between the nut and the headstock. The object of this spring is to allow the headstock to yield when the ingot or shaft becomes elongated by the blows of the hammer without immediately moving the screw; a brake acts on the face of one wheel, and a tail spring bears upon the end of the screw *i''*. The pitch of this screw must be such that it will be turned round by the pressure of the nut when the screw, together with the wheel, has been forced out of contact with the brake, and this occurs whenever the pressure upon the headstock *i'* is in excess of the adjusted strain of the tail spring.

Figs. 8, 9, and 10 represent an end view, a side view, and a plan of a truck for supporting steel ingots or other articles, and holding them while they are being operated upon by duplex steam hammers. *k* is the body of the truck, formed by a strong plate of iron connected by cross beams, and supported on the wheels *l*, which run on cross tram rails placed on the floor of the forge. To the truck *k* is fixed a block *i*, and the block *i'* is capable of being slid to and fro on the truck *k* by the screw *i''*, to increase or diminish the distance between the rollers *i''* supporting the cylindrical tire ingot *h*. By this means the ingot can be held at the same level as the hammer blocks, or the level of the ingot can be varied according to its diameter, or according to the portion that requires to be hammered. The swivel spindle or turntable *i'* is similar to that shown in the specification above referred to, and serves to support the ingot while being hammered circumferentially. The spindle fits in a socket fixed to the truck.

Fig. 11 is a side elevation, Fig. 12 an end view, and Fig. 13 a plan of another of the improved apparatus to support ingots or other pieces of metal while being hammered. *i''* are the supporting rollers mounted in bearings in the frames *k*. The roller *j*, supported in the forked lever *j'*, is for the purpose of supporting short ingots when passing across from one set of rollers *i''* to the other.

Figs. 14, 15, and 16 are three views of another modification of this invention. *k, k*, are two trucks, bevelled at the top, and each provided with a movable block, screw, and supporting roller. When the ingot *h*, or other article to be hammered, is short and thick, as shown in Fig. 14, the trucks and blocks are close together; but as the ingot increases in length, but decreases in diameter, the distance between the blocks *i'* is increased by turning the screw *i''*, to support the ingot and keep it level with the line of action of the hammer blocks; or the level of the ingot can be varied by altering the diameter of the rollers *i''*; or the ingot or other article may be supported in V bearings connected to the trucks *k*. The rollers shown in Figs. 11, 12, and 13 may be mounted on trucks with inclines, in order to vary the level of the ingot; or the rollers may be mounted in a frame sliding vertically, and the height adjusted by means of screws or wedges.

Fig. 17 is a transverse section, and Fig. 18 an elevation of a friction apparatus worked by steam, or other power, for giving to-and-fro motion to the trucks supporting the articles to be hammered. *k* represents a portion of the truck to be moved, and *k'* is a catch fixed to the lower part of the truck. In this catch is a slot or recess for the bent end of the friction bar *n*, which passes between the two sets of friction rollers *o, o'*, and *p, p'*. The rollers *o* and *p* revolve in contrary directions in fixed bearings formed in the bracket or wall plate *q*, and the rollers *o'* and *p'* are supported in the swivel frame *r*, which is fixed on the fulcrum shaft *r'*. To this shaft are fixed the levers *r''* and *r'''*. The former is acted upon by a lever and link to compress the friction bar *n* between either of the rollers *o, o'*, or *p, p'*, and the latter is connected by a chain *s* to the truck. The engraving represents the rollers in the positions they assume when the truck is at rest. When the attendant moves

the lever *r''* in the direction of the full arrow, the roller *p'* presses the bar *n* against the roller *p*, which then moves the truck from the friction rollers, and when the direction of motion of the truck has to be reversed, the attendant moves the lever *r''* in the direction of the dotted arrow, thereby compressing the bar *n* between the rollers *o* and *o'*. If owing to the neglect of the workman the lever *r''* is not acted upon in time, the chain *s*, connecting the truck to the lever *r''*, comes into operation, and throws both the rollers *o'* and *p'* out of gear, thus stopping the truck. Instead of the friction rollers above described, the truck may be moved to and fro by a screw, or by a rack and pinion, with self-acting reversing gear like that employed for working the bed of a planing machine, or the bar *n* may be connected to a piston or ram actuated by steam or water under pressure. When the articles to be hammered are not of sufficient weight to require steam or other power for moving the trucks, they may be moved by a hand winch, stationary or attached to the truck.

SOUTH KENSINGTON MUSEUM.—During the week ending 18th November, 1865, the visitors have been as follows:—On Monday, Tuesday, and Saturday, free days, open from 10 a.m. to 10 p.m., 9,123. On Wednesday, Thursday, and Friday, students' days (admission to the public, 6d.) open from 10 a.m. till 4 p.m., 1,339. Total, 10,462. From the opening of the museum, 5,654,674.

EAST AND WEST JUNCTION RAILWAY COMPANY.—A prospectus has been issued by this company, from which we learn that Messrs. Knight, Dale, and Co., 1, Royal Exchange Buildings, are instructed to receive subscriptions for £300,000 in 15,000 shares of £20 each, in 15,000 provisional scrip certificates to bearer. This railway extends from Towcester to Stratford-on-Avon, a distance of thirty-three miles. Its object is to shorten by thirty miles the present narrow gauge route, *via* Blisworth, between London and the great coal-fields of South Wales, also to afford greater facilities for the coal traffic between South Wales and London, and the return ironstone trade between Northamptonshire and South Wales. The company have secured running powers from Towcester to Blisworth, as well as most favourable arrangements with the Great Western Company.

A WARNING.—At Southwark police-court Mr. William Sketchley, patent engineer, of Weymouth, was brought up on Wednesday, on a warrant from Dublin, charged with defrauding Mr. George Gilks of a steam engine, value £230. Mr. Ribton, in opening the case for the prosecution, said that the prosecutor was an engineer, in extensive business at Hampton Wick, and had, among other things, engines for sawing, planing, &c., for sale. The prisoner introduced himself to him about a month ago, representing himself to be a patent engineer, and selected an engine, for which he was to pay £230 cash on delivery. The engine was delivered in due course, when the prisoner gave his client a cheque for £230 on a Weymouth bank, saying that it was as good as the Bank of England, as he had plenty of money there. The cheque was passed through the prosecutor's bankers and presented at the bank at Weymouth, when it was returned. The engine, it appeared, was disposed of by the prisoner as soon as he was possessed of it, when he absconded, but was traced to Dublin, where he was apprehended in the Exhibition while packing up the engine he had exhibited. The learned counsel said he should produce evidence to support his statement, and asked for a remand to enable the prosecutor to bring forward the bankers' clerks and other witnesses. After the evidence of the prosecutor and the police officer who executed the warrant, the prisoner denied any fraud in the transaction, and said the cheque would have been paid but for the prosecutor's breach of contract. He was remanded till Wednesday, his worship agreeing to accept bail in £500 for his appearance.—*Pall Mall Gazette*.

NOTICE.

We beg to inform our readers that, with the commencement of the new year, THE ENGINEER will be printed throughout from entirely new type, which is now being cast for the purpose. A further announcement will be made in an early number.

TO CORRESPONDENTS.

- B. O. W.—Thanks for your suggestions, which we shall endeavour to carry out.
 A. C. W. R.—Send the description, and, if approved, it shall have insertion.
 W. C.—You can obtain every information by addressing a letter to Messrs. Siemen Brothers, Berlin.
 ARTILLERY.—You can see the gun itself at Woolwich Arsenal we believe; there is no difficulty in obtaining admission.
 T. E. M.—More than a score of patents have been secured for the use of friction rollers in axle boxes, just as you propose.
 G. (Whitehall-place).—We regret extremely that the pressure on our space is so great that we are unable to comply with your request.
 MR. LUDERS, lately connected with the manufacture of the Harrison Boiler, will much oblige by forwarding his present address to this office.
 P. M.—Murray's treatise on the Marine Engine in Weale's series, and Brown and Maine on the Marine Engine, will answer your purpose as well as any books can.
 H. L. (Greenwich).—We have been unable to find anything much resembling the invention to which you refer. Send us as particular a description as you can, and we shall try again.
 S. W.—Half a square foot to a foot of surface per horse power is an ordinary allowance for feed-heating apparatus. If you wish for more accurate information we shall be happy to supply it.
 W. E. B.—We cannot perceive any remarkable superiority in your system of constructing self-tightening railway chairs over many others which have been used and abandoned. It is by no means certain that a "self-tightening" chair is better in any respect than a chair with a wedge; as far as experience has yet gone, it would appear that it is not. Setting this point aside, and taking your scheme on its merits, we find that it presents more than one ingenious feature, which renders it as well worth patenting as any other of the thousand and one inventions for improvements in permanent way which annually find their way to the Patent Office. Its worst defect lies in the tendency to split the chair or force its sides asunder, caused by the load.
 C. J. Z.—Your first scheme does not possess sufficient merit to entitle it to a place in our pages. We are utterly at a loss to perceive what would be gained by adopting the roundabout method of signalling described in your last letter. Have you considered the cost of the "inclined planes" to which you refer? We receive dozens of schemes for intercommunication, each, if possible, more impracticable than the last. We have written on the subject time and again, apparently to no purpose. When will our correspondents learn to spare us? There are the railway companies—why not afflict them? They are able to bear it—we are not. We have every desire to act courteously, but we now beg to state definitely that we shall not take the slightest notice of any letter containing a scheme for intercommunication in railway trains, for at least six months.

ENGINEERS IN AUSTRALIA.

(To the Editor of The Engineer.)

SIR.—I should be much obliged if any of your numerous readers could inform me whether engineers are, at the present time, in requisition in the Australian colonies, and to which of them it would be most suitable to emigrate; indeed, any information on the subject would be very acceptable to
 Manchester, November 21st, 1865. A YOUNG ENGINEER.

SLIDE VALVE PUMPS.

(To the Editor of The Engineer.)

SIR.—Observing a little controversy going on (in your Answers to Correspondents) between Messrs. Courtney, Stephens, and Co., of Dublin, and Messrs. Gwynne and Co., of the Strand, with regard to slide valve pumps, will you kindly allow me to put them right with respect to the origin of them. In the year 1843, I made a model of a steam engine and slide valve pump, which I exhibited before his Royal Highness Prince Albert at Buckingham Palace. I thought, of course, that I was the originator of the slide valve pump; but upon looking over some patents for pumps, I found that I had been anticipated by a Mr. Jeffrey, some one or two years previously, who had a workshop at Blackwall, and was there manufacturing them. I trust that my wish to put those gentlemen right will be a sufficient excuse for troubling you with this letter.
 20, Walnut Tree Walk, Lambeth. T. SMITH (Modeller).
 November 21st, 1865.

LOCOMOTIVE ADHESION.

(To the Editor of The Engineer.)

SIR.—In your impression of the 17th inst., I notice, in a Paper by Vaughan Pendred, Esq., C.E., "On the Adhesion of Locomotive Engines, &c.," a mode of coupling the wheels by friction wheels. As the invention appears to be identical with one introduced by my late father, some thirty years ago, on the Liverpool and Manchester Railway, I forward you a copy of a report of a series of trials that were then made by Edward Wood, Esq., C.E., with an engine so constructed.
 Rainhill Ironworks, near Prescot, Lancashire. THOMAS MELLING.
 21st November, 1865.

[We beg to acknowledge the receipt of Mr. Wood's report, which is unfortunately too long for insertion in our pages. Mr. Melling's scheme differs, however, in many important particulars, from that of Mr. W. B. Adams, described in the Paper in question.—Ed. E.]

MEETINGS NEXT WEEK.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, November 28th, at 8 p.m.: Renewed Discussion upon Sir Charles Bright's paper, "The Telegraph to India, and its Extension to Australia and China."
 CIVIL AND MECHANICAL ENGINEERS SOCIETY.—Wednesday, November 29th, 8 p.m.: Discussion on Mr. Morgan's Paper "On Iron and Timber Roofs."

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* * * To remove what they have discovered to be a prevailing contrary impression, the Proprietors of THE ENGINEER find it necessary to state that Mr. Zerah Colburn ceased to be associated with the Editorship of their journal upwards of twelve months ago; that he is not a contributor to its columns; and that he has no part whatever in its management or conduct.

THE ENGINEER.

FRIDAY, NOVEMBER 24, 1865.

ENGINEERING AID TO CORONERS' JURIES.

THERE is nothing more self-evident in glancing around one than that the social arrangements of this country have as yet failed to make allowances for the great social changes produced by the advances of practical science.

Look where we will we find some hitch or difficulty from this cause. Our law proceedings absolutely fail when dealing with scientific questions; parliamentary committees on technical legislation are mere dull and long-drawn farces; our public instruction in science greatly lags behind that of the Continent; our municipal laws and piecemeal Acts continually fail to meet the new circumstances of the times. Except, perhaps, in America, we boldly say that there is no other country in which so much life is lost and damaged, and so much property wasted, through disasters ironically termed accidents. The whole matter forms a wide subject; but the negligence of our Legislature and our Government could not be better illustrated than by taking as an instance the way in which are conducted coroners' inquests on an engineering disaster.

The position of a coroner and his jury with a tough, or even an ordinary, scientific question before them, can be very easily defined. A few—a very few—of the metropolitan coroners are men of science, one or two being medical men, the others barristers; but the great majority of our provincial coroners are men of no scientific training at all, being generally simply of about the same mental calibre as that of the higher class of tradesmen. Their jurymen are chosen from a much lower class, being mostly tradesmen in a small way, small shopkeepers, and the like. In the case of any disaster causing more or less destruction of life, the human body or bodies are first identified; the inquest is then, most probably, adjourned. Ignorant as the coroner necessarily must be of the merest principles of a case involving engineering points—for even if he be a medical, and therefore a scientific man, he cannot be expected to easily get to the bottom of an engineering question—the helplessness of the jury is yet greater. It is hard enough for the trained and practised intellect of a judge, though helped by the explanations of able special barristers, to get to the bottom of a patent case; and long before its termination it not unfrequently happens that the intellects of the unhappy jury get quite be-fogged as to all the questions at issue. In fact some of the more complicated cases have had to be thrown up from the confessed and utter inability of the court to comprehend them. It is true that such a fierce battle is not made over a question of mere human life as over a question of a large sum of money; it is true that the scientific inquiries involved in a destructive gas, boiler, or naphtha explosion, are not often investigated with the same earnestness as a question of the priority of an invention, with a good round sum of money at stake; but it is a matter of absolutely vital interest to the public that truth should be got at in cases of life and death. Yet the difficulties to be encountered by the coroner and his jury in arriving at the truth in a question involving scientific points are much greater than those of an ordinary court. In the case, for instance, of a disputed patent, each party is at liberty to call a number of scientific witnesses. Without at present entering into the wide question as to the determination of legal matters of the kind—without examining the subject of the value and weight of scientific evidence—it may be sufficient to remind ourselves of the great aid which the explanations of scientific witnesses necessarily are to a judge and jury. It is true that such evidence often is, especially when of the medical kind, notoriously conflicting; but the court can at least hear both sides of the question; both sides can be cross-examined. A coroner can also call in medical assistance to his aid, and can order, for instance, a *post mortem* examination; but will it be believed that, in an engineering question—in, therefore, a question involving both life and property—he has no power to call for scientific assistance beyond that which may be voluntarily tendered? It is a positive fact that, should a gun-powder magazine, a tank of naphtha, a boiler, or a gas meter-house explode, a bridge or a house break down, or a water reservoir give way, the coroner has no power to call for scientific assistance in arriving at the cause of the disaster; that is to say, if he wish for assistance of the kind, he must pay for it out of his own pocket—a thing practically impossible. It is not to be expected that coroners should thus mulct themselves of their often scanty, and always hardly-earned fees, in order to compensate for a blunder and an omission in the law.

We can state an instance, the particulars of which we have heard from one of those chiefly concerned, of the false position in which a coroner is at present placed by the absurd state of the law. About eighteen months ago it may be remembered that some arches under the coal shoots at the Great Northern Railway station suddenly gave way, leading to loss of life. As requested by the jury, Dr. Lankester, F.R.S., the coroner, called upon the services of Mr. Kerr, the Professor of Architecture at King's College, to survey the ruins, and give evidence on the affair at the inquest. For these services Dr. Lankester gave Professor Kerr the very small fee of two guineas. Ten times as much would not have been considered an unusual fee to an engineer of standing. Be this as it may, the coroner, on sending in his account to the bench of magistrates, had even this small fee disallowed. On asking the reason, he was told that magistrates had no power to pay for any professional opinions except those of medical men. Dr. Lankester had thus to put up with the loss. The natural result now is, that he is actually obliged to refuse any similar request which may be made by a jury, and on the simple ground that he has no power to pay for professional assistance beyond that of medical men. This is, indeed, another sample of the justices' justice on the bench, which, like other corporate bodies, with no soul to save nor corpus to kick, may be fairly expected to mostly act in the same way.

The further results of this must be evident to any one who may have stayed half an hour to watch a coroner's inquest. Unless there be, by the merest chance, a man of science amongst the jury; unless the matter be so notorious that the policeman's bull's-eye lamp of public discussion has been turned upon the affair, the coroner and his jury are absolutely in the hands of the counsel and the scientific witnesses of those whose interest it may be to hush up the matter. And we say this with no view of disparaging the honourable men who may appear as scientific witnesses; for a witness can only answer a question—he is not in a

position to determine the questions to be asked him. No one is there to advise the coroner as to the questions he should ask; he has only the light of nature to aid him—a light which is extremely dim for the investigation of a scientific question. That things should exist as at present is scarcely credible, and we feel confident that a change would soon be made if the existence of this omission in the law were only more generally known. The *Daily News* observed some time ago, when speaking of the inquest on the Nine Elms explosion:—"No evidence was adduced save such as the company tendered, and Dr. Letheby was the sole scientific witness whom the jury desired to be examined. It is no disparagement of that eminent chemist to say that, in a question involving engineering and mechanical, as well as chemical science, it would have been important that an independent engineer and mechanic should have been put into the witness-box." While fully acknowledging that our contemporary has taken a very sensible view of the state of the case, we may well doubt whether the writer knew that independent scientific assistance was practically inaccessible to Mr. Carter—that, in one word, he would have had to pay for it out of his own pocket. It is unfortunate that daily and other reformers strain at small points like these, and swallow radical reforms in the constitution of England.

The only exception to the rule that no engineering evidence can be called upon by a coroner exists in the case of a disaster on a railway. As Government exercises a sort of intermittent inspection of railway companies in the interests of the public, a Government inspector generally makes a report on the occurrence, and tenders evidence at the inquest; and his evidence is, of course, perfectly disinterested. This instance is a glaring one of our absurd piecemeal legislation. Why should we act so very differently with respect to, for instance, a boiler explosion on a railway, to what we should do with a boiler explosion anywhere else? In the first case we send down an engineer specially paid for the purpose, who carefully investigates the affair, who writes a full report upon it, and tenders evidence to the jury. Should, however, a stationary boiler explode a few paces from a railway, killing a greater or less number of people, we leave a coroner and jury to investigate a difficult matter, the bearings of which are probably quite novel to them. The result is generally an abortion of justice.

There are two very simple courses which might easily be adopted to remedy the present absurd state of things. The first and most simple is to enable a coroner to call in, and pay for engineering aid and evidence, in the same way as he can now employ medical aid and evidence. If he can pay a doctor for making the autopsy of a dead body, it seems only rational that he should be enabled to direct an engineer to make an autopsy of an exploded boiler which may have led to half-a-dozen sudden deaths. The question only is, whether, in the present social relations of the profession, when every one with sufficient assurance can set up for an engineer, a coroner can well be trusted to make a sound choice. The second question, therefore is, whether we might not adopt the precedent of the course pursued with accidents on railways. This very matter with reference to boiler explosions was raised by an engineer at the beginning of this year before the Society of Arts, and it was observed that:—"What seems to be needed is, that in the event of a fatal explosion the coroner of the district should be enabled to write to the Home Office for scientific assistance in arriving at the originating cause. The Secretary of State might then call upon any competent engineer for a report on the matter, when he could be examined as a witness before the jury. The mere knowledge that any explosion would be strictly investigated by an expert might, in many cases, be sufficient to counterbalance the too prevalent tendency to prefer risk to expense." There is nothing in the law as it now stands to prevent a coroner doing this, and no better course could be advised for the present.

COUPLED LOCOMOTIVES.

AN immense amount of skill and energy has been expended by engineers in combating imaginary difficulties. Some men possess a peculiar aptitude for numerical calculation, and availing themselves of this power they attempt to reduce everything to a question of figures. Now it so happens that in one sense it is possible to prove anything by arithmetic. In order to do this it is only necessary to disregard or distort facts, consciously or unconsciously, and by jumping at a conclusion to arrive at a false basis of operations. It has been said that figures cannot lie, and this is perfectly true, but it is really the easiest thing imaginable to separate figures from facts, and to impart a fictitious accuracy to conclusions which are apparently demonstrated to be exact by the "two and two must make four" system of reasoning. Every school-boy knows that a trifling inaccuracy in the earlier stages of a calculation may swell to an enormous amount before the game of figures is fully played out, and it often happens that men impressed originally, heaven knows how, with certain convictions, suffer themselves to make assumptions containing errors in themselves trifling, regardless of the fact, that these errors grow with each step of any subsequent calculation, until the truth actually disappears either in part or altogether.

Any engineer sitting down quietly to calculate the resistances in foot-pounds caused by coupling two pairs or three of driving wheels would easily, if the bias of his mind leaned that way, satisfy himself that they must amount to such an enormous total, that coupling must be regarded as a most objectionable expedient for obtaining adhesion. It may not be very easy for those who think differently to perceive exactly how such a conclusion can be reached. There is little room to doubt, however, that just such calculations as these have done more to retard the general introduction of coupled locomotives than any obstacle encountered in actual practice. We know that the weight borne by the driving wheels of a locomotive accurately represents a principal factor in every calculation intended to determine its tractive power, and nothing is more absurd, apparently than the practice of applying the entire force developed by

the steam to a single pair of drivers only. On the Great Western Railway, for example, Gooch's heavy passenger engines of the "Iron Duke" class, weighing with the tender, when in running order, sixty-one tons; carry but fourteen tons on a single pair of drivers, a fraction over eight feet in diameter, impelled by pistons eighteen inches in diameter, acting on cranks twelve inches long. These engines are one and all deficient in adhesion in bad weather, notwithstanding the excessive weight which the drivers carry. As the engines alone weigh, full, about thirty-eight tons, there are left some twenty-four tons of load, the whole or part of which might be rendered available for adhesion; and to so render it available really appears so obvious a remedy for a grave defect that the uninitiated are tempted to ask, why on earth coupled instead of single drivers were not employed by the designer? Those who are better acquainted with the methods of reasoning followed in our profession, well know that men like Mr. Gooch do not adopt any particular system of construction without a cause. There have been, and there are at this moment, many able locomotive superintendents, who can in no wise be induced to believe in coupled engines for high speeds, and who are no doubt competent to argue the point in a very convincing fashion. It is only necessary to assume that one class of objections must exist, and to magnify certain others which are actually met with in practice, and one-half the task of demonstration is accomplished. The other half is effected by a similar process applied to the advantages proper to single engines. The thing is, in short, as easily proved as that two and two make four; and thus it was that, for many years, coupling enjoyed small favour and scant justice at the hands of those who design locomotives for express and even ordinary passenger traffic.

Now, it is quite possible to show that most of the theoretical objections brought against the system of coupling driving-wheels are more or less fallacious; but the best of all answers to the arguments of those who oppose the arrangement lies in the fact, that whereas a few years since it was an exceptional circumstance to find a coupled engine hauling a passenger train, at the present moment not less than three-fourths of the locomotive power of Great Britain is represented by either four or six coupled engines; and the use of the former, especially, is increasing so rapidly that it is highly probable, that in a few years the proportion of coupled to single engines will be as eight or nine to one. The exigencies of modern transport are so pressing that weights of $5\frac{1}{2}$ tons to 6 tons, and even seven tons per wheel, are absolutely indispensable to single engines; and these last of course represent loads which only first-class permanent way can endure. If we assume that adhesion only increases in the ratio of the load—and this is tolerably near the truth, the error being on the right side—we find that, by using four drivers instead of a single pair, we at once double the powers of the machine, in so far as these depend upon adhesion for their amount. It is not, perhaps, advisable, under these conditions, to load the wheels so heavily. A load of twenty-one tons, distributed over four coupled wheels, should give fifty per cent. more adhesion than a load of fourteen tons concentrated on a single pair; while the strain on the permanent way would be reduced from that due to seven tons on each wheel to five and a quarter tons. To urge that any difficulty exists providing a place for a second pair of drivers of considerable magnitude, is absurd; and, with proper care, it is as easy to effect a proper distribution of the loads with a pair of six-foot drivers behind the fire-box—and a six-foot wheel is large enough for nearly every purpose—as with a pair of two-foot-nine or three-foot trailers. The only objections, in short, which possess any great weight, lie in the difficulty of getting tires to wear equally, and in maintaining a rigorous equality in the lengths of the coupling rods at opposite sides of the engine. It is true that out of four tires one will turn out now and then very much softer than its fellows, and that as a result the diameter of the wheel to which it is fitted will be more rapidly reduced than the others; but the test of actual practice is the best proof that tires usually wear very equably notwithstanding all the reasons which are adduced to show why they should not; and that although the frictional resistance due the rolling of coupled wheels not identical in diameter over a given length of rail may amount to something very considerable, it seldom rises in practice to anything very objectionable. A few rough experiments have been tried to ascertain the increased resistance due to coupling, but we are not aware they have led to any very definite result. That there is increased resistance there can be no doubt, but whether it is equal to one pound per ton, or ten or twenty pounds per ton, the greater number of railway engineers cannot tell; nor is it easy to determine a factor which varies from day to day. When a coupled engine is first sent out with all the wheels truly turned up, it is certain that the extra resistance must be very small. It goes on increasing daily of course, until it is necessary to re-turn them; but it appears on the whole that the use of heavy steel tires which will not stretch, and are sufficiently hard to run for long periods without much wear, brings this objection to comparatively inconsiderable proportions; while the reduction in the wear and tear of permanent way due to the substitution of loads of four or five tons for those of six or seven tons, is sufficient to compensate for a greater expenditure on locomotive repairs than is actually incurred. It is to be remembered that it is not the actual wear of the tire of any one wheel which measures the mischief, but its wear as compared with its fellows; and the tires on opposite sides of a single engine often wear with an irregularity great enough to produce very considerable resistances, magnified, of course, as compared with the coupled engine, by the increased weight which they have to support. Coupling-rods give quite as much trouble as the wheels, and there is also an element of danger introduced by the possibility of their fracture, which does exist in the single engine. When a coupling-rod does break it generally fails at a weld, and it is possible that the casualty may be brought about by want of uniformity in the length of the rod and a consequent strain. Even these objections exist more on paper than in practice.

