THE IRON AND STEEL INSTITUTE.

The autumnal meeting of the Iron and Steel Institute began on Tuesday morning at 9.30 a.m., in the Hall of the Institution of Civil Engineers, Great George-street, Westminster, Mr. Josiah T. Smith, of Barrow, president, in the chair. The president of the Local Reception Committee, Sir H. Bessemer, and the vice-president, Dr. Siemens, received the Institute. After some formal business had been transacted, and compliments had been exchanged between Mr. Abernethy, president of the Institution of Civil Engineers, and Mr. Smith, a paper by Captain D. R. Jones, of Pittsburg, was read

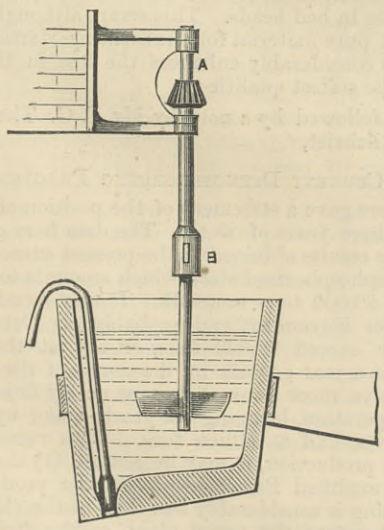
On the Manufacture of Steel and Steel Rails in the United States.

This paper was statistical. It gave particulars of the operations carried on at the Edgar-Thomson Steel Works during the first six months of 1881. In that period the two converters at work produced 76,758 tons of ingots, as against 55,428 tons for the corresponding half of 1880, being an increase of a fraction over 38 per cent. In the converting department, with two converters, each of 7 tons capacity, the best twenty-four hours' work has been 623 tons. The largest production in a single week has been 3433 tons; and the best month's work has been 14,033 tons of 2240 lb. The rail mill, in the same time, has produced 65,087 tons of rails, as against 43,272 tons in the corresponding half of 1880, being an increase of a fraction over 50 per cent. The rail mill is three-high, with rolls 23in. pitch, the train being driven by a 46in. by 48in. engine having balanced slide valves. The average weekly yield of rails during 1881 was therefore 2503 tons, as compared with an average of 1664 tons per week in 1880. In some weeks, however, these averages have been greatly exceeded. During the week ending July 30th, they rolled 11,278 rails of 56 lb. per yard, aggregating 2808 tons. In the following week 11,285 rails of 60 lb. per yard, aggregating 3004 tons; and for the week ending August 13th, they turned out 12,219 rails of 57½ lb. per yard, making a total of 3101 tons. At the Edgar-Thomson Works the output of the rail mill is limited by the quantity of steel furnished by the converting department, and for that reason they anticipate still better results when the three new converters now being erected have been got to work, as thereby the rail mill will be fully supplied.

A paper by Mr. W. D. Allen, of Sheffield, was read

On the Use of a Mechanical Agitator in the Bessemer Process.

The author began by explaining that adequate mixture did not take place in the converter ladle or ingots. Every one who had witnessed the admixture of the highly carburetted spiegeleisen or ferro-manganese with wholly decarburised iron charged with oxygen, would have noticed the violent ebullition and disengagement of gas which accompanies the act of pouring these two dissimilar metals together, and will therefore readily understand how this disengagement of gas continues, though less violently, so long as any portion of these metals remains in an imperfect state of admixture. This is a condition which but too frequently continues during the pouring and solidification of the metal, thus giving rise to the violent ebullition seen in the moulds whilst casting, and consequently to unsound and bubbly ingots; in addition to which, veins or streaks of metal of different qualities and composition run in all directions through the mass, which, though invisible to the eye, become palpably manifest in the physical properties of the steel when employed for delicate purposes. A piece of imperfect glass furnishes a very good illustration of the steel in this condition; for, upon examining the transparent mass, veins, and striæ, arising from difference of density and composition, will be seen traversing in all



directions. The necessity of keeping the metal in a fluid state for some time in order that its different constituents may become thoroughly incorporated, tends further to show the difficulty and uncertainty of ensuring a thorough admixture of the materials in the Bessemer process by the means ordinarily practised, particularly when we consider the large body of steel under operation, and the short space of time at command; and it clearly points to the agitator as our friend by whose assistance we can in a few seconds ensure the perfect amalgamation and admixture so indispensably necessary. This important fact appears to have forced itself on the attention of Sir Henry Bessemer as long ago as 1863, at which period he obtained a patent for various means of ensuring a uniform or standard alloy, to be added to a precisely ascertained quantity of converted metal. In order to ensure a perfect admixture and blending together of these materials, he devised a mechanical agitator revolving in the fluid metal beneath a covering of molten slag, and therefore out of contact with the atmosphere. The constantly increasing demand for Bessemer steel of high and uniform quality caused the writer's attention to be directed to the attainment of that object; but notwithstanding the greatest care in the operation and in the selection of materials, the results obtained in practice seemed, from some occult and undefined cause, to vary occasionally to an extent that was perplexing and unsatisfactory. Continued attention to the subject, however, convinced him that the want of coveted uniformity arose almost entirely from the want of perfect admixture of the carbon and manganese with the converted metal; for notwithstanding the natural tendency there seems to be for the molten spiegeleisen to diffuse itself, and also of the mixing action that does undoubtedly take place in running the charge first into the ladle and then into the moulds, analysis showed a want of perfect admixture, and the steel, though equal enough for rails, was not found so when used for many other purposes. To overcome these difficulties it was decided to make trial of the mechanical agitator above referred to, and one was constructed at the works of the Henry Bessemer Company, and put into operation about three years ago. The mixing or stirring operation takes place in the ladle immediately before casting, and the apparatus is shown in the engraving, and consists of a vertical spindle A, having at its bottom end a socket B. This spindle is supported in bearings, and is fixed at some convenient part of the pit where the ladle of steel can be brought by the ladle crane immediately beneath it. The spindle is driven by bevel wheels and a horizontal shaft, the shaft being sufficiently long to remove any driving appliance from the heat or any splashing that may take place. The agitator itself is simply an iron rod about 1½in. diameter, one end slightly tapered to fit easily into the socket B, where it is held by a cotter, while the other end has a long slot punched in it, through which is inserted the blade or plate of iron, about 2ft. long, 4in. to 5in. wide, and about ⅜in. thick. The blade, after insertion into the slot, is twisted at each end, so as to give it somewhat the form of a screw propeller blade. The rod and blade are coated with loam or ganister, which has to be thoroughly dried, blacked, and carefully prepared. The taper end of the rod is then inserted into the socket B, and cottered into its place ready for use. The ladle of steel immediately it is turned out of the vessel, is brought beneath the agitator, and raised by the hydraulic crane, immersing the blade and a portion of the rod in the steel. Rotary motion of about 100 turns per minute is then given to it, the ladle being lowered and raised again during the operation to ensure all portions of the steel being operated upon. When the stirring is deemed sufficient, the ladle is lowered clear of the agitator, and the casting is proceeded with in the usual way. Nothing could work more satisfactorily than this apparatus has done since the time of its erection. Occluded gases are expelled in large quantities by the operation, ensuring an almost perfect degree of soundness and freedom from bubbles both in ingots and castings; the metal flowing into the moulds with a quietness supposed to be the exclusive characteristic of dead-melted crucible steel. Every ingot formed from the largest charges is now found by analysis to be perfectly uniform in temper and quality, while the thoroughly homogeneous quality of every part of the same ingot is evinced by its behaviour under the hammer or in the rolls, as well as in hardening and tempering. The great extremes and varieties of temper now required also tend to render complete admixture more necessary than heretofore. It sometimes happens that to obtain the required degree of hardness, as much as 14 cwt. to 15 cwt. of spiegeleisen must be added to the charge of five tons, and on other occasions not more than 84 lb. of ferro-manganese is employed for the same quantity of converted metal in order to retain the necessary degree of softness. In such extreme cases the necessity for thorough admixture must be obvious; for in the case of the large addition of spiegeleisen before referred to, a very little want of complete admixture would result in hard places being formed in the steel; and in case of the small addition of ferro-manganese, unless it was well diffused throughout the mass, some portion of the charge would not be workable. The writer observed how small a quantity of ferro-manganese is capable of rendering good Bessemer steel beautifully ductile and malleable when it is thoroughly diffused. He has made charges of five tons with the addition of only 28 lb. of ferro-manganese—75 per cent. manganese—and when well stirred every ingot has hammered and worked beautifully. The stirring operation is found to be very simple in practice, causing no delay or inconvenience of any kind, and costing almost *nil*. This mixing process has been in constant use more than three years at the works of the Henry Bessemer Company, and every charge of steel made during that time has been stirred. In fact, in those works, the stirring operation is by all regarded as one of the most essential in connection with the process, and no charge of steel would now be looked upon as reliable, and in a fit condition for casting, unless it had received this finishing touch.

A paper by Mr. G. J. Snelus, of Workington, was then read,

On the Distribution of Elements in Steel Ingots.

The author began by saying that at the last meeting of the Institute, in the discussion upon Mr. Parry's paper, Mr. Stubbs announced the remarkable fact that he had discovered that "cast steel ingots" could not be strictly said to be homogeneous, and that "a redistribution of the elements took place during solidification, the carbon, sulphur, and phosphorus going to that part of the ingot which remained fluid the longest, so that the centre of the ingot became the most impure." To this, it will be remembered, Mr. Snelus took exception. He now said that, in justice to Mr. Stubbs, he thought it his duty to repeat the experiment upon a very large ingot, as the analyses which he had made previously were with ordinary small rail ingots. In order to give the elements every chance of redistributing themselves, he had a large ingot 7ft. long and 19in. + 19in. cast in moulding sand; and so as to have sufficient impurities to look for, he added a portion of cinder pig to an ordinary charge, by which the phosphorus and sulphur were somewhat increased. After the addition of spiegeleisen the vessel was turned up and the blast sent through for nearly a minute, to insure thorough admixture. The ingot was then allowed to cool very gradually, and although cast on the Saturday, it was not properly cold on Monday morning. Following the plan of Mr Stubbs, he had two slices of the ingot cut off, one 21in. from the top, and another 4in. from the bottom; while the bottom section was almost absolutely sound, the top was a spongy mass, full of cavities, some of these being gas cavities, but many of them being doubtless due to contraction. Drillings from each were then analysed separately, with the following results:—

	Top.	Bottom.
Iron	98·304	99·038
Combined carbon	·760	·350
Silicon	trace	trace
Sulphur	·187	·044
Phosphorus	·191	·044
Manganese	·558	·514
	100·000	99·990

These analyses, it would be seen, confirmed in a remarkable manner those previously obtained by Mr. Stubbs. In order that there might be no possibility of error, however, he had other samples examined with results which further confirmed Mr. Stubbs's accuracy. As there was then no doubt about this redistribution in very large ingots solidifying slowly, it became important to see how far the action affected ordinary plate and rail ingots. These were cast in ordinary cast iron ingot moulds, and therefore set much more rapidly than the large one. The plate steel ingot—made by the Siemens process—was, however, of large size, being 3ft. 6in. long, 21in. + 17in. at top, and 21¾in. + 17¾in. at bottom. It was a good solid ingot. Slices, as before, were cut from the ingot 10in. from the top and 4in. from the bottom, and the analyses gave results in these cases so nearly alike that few chemists would assert positively that there was any real practical difference in the steel at the two points; and yet it was remarkable that, looking at the results as a whole, the probability of redistribution having taken place to an extremely small extent was possible. It is clear, however, that the action cannot be neglected in making large castings and forgings; and it accounts, in all probability, for the mysterious fractures which have occurred to many such articles. To elucidate this matter still further, he had samples cut from the centre of the large ingot 22in. from the top and 5in. from the bottom, forged into bars, and tested mechanically. These gave—

Top .. 46·6 tons per square inch. 8·8 per cent. of elongation.
Bottom 33·8 „ „ „ 21·8 „ „

The difference in hardness was most marked, rendering it difficult to cut the top slice near the centre, while the bottom cut quite easily.

The discussions on these three papers were taken together. They were commenced by Mr. Adamson, who appears to entertain some very original ideas concerning the condition in which sulphur and phosphorus are present in the converter. He stated that he was not surprised to find that Mr. Stubbs should be right, because the difference in the specific gravities of the materials concerned was so great. Thus manganese had a uniform specific gravity of 8, while that of steel was 7·85; accordingly those two would mix well. But the specific gravity of phosphorus was but 1·77, and it would float to the top. As for stirring the molten metal, that could not modify the conditions in the ingot; want of homogeneity there was due to contraction. In a cylindrical steel ingot, 24in. in diameter and 6ft. long, a hard skin would be first formed by the cold mould, and contraction could not take place properly. The contraction in such an ingot would be equivalent to the removal of a bar 4in. in diameter of the whole length of the ingot, and the vacancy which would otherwise exist had to be filled up from the ends if at all; square ingots were better off, as the sides would become concave under the pull of contraction. In some cases feeding the moulds with iron bars, as was done in foundries to get solid castings, had been tried, but with indifferent results.