By the use of mild steel connecting-rods, without a weld, and such an arrangement of bearings on the crank pins that the length of a rod, once adjusted, cannot subsequently be affected by carelessness or ignorance on the part of an engine-driver or fitter, the chances of an accident may be reduced to something merely nominal; and the practice of some of our most experienced locomotive superintendents goes to show that the faith in single engines is rapidly giving place to a creed according to which the four coupled engine is the best for every purpose of passenger traffic. Mr. Beattie, indeed, of the South-Western, has not hesitated to employ four coupled engines with seven-foot drivers, and coupling-rods eight feet long, in working the quickest expresses on the line, with results so successful that we cannot think the time very distant when the main feature of a system of express locomotive construction just now more or less exceptional, will be introduced upon nearly every railway in the kingdom.

THE GANGES CANAL.

FOR some considerable time past—as many of our readers are aware—a spirited discussion has been going on relative to the merits of the Ganges Canal; and now that the matter has been canvassed to the utmost, and finally reported upon by an officer specially appointed by Government, a review of the more salient points cannot fail to interest the profession. In India the interest in the scientific and engineering bearings of the question seems to have been merged in a personal conflict between the gentleman who projected the work and his self-constituted censor, a Madras officer of high standing. The latter gentleman undertook, without solicitation, the invidious task of picking the scheme to pieces, and disclosing, with a refreshing want of reserve, the defects both real and alleged of the whole undertaking. Sir Arthur Cotton, we are bound to believe, allowed his reigning hobby of establishing navigable canals throughout India to lead him to a point, far short of which his dignity and position should have controlled him; and now that the contest is at an end, and his alternative scheme for remedying the alleged defects of the works has been proved inapplicable, it is to be hoped that he will confine himself to such discussions as he is authorized to enter upon.

The Ganges Canal is a work of such magnitude, and involved at the outset so many considerations, that it would be a matter of some surprise if the work on its completion were found to fulfil with accuracy all that was expected of it. For what indeed does our progress in scientific engineering consist of, if not in the improvement on old models and designs; and how difficult would it be to point to any work designed so far back as fifteen or twenty years, that is not now voted, in some degree, capable of improvement? The great canal proves to be decidedly defective in one particular, namely, the inclination of the bed; and Sir Proby Cautley, the designer, frankly admits the error. That ample care and consideration were at the commencement bestowed on the determination of this, the most vital question of the whole undertaking, cannot be doubted; and, so far as we are informed, the design was in this particular generally approved of by engineers of eminence in hydraulic works. The result, however, is unsatisfactory, although it will prove instructive; and Government is now about to enter upon the improvement of the canal. It appears that the evidently high inclination of fifteen inches per mile was fixed upon under the apprehension that the growth of aquatic plants would be favoured by a low velocity, and that when grown they would further retard the current to such an extent, as either to choke the canal, or entail an extravagant outlay for clearance annually. To obviate such a state of things, it was thought expedient to start with a somewhat high velocity of discharge; first, on the assumption that the current would become reduced; and, secondly, that the banks and bed of the canal would derive stability from the vegetation. To determine what velocity would, when so reduced, exactly serve to check the vegetation, without exercising a destructive action, was a matter of considerable difficulty; and in this most important point lies the defect, which it is now proposed to remedy.

In determining the inclination of a canal without sufficiently conclusive data, it would, of course, be natural and wise to adopt such a slope as would give an ample velocity, rather than risk the other extreme. An excessive slope admits of easy remedy, whilst a too gentle inclination proves fatal to the whole. Such, we presume, was Sir P. Cautley's mode of reasoning, and if it has led to a somewhat defective result, the error is one that can be corrected at a comparatively small cost.

By way of remedial measures, two proposals were submitted to Government for consideration—one that of constructing new head works at a point lower down the river than the existing works are situated, and thence cutting a new canal through the high land of the Doab, to join into the present canal. This scheme, proposed by Sir P. Cautley's opponents, having been carefully examined, and the cost estimated, was laid before Government, and, after mature deliberation, pronounced impracticable. Entailing as it does, from the great depths of the excavations, the extravagant outlay for the earthworks alone of over two and a half millions sterling, with other very large items of cost, the proposal has been summarily set aside.

The other project, and that which has received the sanction of Government, is the remodelling of the canal, with a view of remedying the existing defects, and adapting it to purposes of navigation—an application that was not contemplated in the original design. These changes are expected to render the canal in every respect efficient, and have been estimated to cost about five per cent. of the original outlay, bringing the total expenditure to three millions sterling.

The designer of the new works contemplates the construction of locks, the alteration of the masonry falls which regulate the velocity, the adaptation of the canal to carry the required discharge, with a new surface slope, and the additions to the masonry works entailed by the alteration of the canal's sectional area.

The locks as designed will be situated at the sides of the falls instead of being placed apart from the main channel, and a system of fenders will be provided to secure the boats from danger. An average length for the locks of one hundred feet has been determined upon as suitable to the requirements of the navigation.

The system of masonry falls proposed for regulating and checking the velocity of the current, will for the most part consist in the reconstruction of the already existing falls. They were designed with an ogee curve on the down side, which is reported to have proved essentially defective. So long as the discharge was inconsiderable, and the lower part of the fall well protected with tail water, the falls answered well, and did not suffer materially; but with an increased discharge, the accelerated velocity at the fall of the fall was found to act injuriously both on the masonry and on the bed of the canal immediately below, in some cases undermining the foundations. The design to be adopted is a vertical drop fall, with a cistern below, which will contain a sufficient depth of water to resist the concussion from the cascade, and so protect the work effectively. Such an arrangement has been found in practice as effectual as any hitherto designed, and is easy of construction. The dilapidated condition of some of the existing falls is to be attributed, not so much to their form, as to the disturbance of the water level below them. In situations where these should have been a depth of seven or eight feet, the eroding action on the bed has reduced the depth to about two feet, and consequently has exposed the foot of the falls to the whole force of the cascade. The modified form of fall will be provided with an arrangement that is occasionally used in India for distributing or breaking up the cascade. It consists of a grating—usually made of timber—which is fixed in a sloping position near the crest of the weir, and serves in some degree to mitigate the force of the fall.

As a natural consequence of reducing the surface inclination of the canal, or cutting it up into reaches, it will be necessary to increase the sectional area. This it is proposed to effect from the head of the canal down to Roorkee by increasing the depth, as the character of the works does not admit of any alteration of breadth being made. From Roorkee downwards the increase of sectional area will be gained by widening as well as deepening the canal, in such manner as the nature of the soil may determine. The velocities proposed for a full canal will be, for the lightest soil, two and a half feet per second, and in ordinary soil three feet per second will be admitted—such velocities being deemed amply effective to check the growth of weeds, and yet not likely to act injuriously on the banks.

These modifications of slope and sectional area inevitably lead to important changes in the masonry works. The flooring of the bridges will have to be raised or lowered as circumstances dictate. The span and headway will in many cases require to be modified, to adapt the bridges to the navigation; and in some situations an arch will have to be added, for the provision of increased waterway.

Whatever credit Sir A. Cotton and his supporters may take to themselves for the persistency with which he has urged his view of the matter, they cannot well complain of not having obtained a patient hearing from Government. The authoritative tone, indeed, with which he denounced the projectors of the scheme, left no alternative but a thorough sifting of the arguments for and against it. Quoting from the Government proceedings, "Sir A. Cotton has classed the faults which he sees in the Ganges Canal under nineteen heads; five of them he calls fundamental, and fourteen minor mistakes"! A wonderful concatenation of blunders to have passed under the criticism of so many competent officers as were engaged on the undertaking. It appears, however, that the only error of any real importance—that of the inclination of the canal—has so far escaped censure as to be classed as a *minor* mistake; and the whole display has resulted in the substitution of a project which, on being fairly estimated and discussed, turns out to be simply impracticable, not only in point of expense, but on its engineering merits. Such is, in substance, the conclusion arrived at by Government; and as the Governor-General in Council has, after examining the question with impartiality, pronounced it as his opinion, and that of highly qualified officers, that a further outlay of five per cent. will render the canal perfectly effective, not only to fulfil the original intention, but as a line of intercommunication, the assumption that the canal has turned out a failure can no longer be maintained.

FRESH WATER AT SEA.

NOT many years since it was difficult to take up a list of shipping disasters which did not contain some soul-harrowing tale of the sufferings of a crew run short of water. We have no strictly accurate data to go upon, yet we fancy we shall be far within the mark if we state that a couple of hundred valuable lives were lost to Great Britain alone, from this cause yearly. Not only did entire crews perish from absolute thirst, but the sufferings and hardships entailed by the want of the fluid in a tropical climate, indirectly brought about the subsequent deaths of women and children—aye, and strong men, too—among passengers. We seldom hear much of such casualties in the present day; yet it is to be presumed that no material alteration has taken place in the conditions, as far as the winds and the waves are concerned, under which navigation is conducted. It might indeed be assumed that, as many more people go to sea now either as sailors or passengers, than in the beginning of the century, we should find that all the casualties common to a seafaring life would be augmented in proportion. The development of steam navigation does much no doubt to give exemption from a peculiar class of dangers. No longer dependent in an absolute degree on the pleasure of the winds and the waves, we can foretell a few hours the time at which a steamship leaving Liverpool, let us suppose, to-night, will drop her anchors in American waters. As for the baffling calms of the tropics, the auxiliary screw sets them at defiance. But the substitution of steam power for sails will not alone suffice to account for the fact that crews seldom want water in those latter days. Formerly, even in very well-managed emigrant

ships, passengers were frequently placed on short allowance, while that which was facetiously termed "full allowance" was in itself a supply too meagre for comfort, though quite enough to support life and a little over. Government inspection has done a great deal to mitigate this evil among others; more, perhaps, than the increased certainty with which voyages are accomplished. A very large proportion of our emigrant traffic is still conducted by sailing ships, especially in the case of long voyages, and it is probable that it will continue to be so conducted for years to come. The substitution of iron tanks for the clumsy casks of the last century, the increase in the stowage room of ships, and the rigid carrying out of rules, which render it imperative that fresh water enough must be carried under any circumstances to provide for all ordinary contingencies, have brought about excellent results, and we seldom hear serious complaints against shipowners on the score of want of water, even when a voyage is somewhat unusually prolonged. But legal enactments have not done everything. The engineer and the chemist have not been idle, and it may not be uninteresting to see exactly what they have accomplished during the last score of years in the way of supplying fresh water at sea.

In a theoretical point of view, there is no reason why fresh water should not be just as plentiful on board a ship as it is in a barrack, or any other establishment on land where large numbers have to be provided with the fluid. It is always possible to separate the salts by distillation. Had Coleridge's "Ancient Mariner" possessed a little science he would not long have had to say that he had nothing to drink. Not having fresh water on board, he would have gone to work and made some. Indeed, the first sea-water distilling apparatus of which we can discover the history was constructed by an "ancient mariner," in other words a highly respectable and ingenious old skipper, about the close of the last century. The whole story is told in "The Annual Register," we think, for the year 1797 or 1798, we unfortunately forget the precise date. He found himself and his crew of five or six men in a tropical calm without any fresh water, and thereupon he contrived to extemporise a still from one of the cook's coppers, to which he fitted half a small cask as a "head," while he prepared a worm, very ingeniously, from some of his pewter dishes, which he beat out flat, cut into strips, and soldered himself into rough tubes. He very easily obtained a fair supply of water, but he frankly admits that it was so bad that it was hardly drinkable. Then he bethought him of an experiment which he had seen tried before, and he placed fresh wood ashes in the copper. These did not mend matters much, and then he "tried passing the water through a vessel containing half-burned billets from the furnace"—a rude charcoal filter in fact—and he announces with manifest glee, that it thereupon became sweet and excellent. Ideas on the subject of the excellence of potables are, of course, comparative; and we fancy our skipper was not harder to please than any of our readers would have been under the like circumstances. The whole tale is sufficiently remarkable; and the skipper's name deserves to be rescued from the obscurity with which it is at present surrounded. We have failed to discover that the idea thus placed before the world was ever acted upon, at least to any extent, for many years; and it is tolerably certain that the first application on a considerable scale of the principle of distillation to the supplying of fresh water on board ship, dates back no further than the first years of steam navigation; during which it became very usual to fit a box, into which steam could be led from one of the boilers, in one or both of the paddle-boxes, in such a place that the perpetual wash of the spray from the floats kept it cool. Such an apparatus is very commonly employed at the present day, and where it is present it is certain that a crew will not die of thirst. The quality of the water is quite another question.

Very little, if anything, was done to supply sailing ships with distilling apparatus until quite a recent date, notwithstanding that the value of the imperfect apparatus to which we have just alluded was appreciated on board steam vessels, where it was far less wanted. To the late Dr. Normandy is due the credit of first reducing the principle to working conditions, and of supplying a compact apparatus which would readily supply drinkable water in large quantities. His first patent bears date 1856 (No. 1252), and specifies an apparatus consisting of two vertical cylindrical vessels, each of which is traversed by tubes terminating in boxes at each end. Steam at a high pressure is sent into the tubes of the one, and thereby raises the water in the vessel to the boiling point. The steam condensed within the tubes flows back in the form of water to the boiler. The water outside the tubes is raised to the boiling point, and the steam thus produced flows over at a pressure little if anything above that of the atmosphere, into the upper tube-box of the second vessel; and descending through the second set of tubes is condensed, and flows through a suitable pipe from the lower tube-box into a charcoal filter. The water of condensation in this second vessel enters at the bottom, and acquiring heat as it rises, finally reaches a temperature of about 200 deg. Fah., at which water parts easily with its contained air. A pipe is provided, by which the air escaping is led into the upper tube-box of the first vessel, in order to aerate the distilled water. In 1857 Dr. Normandy secured a second patent for certain improvements on the original apparatus; and in 1859 he took out a third, for the application of a donkey engine, to supply the refrigerator with cold water.

Now Dr. Normandy, albeit a clever chemist, was not an engineer; and, regarded from an engineering point of view, the whole arrangement of this apparatus is more or less unsatisfactory. The tubes are made tight by a very peculiar arrangement of separate packings fitted under their edges, and it is an exceedingly delicate operation, even for a trained fitter, to put them properly into their places. Unless remarkable care is taken of the apparatus the joints give more or less trouble, as it is not easy to make them quite tight in the first instance; and a very trifling amount of leakage suffices to render the distilled water brackish. The principles involved in the construction of

the apparatus are right enough; it fails in the details. Still we have reason to believe that when placed in skilful hands it has given considerable satisfaction; but it is not apparently suitable for the ordinary conditions under which machinery is placed in a sailing vessel. A common labourer cannot take charge of it; and yet, to be thoroughly useful, any apparatus of the kind must be capable of standing a good deal of rough usage for months together, without getting out of order. There is yet another argument against the Normandy apparatus which has done much, we imagine, to retard its adoption. It is not complete in itself, requiring a separate boiler to supply steam to the evaporator, and with the production of distilled water its duties begin and end. Now as a rule the owners of sailing ships are not over fond of machinery of any kind, and when they are driven by necessity to resort to its use at all, they prefer that it should do as much as possible. Something very comprehensive is apparently required to suit the prevailing taste; and this fact leads us directly to a second series of patents, secured by W. H. Graveley within the last few years. The first of these was secured in 1858, and provides for the distillation of sea water on a far simpler system than that adopted by Dr. Normandy. Instead of evaporating the water to be distilled by high pressure steam, Mr. Graveley evaporates it by the direct action of a fire, and in this point alone he gains an important advantage by simplifying the entire apparatus. Shortly afterwards he took out another patent, in which the distilling apparatus is combined with an ordinary cooking hearth. And yet more recently he has combined the distiller with a steam engine capable not alone of pumping water, as in Normandy's system, but of hoisting the anchors, two at a time if need be, loading and unloading cargo, washing the decks, acting the part of a fire engine, and pumping out the ship. We recently illustrated the entire machine, so that any detailed description is unnecessary, and would be out of place here. It is enough to say that the waste steam coming from the engine is passed through a small surface condenser, or more strictly a refrigerator, consisting of a series of iron tubes, about an inch in diameter and four feet long, rivetted over the tube plate at the ends. The entire affair, when put together, is galvanised all over, so that the joints must be tight; and it is tested to a water pressure of 60 lb. for an entire week, during which time the pressure commonly falls about 20 lb.: it is not easy to say why, as this system is nearly unique. When the engine is not at work steam is drawn directly from the boiler, and, indeed, as this last has considerably more evaporative power than the demands of the engine require, steam can at all times be supplied in addition to that proper to the exhaust. The entire arrangement is neat and compact, occupying a space of about 2ft. 9in. wide by 6ft. 9in. long and 4ft. 8in. high, working up to 8-horse power, and supplying rather more than 1,000 gallons in the twenty-four hours. The Graveley apparatus enjoys great favour with shipowners, not because the water is better than that supplied by the Normandy system, but because it is simple enough to be kept in order and attended to by men of very ordinary capacity, and it has thus found its way into the Russian and some other Continental navies. A recent regulation of the Board of Trade supplies shipowners with a powerful inducement to use some good distilling apparatus, ships so provided being permitted to proceed to sea with one-half the quantity of water otherwise necessary, so much space being, of course, rendered available for cargo.

It is worth remarking that although an aerating apparatus is included in both Normandy's and Graveley's patents, it is never required. We all know that the distilled water of the chemist is flat and tasteless; but we know from personal experience that this is not the case, or at least need not be the case, when the distillation is conducted on a large scale on board ship. It would appear in the first place that the steam carries over a certain amount of spray or free water with it, which supplies some of the salts normal to palatable waters, while the conditions under which the condensation is effected are such that the air contained in the feed water pumped into the main boiler cannot avoid passing through the condensed water, and thereby aerating it, slightly, it is true, but enough to remove any objectionable flatness. To provide for blowing off much more water is fed in than is subsequently condensed, and of course the quantity of air rising through the condenser and filter is proportionally increased.

It will be seen that the whole subject lies within very narrow limits—only two firms in England constructing distilling apparatus being recognised by the Government—while the invention, if invention it can be called, is of strictly recent date. One is tempted to ask why some system of the kind was not adopted long since? Now the thing has been done it looks absurdly easy; but we must remember that until Dr. Normandy and Mr. Graveley entered the field, shipowners, chemists, and engineers were in this matter very much in the condition of the courtiers before Columbus broke the egg.

WOMBWELL COLLIERIES.—At a meeting of delegates held on Thursday, at Wombwell, near Barnsley, at which nearly forty collieries in the district were represented, the following resolution was unanimously adopted:—"That every workman do restrict the output of coal to one-half the usual quantity; but the time for that restriction to take place to be hereafter determined upon by the council of the Miners' Association." It was also resolved at the same meeting—"That the delegates do seek another interview with the masters with a view of coming to an amicable arrangement of the dispute without a collision." We sincerely hope that the above very sensible course may lead to a peaceable solution of the question.

FOREIGN AND COLONIAL JOTTINGS.—The Belgian Government contemplates a change in the postal service between Dover and that portion of Northern Europe hitherto communicating with England through Ostend. It has been ascertained that tidal influences militate in favour of Nieuport as a landing-place for the opposite coast, and a branch line from Bruges to that point is forthwith to be laid down for mail transit. The Ramsgate packets will probably not discontinue their usual course of summer trips to Ostend.—The Prussian Government has decided on constructing a new military port in the Baltic, which will be some distance from Kiel. A maritime commission, presided over by Admiral Jachman, is now engaged in discussing important propositions.—A railway from Rome to Ancona is announced as completed, with the exception of the bridge over the Tiber at Calle Rosetta, which will soon be finished also.

SOCIETY OF ARTS.

RECENT RESEARCHES ON METALS AND ALLOYS.

By Dr. F. CRACE CALVERT, F.R.S., F.C.S.

The importance of the subject which I intend to bring before you this evening is so extensive, that it ought to be the subject of a series of lectures instead of attempting to condense it into one, and, therefore, I shall only give a *resumé* of some of the discoveries which have been made during the last two years.

You are probably all aware that England occupies the first position among nations as a source of mineral wealth, and to enable you to appreciate the truth of this assertion, allow me to cite a few figures, published by Mr. Robert Hunt, F.R.S., the keeper of mining records at the Royal School of Mines. In 1863 the value of minerals produced was £29,151,976, from which metal of the value of £36,364,327 was extracted. There were produced—

Tin ore	15,170 tons
Copper ore	212,947 "
Lead ore	91,283 "
Silver ore	88 "
Zinc ore	12,941 "
Iron ore	3,500,000 "

Further, it is interesting to compare the results given by Mr. Hunt in 1858 with the above, for we find that the mineral wealth of England has nearly doubled in five years, for in 1858 the value of the metals produced amounted only to £18,105,708. I must not omit to state that, during the last few years, England has also taken the lead in the manufacture of aluminium (Jno. Bell and Co., manufacturers, Newcastle) and magnesium, by Messrs. Mellon and Co., Salford, who have adopted the method proposed by Mr. Sonstadt. As to the four new metals which have been of late discovered, viz., cesium, rubidium, thallium, and indium, they are as yet but scientific curiosities, but as their discovery is due to spectrum analysis, I shall refer to them more especially when treating of the method by means of which the discovery of these metals has been made, an illustration of which I shall be able to give, through the kindness of Mr. Ladd, who will show you the various spectra on the screen at the conclusion of the lecture.

Since I had the pleasure of drawing your attention last year to the then novel application of magnesium to the art of photography, owing to the intense light which that metal produces (for it has been calculated to be equal to $\frac{1}{100}$ th part of that of solar light, and has been seen at a distance of twenty eight miles at sea, and also to its intense actinic power), Mr. Butinck has proposed the substitution of this metal for zinc in galvanic batteries, and states that he believes the substitution would prove a very advantageous one to electricians. The employment of this metal will be greatly facilitated by the large works which have been erected for its manufacture at Boston, in America.

Although Mr. Faraday observed many years ago that light was transmitted through thin leaves or sheets of the following metals:—platinum, palladium, rhodium, gold, silver, copper, tin, lead, iron, and aluminium, still we were not prepared for the interesting results that Mr. Quincke has obtained and published in the "Philosophical Magazine" for March, 1864. That gentleman endeavoured to determine directly the velocity with which light travels through metals, and he found, strange to say, that it travels faster through gold and silver than through a vacuum. Further, he adds that he was unable to detect any difference in the components of the light which had previously passed through transparent substances, such as plates of glass. The comparative rapidity of light in passing through metals and a vacuum appears to me to be in favour of the new theory of light, which I took the liberty of expounding to you in my first lecture. Although we could conceive the passage of light through a thin film of metal, still chemists were astonished when Mr. Henry St. Claire Deville, whose name I have had the pleasure of often citing in these lectures, published, conjointly with Mr. Frost, some interesting papers on the porosity of substances under the influence of high temperatures. His experiments enabled him to show that even platinum and wrought iron tubes, the latter one-eighth of an inch thick, are, when carried to a high temperature, permeable to gases. The importance of these results cannot be overrated by chemists, when the permeability of platinum is considered, as that metal has been employed by them under the conviction that its high density and mode of manufacture destroyed all porosity. As to iron, the knowledge of that fact is most important, especially in the manufacture of coal-gas, where iron retorts are used for distilling the coal. So complete is the permeability of iron at a high temperature, that an iron tube which had been filled with hydrogen gas before the experiment, was found to contain only a trace of it at the end of a few hours.

Considering the short space of time which I have at my command, I can only state that you will find in the Royal Society's Transactions (vol. clix., part 1, page 1) a most elaborate paper on "The Influence of Temperature on the Electrical Conducting Power of Metals," and also (vol. cl., part 1, page 85) one on the "Conductibility of Copper." These researches of Dr. Mathiessen deserve the close attention of all electric telegraph engineers.

The study of metals must convince every student that, although science has progressed in a marked manner during the last fifty years, still that there is a great deal more to do than has been done. Although we have known copper, zinc, lead, tin, and iron for many centuries, still hardly a month passes without new properties of these metals being discovered, or facts connected with the improvement of their manufacture or the removal of the impurities they contain. I therefore deem it my duty to advert to a few papers that have been published recently respecting certain impurities which particular metals contain, which impurities, in some instances, enhance the value of the metal, and in others lower their commercial value. No other class of substances teaches the young chemist the difficulties and the labours he must be prepared for, if he wishes to be what is technically termed a good operator, and if he pretends to prepare a pure substance. I would, therefore, advise all young men studying chemistry, carefully to read the labours of J. S. Stas on "The Determination of the Equivalents of Chlorine, Sulphur, Nitrogen, Silver, Potassium, Sodium, and Lead," published in the "Moniteur Scientifique" of 1861 and 1864, where they will notice that Stas has spent months of time to obtain a few ounces of pure silver, lead, &c.