Dr. Siemens said that it must be borne in mind that they had two distinct questions to deal with—First, mixing in the converter or ladle; and second, action in the ingot mould. The questions had attracted his own attention. He had not been bold enough, he confessed, to try a mechanical stirrer, but he had tried poling as practised by coppersmiths; that is stirring the metal in the ladle with long, dry, wooden poles, which did not alter the constituents of the metal, and gave very good results. Mr. Snelus had shown very clearly that liquation went on, and he thought it should be generally known that time played an important part in chemical processes. It was possible to have imperfect chemical mixture. Thus carbonic acid escaped freely all at once from soda water recently made, but if the soda water were kept for three months, it would be found that the carbonic acid gas left the water with much reluctance. If steel lay molten in the ladle for a quarter of an hour its quality would be greatly improved. In his opinion the duration of the period during which the steel lay in the ladle would account for the anomalous results often obtained as to diversity of structure.

Mr. I. L. Bell held that no doubt casualties might be attributed to imperfect distribution of the metalloids in steel. In a rail a very small excess of phosphorus in one place would render that place brittle, and lead up to a fracture. As to the results obtained by Mr. Snelus with a large ingot, he held that they ought not to be accepted until they had been confirmed by more experiments. More than twelve years ago he had himself called attention to possible redistribution, and he had a large white cast iron ingot cast and split with a steel wedge. Samples taken

from this clearly showed redistribution, but in a direction contrary to that found by Mr. Snelus. Sulphur, being 100 at the centre, was 130 towards the outside, while carbon rose from 100 at the middle to 114 outwards. He might say that fluidity was not necessary to obtain redistribution of elements. He took a small plate of wrought iron ½in. thick, and had it carefully ground on one side. He then took a similar plate of cast iron ; had it ground, and the two plates secured together with screws. A mass of cast iron was then cast round the two to protect them, and the whole placed in a hot-blast stove for a month. At the end of that time, on breaking up the mass and extracting the plate of wrought iron, it was found to be carbonised, while the cast iron plate was decarbonised to an appreciable extent. He concluded by demolishing Mr. Adamson's argument by pointing out that sulphur and phosphorus never existed free in steel, but always in the form of sulphides and phosphides, the specific gravities of which were nearly that of iron.

Professor Abel cited some experiments made with their steel washers which showed that at a red heat carbon passed from cast iron to soft steel. Although Mr. Adamson was wrong about specific gravities, it must not be forgotten that the sulphides and phosphides were more fusible than steel, and would tend to be eliminated as the ingot cooled. Thus, some twenty-five years ago they were casting shot in a hurry at Woolwich ; they used an iron rich in sulphur, and it was found that when the shot cooled the sulphide of iron was excluded in the form of wasty excrescences.

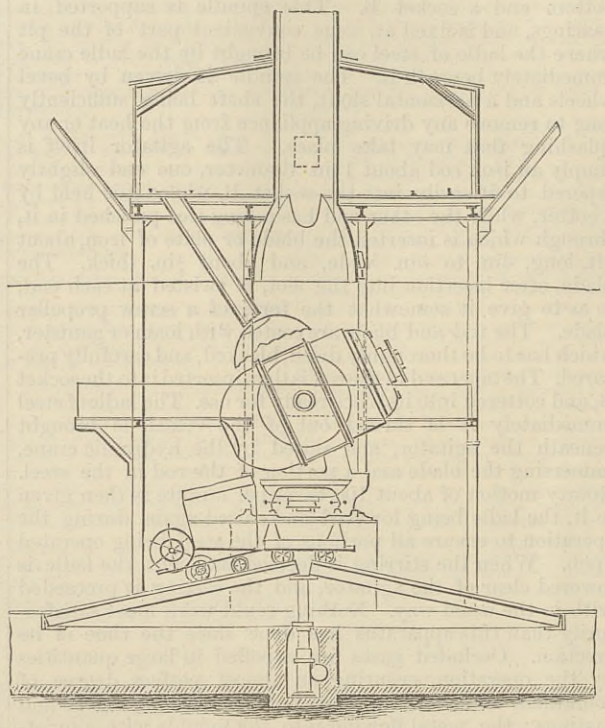
Mr. Riley said that as regarded Mr. Bell's experiment, it conveyed no trustworthy information, because it was notorious that an ingot of white iron could hardly be cast in which any equal distribution existed, and there was no doubt that phosphorus does liquate out in the form of small peas from pig iron. Mr. Bell had not tested for phosphorus at all. Specific gravities played a part in all these matters. Thus, tungsten with a specific gravity of 17·6 being alloyed with steel with a specific gravity of 7·5, a button weighing a pound would have a specific gravity at the top of 9·10, and the bottom of 11·7 No doubt great difference in chemical composition might exist in the same steel bar, and he cited instances to prove this, where drillings from holes bored close to each other in a standard bar gave widely different results on analysis.

Sir Henry Bessemer said that he had had considerable experience with the mechanical stirrer. Bessemer steel, as ordinarily made, would not do for cutlery, because of the variation in the texture of even small samples. Thus one side of a table knife would be hard while the other side was soft, and he might say that he had met with a hydraulic press cylinder which, after it had been partly bored, could be bored no further because of the presence of striæ so hard that the boring tool would not touch them. However, the metal made with the stirrer was totally different from the metal made without it. It was so good that it was sold as the best crucible steel, and no one could tell the difference. Sir Henry then explained how what is known now as crucible steel is made. He said that the old crucible steel was a splendid material, made of Swedish iron blister bars ; but modern crucible steel is made of old rail ends and scrap of all kinds pitched into the converter and run into the ladle, from which it is poured into a lot of crucibles, and from these again into the ingot mould, the steelmaker explaining that the steel is refined in the crucible, just as one might say that by letting wine stand in a glass on the dinner table it would be improved. Sir Henry's graphic sketch was received with shouts of laughter, and certainly was very hard on the men of Sheffield.

A vote of thanks having been passed to the authors, a paper by Herr Paul Kupelwieser, of Witkowitz, Austria, was read,

On the Basic Bessemer Process.

After some preliminary remarks, the author went on to say that the progress of the basic process during the past year seems rather to have been one of regular development than of any remarkable novelty. The vulnerable point of the process is undoubtedly the relatively small durability of the refractory linings. In spite of the numerous trials that have been made of other materials, with, in some cases, fair results, the works with which he is acquainted still use the materials originally proposed by Mr. Thomas, viz., either the basic bricks or the shrunk lime and tar mixture. He had been enabled, however, to use a raw material containing a comparatively small percentage of silica for the manufacture, thus materially improving the quality of the bricks; and he had also succeeded in burning a large number of bricks together by stacking them high in the kilns, so as to obtain a notable economy of fuel. Ground brick, mixed with 5 to 10 per cent. of tar, is also used in several places for linings as well as repairs. Basic tuyeres, though they have been manufactured and tried in many places, are not at present in current use. Magnesia obtained by precipitating the magnesia from its chloride by milk of lime, seems, from experiments made on a small scale, to be a promising material for making tuyeres. The two forms of converter bottom in general use are the pin bottom, in which the blast holes are formed by ramming round iron pins, and the tuyere bottom, in which the ordinary fire-clay tuyeres are used, the bottoms being made up either with basic bricks or rammed material. The changeable Holley bottom is used in nearly all the basic works. In the adaptation of existing Bessemer works to the new process, as well as in new plant, it is desirable to have the ingot pit somewhat removed from the vessels, so as to have around the vessels ample room for bringing in the lime additions and removing the quantity of slag which is peculiar to the process. The steel ladle is therefore usually transferred from the immediate neighbourhood of the converter by some mechanical arrangement, or a small locomotive, to a separate casting pit, where the casting, stripping, and loading of the ingot takes place. It is probable that the cost of conversion in the basic process will always be somewhat higher than in the acid process, and on this account the pig iron employed for the former should be at least so much cheaper than that employed for the latter as to pay for the cost of the lime additions and for the expense of handling both these and the greater bulk of slag produced, and also for the somewhat increased waste, and, for the present at least, a somewhat larger consumption of refractory material. On the other hand, the basic process, as regards the quality of its products, is not only completely equal to the acid process, but even, in the author's opinion, superior to the latter. Passing on to his personal experience at Witkowitz, the author stated that already from the early experiments with the basic process which took place two years ago at Witkowitz, he perceived that the chief value of the new process consisted, not, as elsewhere, in the production of a cheaper steel, but in being able with the existing materials to turn out a product which, on account of its purity, might compete with the renowned qualities produced by the Alpine works. In consequence of this conclusion, and of the fact that their existing Bessemer plant, built fifteen years ago, would not allow of a rapid working of the basic process, they concentrated their attention on the production of ingot iron, for plates, in the converter. So highly was the quality of soft basic steel thus produced appreciated by consumers, that even when in March of this year the first two vessels of the new plant, specially erected for the Thomas-Gilchrist process, got to work, it was



decided not to devote it to the manufacture of rails by the Thomas-Gilchrist process ; for, although they were able to manufacture rail steel of the requisite hardness and purity with perfect facility, the demand for the soft basic ingot iron had become so active that it caused them to devote the new plant solely to the manufacture of dephosphorised soft metal, and to leave the old plant to the manufacture of rail steel by the old Bessemer process. As, however, both plants are at present served by the same blowing and hydraulic engines, they can only be worked alternately. On the completion of the new plant by the erection of two further converters in place of the old small vessels, it is intended to make none but basic steel. With reference to the products manufactured from ingot metal produced by the basic process, the experience at Witkowitz has been as follows: (1) Boiler plates made from the basic material are at least equal to the best known brands in quality. (2) Plates to the number of many thousands have been delivered to a German tube-rolling mill for the purpose of the manufacture of welded locomotive tubes, and have been proved equal to those made from the best Swedish material. The author exhibited some specimens which show the excellence of the welding, manufactured in the tube-rolling mills of Messrs. Huldschinsky and Sons, of Gleiwitz, Prussian Silesia. The ease with which dephosphorised ingot iron can be welded is proved by the fact that the plate shearings are regularly piled and rolled into rods, forming an excellent rivet iron. The plate scrap when piled with mill bars and rolled into plates also yields iron (*Schweisseisen*) plates, which in tensile strength and elongation is superior to the best plates of this kind that are manufactured. The softest kinds of dephosphorised ingot iron approach to the absolute maximum of conductivity of pure iron, the almost total absence of the metalloids minimising the resistance offered by wires of this material to the electric current. The author gave a large number of figures to show the excellent quality of the material. The following table shows the chemical composition of ingot iron after the disappearance of the lines of the spectrum :—

	Per cent.
Silicon	trace
Manganese...	0·18
Phosphorus	0·82
Copper	0·20
Sulphur	0·09
Carbon	0·16

In order to produce a sufficiently hot steel they have a rule that the sum of the silicon and phosphorus in the pig should amount at least to 2½ per cent. With regard to the lining material, good results have been obtained with limestone as a raw material, as well as with dolomite. The lining material at Witkowitz is made with limestone with from 1 to 1½ per cent of silica. The bricks used for lining the converters and making the bottoms consist mainly of lime with a little magnesia, and about 2½ to 3 per cent. of silica. The bottoms made from these bricks last for thirty charges and over, if the tuyeres are changed after five to eight charges, and fresh basic material is added round the tuyeres. The complete renewal of the bottoms takes place on an average after they have undergone repairs four or five times. Six bottoms are sufficient for an uninterrupted run of 150 to 200 charges, or as many charges as can be ordinarily got out of two converters without changing the lining. It follows from this that for very large makes by the basic process four converters are necessary. It is found that the waste in the converting process is larger than in the acid process, varying from 15 to 17 per cent., the higher figure being obtained when a very soft, high quality is sought for. They have added to their old Bessemer plant two converters, which have been built with a special regard to the peculiarities of the Thomas-Gilchrist process. These two converters, which constitute only the first half of the proposed additions, have been in operation since the spring of this year. The vessels are egg-shaped in form, as shown in the section, and perfectly symmetrical, with the mouth at the apex when placed in a vertical position. Perpendicularly over the mouth is placed a movable chimney to carry off the products of combustion issuing from the converter. The plant is arranged so that the vessels can pour their contents on either side. It is known that, by the action of the refractory basic slag, the belly on which the metal rests in the inclined converter after the afterblow is continually getting narrowed by the accumulation of slag, while the upper side of the converter opposite the belly undergoes a considerable amount of wear. By the alternate use of the two bellys a greater durability of the lining is secured, while the throat remains perfectly clean. This arrangement has answered its purpose perfectly. In consequence of this peculiarity of construction a double-acting steam engine for turning the converters is used. The casting arrangement is likewise peculiar. Each converter has a long casting-pit on either side of it, in the direction of its axis. On the edge of these pits run rails, which connect the pits on opposite sides of the converters with each other. Instead of employing a centre crane, the ladle, which is, carried on a car, is brought into the position for receiving the steel by raising and lowering the track on which it runs. For this purpose an hydraulic piston is placed under the converter ; the piston carries a cross piece, on which rest the ends of the two tracks that converge from either casting pit, but are not connected together. Each of these tracks is carried on strong girders for a distance of six metres from each side of the converter. Now if the ends of the track which are under the converter be raised by means of the piston, the other ends being supported on pivots at a distance of six metres from the converter, the track assumes an inclined position. Thus, the car bearing the ladle is brought into position under the mouth of the converter by the movement upwards of the car track when the converter is to be emptied. And as the sloping track is lowered with the turning of the vessel, the ladle is not only lowered, but moves in a horizontal direction, so as to keep its position under the throat of the vessel till the emptying of the vessel is finished. The taking off and replacing of the changeable bottoms on the car standing over the hydraulic piston is also effected by the same arrangement, two of the wheels of the car resting at the same distance from the centre on each movable track. On this track running under the converters special cars are run for receiving the slag poured out of the converter before the addition of the spiegel, and the slag is carried on them direct to the blast furnace to be used over again. The steel ladle is run backwards and forwards, the slag is removed, the ingot is stripped, and finally the change of bottoms is effected on the same track. A small 10-horse power locomotive is employed to do all this work. The author mentioned a circumstance which renders the production of the very softest qualities somewhat difficult and comparatively expensive. It is the unquiet casting of the softest qualities of ingot metal. The lively evolution of gas from the softest qualities, while cooling in the mould, causes at present, even with the most careful pouring, considerable loss in bad heads. This scrap, although it forms an excellent pure material for the Siemens-Martin process, nevertheless considerably enhances the loss in the manufacture of the softest qualities.

This was followed by a note by Mr. S. G. Thomas and Mr. P. C. Gilchrist,

On Current Dephosphorising Practice.

The authors gave a statement of the position of the process after three years of work. The data here given are based on the results obtained in the present current manufacture of dephosphorised steel, which amounts to between 27,000 and 29,000 tons a month. It may be added that the make for November, and probably for October, will considerably exceed 30,000 tons, or say at the rate of 360,000 tons a year ; while in the course of the next few months twelve more converters, now nearly finished, will come into operation, bringing the yearly make up to considerably over half a million tons. With regard to the question of production, it may be noticed (1) that at present in the modified Bessemer process the production of steel per lining is considerably less than in the old process, and that therefore the vessel plant, or the facilities for changing the vessel, should be increased for a given make; (2) that the make per unit of blowing and hydraulic engine power, and, in consequence, per unit of boiler and crane capacity, is substantially the same for both processes, and that therefore no increase in engine, boiler, or crane power is required for the dephosphorising Bessemer process. As an illustration of the actual present productive capacity of old works modified for the new process, it may be mentioned that there are now at work in Germany two three-vessel basic pits, each regularly turning out 24 or more charges per twenty-four hours, which probably equals the full average of English practice with two-vessel hematite pits. With the Holley system of removable shells there would seem to be no reason for anticipating any difficulty in obtaining from a single two-vessel basic pit any amount of steel that could be handled, or say at least 50 charges per double shift. In America a still larger production is expected from the new basic works. The durability of

linings is intimately connected with the subject of productive capacity. In present practice the necessity for considerable repairs to the lining arises after from 35 to 90 blows. Thus it appears from the returns from various works that more or less extensive repairs are required on an average after 70, 60, 45, 40, and 60 charges respectively, or say an average of 56 charges. Practice varies much as to the mode of conducting these repairs. There are very important advantages in the system worked by Mr. Richards, of performing them with liquid lime-tar without cooling the vessel. This enables a badly worn lining to be made as good as new in less than fifteen hours, as a maximum, after the last blow. In some works, when a vessel is badly worn the whole lining is knocked out and replaced; in most, however, the more economical mode of merely renewing the worn portion is employed, and an absolutely new lining is only put in after many months' working. Not less important than the durability of linings is that of durability of bottoms. The average number of blows per bottom are reported by ten works as follows:—8½, 21, 13, 14, 18, 12, 14, 15, 12, or an average of over 14 blows. In nearly all cases only pin-bottoms are used, so no tuyeres are replaced. The average would be higher if only the results of the past few weeks were taken. In many cases lime bottoms have run for 24 heats, and even over. The average duration of silica bottoms in England would appear to be under 11 blows, the best average being 14, and the lowest 9, besides replacements of tuyeres. Perhaps, however, the best criterion of the relative durability of basic lining material is afforded by the consumption of refractory basic materials for linings and bottoms per ton of steel produced. Unfortunately, reliable figures on this head are not always obtainable. The following represents the total consumption of basic refractory material—in the only works in which trustworthy account seems to be kept—in kilogrammes per thousand kilos.—one ton—of steel:—About 40, 38, 70, or a mean of 48 kilos., or rather under 1 cwt. per ton of steel. The 70 kilos. being in a new place not yet in regular work, it may be assumed that 48 kilos. is more than the actual mean, which is probably under 45 kilos. The consumption of ganister and tuyeres in the hematite process is probably about 30 kilos. The consumption of coal in the burning and shrinking of the calcareous refractory lining and bottom material varies very greatly, being now considerably less than in early practice. Thus, for the production of a ton of prepared refractory basic material, the consumption of coal varies between 17 cwt. and 3½ tons at different works, being 2 tons, 3 tons, and 3½ tons, 17 cwt., 20 cwt., and 22 cwt. At three works, where the cupola mode of preparation is adopted, the consumption of coke is 21 cwt., 18 cwt., and 15 cwt. With good firing arrangements and regular work, there seems no difficulty in obtaining a ton of lining material with a consumption of considerably less than 24 cwt. of coal, or say 16 cwt. of coke. At the average cost of limestone and coal or coke in English steel-making districts, the maximum average cost of basic lining material would be considerably below 27s. a ton; in some it would be below 20s. The cost has been reduced already very much below the first figure in several existing works. Taking as an average 1 cwt. of basic material—including tar—per ton of steel made, the cost of material would be about 1s. 8d. per ton of steel produced. Should it prove practicable to commercially produce magnesia at a very low figure, this may prove a useful material. The consumption of lime for additions varies between 13½ and 17½ per cent. on the weight of the pig used—say, an average of rather over 15 per cent. on the steel, or 3 cwt. per ton. The result of recent trials makes it probable that a little over 2 cwt. may perhaps prove sufficient. The slag produced in conversion is in all new works allowed to run direct into a slag bogey, so that there is no handling of slag at all. The composition of the slag, *i.e.*, its contents of iron, manganese, lime, magnesia, and phosphorus, is such as to give it in the blast furnace rather more than the value of an equal weight of limestone. The loss of metal, including re-melting—when practised—varies considerably, being in all cases in excess of the loss obtained in the hematite process. The absolute loss reported from eleven works is 14, 13, 16½, 16, 16, 15, 15½, 11, 13½, 17, and 19 per cent. respectively, or an average of 15 per cent. There is, however, reason to believe that the 17 and 19 per cent. losses reported are abnormal, and probably incorrect. The average loss in conversion in English hematite practice is probably about 12 per cent. The duration of the blow, including the afterblow, varies from 13 to 25 minutes, averaging about eighteen minutes. The average pig used in various works varies in composition as follows:—White iron is generally preferred; at Eston, however, Mr. Richards blows white, grey, and mottled indifferently, all direct from the furnace. Only direct working is carried on at Eston and Creusot, and mixed direct and cupola working at two other works.

	1	2	3	4	5	6	7	8	9	10	11
Phosphorus	1·75	2·00	2·5	2·5	2·5	2·	2·2	3·00	2·	2·	1·0
Silicon ..	1·2	1·0	·5	·5	—	·70	·80	·50	·70	1·3	1·00
Manganese	·35	1·00	2·00	1·7	1·00	—	1·2	2·0	1·0	1·7	1·6
Sulphur	·10 to ·2										

All these varieties, which are the average of the charges used at the several works, work well, but considerably wider limits of composition are actually employed. As to the quality of the steel produced, the rapid extension of its employment for every purpose for which Bessemer steel has ever been used—excepting perhaps the manufacture of Bessemer tool steel—is the best evidence.

The discussion on the preceding papers was opened by Mr. Holley, who stated that in the United States they had not yet made steel by the basic process, but they had nearly completed new works for the purpose, and the patent had been purchased for America. Hitherto the demand for steel had been so great that the American ironmasters could not spare time to remodel their works. He could confirm all that had been said as to the excellent quality of the material. It had, he thought, been proved last year, that all chemical difficulties had been overcome, and only mechanical difficulties remained to be dealt with. Well, these had now been got over. The tar mixture had proved of great value for repairs. He had considerable experience for many months in Europe with the process, and he might say that as much as 600 tons a week were turned out with two converters, while the linings lasted for as much as sixty and seventy heats. They were doing better on the Continent than they did with the acid process five years ago. Commenting on the general question of the output from Bessemer plant, he explained at some length why they got such enormous yields as they did in America. He proved that an additional expenditure on a steel works of about 40 per cent. would quite double its output. As to labour, he had made some investigations, and found that in a works turning out 10,000 tons per annum one man made 507 tons. In a works making 8400 tons, one man made 420 tons; in a 9000-ton works one man made 555 tons. The reason why they did so well in the States was that great attention was paid to apparently small details. The men never had to wait a moment for anything, and all possible precautions were used to secure their comfort while working, viz., providing adequate ventilation, &c. In English works he found the important things done to perfection, while small things are left to take their chance. But in a steel works nothing was unimportant. Again, it was highly important that steel should be made in one place and all repairs made in another at a reasonable distance, so that the two things might not interfere with each other; finally, he would add that two pits only cost 50 per cent. more than one pit.

Mr. Snelus said that he had often pointed out that the great point to be attended to was to keep silica, in every shape and form, away from basic plant. If only a good magnesian tuyere could be got it would be a great gain. Samples on the table promised well. It ought to be known that the basic process could be made to give absolutely pure iron. Mr. Riley said that he had tested 5000 tons of steel made at Hayanges, which was wonderfully uniform. It had been said that hard steel could not be made by the basic process. This was not the fact, however. He had seen basic steel with 0·42 per cent. of carbon in it.

Mr. Bell said that they had tried basic rails on the North-Eastern Railway, testing twenty of them against fifty acid rails by the best makers, and he found that the composition of all was the same, phosphorus being ·053 per cent. They had only had two years' experience of them in wear, not enough to enable an accurate value to be attached to them, but they promised well. He had the courage—Mr. Riley said the rashness—to try rails with a great deal of phosphorus in them on the North-Eastern; none of these rails had broken. The phosphorus was kept in to give hardness. He held that there was no objection to using rails with more phosphorus than was usually held to be safe. The tests imposed on rail makers were far too high, and in the wrong direction. On the North-Eastern Railway they did their best to get 0·5 per cent. of carbon from the rail makers.

Mr. Riley said he did hold that Mr. Bell was rash, very rash, to use such rails as he spoke of. When carbon was low there was a covering margin of ductility left which would compensate for an excess of phosphorus in one place in a rail; but unless absolute uniformity of chemical composition could be secured, then 0·5 carbon left no margin and was too great. By itself it meant no harm, but when besides 0·5 carbon we had ·2 per cent. silicon, and sulphur and phosphorus to match, what would happen? besides it was by no means certain that hard steel rails lasted longer than soft rails. Silicon was always present in basic steel; in Germany it regularly reached 0·3 and 0·4 per cent., while phosphorus was 0·1.

As soon as Mr. Riley sat down Mr. Bell stood up and stated that out of 200 analyses, he had never found a trace of silicon, to which Mr. Riley replied he had made 500 analyses, in all of which he found silicon.

Mr. Gilchrist concluded the discussion by saying that it was found that admirable steel could be made by his process from common cinder pig by adding manganese to keep out the sulphur.

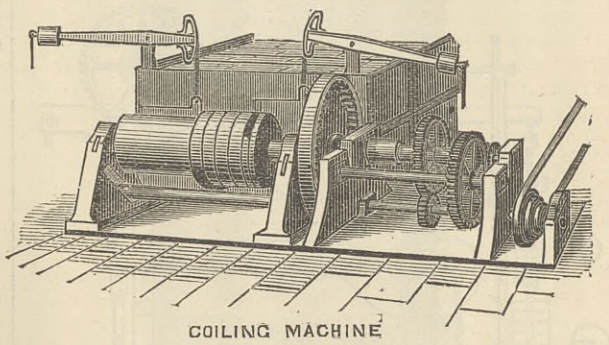
The meeting was numerously attended, but many influential members were absent at the quarterly meetings.

In the afternoon excursions were made to Messrs. Siemens' Telegraph Works, described in The Engineer for 30th September, and down the river to the works of Messrs. John Penn and Co., Messrs. Samuda, and the Albert and Victoria Docks. In the evening about 200 members dined by invitation with the Lord Mayor at the Mansion House.

On Wednesday morning proceedings were resumed at 9.30. The first paper read was

On the Metallurgy and Manufacture of Modern British Ordnance.