Copper.—The same may be said of the researches of Mathiessen to obtain pure copper, for his studies above alluded to have enabled him to state that there is no alloy of copper which conducts electricity better than pure copper (page 92 of the above memoir), for he found that the most minute quantities of arsenic, phosphorus, sulphur, selenium, tellurium, and oxygen diminished the conducting power of that metal. Whilst on the impurities of copper I must not fail to mention some valuable additions which Messrs. Abel and Field have published in the journal of the Chemical Society of London, on the means of determining various impurities which copper contains; thus they found sometimes traces, and sometimes several per cent. of the following impurities in many samples of commercial copper, silver, arsenic, antimony, bismuth, lead, tin, and iron (see Tables, vol. xiv., page 302), and Mr. Abel, in a paper inserted in the same journal in 1864, proved that copper contained sulphur as a general constituent, but only in minute quantities; selenium, as an occasional constituent; and that oxygen was always present, and sometimes in considerable proportion; thus, in dry copper he found the quantity of oxide of copper, not as Messrs. Dick and Percy have stated, from 10.21 to 9.34 per cent., but from 3.77 to 4.36 per cent. Mr. Abel gives the following numbers as representing the average proportion of oxygen obtained with a series of samples taken in diverse stages in the manufacture of copper:—

	Oxygen per cent.
"Dry" copper	0.42
Ditto (another specimen)	0.50
"Half-poled" copper	0.20
"Tough-plitch"	0.03
"Over-poled"	0.03

Iron.—As far as our present day's knowledge extends, no metal is more influenced than iron, either for good or for bad, by the presence in it of a minute quantity of another element; thus a few thousandths of carbon transforms it into steel, and a few per cent. of the same element converts it into cast iron; a few thousandths of sulphur, or a few per cent. of silicium, renders iron "red-short," that is to say, brittle at a red heat, whilst the same quantity (thousandths) of phosphorus makes it "cold-short," or brittle at natural temperature. These facts explain why iron smelters and manufacturers do all in their power to use ores as free as possible from these impurities, or apply all their skill to remove them from the ores or metal when present. I am, therefore, satisfied that all iron smelters will appreciate the value of the following facts, published by M. Caron in the "Comptes Rendus" of the Academy of Science of 1863, on the influence of manganese when used on the blast furnace to remove silicium from cast iron. The following table shows the relative quantity of manganese and silicium existing in the cast iron thus produced:—

No.	Manganese.	Silicium.
1	7.93	0.05
2	6.32	0.08
3	4.70	0.30
4	3.81	0.55
5	2.25	0.76
6	3.90	0.50 cold blast.
7	2.10	0.75 hot blast.

This table shows that as the quantity of manganese decreases in the pig iron the quantity of silicium increases; further, that the higher the temperature (all the rest of the operation being conducted in the same manner), the quantity of silicium increases and the manganese decreases.

M. Caron has further made the important remark, that it is the interest of the iron-smelter to use as much lime in the blast furnace as practicable when manganiferous ores are employed, for not only does lime facilitate the introduction of manganese into the iron, but also helps in a degree to remove the excess of silicium.

Eight or nine years ago I made the observation that if manganese had not the property of removing phosphorus from iron, it had the one of hiding or of counteracting the bad influence of that element on iron; in fact, I found that cast iron, containing as much as one or two per cent. of phosphorus, would yield good mercantile iron if the pig iron contained at the same time five or six per cent. of manganese, and I have lately heard that manganiferous ores have been used with great advantage by the Cleveland iron smelters to overcome the "cold shortness" of their cast iron, which is due, as is well known, to the presence of phosphorus compounds in the Cleveland iron ore.

It is highly probable that the advantages which have been derived from the employment of spiegel-eisen iron, in improving the quality of steel produced by Bessemer's process, is owing, not only to the fact that this peculiar iron contains a large quantity of carbon, which it yields to the molten iron contained in the large crucible used in Bessemer's process, but that the manganese it contains contributes also to hide the influence of the phosphorus or to overcome the detrimental properties which a trace of phosphorus would impart to the steel produced by this process. I say hide, because the phosphorus is still present, since that substance cannot be removed by the above process from any pig iron in which it may be present.

M. Caron has published in the "Technologist" for 1864, a paper in which he shows that no amount of lime on the blast will remove phosphorus from any ore which may contain it; and that tin plate manufacturers and others who employ charcoal iron should pay the greatest attention to the quantity of phosphorus contained in the charcoal they employ for refining ordinary iron; thus some charcoals are susceptible of yielding as much as one per cent. of phosphorus to iron, while others only 0.12 per cent., and, lastly, some only a trace.

If phosphorus, sulphur, and silicium are injurious to the quality of iron, the metal called tungsten, on the contrary, appears to improve in a marked degree its quality, especially when in the state of steel. This fact has not only been demonstrated beyond all doubt by Mr. Mushet, but also recently by some scientific researches due to M. Caron, who has proved that steel containing tungsten presents greater tenacity, and can be used with great advantage for many purposes; in fact, he thinks that tungsten can be used instead of carbon as a converter of iron into steel. There can be no doubt that the employment of tungsten in connection with the hardening of steel, and other various applications which that metal is susceptible of, will be greatly enhanced if the fact stated in the "Chemical News," of August 25th is brought to bear, viz., that a Swedish chemist has found a simple and practical method of extracting tungsten from its ore so as to reduce its cost of production to a few shillings per pound.

Mr. R. Johnson and myself have published a paper in the "Memoirs of the Royal Society," in which we showed that the conductivity of iron was greatly modified by the quantity of carbon it contained, as proved by the following table:—

	Found.	Conductibility of silver = 1,000.
Wrought iron	13.92	436
Steel	12.65	397
Cast iron	11.45	359

We also found that the hardening of steel had the greatest influence on its expansibility, for while a steel bar, hardened to the maximum, expanded to a degree which may be represented by 84, the same steel rendered as soft as possible expanded only 62.

Although the oxidation of iron, or its rapid destruction under the influence of the carbonic acid and oxygen of the air, is a source of great advantage to those who manufacture this article, still in many instances it is a source of annoyance to those who possess articles made of that valuable metal, and in others it is a national loss, as in the rapid decay which our iron ships of war undergo. Allow me, therefore, to say a few words on these points.

It is easy to preserve small articles made of iron from rust, either by plunging them into a weak solution of caustic alkali (whether the iron is preserved by a peculiar action of the alkali, or because it prevents the action of the carbonic acid of the atmosphere in conjunction with oxygen and moisture, are points to be determined), or covering them with a varnish made of india-rubber, gutta-percha, and a small amount of fatty matter. As to the preservation of ships' bottoms from corrosion, without entering here into the various methods that have been proposed of late to effect this important object, still I deem it my duty to call your attention to one or two methods that have been tried with apparent success; thus, Mr. Leach has applied on the iron surface of ships' bottom a coating of gutta-percha or other cement, and fastening by it sheets of glass of about one-fourth of an inch in thickness. The glass is previously bent to the shape of the ship, and pierced for the reception of the screw or bolts, which are preserved from immediate contact with the metal bolts by coating them with a little of the fastening mixture.

M. Becquerel relates, in the "Comptes Rendus" of the Academy of Sciences, 1864, the results which obtained by the application of his galvano-electric process on the iron keels of some of the French men-of-war. This process is based on the same principles as those adopted by Sir Humphry Davy, in 1824, for preventing copper sheathing from being rapidly corroded by sea water, and which consisted, as you are aware, in attaching at various distances blades of zinc between the wooden side of the vessel and the copper sheets, or what effected the same purpose, in using brass nails for fastening the copper to the sides of the vessel.

M. Becquerel employs zinc in connection with iron, thus establishing a galvanic current which renders the iron, like the copper in Sir H. Davy's experiment, electro-negative, or possessing the same kind of electricity as oxygen, therefore communicating to it the property of liberating oxygen from any compound, instead of absorbing or fixing it. M. Becquerel has proved that the galvanic action of the zinc on the iron exercises its influence on the whole of the iron surface of the ship, but nevertheless that its influence decreases as the square of the distance, and consequently that its action is only sufficiently powerful to preserve iron from corrosion for a

limited distance, and consequently the preserving bands of zinc must be placed at short intervals from each other.

Mr. Johnson and myself published, as I hope you will remember, in the "Journal" of the Society, two or three years since, two papers bearing upon this same subject, the first paper containing facts exactly identical with those published in 1864 by Becquerel; the second showing the advantage that would be derived by shipbuilders in using galvanised iron plates instead of wrought iron ones for plating our men-of-war; for you are aware that the attack of sea water on iron plates in contact with oak was very great, being 2.880 as compared with galvanised iron, which was only of 0.095, all the circumstances of action being equal in both cases.

But the most important result that Mr. Johnson and I have arrived at on this point is the demonstration, in a paper we have published on "The action of sea water on certain metals and alloys," that the action of sea water on lead is nearly nil, as seen by the following table:—

Action of Sea Water upon Metals.	
1 Metre.	Grammes.
Steel	29.16
Iron	27.37
Copper (best selected)	12.96
(rough cake)	13.85
Zinc	5.66
Galvanised iron (Johnson's process)	1.12
Block tin	1.45
Stream tin	1.45
Lead (virgin)	trace
Lead (common)	trace

This metal can, therefore, be used with great advantage to preserve the keels of iron ships from being corroded by the action of sea water, and that the objection which might be raised as to its softness might be easily overcome by adding to lead a few hundredths of either arsenic or antimony, which would increase its hardness, and thus render it better fitted for the purpose referred to. From experiments that we have made we can further state that, in our opinion, Muniz's metal is a far superior article to copper for sheathing ships. (See "Society of Arts' Journal," April 21, 1865.)

As a few ladies have done me the honour to attend these lectures it may be interesting to them to have a simple method of cleaning silver or silver plate, without the trouble of employing rouge or other cleaning powder, which, besides rapidly wearing off the metal, takes up much of their servants' time. It consists in plunging for half an hour the silver article into a solution made of one gallon of water, one pound hyposulphite of soda, eight ounces muriate of ammonia, four ounces liquid ammonia, and four ounces cyanide of potassium; but as the latter substance is poisonous, it can be dispensed with if necessary; the plate being taken out of the solution is washed, and rubbed with a wash leather.

Improvements have also been made of late in coating cheap metals, such as iron and brass, with more valuable ones, so as to enhance the value of the fancy articles made with them. If you remember, I referred to a process, devised by M. Oudry, for coating cast iron with copper or bronze. The method that I wish now to bring before your notice is one devised by Mr. Weil, and is based on the same principle as the one which has been in practice for some time in tinning iron pins, or covering brass with gold, viz., plunging the article to be coated into a boiling alkaline solution of a salt of tin, or a salt of gold; and, in the case of Mr. Weil, into one of copper, which consists of an organic salt of copper—say, the double tartrate of copper and potash—with an excess of alkali, taking care that the cast or wrought iron to be coated is in contact with a brass wire during the operation.

I shall now take the liberty of dwelling for a short time on various memoirs which have been published in connection with the physical properties and chemical composition of alloys.

You will find in the "Transactions of the Royal Society," vol. cl., some extensive researches, by Dr. Matthiessen, on "The electrical conducting power of alloys;" also, in vol. cliv., on the influence which heat exercises on that important physical property of alloys. Mr. Johnson and myself have published papers on the density of alloys, as well as on the hardness, expansion, and conductivity of the same. It was admitted, some years ago, that alloys were simply a mechanical mixture of various metals; but the systematic researches which we have published leave no doubt that, when certain metals, such as tin and copper, bismuth and lead, zinc and copper, are employed in equivalent quantities, and that the proportion of each metal does not exceed two or three equivalents of one to one equivalent of the other, that they are susceptible of combining and forming definite compounds. I may state, in corroboration of this statement, that if one equivalent of zinc and one equivalent of copper are melted together, or 49.32 of copper and 50.68 of zinc, and well stirred, and allowed to cool until a crust is formed on the surface, and then a hole be made in the crust and the fluid portion poured out, well defined prismatic crystals, sometimes of $\frac{1}{2}$ in. long, will be found to coat the interior of the solidified mass; while if 45 per cent. of copper and 55 per cent. of zinc—that is to say, proportions which are no longer equivalent to each other, then, instead of obtaining a fine golden-coloured crystalline alloy, a white amorphous mass will be produced; in fact, no brassfounder attempts to use more than 40 per cent. of copper to produce brass, for experience has taught him that, if he exceeds that quantity, he obtains such a white metal that it is no more a marketable article. Another example is furnished by certain alloys for bronze. Thus, when two equivalents of tin for one equivalent of copper are employed, the conductivity of this alloy for heat is equal to that of both the metals together entering into its composition; while if the conductivity of alloys composed of three equivalents of copper to one of tin, or four equivalents of copper to one equivalent of tin, is ascertained, it will be found that their conductivity is quite different and independent of that of the metals entering into their composition; in fact, the conductivity of four equivalents of copper and one equivalent of tin is five times less than the one first cited.

Without occupying your time with further instances let me call your attention to an important fact that Dr. Matthiessen, Mr. Johnson, and myself have observed, viz., that the addition of a small quantity of a metal which may be considered as an impurity, completely modifies, in many instances, its properties; and the most important example that I am acquainted with is, the influence which the addition of 1 or 2 per cent. iron exercises on the properties of brass. If a brass be composed of 60 per cent. copper and 40 per cent. zinc, it will be susceptible of being drawn or bent when cold, but cannot be forged or worked when heated; while if 1.75 or 2.0 per cent. of iron be substituted for the same quantity of zinc, then a most valuable brass is obtained, for not only is this brass capable of being forged at a red heat like iron, but its tenacity is increased in an enormous proportion, for each square inch of surface is able to support a "breaking weight" of from twenty-seven to twenty-eight tons, a tenacity nearly equal to that of iron.

Messrs. Beyer and Peacock, of Manchester, who experimented with bolts made of this alloy, in the hope of substituting them for iron ones in the fire-boxes of locomotives, found that these bolts would support a strain equal to those of iron, and that the threads of the screw were not stripped with more facility than those of iron when exposed to the same strain.

There is no doubt that when this alloy becomes more generally known many valuable applications of it will be made in the arts and manufactures.

While dwelling on valuable brass alloys let me state that two alloys have lately been introduced which will prove useful to those requiring them, namely, a white alloy, which is chiefly employed for the bearings of the driving wheels of locomotives, owing to its extreme hardness, and which is composed of:—

Zinc	77
Tin	17
Copper	6
	100

The other alloy has been lately proposed to calico printers by Mr. Lessen as a substitute for the steel blades used by them to remove

the excess of colour which adheres to the surface of their printing rollers, and which blades bear the name of "doctors."

Mr. Lessen's metal is composed of:—

Tin	4.93
Zinc	9.74
Copper	85.29
	100.00

This alloy is stated to have all the flexibility, tenacity, and hardness required for the "doctors" used in calico printing, and, further, it presents the great advantage of not being acted upon by acid liquors, which action is often a great source of annoyance to calico printers.

I shall conclude this lecture by alluding to the extraordinary modification in the fusibility of metals when several are fused together; thus, for example, the following well-known alloys which liquify in boiling water:—

	Newton's alloy fusible at 212 deg.	D'Arcet's alloy fusible at 201 deg.
Bismuth	5	8
Tin	3	3
Lead	2	6

While the fusing point of these metals, when taken separately, is as follows:—

Bismuth	513 deg.
Tin	451 "
Lead	621 "

Therefore, the fusing point of each metal is several hundred times higher than when they are mixed in the above proportions.

A still more fusible alloy has lately been brought before the notice of the public by a Mr. Wood in one of the American journals, in which he states that by melting together—

Lead	8 parts.
Bismuth	5 "
Tin	4 "
Cadmium	3 "

An alloy is obtained whose point of fusion is equal to 140 deg., therefore susceptible of being used with great advantage for dental purposes.

I have now to refer to the four metals which have recently been discovered, viz., cesium, from *caesius*, "sky coloured," owing to two blue lines which it produces in the spectrum; rubidium, from *rubidus*, "dark red," owing to the existence in its spectrum of two red lines of remarkably low refrangibility; thallium, discovered by Mr. William Crookes, and which derives its name from *thellos*, "a budding twig," symbolising the beautiful green tint of budding vegetation; and indium, discovered by Messrs. Reich and Richter, of Freiberg; all of which are due to the introduction into science of a mode of investigation, known as the "spectrum analysis."

BISMUTH.—It is stated in the *South Australian Register* of Sept. 27th, that a very promising bismuth mine in Spencer's Gulf is being vigorously worked, and is likely to prove valuable.

STEAM AND CANVAS.—A New York paper speaks of the remarkable decline of sailing power and advance of steam power on the ocean, as evidenced by the fact that on one day twenty steamships left that port—two of them for Europe and eighteen for the Southern ports, to aid in the work of reconstruction. It is an evidence, also, of the way in which that country adapts itself to circumstances. Its sailing marine was becoming almost cumbersome. It had not dock and pier room enough to accommodate it; but as one steamship can do more carrying trade than a dozen sailing vessels, in consequence of the rapidity and regularity with which it traverses the ocean, the latter will gradually vanish, and the United States be able to do all the carrying trade they require with half the accommodation at the piers and docks.

DIVING IN A PIT SHAFT.—An interesting undertaking has just been concluded at the Grove Pit, the property of C. R. Vickerman, Esq. It seems that some three weeks since, the main rod (16 inches square) of the 80-in pumping engine broke short off, about twenty feet from the surface; it was of course necessary to put a new one. While the new rod was being made and fitted the water rose in the pit till it had covered the piece enclosing the valve or clack, and it was found some short time (twenty-four hours) after the pumping engine had been set to work, that the valves would not act; the water consequently rapidly increased till there was a depth of twenty-six feet in the pit. There were now but two courses open to the proprietor, either to put down a new set of pumps, at a heavy cost of time and money, or to employ the more novel agency of divers. Mr. Vickerman chose the latter, thereby starting many of the people of the neighbourhood. Messrs. Wilton and Bolton, the celebrated divers (the former of whom is well known in this neighbourhood by his work on the "Sir Henry Pottinger," sunken in the Carmarthen Bay, and the removal of the "Prince Consort" rock at Pembroke Dock), arrangements were made for their going down. A platform was erected about four feet above the water, from which they descended to the bottom by means of a ladder. They were attended by six men, under the direction of Messrs. Cadman and Foley, the managers of the colliery, for the purpose of working the air pumps of the Heineke apparatus used, and rendering any assistance that may have become necessary. The three particular disadvantages the divers had to contend with were, firstly, that the pieces of iron were heavy; secondly, they were restricted for room; and last, but not least, they had to work in the dark. To get to the damaged clack or valve, the diver (for they worked alternately), had to take off an iron door, fastened with massive bolts and nuts, weighing upwards of five cwt. As the space in some places between the door and the side of the pit was not more than from twelve to eighteen inches, much of the work had to be done with one hand. On the door being removed it was found (as had been expected) that the cutter which makes fast the iron guard which serves to keep the centre piece of the "clack" weighing about one cwt. (which works on a pin or swivel) in its place, had been knocked out. The guard was thus rendered useless. No doubt this being the case the working of the engine caused the upper portion of the valve to knock on the spindle, drove out the under cutter, which kept it in its place. The spindle thus liberated, fell through the clack and seating, to the bottom of the pump. The top and middle piece of the valve having been taken out with much difficulty and considerable dexterity, a new spindle was lowered down and fitted. This part of the work was accomplished in about four hours; then came the hardest part of the undertaking. The spindle being fixed, it was necessary to raise the centre part of the valve, weighing one cwt., at arm's length, and place it on the spindle. For some time it seemed almost impossible. A little judicious application of tackling, however, obviated the difficulty, the piece was raised, dropped over the spindle, the guard replaced, and the door again screwed on. About five or six hours were consumed in this part of the operation. Upon starting the engine it was found that the pole of the pump would not throw water, and it was suspected that the iron door had not been put properly in its place. On the divers again descending, this was found to be the case. After two or more attempts they succeeded in fixing it on firmly; three or four days served to clear the pit of water, and the colliery works are now going on as usual. We have paid particular attention to the above, for we considered it a very novel undertaking, and one fraught with the utmost importance to colliery proprietors; and we think Mr. Vickerman deserves their thanks for his enterprising spirit. It was but an experiment—success was by no means certain, failure very possible. He elected the almost untried novelty, and, we are happy to say, eminently succeeded. According to the old method of putting in a new lift of pumps, many weeks would have elapsed before the pit would have been in working order, and much inconvenience, if not distress, have been experienced by the colliers thus thrown out of work. The Grove Pit, at which these operations have been going on, is almost a new one, and is considered one of the finest in South Wales; it is fifteen feet in diameter, with a depth of 105 fathoms. The best engines and most modern appliances contribute to its completeness almost regardless of expense.—*Pembroke Herald*.

MR. KIRKALDY'S NEW TESTING AND EXPERIMENTING WORKS.

In the early part of last year we stated that Mr. Kirkaldy, the author of the well-known work on the strength of iron and steel, intended to erect in London some machinery for testing the strength of materials and details. The works will be opened to-morrow, at the Grove, Southwark-street, adjoining Messrs. Easton, Amos, and Sons' works. The machinery has been constructed by Messrs. Greenwood and Batley, of Leeds, according to Mr. Kirkaldy's patented designs, and under his immediate superintendence. We need scarcely say that Mr. Kirkaldy has adopted a very complete and delicately adjusted series of levers for registering the force exerted. In an account of his works, which Mr. Kirkaldy intends to publish, he says that his "apparatus is adapted for any kind of strain—pulling, crushing, bending, twisting, shearing, punching, bulging, buckling, collapsing, or bursting; and to any amount from 10 lb. to 1,000,000 lb. It will also test with equal accuracy specimens of substances, as well as manufactured articles; and will, as required, ascertain the ultimate breaking strain or any lower amount of proof strain."

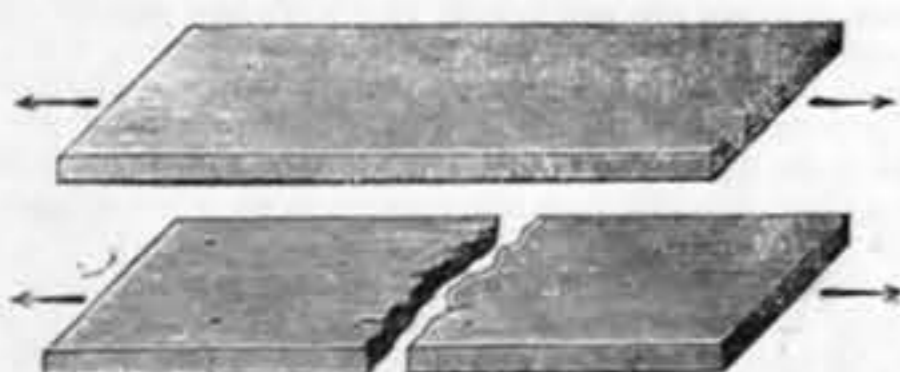
By means of his patent indicator dial, Mr. Kirkaldy tells us that "the slightest change in the form of the article under experiment, whether by elongation, contraction, deflection, or otherwise, is readily observed and exactly measured. The elastic limit, or when permanent set takes place in materials, can thus be ascertained with precision and duly recorded. Many facts connected with this very important subject will thus be obtained."

We have little doubt "that civil, military, mechanical, and mining engineers, architects, ship and bridge builders, boiler makers, and others, will often find this testing apparatus advantageous in determining the best proportions of most structural details, as well as the materials, and variety of materials specially adapted to their different requirements." The machine may be employed for private as well as public purposes. In many instances it will doubtless be considered essential that the results obtained shall be for the exclusive use of the individuals sending the specimens, and at whose expense the trials are made. Thus, makers, by sending their products to be tested and reported upon, can obtain information to assist them in the mixing of their materials and the mode of manufacture. In other cases it may be considered desirable for commercial purposes to have the results of experiments known, and here, doubtless, the employment of a testing machine in the hands of a neutral person would be preferred to a private machine in the manufacturer's own establishment. In many instances it might be quite immaterial what use was afterwards made of facts ascertained for a particular purpose, but, of course, any one wishing to keep the results secret can easily do so by expressing a wish to that effect. In cases of injury from boiler explosions, breakdowns on railways and of machinery, falling of bridges, houses, &c., it must certainly often prove of consequence to have the means of ascertaining whether or not they were owing wholly or in part to the employment of faulty materials.

Every article, when received, will be entered and numbered, and after being tested will be stamped with a mark which is registered under the Trades Protection Act. Certified reports of the results will also be sent to those for whom the experiments were made.

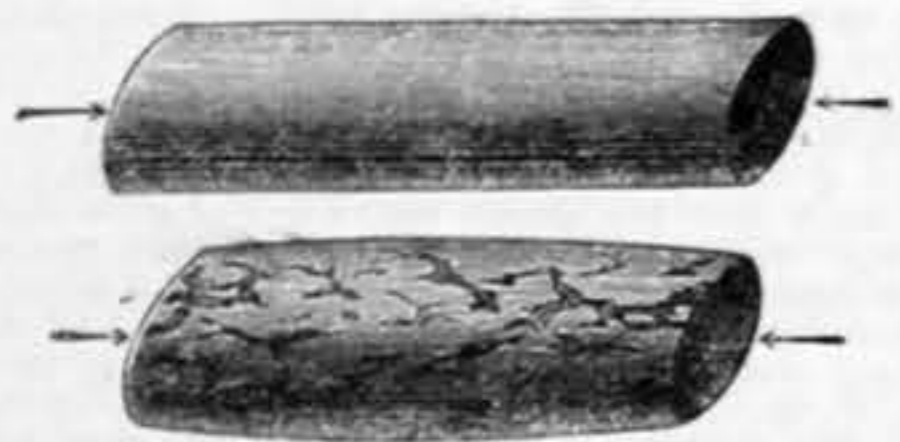
We understand that Mr. Kirkaldy makes a start with a good amount of work in hand. He has thus been employed by Mr. J. Cubitt, C.E., Mr. Henry Carr, C.E., and Messrs. Thorne and Co., to test and report upon the wrought and cast iron, granite, bricks, and cement to be employed in the construction of the new Blackfriars Bridge. He will also test some of the structural details. We hope, and have little doubt, that many other engineers will follow the example of the builders of the new Blackfriars Bridge, and that the insertion of a clause in specifications "Specimens of the work to be tested by Mr. Kirkaldy, of London," will be of no uncommon occurrence.

The illustrations exhibit the specimens before and after being tested, the arrows indicating the direction of strain. Among the details which he expects will be sent to him to be subjected to a:



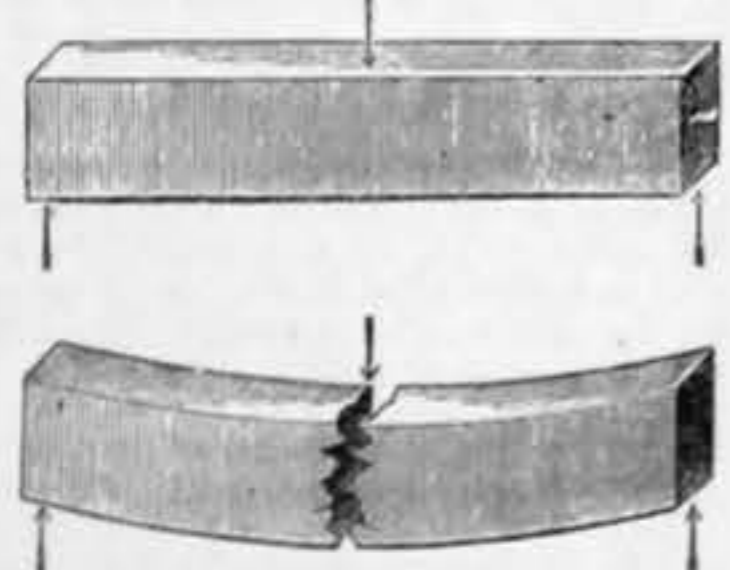
1.—Pulling or Tensile Strain.

may be reckoned—bridge links, wagon and carriage draw bars, coupling links, iron roof tie-rods, boiler stays, springs, bars, plates, angle iron, &c.—in fact, any length up to 300in. Also, crane and other chains, wire and hemp ropes, telegraphic and other wires, &c., up to any length, 20ft. to 25ft. being tested at a time.



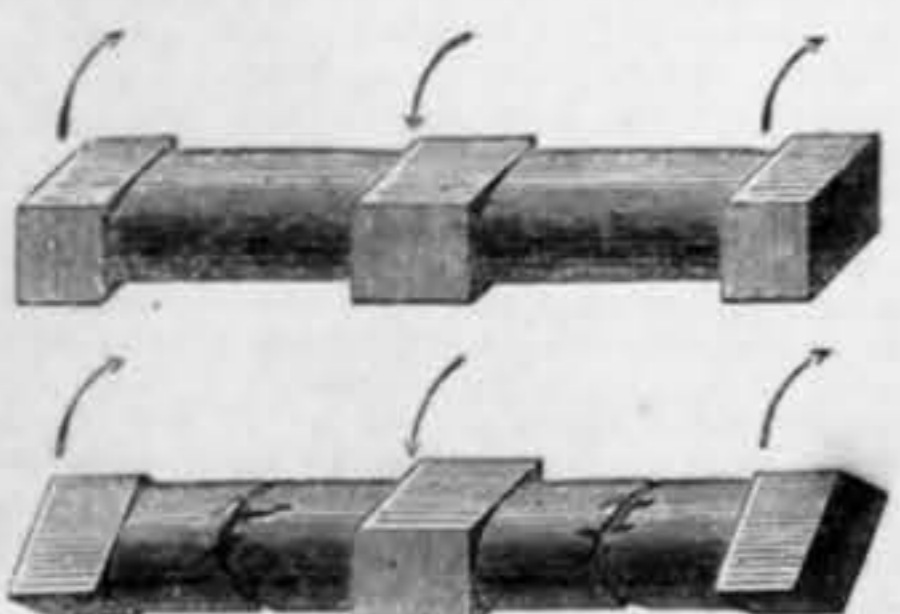
2.—Crushing or Compressing Strain.

Walls, pillars, props, carriage springs, &c.—any length up to 250in.



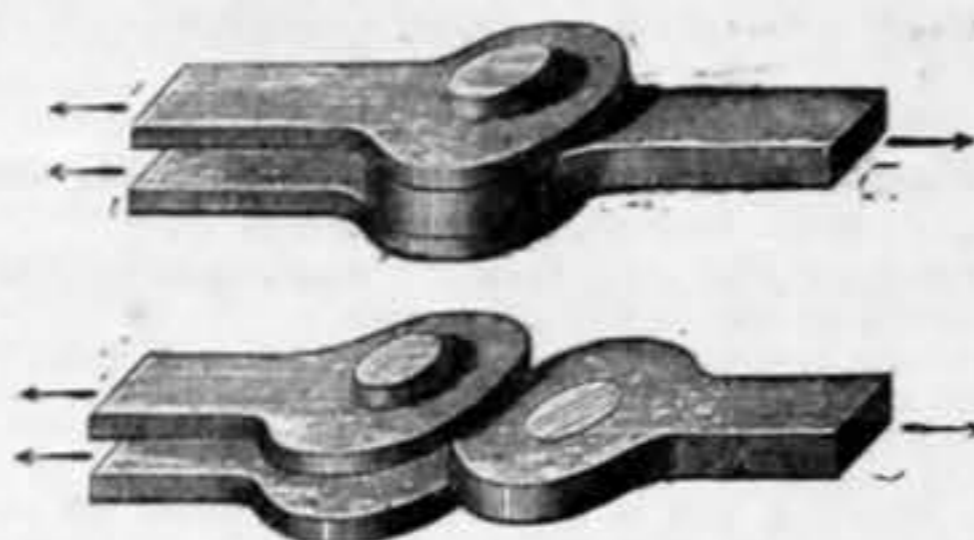
3.—Bending, Transverse, or Lateral Strain (sometimes confusedly called breaking strain).

Girders, beams, joists, rails, axles, tee-iron, &c.—any length, from 10in. to 300in. between the centres or props.



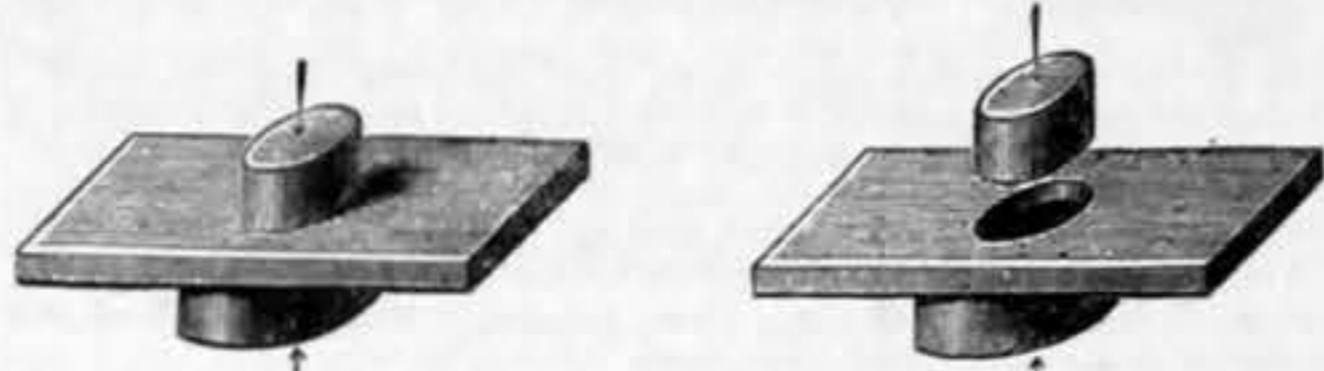
4.—Twisting or Torsional Strain.

Shafting, crank axles, &c.—any length from 10in. to 30in., and from 50in. to 250in.; diameter from 0.5in. to 10in.



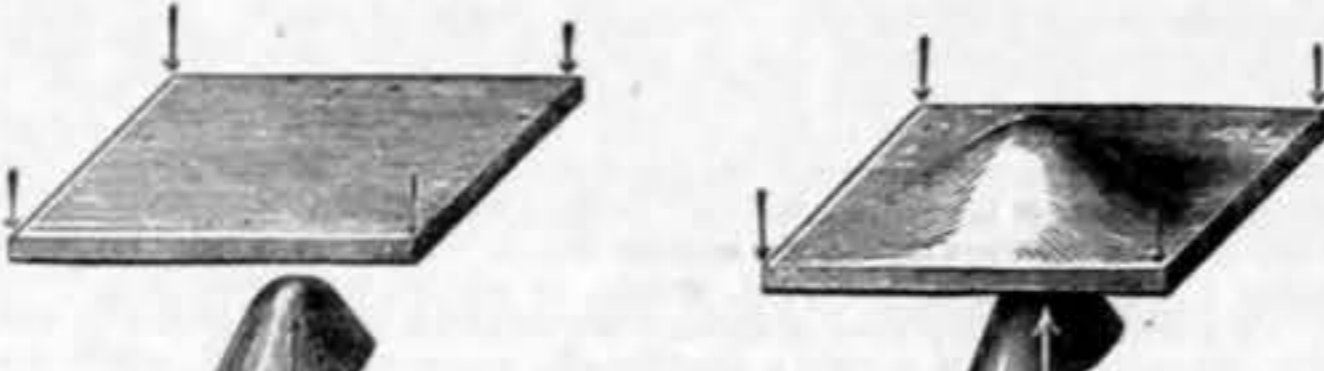
5.—Shearing Strain.

Bridge bolts, sling bolts, hinge pins, cottars, rivets, &c.—diameter from 0.5in. to 10in.



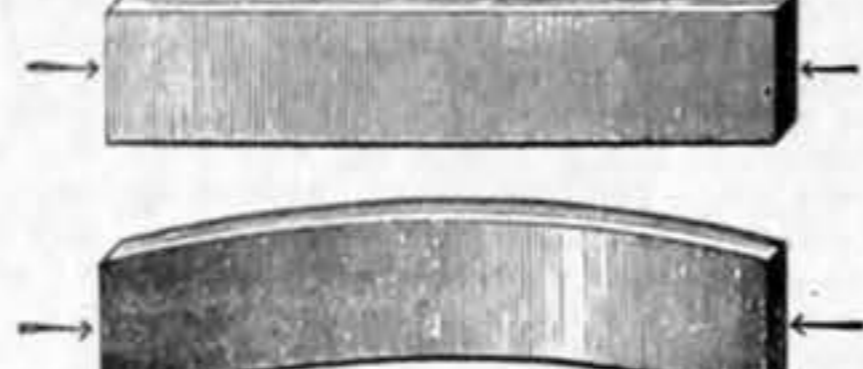
6.—Punching Strain.

Piercing holes in brass, copper, iron, or steel plates, &c.—diameter from 0.5in. to 10in.



7.—Bulging Strain.

Ship grounding on rocks, &c., recess square or circular—any size up to 20in.



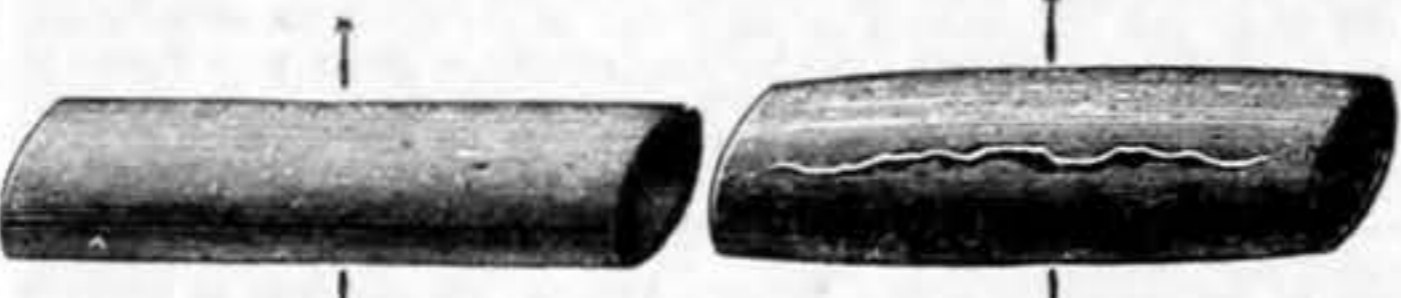
8.—Buckling Strain.

Upper part of a ship's side when the two ends are supported, upper portion of box beams supported at the ends, &c.—any length up to 250in.



9.—Collapsing Strain.

Boiler tubes, having the water and steam outside, or any hollow vessel exposed to external pressure—any length up to 200in., and any size, circular or square, up to 20in.



10.—Bursting Strain.

Boilers, water pipes, steam pipes, boiler tubes having the water and steam pressure and glass gauges, or any hollow vessel exposed to internal pressure—any length up to 200in., and any size, circular or square, up to 25in.

In addition to the above gradually-applied strains the machine can also be adapted to test the effects of percussive, vibratory, jarring, and other impulsive strains, either independently or in combination with a gradual strain-tensile, compressive, or otherwise.

In order that experiments may be made at an even temperature throughout the year the works are uniformly heated by means of hot-water pipes. Materials, however, may be subjected to all degrees of temperature from extreme heat to extreme cold, so as to ascertain the effects produced, both as regards the strength and the rate of expansion or contraction.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Grants of Provisional Protection for Six Months.

- 1895. ALFRED VINCENT NEWTON, Chancery-lane, London, "Certain improvements in envelope machines."—A communication from Thomas Venzie Waymouth, Henry Clay Berlin, and George Jones, New York, U.S.—*Petition recorded 20th July, 1865.*
- 2227. JAMES COLE GREENE, Green Lanes, Islington, Middlesex, "The improvement of the permanent way of railways and carriages for the same."—*Petition recorded 30th August, 1865.*
- 2641. GEORGES ROSSELET, Rue St. Appoline, Paris, "A new method of obtaining and applying water as a motive power for propelling ships by means of paddle wheels inside and outside."—*Petition recorded 13th October, 1865.*
- 2581. THOMAS HUNGATE FRESTON DENNIS, Chelmsford, Essex, "Improvements in greenhouses."—*Petition recorded 18th October, 1865.*
- 2719. ISHAM BAGGS, Chancery-lane, London, "Improvements in the manufacture of inflammable gases and in their application to useful purposes."
- 2732. SAMUEL PARKES MATTHEWS, Wolverhampton, Staffordshire, "An improved method of hanging or suspending blinds from blind rollers, and improvements in the manufacture of such rollers."—*Petitions recorded 21st October, 1865.*
- 2736. MATHIEU JULIEN, sen., Rue de Richelieu, Paris, "An improved mode of transmitting motion to the styles or hands of the dials of counters used for indicating and registering the distances public vehicles or private carriages travel."—*Petition recorded 23rd October, 1865.*
- 2756. THOMAS RUSSELL CHAMPTON, Great George-street, Westminster, "Improvements in the construction of roadways, floorings, and other surfaces."
- 2760. JAMES JOHNSON, Stoke-upon-Trent, Staffordshire, "Certain improvements in 'crossings' to be employed on railways or tramways."
- 2762. HENRY WILDE, Manchester, "Improvements in the construction and working of electric telegraphs and in apparatus connected therewith, partly applicable to other purposes."
- 2765. WILLOUGHBY SMITH, Wharf-road, London, "Improvements in testing and working submarine electric telegraph wires."
- 2766. LEONARD BENNETT, Worcester, "An improved needle."—*Petitions recorded 28th October, 1865.*
- 2768. SCIPION SEQUELIN, Camden Town, Middlesex, "Improvements in the purification and preparation of animal and vegetable wax, stearine, spermaceti, paraffin, and other solid, waxy, or fatty substances."—*Petition recorded 27th October, 1865.*
- 2776. THOMAS BROWN JORDAN, Milton Cottage, South Lambeth, Surrey, "Generating steam in combined vertical cylinders."
- 2782. JAMES BUCKINGHAM, Westmoreland House, Walworth Common, Surrey, "Improvements in lathe chucks."—Partly a communication from Charles Churchill, New York, U.S.

- 2786. HENRY LARKIN, Torriano Cottages, Leighton-road, London, "Improvements in lamps for the combustion of magnesium, and in preparing magnesium for burning."
- 2787. JAMES HINKS and JOSEPH HINKS, Birmingham, "Improvements in lamps for burning paraffin oil and other volatile liquid hydrocarbons."—*Petitions recorded 28th October, 1865.*
- 2788. JARREZ STANLEY, Nottingham-street, Sheffield, "Improved knicker-bockers or leggings."
- 2792. ALEXANDER BRAQUENIE, Paris, "A new kind of double face carpet or tapestry with similar or different patterns on each face."
- 2794. ROBERT GIRDWOOD, Edinburgh, Midlothian, N.B., "Improvements in envelopes and in the construction thereof."
- 2796. WILLIAM EDWARD NEWTON, Chancery-lane, London, "Improvements in the construction of mining picks."—A communication from the Washoe Tool Company, New York, U.S.—*Petitions recorded 30th October, 1865.*
- 2798. DAVID PERFIT GRIFITHS MATTHEWS, Newport, Monmouthshire, "Improvements in means or apparatus for distributing sand or other suitable matters on the rails of railways to promote adhesion of the locomotive wheels thereto."
- 2800. CHARLES CHATTAWAY, Rood-lane, London, "Improvements in fire-arms."—A communication from Emile Della-Noce, Via Berthollet, Turin, Italy.
- 2802. THOMAS FREDERICK CASHIN, Sheffield, and JOSEPH FELIX, Park Gate, near Sheffield, "Improvements in fasteners for driving bands, straps, belts, harness, or other such like purposes."
- 2804. ARTHUR DEBLANDES, Manchester, "Certain improvements in the apparatus employed in the manufacture and production of metallic pipes, tubes, or other similar hollow castings."—A communication from Alfred Bertsch, Marquise, France.
- 2806. MOSES BAYLISS, Gracechurch-street, London, "Improvements in the manufacture of spikes."
- 2808. HENRY YOUNG DARRACOTT SCOTT, Ealing, Middlesex, "Improvements in the treatment and deodorisation of sewage water."—*Petitions recorded 31st October, 1865.*
- 2810. JOHN SELLARS, Manchester, "Improvements in the manufacture of artificial gum, size, or stiffening matter."
- 2813. AUGUSTE BOISSONNEAU, Paris, "Improvements in artificial eyes."
- 2814. LOUIS PFIFFER, Walbrook-buildings, London, "An improved fastening for travelling bags and other similar receptacles."—A communication from Auguste Schubeus, Paris.
- 2816. JOHN KAY FARNWORTH, Alderley Edge, Cheshire, "Improvements in apparatus for raising and lowering the windows of railway and other carriages and other windows."
- 2818. CHARLES HENRY WOOD, Jewry Chambers, Aldgate, and EDWARD LOUIS BARRET, Thrawl-street, Spitalfields, London, "An improved mode of purifying gas."—*Petitions recorded 1st November, 1865.*
- 2821. HENRY JONES, Soho-square, London, "Improvements in the implements or articles employed in the game of indoor croquet."
- 2822. WILLIAM EDWARD GEDGE, Southampton-buildings, Chancery-lane, London, "An improved apparatus for increasing draught in and preventing or curing smoky chimneys and economising heat."—A communication from François Perrachon, Faubourg St. Martin, Paris.
- 2823. WILLIAM BROWN WEST, Manchester, "Improvements in goffering and plaiting machines."
- 2824. MURDOCH CAMPBELL, Clonreher, Queen's County, Ireland, ALGERNON CHARLES PLUMPTRE COOTE, and JOHN CHARLES AUGUSTUS HENRY WOLFRAM, Blackheath, Kent, "Improvements in arrangements or apparatus for drying peat."
- 2825. LUDWIG SCHAD, Warrington, Lancashire, "Improvements in the manufacture of colouring matter for dyeing and printing."
- 2826. ENOCH RUSHTON, Macclesfield, Cheshire, "Improvements in machinery or apparatus for reeling silk, cotton, or other fibrous threads in the form of skeins."
- 2827. WILLIAM EBENEZER DOBSON, Nottingham, "Improvements in dressing laces or other fabrics."
- 2829. LOUIS PEBEYRE, Rue du Four St. Germain, Paris, "An improved apparatus for burning petroleum and other volatile oils."
- 2830. GEORGE BARTLETT, Brixham, Devonshire, "Improvements in artificial manure."
- 2831. CHARLES FREDERIC HENWOOD, East India Avenue, London, "Improvements in projectiles."
- 2832. EDWIN CLARK, Great George-street, Westminster, "An improved method of sheathing iron vessels."
- 2833. JAMES WEBSTER, Birmingham, "Improvement in generating and applying certain gases, and in apparatus to be employed therein."—*Petitions recorded 2nd November, 1865.*
- 2834. REUBEN CORNELIUS LILLY, Birmingham, "An improved penholder."
- 2835. HENRY BESSEMER, Queen-street-place, New Cannon-street, London, "Improvements in the manufacture of iron and steel and in apparatus employed in such manufactures."
- 2838. JAMES BALLEEN ELKINGTON, Newhall-street, Birmingham, "Improvements in the manufacture of copper from copper ore."
- 2839. RICHARD SMITH, Jun., Belper, Derbyshire, "Improvements in mounting and driving millstones."
- 2840. GEORGE WILSON and WILLIAM KITCHING HYDES, Sheffield, "An improved arrangement of buffing and drawing apparatus for railway carriages."
- 2841. ALEXANDER HORACE BRANDON, Rue Gallon, Paris, "Improvements in machinery for receiving and transmitting signals."—A communication from Ambjorn Pietro Sparre, Rue Gallon, Paris.—*Petitions recorded 3rd November, 1865.*
- 2845. HENRY RADCLIFFE, A'am-street, Adelphi, London, "Improvements in apparatus for effecting communications between the passengers, guard, and engine driver in railway trains, and for giving notice to engine drivers in case of accidents."—A communication from Samuel Cornwallis Amesbury, Fort William, Calcutta, East Indies.
- 2849. PATRICK BENIGNUS O'NEILL, St. Mary's Villa, Fulham, Middlesex, "An improved self-acting boiler feeder or apparatus for supplying steam boilers with water."
- 2850. JOHN KING, Endell-street, and ALFRED WATSON, Ely-place, London, "Improvements in the frames and fastenings of carpet and other bags."
- 2852. WILLIAM GARDNER, Queen-street, Cheapside, "Improvements in locks."
- 2853. JAMES THYS, Grove-road, Mile End, Middlesex, "An improved non-conducting composition for preventing the radiation or transmission of heat or cold."
- 2855. FREDERICK CAMPBELL, Duke-street, St. James's, London, "Improvements in treating or curing the leaf tobacco, and in apparatus employed therein."
- 2856. JOSEPH WHITWORTH, Manchester, "Improvements in preparing the ammunition or charges for rifled ordnance and rifled fire-arms."—*Petitions recorded 4th November, 1865.*
- 2859. ALFRED PARAF, Manchester, "Improvements in printing and dyeing textile fabrics and yarns."
- 2860. RICHARD CHRISTOPHER MANSFELD, Ashford, Kent, "Improvements in the construction of wheels for engines and vehicles used on railways."
- 2861. ROBERT FLUDE, Leicester, "Improvements in means or apparatus for finishing the soles of boots and shoes."
- 2862. WILLIAM HEBDON, Mortimer-road, De Beauvoir-square, Kingsland, Middlesex, "Improvements in machinery for measuring woollen and other cloths."—*Petitions recorded 6th November, 1865.*
- 2866. MARTYN JOHN ROBERTS, Pendarren, near Crickhowell, Brecknockshire, "Improvements in means or apparatus for preparing, spinning, twisting, doubling, or winding cotton, wool, flax, or other fibrous material."
- 2867. DAVID BARKER, St. James's street, Piccadilly, London, "Improvements in the manufacture of bricks, artificial stone, and marble."
- 2871. HENRY HIDES, Mortimer-street, Cavendish-square, London, "An improved splint for surgical purposes."
- 2873. FRANCIS GRAHAM BENNETT, Grand Parade, Brighton, "Improvements in apparatus for facilitating the walking of invalids."
- 2874. GEORGE ALEXANDER SMITH, High-street, Bloomsbury, London, "Improvements in the manufacture of cushions for billiard tables."—*Petitions recorded 7th November, 1865.*
- 2877. CHARLES MOLE, Pembroke-terrace, Regent's Park, London, "Improvements in the manufacture of boots and shoes."
- 2879. JULES ADOLPHE RAINE, Calthorpe-street, Gray's-inn-road, London, "Improvements in locks and such like fastenings."
- 2881. NEVILLE BEARD and JOHN MAIDEN, Hollinwood, Lancashire, "Certain improvements in mechanism or apparatus to be employed for lubricating the cylinders of steam engines or other similar frictional surfaces."
- 2883. JAMES EASTWOOD, Blackburn, Lancashire, "Improvements in machinery or apparatus employed for sizing yarns."
- 2884. THOMAS WESTLEY and WALTER BIBBY, Preston, Lancashire, "Improvements in ships' and pulley blocks for general purposes."
- 2885. CHARLES COCHRANE, Woodside Ironworks, near Dudley, Worcestershire, "Improvements in apparatus for separating dust from the gases evolved from blast furnaces."
- 2886. WILLIAM DANIEL ALLEN, Sheffield, "Improvements in casting hoops of steel suitable for making tires."
- 2887. JOSEPH BERNARD OSCAR LASSUS, The Crescent, Minories, London, "Improvements in the means of renewing the teeth of worn-out files."—*Petitions recorded 8th November, 1865.*

Inventions Protected for Six Months by the Deposit of a Complete Specification.

- 2880. JOHN HENRY JOHNSON, Lincoln's-inn fields, London, "A mode or modes of inserting glass or other transparent plates in the fabric of umbrellas or in other plant fabrics."—A communication from Erasmus Allington Pond, Mark Staples Richardson, and Edmund Alonzo Morse, Rutland, Vermont, U.S.—*Deposited and recorded 8th November, 1865.*
- 2901. DANIEL SLATER, Ketterick, Northamptonshire, "Improvements in cabinet furniture."—*Deposited and recorded 11th November, 1865.*

- 2921. HENRY COGSWELL DAVIS, Boston, Suffolk, Massachusetts, U.S., "A new and useful improvement in nail machines or the feeding mechanism therefor."—A communication from Cyrus Dexter Hunt, Fairhaven, Bristol, Massachusetts, U.S.—Deposited and recorded 13th November, 1865.
- 2924. HENRI ADRIEN BONNEVILLE, Porchester-terrace, Bayswater, Middlesex, "Improvements in apparatus for threading needles."—A communication from Frederick Emile Texier and Victor Texier, Rue de la Roquette, Paris.—Deposited and recorded 14th November, 1865.

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

- 3105. JAMES CHALMERS, Knight's-place, Vauxhall, Middlesex.—Dated 19th November, 1862.
- 3068. WILLIAM HENRY ANDREW, Sheffield.—Dated 14th November, 1862.
- 3081. WILLIAM HENRY JAMES, Old Kent-road, Surrey.—Dated 15th November, 1862.
- 3096. EDWARD PIRCE HOUGHTON, Liverpool.—Dated 18th November, 1862.
- 3104. HENRY JOSEPH FERDINAND MARMET, South-street, Finsbury, London.—Dated 19th November, 1862.
- 3124. WILLIAM BOTTOMLEY, Bramley, Leeds, Yorkshire.—Dated 20th November, 1862.

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

- 2581. MATTHEW ANDREW MUIR and JAMES MCLWHAM, Glasgow, Lanarkshire, N.B.—Dated 17th November, 1858.
- 2625. WILLIAM MARSHALL, Leith-walk, Edinburgh, N.B.—Dated 19th November, 1858.
- 2630. THOMAS TOKES CRESSEY, High-street, Homerton, Middlesex.—Dated 19th November, 1858.
- 2638. WILLIAM and JOHN LEA, Wolverhampton, Staffordshire.—Dated 20th November, 1858.
- 2640. HENRY JORDAN, Liverpool.—Dated 20th November, 1858.