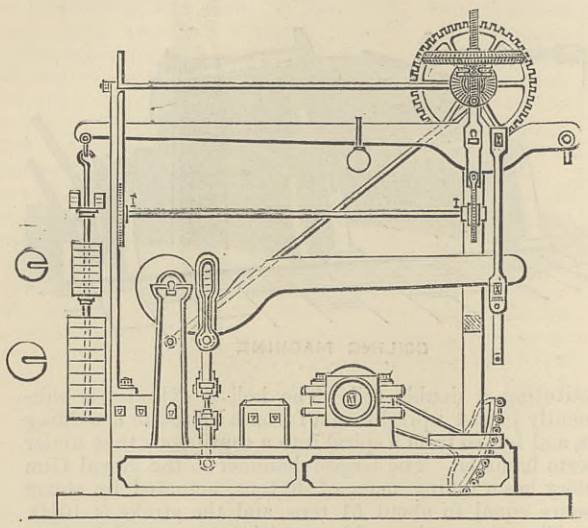
The author began by glancing at the history of his subject, and before entering into a description of gun-making, described briefly the nature of the strains to which a piece of ordnance is subject when fired. Five and twenty years ago powder was powder. It was called an explosive, and indeed the term was hardly misapplied. Now, it is simply a substance which burns with great rapidity, the products of combustion consisting of liquids and gases, the latter occupying roughly about 280 times the volume of the powder before ignition. The fine-grained powder used with the old smooth-bored guns burnt up so quickly that even round shot had barely time to move from their seat before combustion was complete, and it was found that with elongated projectiles, which moved less readily, the pressure set up by the gas was so high and so long sustained at its maximum that the old materials were unable to support it. With the large slow-burning powders now used, long heavy shell move quietly off under the impulse of a gradual evolution of gas, the pressure of which continues to increase till the projectile has moved a foot or more; then ensues a contest between the increasing volume of gas, tending to raise the pressure, and the growing space behind the advancing shot, tending to relieve it. As artillery science progresses, so does the duration of this contest extend farther along the bore of the gun towards the great desideratum, a low maximum pressure long sustained. After referring to the principle of shrinkage, Col. Maitland went on to describe in detail the process of making guns at Woolwich. The wrought iron coils used in the Royal Gun Factory are made chiefly from wrought scrap purchased from the contractor, Mr. Moss Isaacs. Railway scrap is preferred, and the more bolts in it the better. A proportion of puddled iron is also used, derived from the old cast iron guns of the service. Blooms of these materials are rolled into flat bars, piled with the scrap inside and puddled iron outside, and rolled into bars of such section as may be required. The heaviest bar rolled is a little over a ton in weight. Several of these bars are then welded end to end, till a bar in some cases 240ft. long is formed. This is then heated in a very long narrow furnace, pulled out at one end, and coiled round a mandril to form a hollow cylinder, as shown in the annexed cut. In some cases the bar is wound round a previously formed coil,



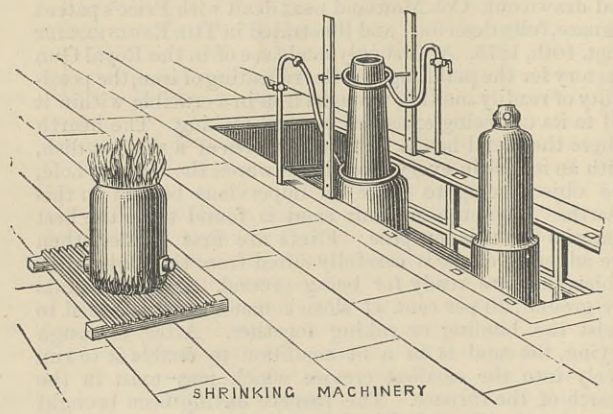
COILING MACHINE

constituting a double coil. The hollow cylinder is subsequently placed upright in a furnace raised to a welding heat, and forged from a spiral into a continuous tube under a steam hammer. The largest hammer in the Royal Gun Factory has a falling mass of 40 tons, actuated by steam pressure equal to about 51 tons, and the stroke is 10½ft. long. Thus the maximum blow which can be struck is about 960 foot-tons. It has been illustrated in our impression for Aug. 21st, 1874. Prior to 1864-65, £22 per ton was paid for bar iron for coils. From that date to 1867-68 a cheaper iron was obtained from the trade, at a cost varying between £8 10s. and £10 10s. per ton, the price of Marshall's and Mill's iron for inner barrels being £25. In 1867-68 the manufacture of iron was started at the Royal Gun Factory, and the prices for coil iron have ranged from £7 8s. to £10 14s. per ton, the present price being about £9; whilst the cost of A iron for inner barrels has varied from £11 7s. to £17 15s. The present rate is £12 5s. The steel used for guns is procured by contract. The principal portion is supplied by Messrs. Firth of the Norfolk Works, Sheffield, but some tubes for the smaller natures of ordnance have been obtained from Messrs. Vickers, and Messrs. Cammell, also of Sheffield, and from Sir J. Whitworth and Co., of Manchester. The material supplied by Messrs. Firth is entirely composed of crucible steel. It is of high excellence; the rejections are but few; and, up to the present time, their experience leads them to consider it as undoubtedly the most trustworthy steel in the market, particularly when large ingots are required. The steel supplied by Messrs. Vickers comes out particularly well under the tests, but they have not yet had sufficient experience of it to enable them to speak very positively of its uniformity. It is produced by the Siemens-Martin process. The fluid compressed steel which forms the Whitworth speciality is of high excellence, and as a rule the castings are very sound. The qualities of the material as shown by the tests are, however, scarcely so suitable to the peculiar necessities of gun manufacture as could be wished. No doubt its percentage of elongation would be improved if it were more worked and drawn out. Col. Maitland next dealt with Price's patent furnace, fully described and illustrated in The Engineer for Sept. 10th, 1875. At first only made use of in the Royal Gun Factory for the puddling and the reheating of iron, the possibility of readily melting wrought iron in a crucible within it led to its use being extended to steel making. The hearth where the metal has to lie is in the form of a shallow dish, with an incline in every direction towards the tapping hole, the object being to make an impervious bottom to this hearth. Fine pure silicious sand is found to be the best material for this purpose. Flints are first roasted, then the adhering chalk is carefully sifted from the flints, after which they are ready for being ground. After the flints are ground, 10 per cent. of clean common sand is added to assist the binding or caking together. After thorough drying, the sand is in a fit condition to enable it to run freely into the smallest crevice which may exist in the hearth of the furnace. The furnace having been brought to an intense heat, a thin layer of the prepared sand is spread evenly over the bottom, and subjected for more than an hour to the highest temperature attainable. The sand will now be set or caked. The furnace door is opened, and then another layer of sand is spread over. This is repeated several times, until a depth of from 2in. to 3in. is attained. It takes a whole day to make the bottom of a new furnace. The hearth being ready and the tapping hole made, the furnace is ready for being charged. For a 3-ton ingot the average charge would be 24 cwt. of selected pig, with 24 cwt. of scrap steel and 2 cwt. of iron ore. At the end of four hours this will be melted. Then more scrap steel, or wrought iron, as the case may be, is charged hot in portions of about 4 cwt. at a time. This takes fifteen to twenty minutes to melt, and gives the furnace time to regain its heat. These supplementary charges are repeated until about 20 cwt. of hot steel scrap or wrought iron has been added to the bath. Care is taken that the proportion of carbon in the melted metal does not get too low before the whole of the charge is put into the furnace. When the charge is all melted, a specimen is taken from the bath and tested for carbon; and more oxygen is supplied, if necessary, by means of

iron ore. At this stage about 28 lb. of ore may be added; and at intervals of fifteen minutes more ore is thrown in, should it be required, and the metal again tested. A specimen taken from the bath, beaten out with the hammer while hot and cooled in water, should hardly show any signs of being tempered. It should bend over double and behave like a piece of soft iron. Another testing piece, cooled outright without being first hammered, should, when submitted to the hammer, show a toughness and softness almost equal to that of copper. The metal is now ready for the ferro-manganese. From 1 to 1½ per cent. is used for making our soft steel. The ferro-manganese is broken in small pieces, placed in iron scoops, and made red-hot before being put into the furnace. From eight to ten minutes is allowed the manganese, and then the metal is tapped. Col. Maitland next described the system of testing steel adopted at Woolwich. The testing machine is shown in the accompanying engraving. The author gave a series of



tables of the results obtained in testing. The usual strength is 31 tons elastic limit. 50 tons breaking strain, elongation from 13 to 25 per cent. Ingots which pass all the tests are accepted, and are toughened in oil at an approved temperature previous to being put into the gun. The operation of toughening in oil was next described. It consists in heating the roughly-bored tube to the approved temperature in a vertical furnace, and then plunging it bodily into a bath of rape oil, in which it is allowed to cool. The process of toughening not only warps the steel a little, but sometimes causes the surface to crack. The barrel must therefore be slightly turned and bored to make it straight inside and outside, as well as to remove any flaws that may have been generated. This second boring is performed with a cylindrical boring-head, fitted with five long-edged cutters and five wood burnishers. By this the cracks are generally removed, but lest there should be any dangerous flaws the steel barrel is subjected to a water-test. To facilitate the performance of the operation of toughening, a large furnace and oil tank have been nearly completed in the Royal Gun Factory. At a distance of 7ft. from each other, two large circular pits have been dug, the bottom of each being laid with concrete to a height of 3ft. Into the larger of these there has been introduced an iron cylinder, which, when lined with fire-brick, will serve as a furnace for heating tubes to the required temperature. The smaller pit contains two iron cylinders, one within the other. The inner of these cylinders will serve in future as an oil tank. It is 32ft. 6in. deep, and 6ft. in diameter of circular section, and will therefore hold about 5726 gals. of oil. The height of the crane over the tank allows of the easy manipulation of the longest tubes which could be required.



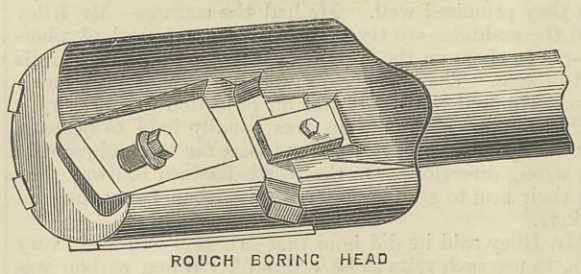
SHRINKING MACHINERY

Shrinking was next described; the apparatus is shown by the engraving. The outer coil is expanded by heat until it is sufficiently large to fit easily over the inner coil or tube—if a large mass, such as the jacket of a Fraser gun, by means of a wood fire, for which the tube itself forms a flue; if a small mass, such as a coil, in a reverberatory furnace at a low temperature or by means of gas. It is then raised up by a travelling crane overhead and dropped over the part on to which it is to be shrunk, which is placed vertically in a pit ready to receive it. The heat required in shrinking is not very great. Wrought iron on being heated from 62 deg. Fah., the ordinary temperature, to 212 deg., expands linearly about $\frac{1}{1000}$th part of its length; that is to say, if a ring of iron 1000in. in circumference were put into a vat of boiling water it would increase to 1001in.; and according to Dulong and Petit, the coefficient of expansion, which is constant up to 212 deg., increases more and more from that point upwards, so that if the iron ring were raised 150 deg. higher still—*i.e.*, to 362 deg.—its circumference would be more than 1002in. No coil is ever shrunk on with so great a shrinkage as the $\frac{2}{1000}$th part of its circumference or diameter, for it would be strained beyond its elastic limit. Allowing therefore a good working margin, it is only necessary to raise a coil to about 500 deg. Fah., though in point of fact coils are often raised to a higher degree of temperature than this in some parts, on account of the mode of heating employed. With respect to the mode of cooling during the process of shrinking, care must be taken to prevent a long coil or tube cooling simultaneously at both ends, for this would cause the middle portion to be drawn out to an undue state of longitudinal tension. In some cases, therefore, water is projected on one side of a coil so as to cool it first. In the case of a long tube of different thickness like the B tube of a R.M.L. gun, water is not only used at the thick end, but a ring of gas or a heated iron cylinder is applied at the thin or muzzle end, and when the thick end cools the gas or cylinder is withdrawn from the muzzle, and the ring of water raised upwards slowly to cool the remainder of the tube gradually. As a rule the water is applied wherever there is a shoulder, so that that portion may be cooled first and a close joint secured there. As to the absolute amount of shrinkage given when building up our guns, let us take the 12½in. muzzle-loading gun of 38 tons as an example.

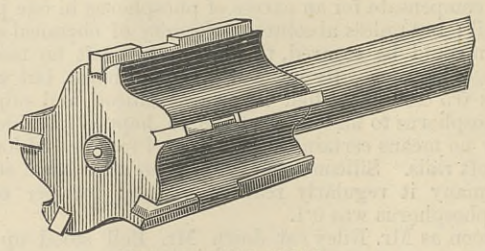
Shrinkages of Coils of 12·5in. R.M.L. Guns.

Coils.	Shrinkages.				Remarks.
	In inches.		In terms of dia.		
	Rear.	Front.	Rear.	Front.	
Breech-piece.	·022	·026	$\frac{D}{857}$	$\frac{D}{807}$	Shrunk on A tube.
B coil	·055	·01	$\frac{D}{561}$	$\frac{D}{190}$	,, ,,
B tube	·035	nil.	$\frac{D}{668}$	nil.	,, ,,
C coil	·03	·06	$\frac{D}{1134}$	$\frac{D}{729}$	Shrunk on to breech-piece and rear end of 1 B coil.