Notices to Proceed.

- 1799. HENRY DUNCAN PRESTON CUNNINGHAM, Bury, Hampshire, "An improved method of training guns."
- 1805. WILLIAM GOULDING, Ayleston-street, Leicester, "Improvements in ornamental fences and baskets to contain flowers and other articles."—Petitions recorded 7th July, 1865.
- 1826. ROBERT HINSON, Liverpool, "Improvements in food for horses, and in the preparation of the same."
- 1827. HENRY FRANKLEY, Halifax, and CHRISTOPHER SMITH, Batley, Yorkshire, "Improvements in machinery for washing, wringing, mangling, and drying domestic clothes or other fabrics and fibrous substances."—Petition recorded 10th July, 1865.
- 1830. FREDERICK MASSEY, Tysoe-street, Clerkenwell, London, "Improvements in ships' logs."—Petition recorded 11th July, 1865.
- 1839. SAMUEL BURT HOWLETT, Chelsea, Middlesex, "A new instrument or anemograph for delineating and registering the direction and force of the winds."
- 1840. AUGUSTE DENATROUZE, Golden-square, London, "Improvements in apparatus and equipments used by persons employed under water, part of the improvements being also applicable for the use of persons employed where noxious gases or vapours prevail."
- 1841. HARRISON BLAIR, Kearsley, Lancashire, "Improvements in the production of gases from aqueous vapour, and in the application thereof to heating purposes."—Petitions recorded 12th July, 1865.
- 1847. WILLIAM MADDOWCROFT, Hammersmith, Middlesex, "Improvements in the construction of rollers for window blinds, and in apparatus connected therewith."
- 1848. JOHN BISHOP CHATTERLEY, Birmingham, "Improvements in the manufacture of cruet frames."
- 1850. DAVID FULTON and JOHN FULTON, Glasgow, Lanarkshire, N.B., "Improvements in mandrils for rollers, such as are used for printing or embossing."
- 1853. STAVENS TRIPP, Dane's Inn, Strand, London, "Improvements in the means of securing envelopes for enclosing letters and other papers."
- 1855. ANDREW EDWARD MOLIN, Fahlun, Sweden, "Improvements in separating gold from ores containing copper and gold."—Petitions recorded 14th July, 1865.
- 1863. STEPHEN DUMMER, John-street, Hampstead, Middlesex, "An improved mattress and palliase for the use of the nursery, invalids, or hospitals."
- 1864. RICHARD ARCHIBALD BROOMAN, Fleet-street, London, "Improvements in pumps."—A communication from Jean Pierre Tajan, Paris.—Petitions recorded 17th July, 1865.
- 1880. JOSEPH GRINDLEY ROWE, Queen-square, Westminster, "Improvements in signal and alarm apparatus for railways and railway trains."
- 1887. THOMAS HENRY INCE, Westminster Palace Hotel, Westminster, Middlesex, "Improvements in shoeing horses."—Petitions recorded 19th July, 1865.
- 1921. RICHARD ARCHIBALD BROOMAN, Fleet-street, London, "A new or improved instrument to be employed in examining and facilitating operations in the throat."—A communication from Philippe Othon de Ciermont, Paris.—Petition recorded 24th July, 1865.
- 1929. EDWARD SPICER, New Bridge-street, Blackfriars, London, "Improvements in compositions similar to gunpowder, for blasting, for use in ordnance and fire-arms, and for other purposes."—A communication from Pedro Niser, Melbourne, Australia.—Petition recorded 26th July, 1865.
- 1969. JOHN SWINBURNE, Wenlock-street, City-road, and JAMES LAMING, Lauderdale-buildings, Aldersgate-street, London, "Improvements in means or apparatus for stopping or retarding railway carriages."—Petition recorded 29th July, 1865.
- 1979. ALFRED VINCENT NEWTON, Chancery-lane, London, "An improved method of obtaining induced currents of electricity from magnets and induction coils."—A communication from Jerome Kidder, New York, U.S.
- 1980. ALFRED VINCENT NEWTON, Chancery-lane, London, "An improvement in refining petroleum and other hydrocarbon oils."—A communication from Robert Augustus Chesebrough, New Rochelle, New York, U.S.—Petitions recorded 31st July, 1865.
- 2106. FRANCOIS ANTOINE EDMOND GUIRONNET DE MASSAS, Hoxton, Middlesex, "Improvements in machinery for treating cotton seeds, in order to remove the cotton therefrom and to prepare the seeds for crushing."
- 2209. GEORGE TOMLINSON BOUSFIELD, Loughborough Park, Brixton, Surrey, "Improvements in folding chairs."—A communication from James Gouley English and Edwin Francis Mersick, Newhaven, Connecticut, U.S.—Petitions recorded 26th August, 1865.
- 2294. JOHN MATTHIAS HART, Cheap-side, London, "Improvements in the construction of iron safes, strong boxes, and other receptacles."—Petition recorded 7th September, 1865.
- 2405. WILLIAM WATKIN, St. George's-road, Southwark, Surrey, "Improvements in and applicable to furnaces for the consumption of smoke."—Petition recorded 21st September, 1865.
- 2532. WILLIAM ROBERT LAKE, Southampton-buildings, Chancery-lane, London, "An improved sewing machine."—A communication from Henry Hudson, Three Springs, Pennsylvania, U.S.—Petition recorded 3rd October, 1865.
- 2677. ARTHUR HILL HASSALL, Wimpole-street, London, "Improvements in the preparation of meat for food."—Petition recorded 17th October, 1865.
- 2766. THOMAS RUSSELL CRAMPTON, Great George-street, Westminster, "Improvements in the construction of roadways, floorings, and other surfaces."—Petitions recorded 26th October, 1865.
- 2803. ROBERT CASSELLS, Glasgow, and THOMAS MORTON, Motherwell Ironworks, Lanarkshire, N.B., "Improvements in furnaces."—Petition recorded 31st October, 1865.
- 2872. GUSTAVUS ADOLPHUS JASPER, Middlesex, Massachusetts, U.S., "Cleansing or bleaching of sugar, which invention may also be applicable to other purposes of like character."—Petition recorded 7th November, 1865.
- 2884. THOMAS WESTLEY and WALTER BIBBY, Preston, Lancashire, "Improvements in ships' and pulley blocks for general purposes."—Petition recorded 8th November, 1865.
- 2921. HENRY COGSWELL DAVIS, Boston, Suffolk, Massachusetts, U.S., "A new and useful improvement in nail machines or the feeding mechanism therefor."—A communication from Cyrus Dexter Hunt, Fairhaven, Bristol, Massachusetts, U.S.—Petition recorded 13th November, 1865.
- 2925. HENRI ADRIEN BONNEVILLE, Porchester-terrace, Bayswater, Middlesex, "Improvements in apparatus for threading needles."—A communication from Frederick Emile Texier and Victor Texier, Rue de la Roquette, Paris.—Petition recorded 14th November, 1865.

And notice is hereby further given, that all persons having an interest in opposing any one of such applications are at liberty to leave particulars in writing of their objections to such applications, at the said office of the Commissioners, within twenty-one days after the date of the Gazette (and of the Journal) in which this notice is issued.

List of Specifications Published during the week ending 18th November, 1865.

- 77, 10d.; 78, 8d.; 79, 4d.; 80, 4d.; 81, 4d.; 82, 8d.; 83, 10d.; 84, 8d.; 85, 10d.; 86, 1s.; 87, 6d.; 88, 4d.; 89, 10d.; 90, 1s. 4d.; 91, 6d.; 92, 4d.; 93, 8d.; 94, 4d.; 95, 1s. 4d.; 96, 1s. 4d.; 97, 4d.; 98, 4d.; 99, 8d.; 100, 10d.; 101, 8d.

* Specifications will be forwarded by post on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post-office Order, made payable at the Post-office, 6, High Holborn, or Mr. Bennet Woodcroft, her Majesty's Patent Office.

ABSTRACTS OF SPECIFICATIONS.

The following descriptions are made from Abstracts prepared expressly for THE ENGINEER, at the office of her Majesty's Commissioners of Patents.

CLASS 1.—PRIME MOVERS.

Including Fixed Steam and other Engines, Horse, Wind, and Water Mills, Gearing, Boilers, Fittings, &c.

1152. R. A. BROOMAN, Fleet-street, London, "Smoke-consuming furnaces."—A communication.—Dated 25th April, 1865.
The object of this invention is to construct furnaces in which the smoke is burnt at the moment of or immediately after its formation. The invention mainly consists in the employment of supplementary fire-places of special construction, in which the combustion is effected by air forced in by a fan or otherwise, and in the formation of lateral air chambers or arches, by which the air is introduced to facilitate combustion, and to flame the gases at the upper part of the supplementary fire-places.—Not proceeded with.

1180. A. C. HENDERSON, Charing Cross, London, "Water wheels."—A communication.—Dated 28th April, 1865.
This invention consists in the use of a large wheel furnished with an endless chain or buckets, the length of chain, number, and capacity of the buckets varying according to the force required; connected with the driving shaft of the wheel above mentioned is a pump of sufficient power to force water either to the top bucket of the endless chain, or to a reservoir placed at a convenient level for the purpose of feeding a second set of buckets connected with and set in motion by the large wheel. This second set of buckets, considerably less in number than on the endless chain above mentioned, is for the purpose of supplying the first or highest bucket of the endless chain as it descends, the quantity of water being so regulated as to exactly meet the supply required for this purpose. Thus arranged the wheel is set in motion by forcing up sufficient water to supply all the descending buckets on the endless chain, which, say, are thirty in number; the power thus obtained, would, of course, be sufficient to force up, by pumps or otherwise, sufficient water to fill the top bucket as the lower one empties itself, saving a considerable amount of power, which can be employed for driving machinery, all that is requisite being a free escape for the water from the lowest bucket on the endless chain, and the filling the buckets when first setting the wheel in motion.

1189. A. C. HENDERSON, Charing Cross, London, "Water wheels."—A communication.—Dated 28th April, 1865.
This invention consists in the use of a large wheel furnished with an endless chain or buckets, the length of chain, number, and capacity of the buckets varying according to the force required; connected with the driving shaft of the wheel above mentioned is a pump of sufficient power to force water either to the top bucket of the endless chain, or to a reservoir placed at a convenient level for the purpose of feeding a second set of buckets connected with and set in motion by the large wheel. This second set of buckets, considerably less in number than on the endless chain above mentioned, is for the purpose of supplying the first or highest bucket of the endless chain as it descends, the quantity of water being so regulated as to exactly meet the supply required for this purpose. Thus arranged the wheel is set in motion by forcing up sufficient water to supply all the descending buckets on the endless chain, which, say, are thirty in number; the power thus obtained, would, of course, be sufficient to force up, by pumps or otherwise, sufficient water to fill the top bucket as the lower one empties itself, saving a considerable amount of power, which can be employed for driving machinery, all that is requisite being a free escape for the water from the lowest bucket on the endless chain, and the filling the buckets when first setting the wheel in motion.

1195. A. WYLLIE and J. M. F. GRAY, Liverpool, "Steam engines relating to valve motions, governor and drain pipes."—Dated 29th April, 1865.
This invention relates, first, to an improvement in the valve motion of engines having oscillating cylinders. The improvement consists in adapting the traverse link to be used as a reversing gear in combined engines; and for variable expansion the patentees accomplish this by constructing the traverse link so that it can be thrown into inclined positions, but still retaining a vertical motion. This vertical motion is made to be of itself just sufficient to uncover the steam ports and give sufficient lead to the valve, and they depend upon the inclination of the traverse link for the rest of the motion of the valve. The traverse link is horizontal when the engine is stopped; by inclining it one way the engine goes ahead, by inclining it the other the engine is reversed. The invention relates, secondly, to an improvement in the gear for working a separate expansion valve, and the improvement consists in the simplification of this gear. The patentees use one eccentric rod as before, but they attach the other end of the link direct to the end of a lever for shifting the link, so that the attachment for support forms also the means for shifting the link, and they modify the curve of the link so as to compensate for the nature of the curve in which the supported end is shifted. The invention relates, thirdly, to an improved method of reversing when the valves are worked from a separate shaft driven by toothed gearing from the crank shaft. They propose to accomplish it by shifting only one intermediate driving wheel perpendicularly with the line joining the centres of the two adjacent wheels. When the three centres are in a line, the engine is stopped; the intermediate driver is shifted to one side for motion ahead, and the other side for reversing. The teeth of the wheels should be made involute. They propose also to work expansion valves with toothed gearing as above, and to alter the grade of expansion by shifting an intermediate driving wheel. The invention relates, fourthly, to an improved governor for steam engines. They propose to introduce a self-acting steam valve to regulate the admission of steam to the engine. The opening of this valve is to be dependent upon the difference between the pressure of steam in the boiler and the pressure of the steam at the valve before the steam passes the valve. The same end has been sought by means very similar in Waddle's steam governor, but there the opening of the valve box has been regulated by the difference between the pressure on the opposite sides of the valve itself. The invention relates, fifthly, to an improved drain pipe for horizontal cylinders. They propose to lead a pipe from the inside of the cylinder at the centre of its length. In condensing engines they lead this pipe to the condenser with a retaining valve on the pipe, and in non-condensing engines this pipe opens to the atmosphere. The pipe should have a cock or valve to regulate the amount of opening. The invention relates, sixthly, to an improved arrangement of drain pipes for cylinders which are not horizontal. On the side of the cylinder at the top they place a pipe with two openings into the cylinder, so that, when the piston is at the top, there is communication between the top of the piston and the underside of the piston, but when the piston has moved down a small distance, it closes the lower opening, so that the communication is only open while the piston is near its top position. The pipe is placed to drain from the upper side of the piston in the lower end of the cylinder, and a common drain cock is placed at the bottom of the cylinder, which, in the case of condensing engines, has a branch pipe leading to the condenser, and another branch opening to the atmosphere with a valve on it.

1212. D. RANKIN, Greenock, "Marine steam engines."—Dated 1st May, 1865.
This improved arrangement of steam engines comprises one or more oscillating cylinders, each piston being fitted with two piston rods in a plane at right angles to the crank shaft. A cross head is fixed on the two piston rods, and on the side next the cylinder this cross head is formed to receive bearing brasses, and a cover for connecting it upon the crank pin. With this arrangement the cylinder can be placed so nearly to the crank shaft that the crank pin will have only the thickness of the bearing brass with its cover, and a slight clearance in addition between it and the cylinder cover, while the stuffing boxes for the piston-rods can, without inconvenience, be made of the extra length well-known to be desirable with oscillating cylinders. Not proceeded with.

1226. T. RUSSELL, Weinsbury, Staffordshire, "Valves for liquids, steam, and gases."—Dated 2nd May, 1865.
This invention consists of certain improvements in valves for liquids, steam, and gases, whereby the valve is raised from and lowered on to its seat by means of a hand wheel or collar working on the body of the valve, the axis about which the said hand wheel or collar rotates being coincident with the axis of the valve.

CLASS 2.—TRANSPORT.

Including Railways and Plant, Road-Making, Steam Vessels, Machinery and Fittings, Sailing Vessels, Boats, Carriages, Carts, Harness, &c.

1157. W. ELDER, Dundee, "Improvements in steering ships or vessels, and in machinery or apparatus connected therewith."—Dated 25th April, 1865.
This invention has for its object the means of steering ships by machinery actuated by means of a piston working in a cylinder, which piston is moved preferably by steam, although water, compressed air, or other suitable medium for producing pressure, may also be used. The cylinder is arranged upon a sole plate which carries all the gear of the machine, and is arranged transversely on the deck, gangway, hurricane deck, poop, engine room, lower deck, or any other convenient part of the ship, and the piston rod passes through both ends of the cylinder, to each end of which chains are attached, which pass over sheaves or pulleys situated at the extreme traverse of the rods; and their other ends being turned back to midships pass each other in separate grooves over the driving wheel, and are each made fast thereto. This driving wheel is mounted upon a short shaft lying at right angles to the cylinder, and which shaft is at about the middle of one side of the cylinder, close behind the driving wheel; on the same shaft is fitted the brake and steering wheel, of larger diameter, which is furnished with three grooves, one of which is to contain the brake strap, which can be tightened more or less, or released altogether, at pleasure, instantaneously, by the slightest move of the steersman's foot. The purpose of this brake is to have a slipping or frictional command of holding the rudder in any weather. The other two grooves are for receiving the port and starboard chains, which are separately made fast thereto, the other ends of which are led off in the usual way to the compensating tiller on the rudder head or intermediate shaft, in such manner that, when the piston moves in the cylinder, its motion is communicated to the rudder.

1158. J. T. BURNELL, Chatham, "Construction of railway rails and wheels."—Dated 25th April, 1865.
In order to enable locomotive engines to draw trains up steep inclines, the patentee makes the heads of the rails wedge-shaped, or inclined at the sides and flat on the top or table. The tire of each of the driving wheels of the locomotive engine he makes with a groove corresponding with the

form of the head of the rail, so that the driving wheels rest on the sides of the rail, and do not bear on the top or table. The two sides of the groove in the wheel thus nip the head of the rail, and in this manner a greatly increased adhesion is obtained. The other wheels of the train may run upon the top or table of the rail in the usual manner. Where there are portions of the line of railway which are comparatively level it is desirable to make the driving wheels of the engine double, that is to say, one part grooved and another part plain, so that, on the level, the plain parts of the driving wheels may run on ordinary rails, on which also the carriages of the train travel, while on the inclines the grooved parts of the driving wheels run upon rails with wedge-shaped heads, as before described.

1162. W. HUSBAND, Hayle, Cornwall, "Securing or fastening wooden planking to iron frames in ships or vessels, and also to the outside of iron ships."—Dated 25th April, 1865.

This invention relates, first, to improved methods of securing or fastening wooden planking to the interior of iron frames of ships or vessels, whether such frames be in the form of angle iron, plate iron, or iron of any other form, the word "planking" to include every part of the external timber, and the keel, stern, and stern posts. Secondly, to securing or fastening wood in planking to the exterior of iron ships or vessels, in order to attach copper or other metallic sheathing to such wood, and thus to prevent electrical action between the iron and the sheathing. It has hitherto been the practice in fastening planking to the frames or ribs of vessels to form the bolt holes through the planks, and to insert the bolts or screws from the exterior of the planks to the ribs or framing, so that contact occurs between the bolt head and the sheathing of the ship. But this invention consists in tapping on the interior side planking parallel screw-heads, extending to a sufficient depth to ensure a firm hold to the frames by the insertion of screws formed parallel throughout their length. By previously tapping the planking the parallel screws are readily inserted, and will give a much greater holding power. Taper screws may, however, be used if desired without tapping; but this plan is inferior in strength and holding power. Copper or metallic sheathing may thus be applied to a flush wooden surface, and, consequently, galvanic action will be prevented. The inventor likewise proposes to apply wooden planking to the hulls of iron vessels by tapping the planking as before, and boring or tapping the iron plating, and securing the wood to the iron from the inside by parallel screws or by taper screws. In this case also no galvanic action can arise with the sheathing. He proposes to galvanize or tin the points or screws of copper or patent metal bolt so as to avoid contact and electrical action between the copper or composition and the inner frames in ships.—Not proceeded with.

1163. R. ECCLES, Rock Ferry, Cheshire, "Railway chairs."—A communication.—Dated 26th April, 1865.

In performing this invention the inventor shapes one of the inner sides of the railway chair to fit one side of the rail, and there is a groove forming the segment of a circle on the other inner side of the chair. When the rail is placed on the chair to be fixed in it, he inserts a block between the rail and the part of the chair where the groove is, one edge of such block being formed to fit the shape of the rail, and the other edge of it having a groove forming the segment of a circle. When this block is placed in the required position the two grooves form a concentric channel. In order to fix the rail in the chair he inserts a bar or clamp of eccentric form in the concentric channel, so that, by turning it by means of a spanner or wrench, the rail is firmly held in the chair. A small wedge is then inserted through a hole in the upper part of the chair to pass through a notch or slot in the eccentric bar, and thus preserve it in its required position.—Not proceeded with.

1170. S. HARVEY, Clerkenwell, London, "Machinery for cutting or shaping masts, spars, and other beams and articles of wood."—Dated 27th April, 1865.

Upon a frame or bed the patentee mounts a horizontal cylinder made to rotate upon its axis by a worm in gear with teeth on the cylinder or otherwise. One end of this cylinder is flanged, and the flange carries six or other convenient number of pins, on each of which a lever is free to turn in order that the levers may approach nearer to or recede from the centre of the cylinder, according to the diameter of the mast or other article to be formed. The inner ends of the levers carry horizontal spindles, on which loose pulleys are mounted; some of these spindles, by preference three, carry circular saws secured to the pulleys, while on each of the other three spindles flying cutters are mounted. The pulleys, saws, and cutters are driven by bands or otherwise, and another band passes round all the pulleys or spindles to keep the saws and cutters to their work. On each spindle the patentee casts a groove or grooved wheel or flanges to receive a plunger block which carries a guide roller, the distance of which from the spindle can be regulated by screws and nuts, or otherwise. On one end of the timber to be shaped the patentee fits a template corresponding to the form of the mast or other article to be produced. The patentee mounts this timber on a horizontal travelling platform, and brings the end carrying the template to the end of the cylinder on which the saws and cutters are fitted.

1215. M. W. RUTHVEN, Harlow-villas, East India-road, London, "Propelling vessels."—Dated 1st May, 1865.

This invention is applicable to the propelling of vessels where water is constantly pumped by one or more rotating or centrifugal pumps to outlets or passages on either side of a vessel, the centrifugal pump or pumps being situated most conveniently intermediate of the two sides of the vessel. Ordinarily it is preferred that on each side of a vessel there should be two tubular passages, one opening out in a direction towards the stem of the vessel, and the other opening out in a direction towards the stern of the vessel, and where the two are connected to a common supply pipe from the rotating or centrifugal pump or pumps, there is applied a rotating sluice, which is preferred to be cylindrical, but it may be somewhat conical. This rotating sluice is closed at both ends, and it is also closed on one side to such an extent that, when the closed side is turned opposite either of the tubular passages, the way through that passage will be closed against the passage of water, and the water will flow freely through the other outlet passage. The rotating sluice turns on an axis at its two ends, so that the sluice can be readily turned to allow the water to pass to either of the tubular outlet passages, and so as to produce either stem or stern way.

CLASS 3.—FABRICS.

Including Machinery and Mechanical Operations connected with Preparing, Manufacturing, Printing, Dyeing, and Dressing Fabrics, &c.

1155. J. WILKINSON, jun., St. Helen's Mills, Huddersfield, Yorkshire, "Apparatus for printing felts, floorcloths, carpets, and woven fabrics."—Dated 25th April, 1865.

Upon a suitable framework the patentee mounts, at convenient distances, a series of cylindrical pattern rollers, cut to the pattern it may be desired to impress (each pattern being fitted with woollen cloth, or other suitable absorbent) upon the felts, floorcloths or woven fabrics. Underneath these rollers he places cylinders, free to revolve in bearings secured to the frame, and at such distance from the pattern rollers as will allow the material to be printed to pass between them, and, at the same time, to receive the impression of the pattern rollers, which are supplied with colouring matters from feed rollers covered with suitable material, such as woollen cloth, such feed rollers being each one of a series of three similarly covered, and in contact with each other, the last rollers of the series revolving in troughs furnished with the requisite colouring matters. Within the frames at either side, and extending from end to end of the same, he places endless chains of the well-known construction, furnished with tenter pins, and on either side of the machine; at the front end, where the cloth is fed, and also at the back end, he places a wood roller, furnished with an india-rubber or elastic ring over the line of traverse of the tenter pins.

1159. J. C. WICKHAM, Armagh-road, North Bow, and A. E. DEISS, Bow Bridge, Middlesex, "Manufacture of waterproof fabrics."—Dated 25th April, 1865.

In performing this invention the inventors take vegetable gum of the class to which gutta-percha or india-rubber belong, and reduce the same in a masticator to small pieces. This disintegrated gum they dissolve to a suitable consistency by the application thereto of bi-sulphuret of carbon, to which is added from one and a half to two per cent., or thereabouts, of chloride of sulphur, either with or without the use of heat, as thought desirable. The gum, being well mixed with the solvent in a cistern, is allowed to deposit the refuse and colouring matter which it may contain. The clear solution thus obtained they apply to the saturating of the fabric to be waterproofed. To this end they run the solution from the digester into an air-tight chamber, in the ends of which are formed horizontal slots. The slots are covered by guide boxes, fitted with pairs of nipping rollers, between which the fabric to be operated upon is passed. The fabric is drawn from a cloth beam, mounted in an adjacent frame, and guided into the chamber between the first pair of rollers by means of guide ropes. When the fabric has entered the chamber it passes under and over guide rollers mounted therein, and is thereby immersed in the solution. It then passes out at the other end of the chamber between nipping rollers, which express the superfluous solution from the fabric. These rollers may, if thought desirable, be heated. From this chamber it passes to a second and similarly-arranged chamber, the two being connected by a coupling box, and here the fabric is subjected to a temperature sufficient to volatilise the solvent. The heat may be given by a steam or hot-air chest placed below the chamber. This chamber is connected by a pipe with a condenser, to which the volatilised spirit passes, and being there condensed is ready to be used again. In its progress through this chamber the fabric becomes dry; and as it issues out at the end of the chamber it is received upon a cloth beam as a waterproof and vulcanised fabric. It may afterwards receive any finishing that may be thought desirable.—Not proceeded with.

1160. W. OXLEY, Manchester, "Improvements applicable to rollers of machinery for preparing and spinning fibrous substances."—Dated 25th April, 1865.

This invention cannot be described without reference to the drawings.

1169. R. A. BRIDGMAN, Fleet-street, London, "A new or improved method of conditioning or preparing fibres threads and fabrics, and apparatus to be employed therein."—A communication.—Dated 26th April, 1865.

This invention consists in conditioning or preparing filamentous substances by impregnating them preparatory to, or during, or after, the ordinary manipulations they undergo, with air moistened by being forced through or over a pure liquid, or a liquid containing any desired chemical agent or principle. The invention also consists of an apparatus in which the air is moistened and applied. This apparatus consists of a tank or chamber, containing in the lower part a simple or compound liquid; the tank is closed at bottom, except to a pipe leading from an air pump; plates extend across the tank, with perforations at alternate ends, to cause the air to travel in a zig-zag direction, and through a large extent of the liquid, some distance above the level of the liquid is an openwork tray, for supporting the filamentous substance to be moistened. The tank is closed at its sides and top, and is provided with doors, to allow of the substances being placed upon and withdrawn from the tray; and pipes, fitted with stopcocks, are attached, to allow of the escape of air as may be required, or to lead the moistened air to be applied in other vessels.—Not proceeded with.

1193. R. FERRIE, J. MURRAY, and A. WILSON, Paisley, "Dyeing yarns."—Dated 29th April, 1865.

This invention cannot be described without reference to the drawings. 1200. G. P. DODGE, Upper Thames-street, London, "Pickers for looms."—Dated 29th April, 1865.

This invention consists in constructing pickers for looms of india-rubber, or material of which india-rubber is a constituent, the india-rubber being so treated, compounded, or combined with other ingredient or ingredients, as to give the composition the requisite toughness and density.

1215. W. E. NEWTON, Chancery-lane, London, "Manufacture of flock fabrics."—A communication.—Dated 1st May, 1865.

The resistance produced to the action of the drug in either dyeing or printing must be overcome before the cloth is dyed or printed. To effect this the cloth is submitted to a steam heat of from 220 deg. to 290 deg. Fah., for, say, during twenty or thirty minutes. This process has the effect of evolving all the chemical action produced by the ingredients used in the rubber, gutta-percha, or other mixtures of which the cloth is composed; after which the cloth is submitted to a bath of muriate of tin, at from 4 deg. to 12 deg. of strength. The effect of the muriatic acid is to precipitate or solidify the gum or curd evolved from the rubber or gutta-percha, to neutralise the effect of the sulphate of lead, as well as to deposit a coating of tin upon and throughout the flocked surface. After removing the goods from this bath they are submitted to a bath of aqua ammonia and sal soda, of a strength sufficient to neutralise the muriatic acid, or any impurities or other chemical negatives which may be upon the face of the cloth. This latter application may be used either before or after the bath of muriate of tin. The goods are then submitted to a solution of sulphuric acid and chloride of lime, in order to thoroughly oxidise the previous deposit of tin, and afterwards to a solution of sulphuric acid and water, to remove the lime. This combination forms a mordant for any colour which may be desired in dyeing or printing, and, at the same time, permits of the desired colour being obtained at a lower temperature of heat or steam, and of a more uniform and beautiful shade than by any process heretofore known.

1219. W. E. NEWTON, Chancery-lane, London, "Manufacture of waterproof fabrics."—Dated 1st May, 1865.

The patentee claims as a new manufacture the fabric having a back or base of flax, cotton, jute, wool, or other textile material, coated or covered with a sheet of india-rubber, or other vulcanisable gum, or the vulcanisable compounds thereof, and having a face of fibrous substances in the form of a bat or felt, or of other textile material combined and united by pressure, and by the vulcanisation of the gums, and dyed and printed, or dyed or printed, or coloured or stamped, or embossed for the purposes and in the manner described.

CLASS 4.—AGRICULTURE.—NONE.

CLASS 5.—BUILDING.

Including Brick and Tile Machines, Bricks, Tiles, Drain Pipes, and House Fittings, Warming, Ventilating, &c.

1170. J. CUNNINGHAM, Liverpool, "Fire-proof buildings."—Dated 26th April, 1865.

In performing this invention the inventor constructs the floors, partitions, and other internal portions, and sometimes part of the walls, of buildings, to render them fire-proof, of a number of lengths of iron or other metal, rolled or otherwise formed to resemble in transverse section the Z-iron of commerce, and these he places parallel to each other close together, or at such distances apart that the lateral limbs of the Z, that is, those portions which are bent in opposite directions at right angles to the trunk, shall be sufficiently far removed from each other that they will retain prepared lime, or other plaster, placed upon them, and so dispense with laths. The said lengths of iron are tied by rods, which pass through the trunks of the Z's, and pieces of pipe on the said tie rods, or other separating pieces, are used to keep them apart and in proper position. Where the lateral limbs are broad holes might be punched or made in them to give sufficient holding spaces for the plaster.

CLASS 6.—FIRE-ARMS.

Including Guns, Swords, Cannon, Shots, Shells, Gunpowder, Implements of War or for Defence, Gun Carriages, &c.

1177. J. CARR, Birmingham, "Improvements in breech-loading fire-arms and ordnance, and in projectiles."—Dated 27th April, 1865.

These improvements consist in the arrangements of parts hereinafter explained for opening the breech of the gun for loading, and securely closing it for discharge. At the rear or breech end of the barrel the patentee forms a chamber or trough open at top, in which chamber a plug is made to slide. By the sliding of this plug in one or other direction the breech of the barrel is opened or closed. To the top and forward end of the plug a plate or cover is hinged, which plate or cover when shut down closes the top of the chamber. On the under side of this plate or cover is a bolt or wedge, sinuate at right angles to the plate. The plug has a slot, through which, when the plate is shut down, the bolt or wedge passes and engages in a slot made in the bottom of the chamber. By the arrangement of the bolt in the last-named slot the plug is securely fixed, and the breech closed for firing. The bolt or wedge is connected to the plate by its top end, being screwed thereto by a screw having a little play, or by being inserted in a depression on the under side of the plate, and secured by a pin or screw. By this arrangement all pressure is borne by the wedge itself, instead of by the hinge and the junction of the wedge. The cover of the chamber is kept in position by a spring set flush in the plug, and pressing laterally on the wedge; or the spring may be set in the wedge, and made to press on the plug. In order to prevent the plug from being drawn wholly out, the patentee employs a stop formed by a screw pin. The end of this screw pin passes through the side of the gun, and bears against a flat surface filed or otherwise formed on the under surface of the plug. When it is wished to remove the plug the stop must be unscrewed. In order to make the chamber water-tight, and thereby to protect the action from water or damp, he fixes a washer of india-rubber under the head of the screw, by which the bolt or wedge is fixed to the plate or cover. Instead of making the bolt or wedge in the manner described, it may be modified in the following manner:—The wedge is fixed to the plate transversely, that is, it crosses the axis of the plug, and when the cover is shut down the wedge bears against the end of the plug, instead of passing through a slot in it, and takes into a slot in the bottom of the chamber; or the wedge may engage with the chamber by entering slots cut in opposite sides of the chamber. In order to fix down the lid securely during firing he employs a spring bolt, which shoots through the hind part of the lid into the end of the plunger or chamber. This fastening may be applied to fire-arms in which the opening and closing of the breech is effected by a box, the lid of which is jointed at its fore part to the chamber or barrel. In applying the invention to needle guns the patentee makes a needle or striker pass through the top of the fore part of the cover, and through the fore part of the plug or plunger, so as to strike, on the descent of the hammer upon it, the self-igniting cartridge in its rear end. The needle or striker may either be acted upon by the hammer of the lock or by a piece of metal attached to the hammer. In order to prevent the escape of gas on firing he fixes a cap on the end of the plug, the said cap being convex on its external face. The end of the solid plug is flat, so as to leave a space under the convex face of the cap. On the explosion of the cartridge the pressure upon the convex face of the cap flattens it, and causes it to expand and prevent the escape of gas. After the explosion the cap resumes its normal shape. The improvements described with reference to fire-arms may also be applied to ordnance. The improvement in projectiles consists in making in the fore end of the projectile, and in the axis thereof, a hole or depression. This hole or depression constitutes a wind centre, about which the projectile rotates in its flight, and gives great precision to the flight of the projectile.

1182. R. A. BRIDGMAN, Fleet-street, London, "Apparatus for charging and closing cartridge cases."—A communication.—Dated 27th April, 1865.

This invention consists in constructing apparatus as follows:—Upon a lead plate the patentee mounts a vertical rod, on which a charger is pivoted. This charger consists of a tube flanged at bottom and fitted inside another tube, so that on pressure being applied to the charger or inner tube it is pushed down within the outer tube; when the pressure is removed a spring returns the charger to its normal position. The charger carries a cup at the top. The lead plate also supports a carriage free to slide to the right and left within a certain limit in a groove; a cylinder for containing the

cartridge case is hinged to one end of this carriage, and is capable of assuming both a vertical and a horizontal position. A horizontal lever carrying a block at about its middle, and formed with a handle at its outer end, is pivoted so that it may be turned to bring the block against the end of the cylinder when in a horizontal position; a corresponding handle is fixed to the front of the apparatus. A cartridge closer is fitted to the apparatus at the end opposite the lever; the face of the closer is formed to receive the end of the cartridge, and a winch handle is fitted thereto, by which it is caused to rotate when required.

1192. J. BERNARD, Lincoln's-inn-fields, London, "Improvements in boring or excavating and blasting rocks and minerals, and in the treatment of the tools employed therein."—Dated 27th April, 1865.

This invention relates, first, to the use and employment of a novel cartridge for containing the blasting charge employed in blasting rocks and minerals, and consists in so forming the cartridge that the explosive agent employed is protected from the possibility of being crushed or pressed vertically, and is at the same time rendered waterproof, which the patentee prefers being done either by gutta-percha or a solution of india-rubber. The charge is protected from being crushed vertically by being enclosed in a cylindrical casing of such strength as to resist any desired pressure, the casing being also provided with openings in it, which allow the blasting agent to act freely on the substance to be blasted. In some instances he employs a protector for the explosive material, shaped somewhat similar to a cotton reel, and he places the blasting agent round its stem, the necessary fuse or wire passing through one of its ends, and the whole properly secured by means of an outer casing. Secondly, the invention relates to, and consists in, the means and method employed for shaping and treating tools intended for cutting and boring rocks and hard foundations, which operations he performs by means of suitable dies shaped as may be required. This is effected by placing or securing such die or dies in a suitable seat or rest, and pressing or striking the tool to be operated upon until it assumes its proper or required form.

1197. L. W. BROADWELL, St. Petersburg, "Breech-loading guns."—Dated 29th April, 1865.

This invention consists, first, in the employment of a conical gas ring in a corresponding chamber in the bore of the gun, in combination or not with a bearing plate; secondly, in the employment of a curved gas ring in a corresponding chamber in the bore of the gun, in combination or not with a bearing plate; thirdly, in the employment of an adjustable bearing plate in a chamber in the face of the breech wedge, in combination or not with gas rings; and, fourthly, in the construction and employment of a screw on the breech wedge, all fitted and acting substantially in manner and for the purposes hereinafter explained with reference to the accompanying drawings.

1207. E. DELLA-NOCE, Via Berthollet, Turin, "Fire-arms."—Dated 1st May, 1865.

The first part of this invention relates to an improved arrangement of mechanism for placing caps on to the nipples of fire-arms. For this purpose a supply of caps is placed in a tube of an internal diameter slightly larger than the diameter of the caps; this tube is fixed at the side of the barrel, and parallel with it; the tube at its end nearest to the muzzle is closed by a cap or stopper, which can readily be removed and replaced; the other end of the tube is connected to the lump which carries the nipple; through this lump a hole or passage is made, which forms a continuation of the passage through the tube containing the caps; at the back of this lump is placed a slide, which can be moved to and fro in the arc of a circle by means of a thumb piece; this slide closes the rear end of the passage above mentioned formed in the lump. In the face of the slide which closes the passage in the lump a hole is formed of sufficient depth to receive a cap. When the muzzle of a fire-arm is raised, a cap will drop from the tube containing the lugs into the hole in the slide; the slide is then moved by its thumb piece so that the recess containing the cap is brought on the top of the nipple; within the slide is a slot, in which is placed a small lever; the upper end of this lever lies in the bottom of the hole, into which the cap is received; the lower end of the lever, when the slide is moved to bring the cap over the nipple, is acted on by an incline which causes the lever to turn on its centre in such manner that its upper end forces the cap out of the hole in the slide, and presses it firmly on to the nipple; the slide is then, by its thumb piece, moved back to its former position, to be again ready to supply another cap to the nipple when required. In constructing breech-loading fire-arms the inventor closes the breech end of the barrel by a plug capable of sliding backwards on a line with the barrel, as has before been proposed; the plug works to and fro in a tube which forms a continuation of the barrel; the upper half of a portion of this tube is cut away, so that when the plug is drawn back a cavity is formed, into which a cartridge may be dropped, and afterwards pushed forward into the barrel; the end of the plug is caused to enter a short distance into the barrel until a collar on the plug comes against its rear end. In front of this collar a disc of vulcanised india-rubber is, by preference, placed, so that, when the plug is passed forward into its place, the disc may be compressed between the collar and the barrel, and so form a tight joint. The rear end of the plug passes out through the rear end of the tube in which it works, and at its end the plug has a knob or handle formed upon it, by which it can be slid to and fro; the upper portion of the extreme end of the tube is not cut away, but covers over the plug, and holds it down into the tube. To the top of the plug is connected a covering plate, which is attached to the collar at the front of the plug, and also to a similar collar at the rear of the plug; the upper surface of the cover forms a continuation of the upper surface of the barrel, and covers over the open portion of the tube, and also passes over the top of the rear portion of the tube which embraces the plug. When the plug is pushed forward so that its forward end closes the rear end of the barrel, it is retained there by a small block, which passes down through a slot formed transversely across the rear end of its covering plate. This block is formed on its underside to embrace the plug, and a small recess is formed on the top surface of the plug into which a part of the block enters; the back face of the block bears against the front edge of the rear portion of the tube which embraces the plug, and thus, when this block is in its place, the plug is prevented from sliding backwards. The back of the block and the surface of the tube against which it works are made slightly inclined, so that, when the block is pressed down into its place, the plug which closes the breech of the barrel is slightly pushed forward, so as to compress the ring of india-rubber at the front of the plug. The block is hinged to one side of the covering plate, and has a thumb-piece upon it by which it can be turned upwards on its hinge, in order to allow the plug to be slid back to open the breech end of the barrel. The invention also comprises methods of constructing locks for fire-arms.—Not proceeded with.

1209. G. JOHNSON, Wandsworth, Surrey, "Iron fortifications."—Dated 1st May, 1865.

The patentee claims, first, the construction of oblique-sided casemates, which casemates project from and are in conjunction with living breast-works. Secondly, the adaptation of the traverse port for the protection of guns in broadside batteries; also the principle of turning the traverse port round by the application of the recoil of the gun, by effect of which the port is instantly closed. Thirdly, the process of joining together the armour plates and other portions of ships' batteries and forts by the means of opposite dovetail or other undercut groove and milled metal.

1211. J. BLACKIE, jun., Lincoln's-inn, London, "Igniting the fuses of shells."—A communication.—Dated 1st May, 1865.

This invention consists in fitting on the front of shells and round the fuse a corrugated or plain hood kept at a slight distance from the face of the shell for the purpose of directing the flame from the powder to the fuse to cause the ignition thereof.—Not proceeded with.

1225. T. H. CAMPBELL, Madras, "Improving and strengthening shields of steel, iron, or other material for ships, fortifications, &c."—Dated 2nd May, 1865.

The patentee claims the employment of water or other liquid or lightly compressed air confined in cases or cylinders as a backing for shields or plates of steel, iron, and other materials for ships, fortifications, and other constructions, as described.

CLASS 7.—FURNITURE AND CLOTHING.

Including Cooking Utensils, Upholstery, Ornaments, Musical Instruments, Lamps, Manufactured Articles of Dress, &c.

1228. W. E. NEWTON, Chancery-lane, London, "Folding beds and bedsteads."—A communication.—Dated 2nd May, 1865.

One part of this invention relates to folding bed bottoms or mattresses composed of a folding frame containing or having attached to it a series of springs overlaid with stuffing. It consists in connecting the two folding parts or sections of which the frame of the bed bottom or mattress is constructed by means of a double hinge, so that the parts which fold the one upon or against the other without injury to the springs, the stuffing, or the covering thereof, and without straining the connecting joint. Another part of the invention relates to the construction of bedsteads with folding mattresses or bed bottoms, whereby the mattress or bed bottom is made to fold up within a casing resembling in its external form some other piece of furniture which is less unsightly in its appearance, and which occupies less room than an ordinary bedstead.

CLASS 8.—CHEMICAL.

Including Special Chemical and Pharmaceutical Preparations, Fuel and Lighting Materials, Preparation and Preservation of Food, Brewing, Tanning, Bleaching, Dyeing, Calico-Printing, Smelting, Glass, Pottery, Cements, Paint, Paper, Manures, &c.

1117. W. SCARRATT, Russell-street, and W. DEAN, Foley-place, Longton, "Taking impressions from the grain of wood and transferring the same on to various surfaces."—Dated 21st April, 1865.

For these purposes, supposing a board of oak or other wood is to be

employed, its surface is to be evenly planed, and it is coated over on both sides with a solution of pearlsh, composed of one ounce of American pearlsh to one quart of hot rain water; or other caustic material which hardens the same and opens the pores may be used. The surface from which the impressions are to be taken is then to be sand-papered and well rubbed over with raw linseed or other oil, when it will be in a fit state to print from. The pores of the wood are cleaned and kept open by brushing the surface of the wood to be printed from with a common scrubbing or other brush, using therewith mineral turpentine, or naphtha, or common turpentine, or a mixture of any of these articles. If the pores or grain on the surface of the board should clog up or fill with the printing material by being printed from, so as not to give off clean, sharp impressions, it is cleaned as above, and then well rubbed with sawdust, which effectually cleanses and opens the pores of the wood. Again, if through neglect the colour should set in the pores of the board, it must be coated over with soft soap, and a solution of soda or pearlsh; it must remain on from eight or nine hours, and then the board must be well scrubbed with hot water.

1126. E. S. BRAUX and E. PANSIFEX, Paris, "A new process of tanning leather and other skins."—Dated 22nd April, 1865.

The skins are macerated and freed in the usual way from grease and animal matters, the invention relating especially to the after treatment, namely, the tanning, which the inventors effect in the following manner:—A vessel or drum of suitable dimensions, and having, by preference, an hexagonal form, is partially filled with an emulsive liquid hereinafter described. The skins to be treated are introduced, and the aperture well closed, and the vessel, which is supported on suitable bearings, is made to rotate, or is subjected to an oscillating motion. In order that the skins may be the more thoroughly impregnated with the emulsion, bars or ridges of wood are fixed in the interior of the vessel, and the skins falling in them during the rotary movement become thoroughly filled. The above apparatus the inventors do not claim as part of their invention, as several means may be employed with a like result. The emulsive liquid which they employ combines in one those hitherto employed separately. It consists, first, of a tan liquid, prepared in a closed vessel from oak or birch bark, catechu, or sumach, in the following proportions, which, however, must vary according to the nature of the leather. For calf and goat skins, about four and a-half pounds of oak or birch bark, four and a-half pounds of catechu, of two and a-quarter pounds of sumach. Secondly, of a decoction of oleaginous seeds, such as linseed, colza, lichen, or marine moss, and the like, about two and a-half pounds, to which tallow, olein, or other fatty matters for producing a mucilaginous and unctuous mixture, are added, together with twelve gallons of water, and the whole reduced to a density of 45 deg. Baumé. The third and last compound forming part of the emulsive liquid consists of a solution of suitable metallic salts, such as chloride of iron, sulphate of alumina or chromium from two ounces to one pound, to which is added the more recently-employed anti-septics, such as picnic acid, creosote, or their equivalents, in the usual proportions, that is to say, from one three-thousandth to one one-hundredth, according to the degree of purity of the same. The three liquids just described are now mixed as thoroughly as their natures will permit, and form an emulsive liquid, to the action of which the skins are subjected, and the vessel or drum containing both is put into motion.—Not proceeded with.

1153. J. N. BROWN, Handsworth, and T. D. CLARE, Birmingham, "Improvements in the manufacture of iron, and in preparing fuel to be used in the manufacture and melting of iron."—Dated 25th April, 1865.

The patentees claim manufacturing iron either in the blast or smelting furnace, or other furnaces used for melting or refining pig or cast iron, by the use in the said furnaces of a fuel containing ores or compounds of titanium, or ores or compounds of manganese, whether the said fuel be used with or without admixture with coke or other fuel or gaseous mixture. Also, treating or preparing fuel to be used for the said purposes by mixing either with small coal or slack, or other carbonaceous matters which it is intended to coke, or with carbonaceous matters or mixtures which are intended to be compressed into solid fuel, powdered ores or compounds of titanium, or ores or compounds of manganese, so as to form an intimate mixture of the said titanium or manganese ores or compounds and carbonaceous matter, substantially as described.

1154. J. N. BROWN, Handsworth, and T. D. CLARE, Birmingham, "Paints or compositions for coating and preserving metallic and other substances from oxidation and decay."—Dated 25th April, 1865.

The patentees claim preparing the said paints or compositions by the use of powdered limonite, or the other ores of titanium and iron described as being used for the purposes of this invention, mixed with drying oils or other oils or varnishes which are or may be employed to mix with pigments for the production of paints. Also, preparing the said paints or compositions by the use of a mixture of powdered limonite, or the other ores of titanium and iron described as being used for the purposes of this invention, and graphite mixed with drying oils or other oils or varnishes which are or may be employed to mix with pigments for the production of paints.

1161. W. CLARE, Chancery-lane, London, "Manufacture of soluble and assimilable superphosphates of lime by the application of phosphoric acid and acid phosphates."—A communication.—Dated 25th April, 1865.

The patentee claims, first, the application of phosphoric acid at any degree of dilution or concentration for the manufacture of products termed superphosphates, as a substitute either wholly or in part for the sulphuric acid hitherto employed for this purpose. Secondly, the application of alkaline, alkaline terreous, terreous or metallic acid phosphates, at any degree of concentration or dilution, for the manufacture of manures termed superphosphates of lime, the said acid phosphates being used as substitutes, either wholly or in part, for the sulphuric acid usually employed. Thirdly, the application of sulphuric or other mineral acid, of phosphoric acid for transforming into acid phosphate the tribasic or neutral phosphates of lime, which are formed by the action of phosphoric acid on carbonates of natural phosphate. Fourthly, the application of a mixture in suitable proportions of phosphoric acid, or acid phosphates and sulphuric or other mineral acids, for acting on mineral phosphates. Fifthly, adding to any superphosphate a certain quantity of phosphoric acid, in order to enrich it in soluble phosphate. Sixthly, adding to any superphosphate a greater or less quantity of phosphate of ammonia, in order to enrich it in soluble phosphate, and in volatile or fixed alkalies.

1168. F. D. P. J. CABASSON, Paris, "Apparatus for disintegrating vegetable and animal substances."—Dated 26th April, 1865.

For disintegrating as perfectly as may be, and in a very short space of time, the different materials capable of producing paper, and especially the green weed, a portion of the filaments of which are capable of producing fabrics and the remainder paper. According to one arrangement, the apparatus is composed of two vertical cylinders capable of bearing a high pressure, say ten atmospheres; they are made, by preference, of sheet iron, and fitted with safety valves, and with apertures for the introduction and exit of the materials to be disintegrated. Two boiler tubes made of sheet steel, are held in a furnace, and are put in communication with the first cylinders by pipes which, in consequence of the heat, establish a circulation of liquid between the first cylinders and the boiler tubes, for the boilers are heated to the desired temperature in order to obtain a like temperature in the cylinders containing the materials to be disintegrated. According to another arrangement the patentee uses an apparatus in which the cylinders containing the materials are set horizontally, and in which cast iron globes or spheres are placed, so that upon rotary motion being communicated to the cylinders the action or friction of the spheres on the plates facilitate their disintegration. With the view of obtaining the disintegration of the products with greater speed he places in a large horizontal cylinder another but much smaller cylinder set eccentrically to the first, and the circumference of which is in contact with the upper part of a plate provided with cutting blades. This large cylinder is supported in bearings, and is almost filled with liquid and the material or materials under treatment. It has an alternate oscillating motion imparted to it which tends to bring the materials between the small cylinder and the plate, and as the small cylinder has a rotary motion which changes at each oscillation of the large cylinder, the materials under treatment are thus quickly disintegrated.

1173. G. T. BOUSFIELD, Loughborough Park, Brixton, "Manufacture of a new resinous gum or balsam."—A communication.—Dated 26th April, 1865.

This invention consists in the use and adaptation of a new material for the production of a peculiar kind of gum or balsam. The material used is the common grass tree of the Australian colonies, and the article produced from it is proposed to call "bal-sam ambrosine."—Not proceeded with.

1174. W. H. SMITH, St. Ann's gardens, Haverstock-hill, "Improvements in photographing on wood, and in the preparation of wood, canvas, silk, glass, and other substances for the purpose of receiving and retaining impressions."—Dated 26th April, 1865.

This invention has for its object improvements in photographing on wood, and in the preparation of wood, paper, papier mache, china, earthenware, glass, canvas, silk, and other objects for the reception of photographic impressions. These improvements consist in the application of two substances in succession to the object on which it is desired to produce a photographic impression. The first substance forms a base in the pores and interstices, or on the surface of the said object, for the deposition of the second substance, which is sensitised to make it receptive of photographic impressions. The first substance the patentee calls a base, and the second substance he calls a receptive. There are many varieties of both bases and receptives. As regards their ingredients, the bases are composed of valata, india-rubber, gutta-percha, or any gum or resin of a like nature, dissolved in benzole, or in any other hydrocarbonaceous liquid, or it is formed of gelatine and spirits of wine, or an oily matter. The receptives are composed of collodion and gelatine, or any gelatinous substance in a state of decomposition or liquid state, of spirits of wine and of nitrate of silver, the nitrate of silver being mixed with a chloride, a bromide, or an iodide, or some salt having similar qualities.

1204. F. GREGORY, Manchester, "Apparatus employed in breweries and distilleries."—Dated 29th April, 1865.

The patentee claims, first, the machinery or apparatus for mashing with

two heats, consisting of a good mashing vessel with a cavity or jacket surrounding it, into which cavity the patentee introduces the mash water at a higher heat, and, by means as described, a stream of cold water to reduce it to the required temperature; or instead of the said cavity he uses a projecting tube or arm, as described. When two boiling pans are used for obtaining the two heats he conveys the liquid direct to the machine without using cold water. Secondly, the arrangement of machinery or apparatus for cooling and regulating the temperature of the wort liquor in the process of brewing, or other similar purposes, consisting of corrugated metal instead of pipes, as hitherto generally adopted, and the method of raising or lowering the apparatus. Thirdly, the arrangement of machinery or apparatus for compressing or filtering yeast or other substances, consisting of a shaft on each side of a framework, with a right and left-handed screw on it: upon the centre of each is placed a worm-wheel with worms gearing into them, and flexible material to give a yielding pressure. Fourthly, the improved temperator, or apparatus for regulating the heat or temperature of the wort when in a state of fermentation, in which he conveys the wort or other liquid to the centre aperture, so as to form a column of liquid of a greater density or expansion than the surrounding liquid, which sinks to the bottom or rises in the vessel, the displaced liquids rising, falling, and passing through the apparatus, and effectually regulating it to the temperature required. Fifthly, the sparging apparatus for distributing hot water or other liquid on the material in the mash tun, or other vessel, thus mixing or mashing malt or other material with water or other liquor at two or more temperatures.