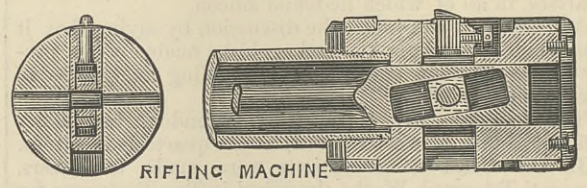
Next a description of boring was given. The term boring is applied either to the process of reaming out the inside of a tube or boring one out from a solid cylinder. Rough and fine boring of an inner barrel, as well as broaching and forming the chamber, are all effected in the same horizontal machines, the difference being in the shape of



ROUGH BORING HEAD



FINE BORING HEAD



RIFLING MACHINE

the boring head and cutters. In this machine the barrel revolves, while the boring head, guided by a supporting frame at the muzzle, simply progresses down the bore, being fed to its work by a long screw which passes through a nut in the sliding saddle to which the bar is fixed. The boring-head used for rough cutting is what is called, from its shape, "a half-round bit;" it has one pointed cutter set angularly and three steel "burnishers," or projections, to keep it steady in the bore. This tool cuts away the metal in front of it, and the same kind of head is used for cutting from the solid. In boring out a steel barrel for a 9in. gun, 8¾in. in diameter are taken out at each cut in segmental chips about ⅛in. thick, and the operation takes fifty-six working hours, or about a week. Fine boring is performed with a round head having long cutters let in lengthways, and five lignum vitæ wood burnishers. The object of having the latter of wood is that they may be set out further than the cutters, and so be cut to the same diameter as the tube on entering it, as well as being expanded up the full size of the bore by the soap and water, which is invariably projected down the bore; moreover, were the burnishers of steel they might indent the bore. Short and light tubes are bored in a horizontal machine, but on the opposite principle to that for inner barrels. The power and economy of the machinery employed is shown by the fact that a hole 10in. in diameter and 10ft in length can be bored out of solid steel at a single operation and at a cost of only 35s. As an example of the accuracy of boring, it may be stated that holes 16in. in diameter have been bored to a depth of 24ft. with a variation of less than 0·01in. in the diameter. The rifling machinery was then described, and subsequently that of turning. The very nature of the manufactures in the Royal Gun Factory necessitates the turning of very large and heavy masses. Lathes have therefore been designed and completed in this department remarkable for magnitude and power. They can deal with weights up to 200 tons, and are sufficiently powerful to reduce by 6in. at a single cut the diameter of a 12ft. tube. These lathes have the following dimensions:—6ft. centres, 60ft. beds. There are nearly 200 tons of material employed on each of them, and the maximum power of their gearing is 150 to 1. Such being the general course of manufacture in the Royal Gun Factory, it will not be out of place here to describe such special appliances as have from time to time been introduced for the better or more economical performance of various parts of the work. Col. Maitland concluded by describing certain special appliances, such as Witham's mechanical puddler, and Crampton's rotary puddling furnaces. This furnace was erected in the Royal Gun Factory in 1872, under the personal superintendence of Mr. Crampton, and an extended series of trials over a period of five years have been carried out with it. The results of experiments with this furnace showed that the iron produced from it was defective in the following important qualifications:—(1) It could not be often reheated; (2) it was not free from blister; (3) it was often red-short. These defects rendered it unsuitable for the manufacture of ordnance. One of Siemens' regenerative gas furnaces was erected and set to work some seventeen or eighteen years ago. This furnace was found at the time to be expensive in prime cost and somewhat costly in repairs. In the manufacture of ordnance continued changes in the direction of increased weight are often made. It thus becomes inadvisable to be hampered with an elaborate system of furnaces difficult to adapt to ever-varying conditions. Under more stable conditions in the future, it may become desirable to revert to this system. The paper concluded with a description of Price's retort furnace.

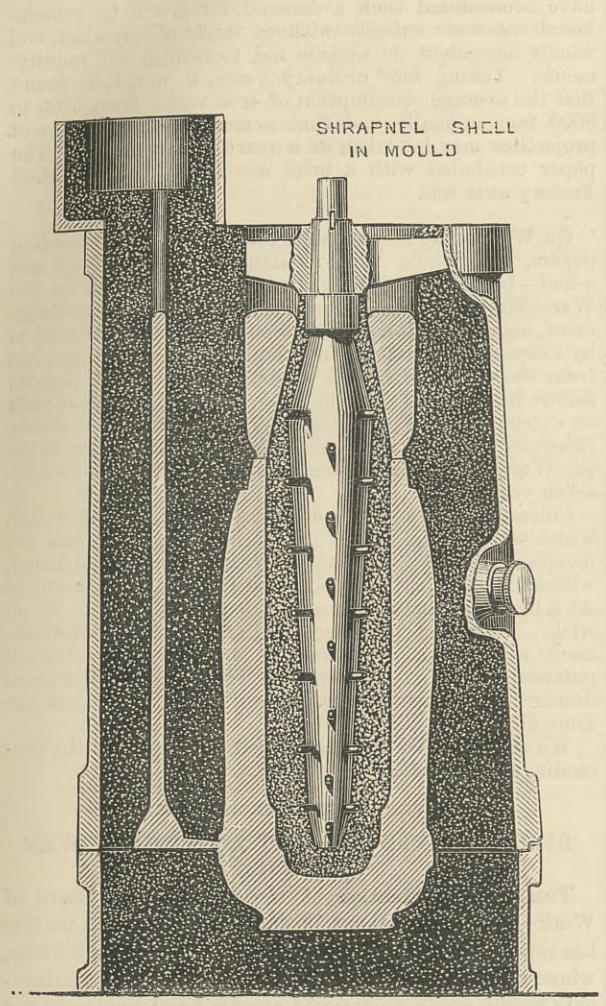
The next paper read was one by Mr. H. J. Butter,

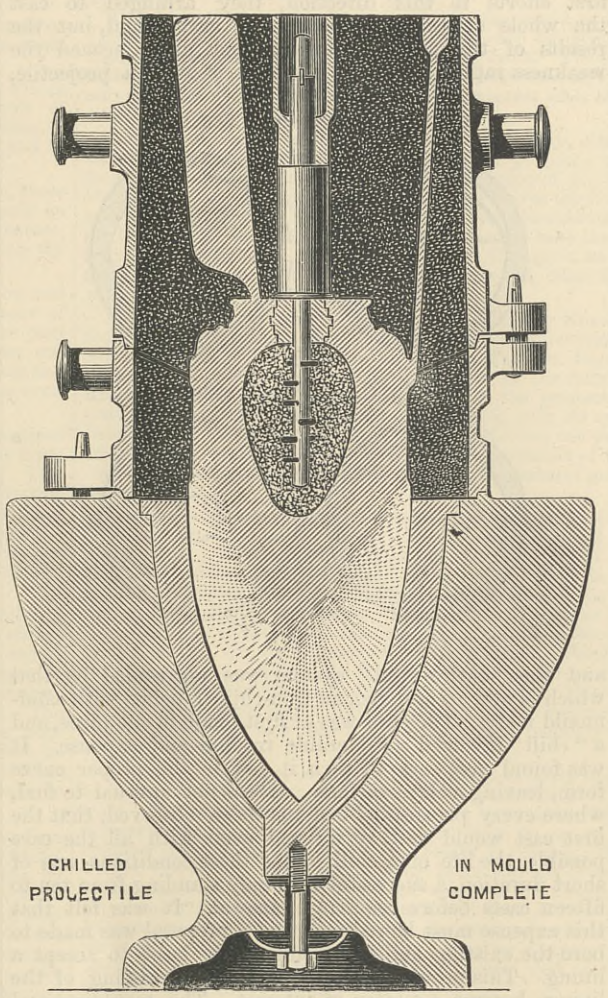
On the Application of Wrought Iron and Steel to the Manufacture of Gun-carriages.

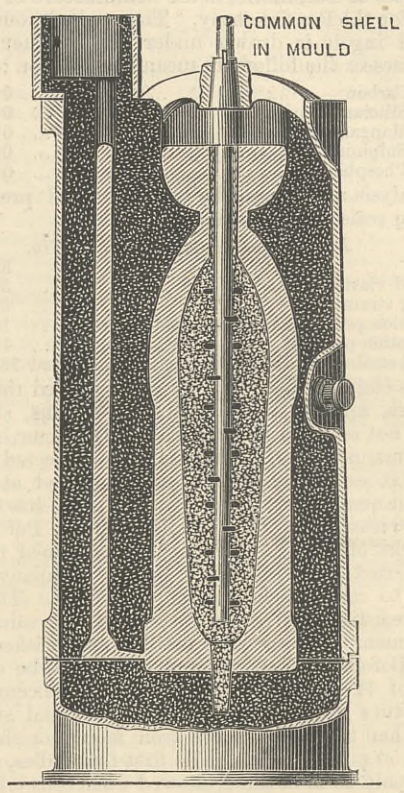
This was a very elaborately illustrated paper, dealing with a subject with which we have for many years endeavoured to keep our readers familiar. Nearly all the apparatus described by Mr. Butter has already been illustrated in our pages. The author began by stating that prior to 1867 all gun-carriages were manufactured of timber, and the Royal Carriage department, for some years subsequently to that date, consisted of a series of ordinary smiths', carpenters', and wheelers' workshops, the only machinery employed being that connected with the saw-mill, a small collection of wood-working tools, and steam hammers. At the present time, owing to the substitution of iron and steel for timber, it presents the appearance of one of the most complete engineering establishments to be found in the kingdom; it possesses the finest examples of modern machine tools, numbering over 700, and it is organised to carry on the manufacture of every variety of article in iron, steel, and timber required for mounting and working the heaviest ordnance, for artillery, transport, ambulance, and engineer services, and the innumerable miscellaneous stores connected with the naval and military services generally. The question of weight decided the rejection of all forms of solid forging in rectangular sections for the sides or brackets of carriages or platforms, and led to the adoption of plate, angle, tee, and H sections, thus dispensing with the employment of useless metal about the neutral axes. Elasticity was a more difficult question to deal with, and led, in the first instance, to the mistake of combining wood with iron, as in the case of the axle-trees of field-carriages. The difference in elasticity of the two materials led, of course, to the destruction of both in detail, and this system was quickly abandoned. In some cases lightness, with the requisite degree of elasticity and strength, was of so much consequence that it was imperative it should at least be equal to that attainable with wood; and although many systems were tried, the manufacture in iron or steel of the articles in question had to be given up. Wheels and the framework of wagons and carts are examples of this class, these being still constructed of timber. The best method of obtaining some approach to the large working limits of elasticity of timber was found to be that of building up the structure in small sections rivetted together, rather than by employing iron rolled or forged into the full-sized sections required. The reason for this was no doubt to be found in the fact that the deflection of the whole mass due to any given strain, while exceeding the limit of elasticity of the solid frame, and giving to it a permanent set, is well within that of each of the smaller sections composing the built-up structure, which, therefore, takes no permanent set, although its ultimate strength to resist rupture would probably be less than that of the solid form. Gun-carriage sides or brackets are made on four different plans. One plan, which was at first adopted for heavy ordnance, but was found unsuitable, and is now confined to carriages for light guns and for field service, consists of a single plate with a frame of angle iron rivetted round the edge. This is termed the "single-plate pattern," and it possesses considerable vertical, but only a small degree of lateral strength. The lattice girder principle is adopted for what are called overbank carriages for 40-pounder guns, in which the great depth of the sides admits of a great saving of weight by the adoption of this method. Another pattern, called the double plate, consists of preparing a frame of rectangular wrought iron, and of rivetting a plate upon each side. This stronger form is much more suitable for heavy ordnance, and admits more readily of the attachment of rollers for the carriage to run upon. Of late years cast iron frames have been substituted for those of wrought iron, and by casting all rivet and bolt holes in them, and by dispensing with planing, a considerable saving in cast iron has been effected. The strains falling upon it in the case of garrison and naval sliding carriages, being all of a compressive nature, have in no instance caused fracture. Another important advantage is that of securing a cast iron surface in contact with the

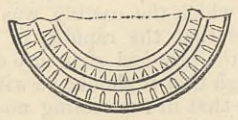
APPARATUS FOR CASTING SHELLS.—WOOLWICH ARSENAL.