1227. F. WISE, Chandos Chambers, Adelphi, London, "A mode of obtaining decoctions and apparatus for carrying the same into effect."—Dated 2nd May, 1865.

This invention consists in separating the particles of a material of which a decoction is to be made by introducing into a body of the said material a current or currents of air, so that the water which is afterwards introduced may be brought into intimate contact with every particle of the material and dissolve all the soluble portions of the same. The invention further consists of apparatus for carrying out the above process, and in the use in connection with the same of a steam casing, by means of which the liquor is maintained at any required temperature, and of a cold water casing for condensing the vapours which arise during the operation. The apparatus cannot be described without reference to the drawings.

CLASS 9.—ELECTRICITY.—NONE.

CLASS 10.—MISCELLANEOUS.

Including all Specifications not found under the preceding heads.

1034. B. W. L. NICHOLL, Oxford-street, London, "Flexible spring waist for boots and shoes."—Dated, 11th April, 1865.

At the waist and between the inner and outer sole leathers, or in a groove in the former or latter, of a boot or shoe the inventor forms a bed or space to receive a metal arch and abutment, which he makes fit and fix in the following manner:—He makes the metal arch flexible, by preference of tempered or spring steel, and at a short distance from the toe end he forms a slot with an enlargement or eye therein, which end he wholly or partly encloses in a flat metal sheath or case, consisting of a plate or plates of metal cut and raised so as to receive the slotted end of the spring, and allow room for it to slide backwards and forwards therein, the other or abutting end being made of increased width, and rivetted to the heel of the inner sole of the boot the forward end of the spring is held in position by a stud fixed to the sheath or plate. This sheath is fixed to the sole by rivetting, the stud being passed through the eyelet in the spring when so doing.—Not proceeded with.

1048. G. JACKSON, Westhorpe, Buckinghamshire, "Rests or supports for cues or other similar instruments used for billiards, &c."—Dated 12th April, 1865.

This invention consists in making a movable rest or support for billiard cues or other similar instruments, capable of being conveniently used during the delivery of a stroke. In constructing the movable rest the patentee uses a block, bar, axle, or frame, mounted upon a roller or rollers, or upon a wheel or wheels. In or upon the upper part of the block he mounts a hole or recess suited to receive the playing end of the cue, which is allowed to rest in it in such manner that it may be easily connected with or disengaged from it at the will of the player. In order that the motion of the cue may be guided freely in any required direction where necessity of adjustment is desirable, he mounts the block or frame upon an axle or jints or pivots.

1050. W. E. NEWTON, Chancery-lane, London, "Elastic binders for boots and shoes."—A communication.—Dated 12th April, 1865.

This invention consists in the employment or use, in place of the ordinary non-elastic shoe string or lacing, of an elastic binder, in combination with hooks, buttons, studs, or other suitable fastenings, so that a short string or binder, not much longer than the shoe for which it is used, will be sufficient to tie the shoe; and the operation of tying the shoe will be considerably facilitated, and the elastic cord will be enabled to accommodate itself to the motion of the foot and ankle. The invention consists further in the use of bell-shaped buttons in combination with a spring, lacing, or binder, so that the operation of lacing up a boot or shoe can be effected simply by winding the string successively round the buttons, and the tedious operation of passing the end of the string or lacing through eyelet holes will be avoided. The invention consists, finally, in the use of a tubular clasp in combination with the elastic cord, and with a button, ball, or other cheek at its end, so that when the tubular clasp is secured to a boot or shoe, the cord can be readily attached to the same, or detached therefrom, simply by springing the same into the clasp, or removing it therefrom; and the operation of replacing an old or torn cord will be materially facilitated without removing the shoe from the foot. For some cases, particularly for heavy shoes, it will be convenient to make the cord partly of elastic and partly of non-elastic cord.

060. J. RIFPOD, Sheffield, "Apparatus for lubricating spindles, shafts, &c."—A communication.—Dated 13th April, 1865.

The patentee claims the employment or use of a chamber containing cotton or other fibrous material, so placed that the oil in passing from the cup or reservoir to the surface to be lubricated shall be compelled to pass through the said cotton or other fibrous material, as described.

1058. C. F. COTTEKILL, Cannock, Staffordshire, "Improvements in pipes for conveying water and gas, and for other like purposes, and a new or improved compound for joining the said pipes."—Dated 13th April, 1865.

According to this invention the pipes are joined by means of a conical socket, or conical loose collar or thimble, in which the end or ends of the pipes are inserted, the said socket or loose collar being provided with a hole through which the lead or other filling composition is introduced into the space between the socket or loose collar and the end or ends of the pipes inserted therein. The composition is composed of pitch and sand.

1063. T. BENNETT, Birmingham, "Manufacture of hoop or narrow strip iron."—Dated 13th April, 1865.

This invention refers, entirely, to hoop and strip iron about and below one inch in width, and will be understood from the following description:—The general size of rolls used in the manufacture of hoop iron, the power of the engine, workman-ship, and other manufacturing incidental expenses, are all comprehended for broad hoops, and to use such power and appliances for the manufacture of narrow strips necessarily causes a waste, and increases the cost of production, in proportion to the narrowness of the strips produced. To avoid this waste and useless expense, the patentee proposes reducing the iron necessary for his purpose to the desired thickness by the ordinary process of rolling, without particular regard to the width of the strip so produced, which, in a general way, he proposes to be one or three inches wide, more or less, as convenient; and strips thus prepared and rolled to the proper thickness he proposes reducing into narrow widths, using for this purpose, by preference, rotary shears, slitters, or cutters.

1065. J. McDOWALL, Johnstone, Renfrewshire, "Apparatus for shaping corks."—Dated 15th April, 1865.

This invention cannot be described without reference to the drawings.

1072. T. NEWBIRGING and A. HINDLE, Bacup, Lancashire, "Wet gas meters."—Dated 17th April, 1865.

This invention consists in making the box or case enclosing the index or registering mechanism tight against the atmosphere, or so as to prevent the air enclosed in it from escaping, which will thus resist the gas pressure, and will prevent the water in the meter from rising up the tube which encloses the shaft giving motion to the registering mechanism.

1073. J. J. MATTHEWSON, Clement-place, Rotterdam, and H. L. R. SCHLEZ, Victoria Villas, Maple-road, Penze, "Rotary aerial windings."—Dated 17th April, 1865.

This invention relates to swings which rotate in a vertical direction upon an axis mounted horizontally in vertical supports or standards, and consists, first, of an improved mechanical arrangement for imparting rotary motion thereto. Upon the ground, and concealed within an ornamental Swiss cottage, the inventors arrange a system of wheelwork worked by a winch handle, and in connection therewith they arrange a pulley, over which, and also over another pulley fixed on the axis of the swing, they pass an endless band, by which they transmit a rotary motion from below to the swings above. A further improvement in rotary aerial swings consists in adapting over each of the several cars of the swing a small balloon, having an air-tight cover fixed over a light framework, and they either inflate the said balloons, or not. The use of these balloons is to allow the wind to act thereon, and assist in turning the swing upon its axis, and, if inflated, to reduce the weight of the swing when in use, and make it move with less exertion.—Not proceeded with.

1076. J. DOUGAN, Coed Talon, near Mold, North Wales, "Apparatus for distilling hydrocarbons from coals, schists, and other minerals."—Dated 17th April, 1865.

For the purposes of this invention a long retort is employed, which is by preference made of iron, and clothed externally with fire-clay or fire tiles, but

other materials may be used in the construction and setting of the retort. The two ends of the retort are closed. The coals, or other minerals capable of yielding hydrocarbons, are fed in at the upper part, and near one end of the retort, by means of a revolving cylinder, into which the coals are received at one part of its revolution, and they are discharged therefrom into the retort at another part of the revolution of the cylinder; hence the products distilled off from the coals or minerals are prevented passing away out of the retort where the feed takes place. The spent matters are delivered from the retort at the other end by means of a similar rotating cylinder. The coals or other minerals fed into the retort at one end are progressively moved towards the other end of the retort by means of a screw extending from the end of the retort where the feed takes place to nearly the other end where the discharge of the spent matter is effected. The shaft or axis of the screw is hollow, in order to allow of the heat and products of combustion passing through the same in their way to a chimney or chimneys after heating the retort. At intervals along the upper parts of the retort are outlet pipes to convey the distilled products to condensers. At intervals along the lower parts of the retorts furnaces or fire-places are constructed transversely to the axis of the retort, and the heat and products of combustion from the fires pass around the retort, and thence away to the chimney or chimneys, heating the interior of the retort by being caused to pass through the hollow shaft or axis of the screw. A slow rotary motion is given to the shaft of the screw by means of a screw or worm working into a screw or worm wheel fixed on the shaft or axis of the screw; or such motion may be otherwise given to the shaft of the screw. Rotary motion is connected to the feeding and discharging cylinders by means of suitable gearing from the screw shaft or otherwise.

1077. A. W. HALE, New York, U.S., "Machines for cutting or mincing meat, suet, &c."—Dated 17th April, 1865.

This machine consists of two spirally grooved or fluted rollers, such grooves or flutes decreasing in depth from the front to the rear or discharge end of the machine; the rollers are placed side by side, and revolve in opposite directions and towards each other, one roller being operated by a crank, and imparting motion to the other. Both rollers are enclosed in a case, with spiral ribs or grooves on the interior. The cutting is accomplished by the shearing of the edges of the spiral flanges of the rollers upon a knife placed intermediate between the rollers, and at such a height that the flanges as the rollers revolve are continually in contact with the knife. The grooves or flutes in the rollers decreasing in depth from front to the rear, the pieces sheared off the substance fed into the machine are continually, by the action of such tapering or diminishing grooves, carried against the knife, and reduced in size until they are cut fine enough to pass through the shallowest end of such grooves. The substance or material to be cut is carried from end to end through the machine partly by the action of the revolving rollers drawing the materials in between them, and partly by the action of the spiral ribs and grooves of the enclosing case. For cutting ordinary fibrous or solid meat the construction above described would be all that is essential. When, however, a soft adhesive substance like suet is to be cut, a different or somewhat varied construction of the rollers is necessary, as all machines heretofore constructed and used, when applied to the cutting of such substances as suet, have become so clogged that very soon they cease to feed, and, consequently, to discharge. This difficulty and tendency the patentee obviates by making the flanges on the roller of a greater diameter and thickness at the feed, or front end of the machine, than at the discharge or rear end, at the same time making them to overlap each other more at the feed than at the discharge end. As the rollers revolve the flanges, overlapping each other to a great extent at the feed, compress and press toward the material collected in the grooves, so that at every revolution of the rollers a considerable space is left in the grooves and the feed funnel for the reception of fresh materials. The rollers thus act not only to draw in the materials to be cut, but also, by the considerable overlap of their flanges at and near the feed end, they continually press forward the substance being cut, thereby making room for the constant reception of fresh material.

1080. J. C. A. HENDERSON, Compton-street, Clerkenwell, London, "Manufacture of ladies' skirts."—Dated 18th April, 1865.

The object of this invention is so to construct ladies' skirts that the metallic hoops may be contracted or expanded in diameter at the pleasure of the wearer. To this end, instead of forming the metallic bands or strips into simple hoops, the inventor gives them an extra turn, so that they form a hoop within a hoop, which hoops are nearly concentric when the skirt is contracted. The hoops are to be connected together, as heretofore, by tapes, or otherwise, and the skirt may be either wholly or partially covered. One of the hoops at the front of the skirt is embraced by a guide, which is carried either with a support pendant from the waistband, or otherwise; and in connection with this guide tension strings may be threaded and carried upwards and attached to some fixed point on the dress of the wearer of the skirt, or otherwise. These tension strings are secured to the inner hoop of the band that passes through the fixed guide in such manner that, when drawn to tension, they will contract this inner hoop, and proportionally expand the outer hoop. As all the hoops of the series forming the skirt are connected together, this movement will be communicated to all, and thus the skirt may be expanded at the option of the wearer.—Not proceeded with.

1081. J. J. JENKINS, Swansea, Glamorganshire, "Manufacture of tin and tin plates."—Dated 18th April, 1865.

In carrying out this invention the patentee applies in the trough or vessel containing the grease and tin or terne metal a pair of vertical rollers, set in adjustable bearings, and in a frame or block which is inserted in a slot formed by vertical projecting guides fixed in the interior of the trough; above these rollers, and extending to the end of the trough, a pair of horizontal rollers is arranged in such manner as to take bearings on the top of the vertical frame or block in sliding journals, in order that the rollers may be tightened up when necessary by a screw passing through the sides of the trough and the bearings. The other extremities of these rollers are held by a pair of journals supported by a projection of the upper portion of the trough, so as to leave the interior end of the trough flush with the cylindrical portions of the rollers, and a similar tightening screw is applied here. The shaft of one of these rollers extends beyond and outside the trough, so as to receive a crank or pulley for the driving motion. On each shaft, just within the trough, a pinion is keyed, and these pinions gearing together, the motion of one shaft actuates the other in a reverse direction. The opposite extremity of the driving roller is provided with (beyond the bearing) a mitre wheel, which gears into a corresponding wheel keyed horizontally on the top of one of the vertical rollers, and these being provided with pinions below their lower bearings, it will follow that they also will rotate reversely. The other portion of the trough is provided with a grate, the level of which corresponds with the lowest part of the rollers, and the plate to be treated is to be let down thereon and inserted laterally between the nip of the vertical rollers, which then immediately draw it underneath the horizontal rollers and over a lifting grate, the attachments to which are brought upwards and between the sides of the trough and the rollers; then, by means of a crank handle, the grate is slightly elevated, and the plate is in turn inserted into the nip or bite of the horizontal rollers, and is thus lifted out of the trough. Tightening screws are to be applied to the vertical rollers in the same manner as those before described. It is obvious that by the removal of the four screws the whole or any part of the apparatus contained in the trough or vessel may be removed, there being no other fastenings employed.

1082. J. TODD, Greenwich, "Machine for straightening, bending, curving, and welding beams, bars, and plates of iron or other metals."—Dated 18th April, 1865.

The patentee constructs these machines with vertical shafts and changing rolls, the latter having grooves, channels, or hollows in their peripheries, formed as the shape or transverse section of the iron or metal to be operated upon may require. The rolls are keyed on to vertical shafts, two of which, carrying a roll each, revolve in vertical fixed bearings, and are turned by wheels or screws driven by steam or other power, and one of which shafts, carrying a third roll, revolves in vertical sliding bearings, so that the said last-mentioned shaft and roll are adjustable to a greater or less distance from the first-mentioned shafts and rolls by screw-gearing and hand-wheel. The top and bottom bearings are housed in metal frames, which, by preference, are connected by pillars of wrought iron. The upper bearing frame forms a table upon which the beams, bars, rails, and the like rest as they are passed between the adjusting rolls on one side and the fixed rollers on the other towards and backwards, by which motions the required circle, curve, or bend is formed, or the straightening operation is effected.

1085. J. GARDNER, R. LEE, and G. H. WAIN, Liverpool, and S. and C. HARGROVE, and S. HARGROVE, jun., Birmingham, "Manufacture of malleable iron sleeves and bushes for pulley blocks."—Dated 19th April, 1865.

In performing this invention the patentees cast from patterns of the required shape, in malleable cast iron, a sheave or bush, provision being made in each case for the section of a series of rollers, which rollers are placed in the body or centre of the sheave or bush, and revolve upon the sheave pin, and are kept apart in the following manner:—They make use of two metallic rings, with cone or other centres cast on to correspond with concave or hollow rollers, and protected by grooved plates, in which they revolve.

1089. J. MERRITT, Westminster Palace Hotel, London, "Inkstands."—A communication.—Dated 19th April, 1865.

This invention consists in combining with an ink reservoir, otherwise of ordinary construction, and provided with the usual dipping cup, a diaphragm valve, flexible, so as to be capable of assuming a convex or concave form, for withdrawing the ink from or forcing it into the dipping cup. And the invention further consists in forming the diaphragm valve for operation, as above referred to, of a concave or convex vulcanised india-rubber disc, in combination with a central knob, the whole being secured in a suitable metallic or other frame.—Not proceeded with.

1091. F. W. GILBERT, Sheffield, "Pulleys used by brewers and others for lifting and lowering weights into and out of carts, wagons, or trucks."—Dated 19th April, 1865.

This invention consists in adapting rollers thereto furnished each with a rack and pawl at one or both ends thereof, the said racks and pawls being so arranged as to allow the aforesaid rollers to rotate only in one direction if

necessary. For example, suppose it be required to raise a flat-bottomed packing-case into a wagon or other like vehicle, when pushed up the pulley the rollers will revolve in the same direction, i.e., towards the tail end of the wagon, and the ratchets and pawls will prevent the said rollers from moving in opposite directions, by which the tendency of the weights to slide or move back will be prevented, or very considerably lessened. The rollers aforesaid are intended to be placed loosely upon the tie rods employed to keep the timber sides of the pulley securely together, and at any required distance apart, and the pawls are fixed to the inner sides of the aforesaid pieces of timber.—Not proceeded with.

1093. M. VOGL, Sambrook-court, Basinghall-street, London, "Machinery for cutting and dressing stones and other hard substances."—A communication.—Dated 19th April, 1865.

This invention cannot be described without reference to the drawings.

1099. M. HOUSSEPIAN, Manchester, "Pumps."—A communication.—Dated 20th April, 1865.

The invention is designed for the purpose of obtaining the suction required in pumps without friction, by means of the rise and fall of an inverted bell or cylinder in an annular cylindrical space containing mercury. The novel arrangement and construction of apparatus constituting the pump consists of an annular space formed by two hollow vertically fixed cylinders surrounding each other, in which a column of mercury is contained, and into which is lowered and placed the open end of an inverted bell or hollow cylinder, which is caused to rise and fall by being attached to the working connecting rod of the pump; the inner fixed cylinder is closed at the top by a valve, as also is the inverted bell or hollow cylinder, the action of which, when being raised, causes the mercury on its outer surface in the annular space to be depressed by the atmosphere, and to rise in the annular space formed between the inner fixed cylinder and the inverted cylinder, thereby (through the medium of the air and water-tight joint so formed) producing a vacuum in the interior of the inverted and inner fixed cylinder, which, being in connection with the suction pipe of the well, fills with liquid, so that when the inverted bell or cylinder descends or falls the valve immediately closes on the top of the inner fixed cylinder, and the water is ejected through the valve in the cover of the inverted bell or cylinder into the outer fixed cylinder, from which it is finally discharged through an outlet in the same in one continuous stream.

1100. T. HAMPTON and J. ABBOTT, Sheffield, "Casting and working so-called Bessemer steel ingots."—Dated 20th April, 1865.

The patentees claim the casting of Bessemer steel ingots in rectangular parallel-sided moulds, divided lengthwise at diagonally opposite corners, by which they are enabled to remove the ingot easily from the mould, and to divide and cut the same up into lengths directly after the metal has sufficiently set, and while it is hot, so as to obviate the necessity for re-heating the ingot for the purpose of dividing the same.

1101. W. CLARK, Chancery-lane, London, "Taps or stopcocks."—A communication.—Dated 20th April, 1865.

This invention cannot be described without reference to the drawings.—Not proceeded with.

1106. W. ROBINSON, Watling-street, London, "Jacks used when roasting and baking."—Dated 20th April, 1865.

For the purposes of this invention a crank, or its equivalent, is applied to the last axis or wheel of an ordinary train used in the construction of such jacks. To this crank or instrument a connecting rod is attached, which, at its other end, carries a screw nut, which, with the connecting rod, is guided by suitable guides in the to-and-fro motion communicated to the connecting rod. The screw nut is thus moved to and fro along a screw shaft or axis, by which such shaft or axis receives an alternating rotary motion. To one end of the screw shaft or axis the ordinary suspending yarms are attached, and to the other end of the screw shaft or axis the ordinary suspending apparatus for the meat or other article is attached.

1108. J. Y. BETTS, Coventry, "Baking of bread, biscuits, and other farinaceous articles."—Dated 20th April, 1865.

The patentee secures several advantages by the introduction and use of steam in a peculiar way in the oven, which should be a close one, and may be heated in any well known or approved manner.

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The patentee secures several advantages by the introduction and use of steam in a peculiar way in the oven, which should be a close one, and may be heated in any well-known or approved manner.

1111. D. S. BUCHANAN, Liverpool, "Protecting letters, numerals, and ornamental designs on glass."—Dated 21st April, 1865.

According to this invention letters, numerals, and ornamental designs of gold or other metallic leaf, or of paint secured to or formed on sheets of glass in the usual way, and through which they are to be seen, are coated over with copal or other varnish, or other adhesive substance. They are then covered over with, or protected by, letters of tin foil, or other thin sheet metal cut to the desired form, and when the varnish or other adhesive substance has "set," the edges are cleaned off.

1119. G. WILLOCK, Birmingham, "Oiling cans."—Dated 21st April, 1865.

This invention has for its object the combination of an oil feeding can with a light to enable engineers and others to oil machinery in the dark. With this view the inventor places a small oil or other burner in the front part of the can, and immediately behind the burner he places a small reflector; the nozzle or duct through which the oil is poured is in front of the light, and consequently, the light is always thrown forward on to the part of the machinery to be oiled. The reservoir of oil is placed behind the light, and is furnished with a suitable handle and spring stop, and the supply pipe to the nozzle passes from the reservoir under the light to the front of the apparatus; a small chimney over the light provides for the escape of the smoke.—Not proceeded with.

1121. G. G. W. and J. BETJEMAN, Pentonville, London, "Cases or receptacles for matches, stamps, cards, &c."—Dated 21st April, 1865.

This invention consists in constructing cases or receptacles for matches, stamps, cards, and other articles of two cylindrical, oval, or other conveniently shaped cases, one of which is made to slide within the other. The outer case is closed at one end, and the inner case at both ends; a recess is formed in that end of the inner case which comes against the closed end of the outer case, to receive a spiral or other spring. A portion of the side of the inner case is removed in order that matches, stamps, cards, or other articles may be placed therein and taken out as required. One of the cases carries a pin or stud which slides in a slot in the other case, and acts as a guide. To close the case, the inner case is pushed into the outer case to the further end thereof, when a spring catch takes into a hole in the inner case and holds it; to open the case a button or stud is pressed down to release the catch when the spiral or other spring will force out the inner case and expose the article therein. The slot before mentioned does not extend to the end of the case so that the inner case is prevented coming out altogether.—Not proceeded with.

1122. R. CANHAM, Clerkenwell, London, "Machinery for moulding and making cores for moulding or casting metals."—Dated 21st April, 1865.

This invention cannot be described without reference to the drawings.

1130. A. GRAINGER, *Hall-place, Kennington*, and C. M. GIRDLER, *Walworth-road, London*, "Manufacture and application of devices and representations to tombstones, &c."—Dated 22nd April, 1865.

This invention consists in the preparation of portraits or likenesses of any person, or thing, or device of any kind, in an earthenware material, suitably glazed and burnt in, as is well understood in the manufacture of pottery, and the adaptation and application of such manufactures to tombstones, or for other purposes where they may be exposed to the action of the weather, or otherwise subject to deteriorating influences.

1132. G. HASKELTINE, *Southampton-buildings, Chancery-lane, London*, "Impediments for removing corks from the interior of bottles, and other vessels."—A communication.—Dated 22nd April, 1865.

In carrying out this invention a spring loop or holder, consisting of a strip or ribbon of steel, or other suitable metal, is made of such a form and size as to pass easily down the neck into the body of the bottle or other vessel, and is capable of expanding therein and forming a loop sufficiently large to pass freely over the cork which is to be removed. At the end or bottom of this loop is fixed a button or disc of metal, or other suitable substance. This button is formed with a channel or groove across its back, and through this groove the ribbon or strip of metal forming the spring loop or holder is inserted and secured by rivetting or otherwise, and the strip of metal forming the said loop or holder is fastened to a shank or rod having on its extremity a handle made of any suitable form and material. When it is desired to remove a cork from the interior of an empty bottle or other vessel, the sides of the spring loop are pressed together; it is then inserted into the body of the bottle, and the bottle is turned with the neck downwards; the cork will then fall within the loop or holder. The latter is then withdrawn by means of the handle on the end of the shank, and while being withdrawn the button or disc is caused to press against and force the cork out of the bottle.—Not proceeded with.

1139. H. C. BUTCHER, *Wellington-street, Strand, London*, "Cigar cutter."—Dated 24th April, 1865.

In performing this invention the inventor cuts a piece of steel plate or other metal about three inches long by about three-eighths of an inch wide, and the thickness of a fourpenny piece or thereabouts. He hollows out each end of this plate to a semicircle, leaving points on each side of the semicircle. He grinds the edges of the said semicircles sharp in opposite directions and both in bevel. To prevent the ends when placed in proper position from swerving from such position, which would render the cutter comparatively useless, he either makes four slits in the steel behind the semicircles, or he makes a pair of loops inside and behind the semicircle which is to be uppermost; or he makes a lug on each side of the semicircle which is to be uppermost; or he effects this object by other contrivance. He finally bends the plate into form, which is that of an ordinary keyhole, so that one end overlaps the other, the two semicircles then forming a circle. The cutter will then have a sharp edge bevelling downward, and another bevelling upward. The cutter, now fully formed, is to be held between the end of the thumb and side of the fore finger of either hand, the end of a cigar is introduced into the circle, and, on pressure, the edges will meet and pass each other, when the cigar end will drop.—Not proceeded with.

1140. W. E. GEDGE, *Wellington-street, Strand, London*, "Apparatus for administering nourishment to the sick or infirm."—A communication.—Dated 24th April, 1865.

This invention cannot be described without reference to the drawings.—Not proceeded with.

1141. W. E. GEDGE, *Wellington-street, Strand, London*, "An improved pessary."—A communication.—Dated 24th April, 1865.

This invention cannot be described without reference to the drawings.