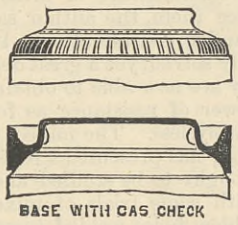
(*For description see page 276.*)

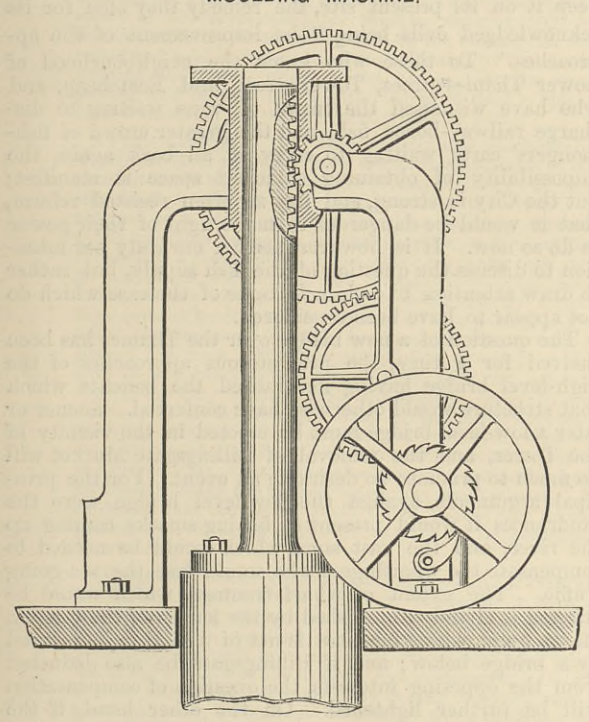


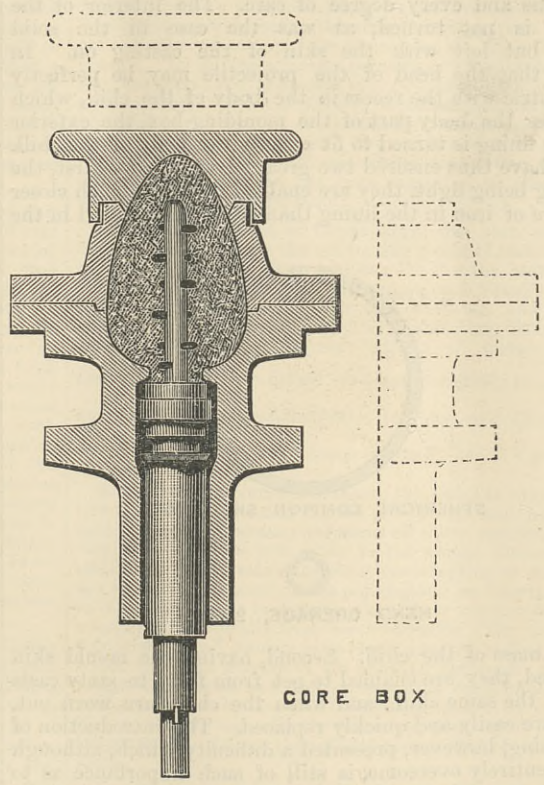


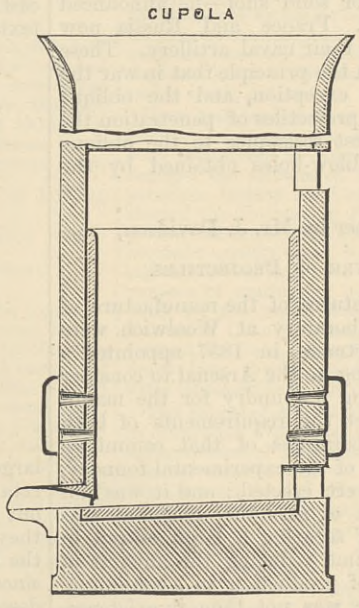


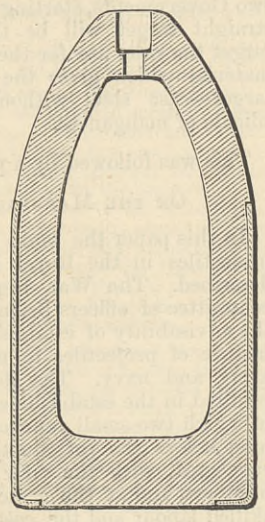












wrought iron upper surface of the platform, which prevents the excessive seizure that always gave trouble when both surfaces were of wrought iron. A fourth form, only recently adopted, is that of having solid brackets forged or made of tough cast steel. The object of this mode of manufacture is to provide the means of inserting the hydraulic compressor inside the bracket, in order to raise the line of resistance as nearly as possible to a level with the axis of the gun, and thus of reducting the overturning moment of the force of the recoil upon the carriage. In the case of the 43-ton breech-loading gun, time would not admit of waiting for the preparation of annealed steel castings, and the brackets were made of pieces of armour plate, which were bored out to form the cylinders of the hydraulic compressors; and although on trial the pressure reached 3 tons to the square inch, and the holes were not lined, there was no leakage from the lamination of the material, as might reasonably have been expected, except in one spot, which was easily stopped by caulking. The bursting strain inside each bracket amounted to fully 1150 tons, and fully proved the remarkably sound work connected with their manufacture. Where so much rivetting is resorted to in structures subjected to violently concussive strains, special care must be taken to procure the best and most reliable iron for making the rivets. After many trials, an admirably uniform and good BBB Staffordshire rivet iron was selected as the best that could be obtained. This was further improved specially for gun-carriage manufacture, and is now known as "BBB rivet iron, special make." Good, however, as this iron undoubtedly is, still better results have been recently obtained by the use of Siemens steel of a peculiar make. The author dealt at some length with the quality of rivet iron and steel, and on the precautions taken in the carriage department for securing supplies of the best and most suitable qualities of iron and steel in general. Tough steel castings are also somewhat extensively used where they can be more economically employed than would be the case to forge the articles. This material stands well the direct impact of blows. As an illustration of this fact it may be mentioned that the large sliding trunnion blocks of turret carriages were originally made of gun-metal, which was found to condense rapidly under the impact of recoil. Wrought iron was tried, and was found to be similarly affected, though in a less degree, whereas since tough steel castings have been adopted for this purpose, no difficulty whatever has been experienced. Stamping under the steam hammer has always been a special feature in the carriage department, and although numerous sets of tools have become obsolete from changes of pattern, there are at the present time over 500 sets in use. The saving in the cost of labour has in several instances exceeded 300 per cent., and is estimated to be on the whole about 80 per cent. Forging by the Ryder machines, of which there are fifteen in use, is also extensively carried on. One other feature connected with the manufacture may be of interest to some who seek to attain great accuracy in finish by means of ordinary workmen and methods of working. Owing to the necessity for perfect interchangeability, with a good fit, of all the fittings of gun-carriages, it was found necessary to adopt a system of rigid examination of each article by means of high and low gauges. At first the limit of variation in size was fixed at + or − ·004in., and was, of course, greatly objected to on the part of the workmen unless the piecework prices were increased. Now, however, it is found perfectly easy to reduce the limit to + or − ·002in. in the regular way of working, at even lower piecework rates than were fixed upon before high and low gauges were introduced. The author concluded by saying that the Royal Carriage Department led the way in England to the substitution of iron and steel in the manufacture of gun-carriages, and determined the general character of the various types. The department also, in conjunction with Captain Scott, R.N., was the first to design machinery for working heavy guns in place of using rope tackles and handspikes. It adopted hydraulic machines for performing various gunnery operations so far back as 1868. The method of using fluids for checking the recoils of guns, now universally adopted, was worked out entirely in all its various features in this department. It produced the first carriage and platform—for a 35-ton gun—which was worked wholly by hydraulic machinery. It has successfully demonstrated, in the case of a 38-ton gun, the entire practicability of working guns in a fort by steam shafting. This latter system is now in course of application to the two 80-ton guns in the Dover turret, which will also be provided with the flexible chain rammer worked out in the Royal Carriage Department.

The next paper read was one by Mr. M. F. Gautier,

On the Application of Solid Steel to Small-arms, Projectiles, and Ordnance Manufacture.

This paper was intended to give the results obtained with cast steel containing silicide of manganese. The steel with silicide of manganese, besides the security which it presents in its homogeneity, preserves, when it has been hammered or rolled, an increased limit of elasticity, with a strong tearing strain and a good elongation. It is not

necessary to seek for anything more in the manufacture of the barrels of guns. M. Nobel, who worked quite recently at the manufactory of arms at Ijef, near to Perm, has used steel with the silicide of manganese, made according to the process of Terrenoire, in the manufacture of the barrels of guns for the Russian army. The steel without blowholes in small ingots is drawn under the hammer alone. It then possesses the following mean composition :—

Carbon	0·120
Silicium	0·234
Manganese	0·527
Sulphur	0·020
Phosphorus	0·109

This analysis answers to the best tests, and presented the following resistance to trials

Diameter of the test 18 *mm.* = 0·7*in.*

	Kilos.	Lbs.
Limit of elasticity	30·13 =	66
Tearing strain	65·50 =	143
Elongation per cent. measure upon 200mm. ...	18·7	
Contraction per cent.	48·30	
Tearing strain according to the section contracted	128·30 =	282

It was claimed that the tests given proved that the steel of Bofors, applied to the barrels of guns, shows itself superior not only to that of Swedish, Bessemer, or Siemens-Martin manufacture, which has been subjected to experiments, but especially to that manufactured at Witten, of which the quality is as good. Not a rupture has taken place in it, notwithstanding the excessive charges. Before quitting the works of Bofors, the author mentioned the tests of artillery cast in steel. The Bofors Company has commenced to cast a field gun of 9 cm. bore. This cannon, which resisted the severest tests, is the admiration of artillerymen. The Swedish artillerymen wished to undertake at Bofors the manufacture of steel tube castings for cannon of 12 cm. steel hoops. The commencement of this manufacture was beset with difficulties, and success only began when they gave to the iron mould or shell a thickness of 150 mm. at least. The first four tubes, cast with a shell of only 25 mm. thick, showed numerous cracks, which made them useless. To avoid this it was only necessary that the mould in which the casting was made should be red hot; it appears that the rapidity of cooling plays an important part in the physical structure of the metal. In fact, it is not enough that it should be without blow-holes; it is also necessary that in the cooling no cracks should be produced. Dealing with the application of metal without blow-holes to the manufacture of armour-plates, and of projectiles to pierce them, the author said that the first question is still under consideration. It cannot be said that it is completely solved, yet a great deal has been done, and in France they are now able to obtain cast plates with nearly as much power of resistance as forged steel plates, at a price considerably less. The mixed plate of iron and steel welded together has presented a resistance so superior that the question ought to be studied anew, and they are now proceeding with some trials of mixed plates of iron and steel without blow-holes welded together. As to projectiles of cast steel—shells or solid shot—he announced some very decisive results. France and Russia now employ no other material for their naval artillery. These two Governments, starting on the principle that in war the straight target will be the exception, and the oblique target the rule, use for their projectiles of penetration the material which gives the best resistance to the oblique target—cast steel without blow-holes obtained by the silicide of manganese.

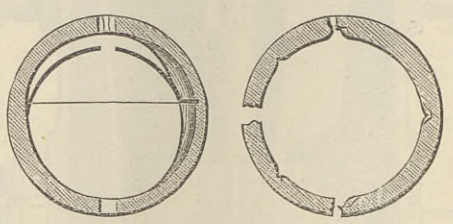
This was followed by a paper by Mr. J. Davidson,

On the Manufacture of Projectiles.

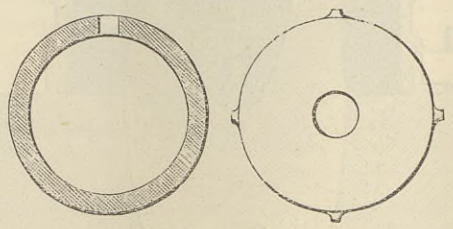
In this paper the main features of the manufacture of projectiles in the Royal Laboratory at Woolwich were described. The War Department in 1857 appointed a committee of officers belonging to the Arsenal to consider the advisability of establishing a foundry for the manufacture of projectiles to meet the requirements of both army and navy. The deliberations of that committee resulted in the establishment of an experimental foundry, in which two small cupolas were erected ; and it was not long before the introduction of moulding machines was suggested, with the view of securing a large output in numbers, and at the same time reducing the amount of skilled labour and the cost of production to a minimum. Machinery of this description was not then in existence, and an inquiry led to the firms of Messrs. Fairbairn, Greenwood, and Batley, of Leeds, and Messrs. Higgins and Co., of Manchester, submitting designs of machines for the purpose. The principle of removing the pattern or lowering it through a fixed plate was in both cases adopted, but the method submitted by Messrs. Fairbairn, Greenwood, and Batley proving the most effective, was, and has since been, almost wholly in use, the modification of a "screw" in place of "rack and pinion" having to be used for the larger natures of projectiles. The core-box machines consist of two halves, forming the desired shape of core, and these were made to recede and face each other by means of a right and left-handed screw. So marked was the success obtained in this small foundry, that it was decided to erect the foundry to which this paper especially applies, and which was designed to give an out-turn of 600 tons per week ; the 6in. spherical projectiles being the means taken to estimate the extent of space required. The foundry having been supplied with its complement of machinery and put into actual working order in the financial year 1858-59, its capabilities were shown by an average output of 500 tons per week for the whole of that year. The supply by the Elswick firm of projectiles as well as guns may be said to have virtually—for the time—stopped the manufacture of all spherical work; but it was seen that in most cases a slight modification or alteration of our existing machines would place them in a condition to proceed with the class of projectiles called for, and it was deemed necessary that this be done as far as possible. These alterations to the machines have enabled the foundry to meet all the succeeding changes up to the present time, *i.e.*, so far as the moulding process is concerned,

The author next came to the introduction of chilled projectiles in the year 1866. The object of chilling, it is almost needless to say, is to ensure penetration, and more especially the penetration of armour plates. In their first efforts in this direction, they arranged to cast the whole of the projectiles in an iron mould, but the results of the firing against armour plates proved the weakness rather than the strength of such a projectile,

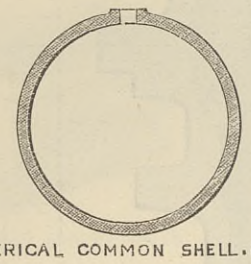
SPHERICAL SHRAPNEL SHELL



SPHERICAL COMMON SHELL



and the "entire chill" system was superseded by that which is now in use, viz., an iron-chilled point with sand-mould body. The chill was at first made in one piece, and a "chill" involved considerable trouble and expense. It was found necessary to turn it out to the proper curve form, leaving a clean surface. It was not unusual to find, where every precaution had not been observed, that the first cast would destroy it; and even with all the care possible, the life of a chill under these conditions was of short duration, a successful chill only standing from ten to fifteen casts before requiring renewal. It was felt that this expense must be reduced, and a proposal was made to bore the existing chills out sufficiently large to accept a lining. This proving a great success, the casting of the linings became a matter of interest. The moulding and casting of the linings are now executed with metal-turned patterns and every degree of care. The interior of the lining is not turned, as was the case in the solid chill, but left with the skin of the casting on. In order that the head of the projectile may be perfectly concentric with the recess in the body of the chill, which receives the body part of the moulding-box, the exterior of the lining is turned to fit exactly the body of the chill. They have thus ensured two great advantages:—First, the casting being light, they are enabled to get a much closer texture of iron in the lining than could be expected in the



SPHERICAL COMMON SHELL. 26 CWT.