1143. J. J. PARKES, *London-street, Paddington*, "Apparatus for making communication from one part of a building to another."—Dated 24th April, 1865.

In communicating or signalling from one part of a building to another the patentee employs wires and cranks somewhat in the ordinary manner, and makes the audible and visible signals by bells or gongs and numbers represented on tablets, but instead of pulling the number up by the wire, as in ordinary, he detaches the tablet and allows it to drop, and so exposes the number as desired. He effects this detaching and dropping of the tablet by peculiar appliances, and he further effects communication between the gong or bell with the wires by a peculiar contrivance hereafter described. The numbered tablets are arranged in rows or series, by preference in vertical rows in suitable slides and frames, in which the numbers are exposed through openings when the tablets are dropped. A pull apparatus is applied to each vertical row to raise the tablets after being dropped; this pull is arranged to lift one or the whole number of tablets at a time, so that, supposing several of them happen to be dropped at the same time, they can be again readily set by the attendant after the signals have been attended to.

1135. W. WILLIAMSON, *High Holborn, London*, "Constructing portable hot rooms or chambers for drying clothes and other articles."—Dated 24th April, 1865.

For this purpose the inventor constructs apparatus consisting of a chamber, in the lower part of which are placed horizontal heating flues or pipes, and in the upper portion are placed frames in which are bars for the articles to be laid on to dry. These frames are carried on wheels which run on suitable rails placed on the lower part of the drying chamber, so that they, with the articles to be dried, may be readily moved into and out of the chamber. In order to heat the chamber he employs a stove of any suitable kind to which the heating flues or pipes are connected. The sides, ends, and top are constructed in the following way:—He employs a series of cast iron frames of any suitable size, similar to the sash frames of a window, and the spaces between the bars are fitted with panels composed of a sheet of felt held firmly between two thin sheets of metal. A panel thus constructed is fitted in any suitable manner into each of the spaces between the bars composing the frame of the drying chamber, and by this means the radiation of heat will be prevented. The bottom of the stove and the bottom of the drying chamber are on the same level, so that they can be on a floor without lowering any portion of the floor for the stove.—Not proceeded with.

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

(From our own Correspondent.)

ON 'CHANGE IN BIRMINGHAM AND WOLVERHAMPTON: Continued Demand for Pigs at Good Prices—GOOD DEMAND FOR BARS: Prices Rising—SHEETS LESS IN DEMAND—PRICES OF STAFFORDSHIRE AND OF SOUTH WALES BARS—LARGE CONTRACTS FOR INDIA—THE RAILWAY COMPANIES AND THE TRADERS: Two Competing Lines—REJOICINGS ON THE MARRIAGE OF THE EARL OF DUDLEY—COAL TRADE: Brisk Demand—HARDWARES: Effects of the War in Child: Excellent General Demand: Localities Specified—ART AND HANDICRAFT: Judicious Advice: How Certain Firms have Risen.

The ironmasters of South Staffordshire did not muster in very large numbers on 'Change in Wolverhampton on Wednesday, in consequence, no doubt, of the tempestuous weather, which had been playing rather roughly with the roofs and stacks at certain of the ironworks and collieries in the district. Fortunately no personal injury was done, notwithstanding that in one instance the walls of a new foundry were brought down, and in others masters had their office chimneys tumbling about their ears. There were still offers in the market from the consumers of pigs who desired to increase the quantities that they had previously bought, but the agents to whom the offers were made desired rather to keep them in abeyance than to accept them at current rates. The tone of the market was cheerful in both departments, the inquiries for finished iron being sufficient to keep most of the works in as steady operation as the production of the puddling furnaces will allow; but complaints were rife that the rates at which many orders had been accepted were much lower than they ought to be.

On 'Change in Birmingham yesterday (Thursday), the reports brought in from the different ironworks in South Staffordshire and East Worcestershire were such as to produce a feeling of satisfaction in the soundness of trade at the finished ironworks, the foundries, and the blast furnaces. Certain proprietors of the last-named class announce that if they had the iron they could sell over again as much pig iron as they have already agreed to supply to their customers in the ensuing three months; and buyers of pig-iron are complaining that the makers are asking more money for their commodity than can be justified by the legitimate wants of the forges and mills. Consumers of pigs who withheld their orders at the Preliminary and Quarterly Meetings are loudest in their complaints, for there can be no doubt that the delay has led to their having to pay more money for their raw material than they could have got it at at that time; and they have not yet bought all they will require before the next great purchases are made. Sales of pigs of many of the descriptions on offer were made yesterday in small quantities. Buyers of finished iron were also on 'Change; but certain of them found it difficult to place their orders out at as low a figure as they desired; makers who were turning out bars at £7 10s. and £7 5s., while the list price

is £8 10s., being too well supplied with orders to make them want any more at the same prices. The makers of first-class iron will not accept at less than £8 5s.; agents of Welsh houses cannot accept other than excellent specifications at from £7 2s. 6d. to £7 5s. The sheet trade is slightly interfered with by the countermanding of galvanised iron orders intended for the Chilean ports, to which places large quantities are sent yearly. Yesterday (Thursday) the East India Railway Company accepted tenders for the ironwork of nearly 1,500 carriages and wagons, and they are still in the market for about 14,000 tons of permanent way iron, as the advertising columns of THE ENGINEER show. Orders and money from the United States continue encouraging, and no complaints are heard from the firms who do most business with the States of any hesitation on the part of their customers there to meet accounts as they become due; and those to whom Southern houses are indebted have full confidence in the probity of their debtors.

The committee of the ironmasters who are conducting the negotiations with the railway carriers continue to receive complaints from different classes of traders in relation alike to the want of accommodation and also the high charges made for the delivery of goods from this district by rail and water. The conclusion is forced upon men who are conversant with the facts that an additional route from this district to London is inevitable. Both the projects which have been before mentioned as competing with the London and North-Western and Great-Western Railway, will go into committee. They are denominated "The South Staffordshire and London Railway," and "The Midland Railway (South Staffordshire Extensions)." The first proposes to make a line from Wednesbury to Coventry, and to get running powers to Wolverhampton over the Wolverhampton and Walsall Railway, which has yet to be made; and the second will connect South Staffordshire, including Cannock Chase, with Water Orton on the Midland line.

The demand for coal keeps large, both on account of the ironworks and also for domestic purposes, but without any marked increase in prices.

The marriage of the Earl of Dudley to Miss Moncrieffe, which took place on Tuesday, was celebrated by unusual rejoicings throughout East Worcestershire. Capt. Barrows, of the Tipton firm of ironmasters of that name, presided at a public dinner at Hagley, and highly lauded the noble earl as a landlord and an employer. At Dudley there was a banquet, and fifteen hundred poor people were supplied with 4 lb. of beef, and the same quantity of bread. The happy bride wore valuable bracelets at the marriage, which were purchased by the Dudley people.

That portion of the foreign demand for hardwares that does not apply to a portion of South America continues satisfactory. But almost every manufacturer in the West Midlands who does business with the country named has during the past week received countermands of orders that had been given out to them for shipment for the Chilean coast. The Birmingham and Wolverhampton factors are cancelling nearly all their orders; and we know of one case in which a factor of the first-named town has required a manufacturer to fetch back goods which have already been delivered. The home demand, however, remains very healthy, so that a tolerable amount of activity prevails in most branches of the hardware trades. Relative to specific industries we have to report that in Birmingham the edge tool makers and the hollow-ware manufacturers are busy; that the wire-drawers are well off for orders, and that the tin-plate workers are fully engaged. The fancy trades are in a better state now than has been the case for some time back, and the jewellers report that their branch is steadily employed. The strike amongst the gun makers still continues. The men have announced their intention to form a co-operative society, and are taking the preliminary steps for carrying out their intention. In Wolverhampton the japanners and the tin-plate workers are working full time, and in larger numbers than they were last year. From the cause before mentioned, not so much is being done by the galvanisers, and by a certain class of lock and bolt makers, but there is only little cause for complaint in the miscellaneous branches. The best lock makers, who a few weeks ago were slack, are now busy, and the safe makers are experiencing a good demand. At Bilston the respective industries are steady; but at Willenhall the lock trade is not so brisk as when we last wrote, the remark applying more particularly to the pad branch. The curry comb makers, however, continue busy on American orders. At Wednesbury and Darlaston activity reigns. At West Bromwich the ironfounders are receiving specifications of some value; the roll turners there are well employed, whilst the chain and anchor makers of that town, and at Stourbridge, Dudley, and Tipton, are working on large contracts. The operative nail makers of Sedgley, Netherton, and the Lye Waste have issued a circular, asking for an advance of 10 per cent. on their wages, in consequence, they say, of the high price of provisions. They remind the masters that trade is in a prosperous state, and intimate that an answer must be given before the 25th. The masters have not, up to the time we write, given their reply.

Anyone at a distance who knows Willenhall, in this district which abounds in men at whom Cupid is notorious for laughing, and whence also hogsheads upon hogsheads of currycombs are now being sent out to the United States, and many tons a week of malleable iron castings to all parts of the world, but where the majority of the workmen are somewhat illiterate will not be a little surprised to learn that in this very unattractive place to everyone but natives, there now stands one of the handsomest literary institutes of which South Staffordshire can boast; and that, moreover, there is, amongst the classes that are conducted in that institute, one in which drawing is taught, by a competent master, and in connection with the Government Department at Kensington, to about thirty students, notwithstanding that the class has been formed only a few weeks. The class owes its existence to a suggestion made at the opening of the institute, a few months ago, by Mr. Rupert A. Kettle, the judge of the County Court of the city of Worcester, who is a Birmingham man, but has long resided in Wolverhampton, and is familiar with the trade wants of the district. On the application of the committee of the institute Mr. Kettle has just inaugurated the winter session of lectures by a lecturer on "Art and Handicraft." The address contained suggestions of much worth to the fashioners of British hardware. He showed them that the first thing to be attended to in the making of a perfect design was to secure the maximum of utility. They must form locks as perfect as they could make them, and as good in workmanship as honest labour could produce, and then they might make them as beautiful as they could without detracting from their utility. He did not see why they should not make locks to be admired when attached to their doors as much for their appearance and beauty of design as for their good workmanship and utility. The locks that were let into doors not only made them weak, but were "dead locks buried." It was not for him to say what particular form of execution should be adopted, or in what particular time this improvement might be brought about, but one thing was certain, that the staple trade of Willenhall was capable of very great improvement. Some of the most finished works of art he ever saw in connection with the useful manufactures of this kingdom were articles much more simple and far less capable of improvement than locks. He instanced door-knockers, fire-dogs, and hand bells. Some of the most beautiful specimens of art metal work were to be found collected in the private museum of Capt. Chenery, of Badger Hall, near Wolverhampton. He warned them against the foppery which had influenced so injuriously many schools of art throughout the kingdom. He was alluding to the art student leaving the domain of practical art for that of ideal art, with the notion that an artist obtained more respect than an artisan. Happily the artisan was fast becoming an artist, and the artist a manufacturer and the employer of labour to an extent which was bringing repute upon his country, at the same time that it brought profit to himself. In proof of this he said that Messrs. Hardman, whose exquisite works in stained glass, in precious and other metals, had now obtained a world-wide repute, were at one time button-makers in Great Charles-street, Birmingham; that in the same street the father of Messrs. Osler, whose out glass was now unrivalled

was a glass toymaker; and that Mr. Skidmore, of Coventry, was a watchmaker. To mention at the present day that an article was made by any one of the above-named firms was at once to show that it was something to which art had been so applied as to make the article of great worth. At the close of the lecture the rector of Willenhall thought that the workman had first to be educated in art, and then the workman would have to educate the public; but Mr. Kettle maintained that the public were already educated, and all that was wanted was that the shopkeeper should be able to supply the article that the public needed.

WALES AND THE ADJOINING COUNTIES.

(From our own Correspondent.)

THE IRON TRADE: Makers well Supplied with Orders: Railway Iron; Steel Rails versus Iron Rails: Improved Inquiry for Plates: The Pig Iron Market—THE TIN PLATE TRADE: Brisk Export Demand—COAL TRADE: Steam in Request: The Continental and Inland Trade: Further Improvement in House Coal—THE CONTRACT FOR THE ALEXANDRA (NEWPORT) DOCKS—MIDLAND AND GREAT WESTERN JUNCTION RAILWAY BILL: Proposed Compromise between the Two Companies: Cost of the Respective Schemes—LAUNCH OF HER MAJESTY'S SHIP VESTAL AT PEMBROKE DOCK—NEW DOCKS FOR CARDIFF—THE MANUFACTURE OF WELSH IRON: Quality and Quantity—NEW ENGINE SHEDS AT ABERDARE—THE SWANSEA WEST PIER EXTENSION—THE MERTHYR DRAINAGE WORKS—EXTENSION OF THE MARSHFIELD WORKS, LLANELLY.

The ironmasters of the district continue well off for orders, and there is a large amount of vitality evinced in the trade. Contracts for railway iron are the principal ones in hand, and the capabilities of several of the leading establishments are being tested to the utmost, both as to quantity and quality. Steel rails are becoming an important branch of the local trade, and both the Ebbw Vale and Dowlais companies have their steel rail mills already in operation, and steps are being taken with the view of meeting the increased demand which is expected to arise. For durability, steel, it is said, is as 12 to 1 as compared with iron, while the price is only twice that of the ordinary iron rail, and hence there is a manifest advantage in favour of steel. For a long time the inquiry for plates has not been so good as for the other descriptions of iron; but within the past fortnight considerable orders for plates have been secured by the local makers. The pig iron market remains without change, and there is hardly a maker in Wales open to an engagement for delivery from here to Christmas.

The tin-plate trade is in a moderately satisfactory state, and, taking into consideration the time of the year, the falling off in the requirements of home buyers is by no means so large as in previous years. The export demand continues brisk.

Steam coal is in improved request, and the favourable winds have enabled a large number of foreign-bound ships to leave. A full average trade is being done with the Continent, and a large quantity is sent inland. There is a further improvement to note in house coal, and many of the collieries are working double turns.

The contract of Messrs. Tredwell and Co. for the construction of the Alexandra Docks has been accepted and signed by the directors. It is said that the terms of the contract are most favourable for the shareholders, and that a commencement of the works will be made almost immediately. The weather of late has been exceedingly mild, and suitable for operations. The intelligence created quite a buoyant feeling among the tradespeople of the port, who anticipate a golden harvest from this local enterprise.

The Midland and Great Western Junction Bill was alluded to in last week's ENGINEER. It is better known in the district as the "Compromise" Severn Bridge scheme; and although promoted by an independent company, it is generally believed that both the Great Western and Midland companies will give it their support. The proposed scheme would give almost as direct a route to the metropolitan market to both companies as they will possess by their schemes, which were passed towards the close of the last Parliament. The inhabitants of the city of Gloucester view the undertaking with much favour, and the Gloucester Chamber of Commerce warmly espouse it, because it will not interfere with the navigation of sea-going vessels up the river Severn to Sharpness. Almost the entire mineral interests of South Wales will also accord to it their support, inasmuch as a saving will be effected by the project of six miles in the road toll to London, Mr. Fowler having, in the Act for the high level bridge, obtained a clause which gave power to charge a twelve miles' toll for crossing it, and as the distance via Sydney is only six miles more, there will be a practical saving of six miles. The new project will not cost one-third of Mr. Fowler's high level bridge scheme; the cost of the latter is put down at £2,000,000, whereas the "compromise" scheme will only cost £650,000. The Sydney project has also this special advantage—that it starts at a point within two miles of the outcrop of the Forest of Dean coal basin, and only sixteen miles of new line will have to be made; while by Mr. Fowler's upwards of forty miles would have to be constructed.

Her Majesty's ship Vestal was successfully launched on Thursday at Pembroke Dock, under the direction of Mr. Fincham, the builder, and Mr. Warren, the foreman. The Vestal is intended as a despatch vessel. She has a projecting prow beneath the water line, and she would doubtless, as a ram, prove a formidable antagonist. Her length between perpendiculars is 187ft.; length of keel for tonnage, 158ft.; extreme breadth, 36ft.; breadth for tonnage, 35ft.; depth in hold, 19ft.; burthen in tons, 1,081; armament four heavy guns; horse-power, 300.

The trustees of the Marquis of Bute have again given the requisite notice of their intention to apply to Parliament for an extension of dock accommodation at Cardiff; and although it is not the grand scheme of the last or the preceding session, it will, nevertheless, be an immense addition to the existing accommodation. The object of the scheme is to convert the present tidal harbour approach into a basin, which will extend 200 yards to the south of the present Bute East Dock, and about 400 yards to the north, and will therefore be something more than 600 yards long. It is also proposed to construct, to the eastward of this, on the "Cardiff Flats," another dock nearly 1,000 yards long. The present project is looked upon much more favourably than its predecessors.

There is a general opinion extant that the Welsh ironmasters cannot compete with Staffordshire for quality, and even in contracts entered into by South Wales works Staffordshire iron is often specified. This has been, of course, a great detriment to the interests of the district, and the subject was mooted at the annual dinner of the South Wales Institute of Engineers, when it was stated by Mr. Monelaus, the president, and other gentlemen, that as good iron had been obtained from Blaenavon, Dowlais, and other works, as it was possible to get from Staffordshire. In Wales the rule had been quantity not quality. It was the easiest thing possible to make good iron, and all they wanted was to be paid for it. There was no lack of good material, nor was there any want of skill in Wales to turn out the best iron in the country. Those remarks were endorsed by Mr. A. Bassett, who is about to construct some lattice bridges, and announced that he was going to specify that they should be made of Welsh iron. It is hoped that other engineers will follow the example of Mr. Bassett, and thus aid in raising the name of South Wales as an iron-manufacturing district, for the quality of its products.

The Taff Vale Railway Company have completed two large and commodious sheds at Aberdare for the accommodation of a dozen engines, so that the different colliery sidings will be closed at a much earlier hour, and greater facilities afforded for the transit of coal.

The works at the Swansea West Pier Extension are progressing most satisfactorily, and Mr. Abernethy, the engineer-in-chief, reports that the piling is completed to a length of 800ft., and the stone work for a length of 580ft., and at a cost below the parliamentary estimate. He considers it necessary that preparations be at once made for the formation of the new channel by the removal of the gravel bank adjoining and beyond the pier extension.

The drainage works at Merthyr have been commenced, and the ceremony of opening the old sewer at a spot called Pedwarback was performed by Mr. G. T. Clark, the chairman of the Merthyr Board of Health.

In consequence of the increased operations at the Marshfield Iron-works, Llanelli, the proprietors have been obliged to erect another extensive forge with new steam hammers, which will afford employment to a large number of additional hands.

SCOTLAND—ITS TRADE AND OPERATIONS.

(From our own Correspondent.)

THE GLASGOW IRON MARKET—ADVANCE OF JOINERS WAGES—NEW LIFEBOAT FOR ANSTRUTHER—NEW IRON PIER FOR KIRKWALL—TRIAL TRIP OF THE KINSALE—EXTENSION OF THE KILMARNOCK WATERWORKS—THE ABDUL AZIZ: TURKISH WAR FRIGATE—CITY OF GLASGOW IMPROVEMENTS AND NEW STREETS—LAUNCH OF THE RIVER EDEN—LAUNCH OF THE BERMUDA—CONTRACTS FOR NEW STEAMERS—RECLAIMING OF LAND IN THE FORTH—LAUNCH OF THE SANDA—SHIPMENTS OF COAL FROM GREENOCK—LAUNCH OF THE A. LOFREZ—TRAFFIC ON SCOTCH RAILWAYS.

The Glasgow pig iron market has changed very little since our last, there was a slight rise in price during the week, but now the tendency is rather in favour of buyers; No. 1 G.M.B., 57s. 9d.; No. 3, 57s.; Middlesbrough Warrants, 51s. to 51s. 3d.

The Admiral Fitzroy, a fine new life-boat, with transporting carriage, &c., has just arrived in Anstruther from the National Life-boat Institution. The boat is 32ft. long by 7ft. broad, and rows ten oars, double banked.

The Kirkwall Harbour trustees have decided upon the erection of an iron pier, which will be accessible to vessels at all states of the tide. Messrs. Laidlaw and Co., engineers and ironfounders, Glasgow, have secured the contract for the sum of £10,490, they binding themselves to have the pier completed by the beginning of October next.

The screw steamer Kinsale, lately built by Messrs. Henderson, Coulburn, and Co., shipbuilders, Renfrew, for the Clyde Shipping Company, Glasgow, to run between Cork, Waterford, and Glasgow, made her trial trip last week, when she ran the distance between the Cloch and Cumrae Lights at the rate of fourteen miles and a half per hour.

The Kilmarnock Waterworks Company intend applying to Parliament this session for a new bill authorising extensions and alterations in the present works, at an estimated cost of £5,000.

Last week the Turkish ran, Abdul Aziz, bade farewell to Scotch waters. A description of this vessel, and her performance, has been given in one or two previous numbers of the ENGINEER.

In the ENGINEER of Oct. 20 we gave an account of extensive and important works about to be commenced in Glasgow by the City of Glasgow Union Railway Company works—which will connect both sides of the harbour and the various railways coming into Glasgow, that will facilitate the transit of passengers and goods, and cut away and alter many parts of the older portions of the city.

The River Eden, an iron ship of 550 tons, B.M., was launched on Saturday last, by Messrs. Hedderwick and Co., Govan, for Messrs. Hargrove, Ferguson, and Co., Liverpool, for the South American trade. She was built under the superintendence of Captain Gambles.

There is at present (says the Alloa Advertiser) a well-grounded rumour afloat that Government intends to take advantage of the refuse thrown out by the Kinneil Ironworks Company, and raise an embankment with it on the south side of the Forth, from near Bo'ness westward to a point opposite Kincardine.

On Saturday last a screw steamer, named the Sanda, for the Clyde Shipping Company, to run between Glasgow, Cork, and Waterford, was launched from the building-yard of Messrs. Henderson, Coulburn, and Company, Renfrew. Her engines and

boiler are made by the builders, and will be put on board at their works by their new steam crane.

The following are the shipments of coal for the past week at Greenock:—1,203 tons, by Glenlee, for Calcutta; 700 tons, by Julia, for St. John, N.B.; 690 tons, by Archibald McMillan, for Bahia; 90 tons, by Elizabeth, for Stranraer; 75 tons, by Union, for Belfast; and 37 tons, by Colina Jemima, for Tyree.

The A. Lofrez, a very fine iron screw steamer, was successfully launched, on Tuesday, by Messrs. William Denny and Brothers, Dumbarton, for Messrs. A. Lofrez and Co., for the Cadiz and Havannah mail service. She is 2,000 tons register, and her engines will be 400-horse power nominal.

A Parliamentary return just issued supplies the following facts relating to the traffic on Scotch railways for the year ending 31st December, 1864:—The total length of line opened was 2,105 miles, being an increase of 91½ over 1863. The total number of passengers (inclusive of holders of season and periodical tickets) was 20,205,455, made up as follows—First-class, 2,691,301; second-class, 1,698,949; and third-class, 15,515,205. The total net increase of passengers for the year, as compared with 1863, was 638,056, which was nearly all of third-class passengers, the increase in that class being 615,565.

NOTES FROM THE NORTHERN AND EASTERN COUNTIES.

(From our own Correspondent.)

LIVERPOOL: Local Railway Projects: Mersey Docks and Harbour Board: Birkenhead: Another Limited Company—STATE OF TRADE: Leeds. South Yorkshire—NORTH-EASTERN DISTRICT: The Cleveland Iron Trade: Railway Matters: Launch of a Screw Steamer: Proposed New Bridge over the Tyne—RAILWAY ENTERPRISE: Hull, West Yorkshire and Lancashire: Great Eastern, Manchester, Sheffield, and Lincolnshire, and Great Northern.

We commence with Liverpool. A scheme has been brought forward for crossing the Mersey by a bridge at the south end of the town, not far from the New Ferry Pier. Mr. Brunlees, C.E., is the author of the project. It is objected that accumulations of sand and silt, at Plackington Bank, not far from the proposed bridge, have, for some time past, seriously interfered with the anchorage and general navigation of the southern portion of the Mersey, and that the piers and abutments of the proposed bridge would add to the inconveniences already existing in connection with the free navigation of the river.

Following the example of many firms, Messrs. John and Thomas Johnson have converted their alkali, soap, rosin, turpentine, and salt works, at Runcorn, Weston, Widnes and Winsford, into a joint-stock company, their business having assumed dimensions almost beyond the limits of private enterprise.

Turning to the north-eastern district, we may remark that the iron trade of the Cleveland country is still increasing. The hills of Cleveland and North Yorkshire are not only made to supply the whole of the extensive works in that district with ironstone, but also include within their range not less than one hundred blast furnaces, with an average weekly consumption of over 70,000 tons of ironstone, to reduce which 17,500 tons of limestone and 42,000 tons of coke are required.

erected to span the river at the points named the speculation would pay a handsome dividend, and would also supply a long wanted communication between the western ends of the sister boroughs. Elswick is now thickly populated; houses and building space are wanted; and there is plenty of open ground on the southern banks of the Tyne, whereon about Kedheugh a vast population could soon be accommodated.

In referring above to the Cleveland iron trade, we should have noticed that the position of the blast furnaces is as follows:—In blast, 84; out of blast, 19; building, 13.

An important new railway project has been launched in Yorkshire. The proposed line is entitled the Hull, West Yorkshire, and Lancashire Railway, and consists of a main line and four branches.

The new Lincoln and Honington Railway, which will shorten the route from Lincoln to London very considerably when completed, is now being carried out by Messrs. Kirk and Parry, the contractors, at various points.

Great complaints have been made of late as to the "chaotic" state of the trains on the Manchester, Sheffield, and Lincolnshire Railway, in the immediate neighbourhood of Manchester. Measures have been adopted for removing these grievances, as between Gorton and Ardwick. The line between Ardwick Junction and London Road belongs to the London and North-Western Company, and, therefore, the Manchester, Sheffield, and Lincolnshire Company, having no control, can have no responsibility for delays occurring there.

PRICES CURRENT OF TIMBER.

Table with columns for 1864 and 1865 prices for various timber types like Teak, Quebec, St. John, etc. Includes sub-columns for per load and per reduced C.

LIVERPOOL PATENT LAW REFORM ASSOCIATION.—The first meeting of the Liverpool Patent Law Reform Association was held on Tuesday evening, at the Free Public Library, William Brown-street, for the purpose of hearing an address on patent law from Thomas Webster, Esq., Q.C. The attendance was rather thin.