HAND GRENADE, 2 LBS.

larger mass of the chill. Second, having the mould skin retained, they are enabled to get from forty to sixty casts out of the same chill; and when the chills are worn out, they are easily and quickly replaced. The introduction of the lining, however, presented a difficulty which, although since entirely overcome, is still of such importance as to deserve a passing notice. While aiming at keeping the point and body of the projectile mould perfectly concentric, the line formed between the chill and lining by virtue of unequal expansion and contraction gave room to particles of sand becoming imbedded between, and a repetition of this evil, besides causing the point to be excentric, resulted in the destruction of the lining, either by altering its form, or more generally breaking it. Altogether, it will be seen that a slight inclination or slope given to the outer lip of the lining acts in such a manner as to throw any sand to the surface or face of the sand mould without affecting either chill or mould. It is now proposed to supersede the studded projectile by one which shall be rotated by what is termed a "studded gas-check." The studs form a weak point in any projectile, more especially so in one intended for armour-piercing. The proposed shell will be cast with a peculiarly serrated base, which will do duty by sustaining the gas-check, which in its turn will be called upon to do the duty previously done by the studs. From 25 to 35 per cent. of the outturn is the most now used of Welsh iron. The remainder is made up of old guns, old shell, and the scrap produced in manufacture, a very ordinary mixture being—

Welsh iron	30	per cent.
Old spherical shell	30	
Old guns	20	
Scrap	20	
	100	

The author described at considerable length the plant in the foundry, and went on to deal with the statistics of output. The largest output of spherical shells of all sizes in one year—1859-60—was 1,937,000, or nearly two millions ; and the weight of iron consumed in their manufacture, irrespective of that melted for pig, &c., was nearly 20,000 tons. Since the introduction of elongated projectiles this quantity and amount has never been required ; indeed, only such an exceptional period as the above could have necessitated such a demand, for it will be remembered we were entirely without stock of any kind, and wholly dependent on outside aid to furnish our requirements. Taking four ordinary years, it would be found that the average consumption of iron varies from 5000 to 8000 tons annually, and that a mean of the numbers of projectiles may be taken at a quarter of a million. The paper concluded with a brief account of the Rifle-shell Factory as it was.

On Wednesday no discussion took place on the preceding papers, the whole time available—about an hour and a-half—being occupied by Dr. Siemens in accusing the War-office of taking his inventions without acknowledgment, and explaining that the Siemens furnace referred to by Colonel Maitland was not built from his designs, but from those of one of his ex-draughtsmen, and that its failure had injured the reputation of his furnaces to such an extent that he had lost £30,000 ; and by Sir Henry Bessemer in recounting his experiences in trying to get the War-office to accept steel as a material for guns twenty-seven years ago.

Colonel Maitland replied in a few well-chosen words, which were received with considerable applause, and the members then adjourned to the Westminster Palace Hotel, where luncheon had been provided by the local committee. At 2.15 a large party proceeded by special train to Woolwich. An idea of what they saw in this immense establishment will be gathered from an account of the Arsenal published in our impression for 30th September. The annual dinner of the Institute was given in Willis's Rooms the same night.

We must reserve until next week our report of the proceedings of yesterday—Thursday.

BILLINGSGATE MARKET AND THE TOWER BRIDGE.

The evident intention of the Metropolitan Board of Works to promote the establishment of a new fish market has roused a strong opposition among the City authorities, whose desperate denials of the shortcomings of Billingsgate would excite amusement among Londoners were not the matter one of such grave importance. Some members of the Common Council are thorough, and are determined not only to retain the market in the City, but to keep it on its present site, the remedy they offer for its acknowledged evils being "the improvement of the approaches." To those who know the neighbourhood of Lower Thames-street, Tower-street, and Eastcheap, and who have witnessed the crowd of vans waiting to discharge railway-borne fish, and the greater crowd of fishmongers' carts waiting to carry it all back again, the impossibility of obtaining sufficient space is manifest; but the City is strong, and has so often resisted reform, that it would be dangerous to make light of their power to do so now. It is, however, neither our duty nor intention to discuss the question of the fish supply, but rather to draw attention to certain features of the case which do not appear to have been considered.

The question of a new bridge over the Thames has been shelved for a time, the preposterous approaches of the high-level bridge having neutralised the benefits which that structure would otherwise have conferred. Sooner or later a low-level bridge must be erected in the vicinity of the Tower, and the removal of Billingsgate Market will do much to promote so desirable an event. For the principal arguments against the low-level bridge were the hindrances it would present to fishing smacks coming up the river, and the vast sums which would be needed to compensate the wharfingers who would lose the sea-going traffic. The extent of wharf frontage which would be affected is already diminished by the length of the Custom House quay, whose business is not of a kind to be injured by a bridge below; and if Billingsgate be also deducted from the opposing interests, the question of compensation will be further lightened. On the other hand, if the present market be perpetuated and extended—it is proposed to add the Custom House quay to it—it will by the creation of new interests enhance greatly the cost of the reform, which will eventually be forced upon the City when the nuisance of the market and the need for a bridge can no longer be endured. On either side of the Thames a million of inhabitants will be benefitted by a low-level bridge, and till their interests are considered no plan for dealing with the wharf space between the Tower and London Bridge can be properly discussed. The present is an opportune time for re-opening the question of a bridge, because the tendency of the port of London to move towards the sea has lately become more apparent. The filling up of St. Katherine's Dock is already contemplated ; the recent inauguration of the Albert Dock is to be followed by new docks at Dagenham and Tilbury; and the supposed necessity for bringing masted vessels to London Bridge should no longer hinder so manifest an improvement. These points were fully discussed in our columns in 1878, and the arguments then put forward in favour of a bridge have increased in force. If the City authorities persist in their endeavours to retain and improve Billingsgate, not only should they be opposed on the score of the fish supply, but also in the interests of bridge communication for eastern London ; and in these interests must be included those of the Metropolitan and District Railways, for now that these lines are to be continued to Trinity-square, with a station on Tower-hill, at the very foot of the proposed bridge, the latter, if properly constructed, will extend the advantages of the railway to the south side of the river, and will act as a valuable feeder to the railway traffic. If the eastern parishes and Sir Edward Watkin will combine their forces, the bridge will assuredly be built.

RAILWAY MATTERS.

The Adelaide and Suburban Tramway Company has declared a 10 per cent. dividend, after making ample provision for wear and tear and depreciation.

The new loan recently contracted by the Victorian Government included £2,500,000 for the construction of railways. The profit on railways during the past year amounted to £750,000.

It is stated that while the express train, conveying the Prince and Princess of Wales, Princess Louise, and the Marquis of Hartington from Ballater on Monday, was near Dinnet station, a tire of one of the engine wheels broke, and another engine had to be procured.

In Maine and New Brunswick, the *Railroad Gazette* says, there are some stickers in the way of names, but what work would an American brakeman make of Cuautillan, Teoleyucan, Huehuetoca, Tlanepantla, and Atzcapotzalco, all of which are stations on the Mexican national road.

The railway bridge over the canal at Leeds, on the London and North-Western Railway, was on Tuesday afternoon the scene of an accident similar to two others which happened within the past fortnight. As the 1.40 p.m. train from Leeds to Manchester was passing over the bridge, five carriages at the rear left the rails and caused a block for four hours. None of the carriages were overturned, but several passengers were shaken.

A map of the Great Eastern Railway, showing its connections with the London, Tilbury, and Southend Railway, and other lines, is published with the Monthly Circular of Mr. W. Abbott. This shows the already existing railway facilities for communication with the new Dagenham Docks, and the proposed new Tilbury Docks, when these two great works are completed; and the communication with Gravesend, which will be opened up by the new line to be made by the London, Chatham, and Dover Company, from near Longfield.

A bad accident recently occurred on the Hobson's Bay Railway, Victoria, caused by the fracture of the tire of one of the wheels of a carriage in an express train. This carriage and two others following it immediately went off the line, and were precipitated over an embankment and smashed to pieces. Four of the passengers were killed, and about twenty others more or less injured. The causes which led to this fracture may be developing in a large number of tires of the same age, so that great care should be exercised in inspecting them, and all those that have run a large number of miles, unless of tolerably hard crucible steel, should be taken off and annealed.

A new system of manipulating old rails is described by the *Iron Age* as about to be put in operation at the Sedalia Rolling Mills, U.S. "It provides for a combination of rolling and forging, by which they are enabled to splice and weld together two or more short rails, making them into one of usual length. They also manufacture steel frogs from solid steel, or in several parts welded together, as may be desired, and also weld solid frogs for crossings from either steel or iron rails. By this machine they are capable of converting old, poor-shaped, and other odd-shaped, old-fashioned rails into fish joints as perfect as new iron, the increase in durability by the rails being hardened and steeled, steel facing, splicing of short, &c., as compared with blacksmithing or hand work, being accomplished at a slight expense. The revolving hammer by which these great effects are produced is composed of a concentric ring enclosing six revolving swage collars running at a speed of 850 revolutions per minute, striking 5000 blows per minute, or thirty blows to the inch on the moving rail while being rolled and held in the grasp of the rolls as if by a vice, thoroughly welding the fibres, renewing the life so that the iron becomes steeled, and almost, if not quite, equal to steel. This gives it at least a threefold life as compared with new iron."

At the meeting of the Mersey Docks and Harbour Board this week, Mr. Holt said that there were two resolutions of the Works Committee on the subject of the Mersey Railway Company, which was busily constructing a tunnel under the river. The first referred to a communication from the company agreeing to the terms on which the board let them a piece of land at Birkenhead for sinking a second shaft. The other resolution had reference to an agreement for letting the company additional land on the Liverpool side of the Mersey, in a south-easterly direction from their present holding at the George's Dock passage. This would allow the company to sink a second shaft on the Liverpool side of the river. The company profess to carry on their work both at the heading and main tunnel with the utmost possible speed, and they required a second shaft in order to remove the *débris* from the larger undertaking. The committee wished to give every opportunity to the company for proceeding with the works consistent with guarding their own position both at present and in the future. Mr. Forwood rejoiced that the committee had granted facilities to make the tunnel, which was long wanted. Mr. Laird explained that the second shaft would reduce the time for completing the works by about six months. The recommendations were adopted.

Of the 265 persons killed and 509 injured on our railways during the first six months of this year from causes other than accidents to trains, rolling stock, permanent way, &c., including accidents from their own want of caution or misconduct, accidents to persons passing over level crossings, trespassers, and others, 32 of the killed and 371 of the injured were passengers. Of the latter, 9 were killed and 33 injured by falling between carriages and platforms, viz., 4 killed and 20 injured when alighting from, and 5 killed and 13 injured when getting into, trains; 8 were killed and 244 injured by falling on to platforms, ballast, &c., viz., 6 killed and 230 injured when alighting from, and 2 killed and 14 injured when getting into trains; 7 were killed and 3 injured whilst passing over the line at stations; 45 were injured by the closing of carriage doors; 2 were killed and 11 injured by falling out of carriages during the travelling of trains; and 6 were killed, and 35 injured from other causes. 37 persons were killed and 14 injured whilst passing over railways at level crossings, viz., 27 killed and 11 injured at public level crossings, 5 killed at occupation crossings, and 5 killed and 3 injured at foot crossings. 136 persons were killed and 63 injured when trespassing on railways; 32 persons committed suicide on railways; and of other persons no specifically classed, but mostly private people, having business on the companies' premises, 28 were killed and 55 injured.

Probably the quickest work ever done on track in America was on the special road laid for the late President Garfield's train at Long Branch. Assistant superintendent Stearns, of the Central Railroad of New Jersey, telegraphed B. Murtaugh, track master, at 12.46 p.m. on September 5th, to lay new track from the main line at Elberon to Francklyn cottage, a distance of 3420ft. At 3 p.m. the first ground was broken with but 12 men; after 3 p.m. each train brought men until 7 p.m., when 351 skilled trackmen were on the ground; the construction train with sleepers and switch material arrived at 7.15. The first rail was laid at 7.45 p.m. and the last rail at 2.40 the morning of the 6th, when all stopped work till 5, at which time work was resumed, and at 9 a.m. the 3420ft. of new track was completed and an engine ran several trips over it to test it. The following is a report of material used: Sleepers 1767; fish joints, 203; railroad spikes, 3600 lb.; cut spikes, 100 lb.; plank for road crossings, 4000ft.; handled and used 300 cubic yards of earth and cinders for grading and surfacing track. In addition to the above there were: Station lamps, 14; hand lanterns, 36, and 14 two-horse teams with their drivers, volunteered and did good work. Only 15 hours and 20 minutes in making and surfacing 3420ft. of track. George W. Abbott, track master from Somerville, assisted Mr. Murtaugh, and assistant-general superintendent Stearns was on the ground most of the time. The receiver subsequently issued an order thanking the officers and men for their prompt and efficient work.

NOTES AND MEMORANDA.

"Officier de l'Instruction Publique" has been added by the French Government to the honours conferred upon Dr. C. W. Siemens.

The longest span of telegraph wire in the world is stretched across the Kistnah river from hill to hill, each hill being 1200ft. high, between Bezorah and Sectanagrum, in India. The span is a little over 6000ft. in length. The *Scientific American* says that the only mechanical contrivance used in stretching this cable across the river was a common windlass.

Celluloid may be used for preserving engravings, *clichés*, and stereotypes. The process employed for this purpose, we learn from *La Nature*, consists in taking an impression of the engraved block by means of a special cement, which receives the impression and rapidly hardens. The presses used to take the first impression are heated, and the sheet celluloid is then used to take the counter impression from which to print. Celluloid thus gives an exceedingly clear reproduction of specimens of lace and other fine work with difficulty obtained in any other way.

According to an address by the Hon. John Jay Knox, Comptroller of the American Currency, at the annual convention of the American Bankers' Association at Niagara Falls in August last, "There is not sufficient gold or silver coin in the country with which to pay for the one-twentieth part of the products of the present year; but the machinery of the bank, with its system of checks, and bills of exchange, and Clearing Houses, can pay for it all in dollars, every one of which will be an equivalent of the true standard dollar at twenty-five and eight-tenths grains of gold, nine-tenths fine."

A method for determining the total solid matter in solution in different waters is described in the *Journal* of the Chemical Society, by Dr. Mills. The method is based on the fact that if a small glass bead with an attached weight is allowed to ascend in a saline solution of known strength, it will rise more slowly, the greater the amount of solvent present. Experiments are given showing that the rate of ascent is also dependent on the nature of the soluble matter, *i.e.*, on the viscosity of the solution. For detecting variations in the solids in the same water, for preparing standard solutions, &c., the bulb method is likely to be useful. Experiments detailed in the same paper lead Mills to regard the specific gravity of a potable water as a direct indication of the quantity of total solids in solution.

An electro-magnet of enormous dimensions has lately been made by Messrs. von Feilitzsch and Holtz for the university of Greifswald. The case is formed of twenty-eight iron plates bent into horseshoe-shape, and connected by iron rings so as to form a cylinder 195 mm. in diameter. The height is 125 ctm.; the total weight 628 kilogr. The magnetising helix consists of insulated copper plates and wires having a total weight of 275 kilogr. With fifty small Grove elements the magnet will fuse in two minutes 40 grammes of Wood's metal in the Foucault experiment. The plane of polarisation is rotated in flint glass after a single passage. The core of the largest magnet hitherto known, that of Plucker, weighed 84 kilogr. and the wire 35 kilogr.

Nickel was at one time deemed infusible, and at best only metalloid. It is many years since that its infusibility was conquered, and now pure nickel may be procured in almost any form. The latest achievement in this direction appears to be the successful reduction of iridium from its ores by Mr. John Holland of Cincinnati. By mixing a certain percentage of phosphorus with the ore, the metal can, according to a new American monthly magazine entitled *Progress of Science*, be melted and run into bars; the phosphorus can then be eliminated by heating the bars to a white heat in the presence of lime. The metal cannot be forged or filed nto shape, but is cut with a revolving copper disc and emery and oil or water. Its use has been suggested as electrodes in lieu of carbon in the electric lamp.

Professor Lorenz of Copenhagen, has been employing two methods for obtaining the conducting power of metals for heat and electricity, and gets these results: (1) For the better conducting metals, a confirmation of Wiedemann and Franz's law, that the ratio of the two conductivities, both at 0 deg. and at 100 deg. is nearly constant; in the inferior conductors it increases much with decreasing conductivity; (2) in all metals except iron, the ratio $\frac{k_{100}}{k_{100}} : \frac{k_0}{k_0}$ is constant, and approximately equal to 1·367 (k and k denoting the conductivities for heat and electricity respectively.) Thus, for absolute temperature T, $\frac{k}{k} = T \times$ constant.

A German economist has taken the pains to examine comparative statistics concerning the use of matches, and has come to the conclusion that Germany surpasses all other countries in the consumption, which he sets down to the almost universal custom of smoking. In Germany the daily consumption of matches is from ten to fifteen per head of the population: in Belgium about nine; in England eight; in France six. Their consumption diminishes steadily and naturally from north to south. The total daily consumption for all Europe is estimated at two milliards of matches, which gives an average of six or seven per head. Reckoning the weight of a match at a decigramme, this consumption will represent a daily absorption of 200,000 kilogrammes of wood. So that Europe uses up annually the immense quantity of 72½ millions of kilogrammes, or more than 80,915 tons weight of wood in matches alone.

Three machines are exhibited in the Paris Exhibition which must be of great interest to all electricians, and which will hereafter be of historic importance. These are three magneto-electric machines, constructed by Professor Pacinotti, of the Cagliari University, and well known to fame by his invention of the ring-shaped armature as used in the Gramme and Brush machines. The first machine of this kind, made by Pacinotti at Pisa in 1860, is exhibited, as well as a second machine made by him in 1873. The second is a dynamo-electric machine in which a shunt is employed so that the current is divided between the fixed electro-magnet and the resistance, two pairs of brushes making contact with the different segments of a commutator. The third machine exhibited was constructed in 1878 from a model made three years previously, and is a direct application of Arago's experiment, showing the deflection of the magnetised needle by a revolving copper disc, the electric effect being derived from the induced current in the copper disc.

According to MM. Behm and Wagner's *Bevölkerung der Erde*, Europe has now a population of 315,929,000 inhabitants; Asia, 834,707,000.; Africa, 205,679,000; America, 95,405,000; Australia and Polynesia, 431,000; the Polar regions, 82,000; giving a total for the globe of 1,455,923,000, being an increase of 16,778,000 according to the latest known censuses. At the end of 1877 Germany had a population of 43,943,000; Austria and Hungary—1879—of 38,000,000; France—1876—of 36,900,000; Turkey in Europe, of 8,860,000; Russia of 87,900,000. In Asia, China possesses 434,900,000 inhabitants; Hongkong, 130,144, Japan, 34,300,000; according to the census of 1878. The British possessions in India number 240,200,000 people—an estimate made before the census of this year—the French possessions 280,000; Cochin China, 1,600,000; the East India islands, 34,800,000; the islands of the South Sea, 878,000. The area of Africa is estimated at 29,383,000 square kilometers, divided as follows:—Forests and cultivated land, 6,300,000; savannahs, 6,235,000; steppes, 4,200,000; deserts, 10,600,000. The inhabitants of British North America number 3,800,000; of the United States, 50,000,000; of Mexico, 9,485,000; and of Brazil, 11,100,000. The Polar regions extend round the Arctic circle with an area of 3,859,000 square kilometres, and the Antarctic regions about 600,000. The population of the former is small, with the exception of Iceland, which has 72,000, and Greenland 10,000.

MISCELLANEA.

A block of stone, 65ft. long, 30ft. wide by 10ft. thick, has been quarried on Spoon Island, Queen's County, New Brunswick.

The Phosphor-Bronze Company, Limited, has been awarded the highest order of merit and gold medal at the Adelaide Exhibition, for phosphor-bronze, and articles made therefrom.

The engineer of Ottawa has reported against the proposal to light the city by electricity. The present cost of doing so by gas is stated to be £2546. Electricity generated by steam would cost £4960, and, if water power were utilised, £3200.

At the Nepean—Adelaide—Waterworks 350 men had, at receipt of last mail, struck for higher wages; they demanded 8s. per day, instead of 7s. 6d. they were receiving, and they also required two intervals during the day of a quarter of an hour each for smoking.

It seems that the earthquake in the Abruzzi was far more destructive than was at first thought. The Commission of Succour reports that of 1340 houses, seventy-nine must be re-built, and 618 have been rendered uninhabitable, so that about four-fifths of the population are without shelter.

In view of the opening of the St. Gothard Railway, it is proposed to connect the Adriatic with the Lago Maggiore by a system of canals, of which the termini will be at Venice and Magadino, in the Canton of Tessin. As the Po and the Cavour Canal can be utilised, the undertaking will be neither difficult nor costly, and a group of Italian bankers have promised their financial co-operation.

The Chinese Ambassador, Mr. Li-Fong-Pao, and suite, on their return from The Hague, on Monday, the 3rd inst., inspected the extensive wire, wire-rope, and telegraph cable works of Messrs. Felten and Guilleaume, at Carlswerk, Mulheim-on-the-Rhine, and 101, Leadenhall-street, London, this firm having supplied the galvanised wire for the Chinkiang Tientsin Telegraph Line, as well as the wire rigging and hawsers for the Chinese men-of-war which are now being built in Germany.

The dimensions of the new ironclads of which the Italian Admiralty have recently ordered the keels to be laid down within the month, one in the dockyard at Spezia, and the other at Venice, are as follows:—Length, 100 metres; immersion, 7 metres 65 centimetres; displacement, 10,000 tons; engines, 10,000-horse power, giving a presumed velocity of sixteen miles per hour. The cuirass, which is to extend over a length of 55 metres, will be 45 centimetres thick and 40 at the bulwarks and turrets. The guns are to be of the kind which, three years hence, when the ships are ready for them, shall have been found by experience and experiment to be the most useful.

On the afternoon of the 10th inst. an iron screw steamer, the Zuid Holland, of 2270 tons gross register, and 220-horse power nominal, for the Rotterdam Lloyd's Mail Line between Holland and Java, was launched from the yard of Messrs. Raylton, Dixon, and Co. The dimensions of this vessel are:—Length, 311ft.; breadth, 37ft.; depth, 27ft. She is classed 100 A1 at Lloyd's, and will be fitted with cabin accommodation for first-class passengers in large deck-house, specially arranged for good ventilation, and containing large saloon panelled in polished marble. This vessel is the sixth which has been built for the same line by Messrs. Raylton, Dixon, and Co., and is a sister-ship to the s.s. Utrecht, also trading between Rotterdam and Java.

We have received a copy of a new edition of section 1 of the voluminous catalogue of the machinery constructed by Messrs. S. Owens and Co. This part contains illustrations and descriptions of pumps of every kind, except the centrifugal made by the firm, as employed for domestic, agricultural, manufacturing, and industrial purposes, and as supplied to deep or shallow wells, for pumping liquids and semi-liquids, and as worked by steam, horse, wind, water, and hand-power. It also contains illustrations and particulars of hydraulic rams, fire engines and fire pumps, pumps for railway stations and public places, sluices, water wheels, water carts and barrows, and the various fittings and pipes required for the installation of hydraulic machinery. It contains a good index and is neatly got up.

The first manufactory of translucent porcelain in the United States, the *Engineering and Mining Journal* says, has recently been established in New Orleans by Mr. Eugene Surgi, who has engaged the services of Mr. d'Estampes, formerly director of a porcelain factory at Vierzan, France. The latter had already started the business in New Orleans in a small way, but was importing his kaolin from France, being ignorant that kaolin of the requisite quality could be obtained in the country. The firm of capitalists who took over the business of Mr. d'Estampes for the purpose of conducting it on a large scale, caused a search to be made for the proper kind of kaolin, and ultimately found it in Robertson County, Texas, on the line of the Houston and Texas Central Railroad. The first batch of the new porcelain has been drawn from the kiln, and is said to be excellent ware, though a little off colour from the dampness of a new kiln.

The School of Art Wood Carving, Albert-hall, South Kensington, in connection with the City and Guilds of London Institute for the Advancement of Technical Education, has reopened after the usual summer vacation, and we are requested to state that free studentships in both the day classes and the evening classes are at present vacant. These studentships are maintained out of funds provided by the City and Guilds of London Institute for the Advancement of Technical Education. The day classes are held from 10 to 5 on five days a week, and from 10 to 1 on Saturdays. The evening classes are held from 7 to 9 on four evenings a week, viz., Monday, Tuesday, Thursday, and Friday. The fees for day students are £2 a month, or £5 a quarter; the fees for evening students are 15s. a month, or £2 a quarter. All necessary information, with forms of application and prospectuses of the school, may be obtained by letter, addressed to the Secretary, School of Art Wood Carving, Royal Albert-hall, Kensington, S.W.

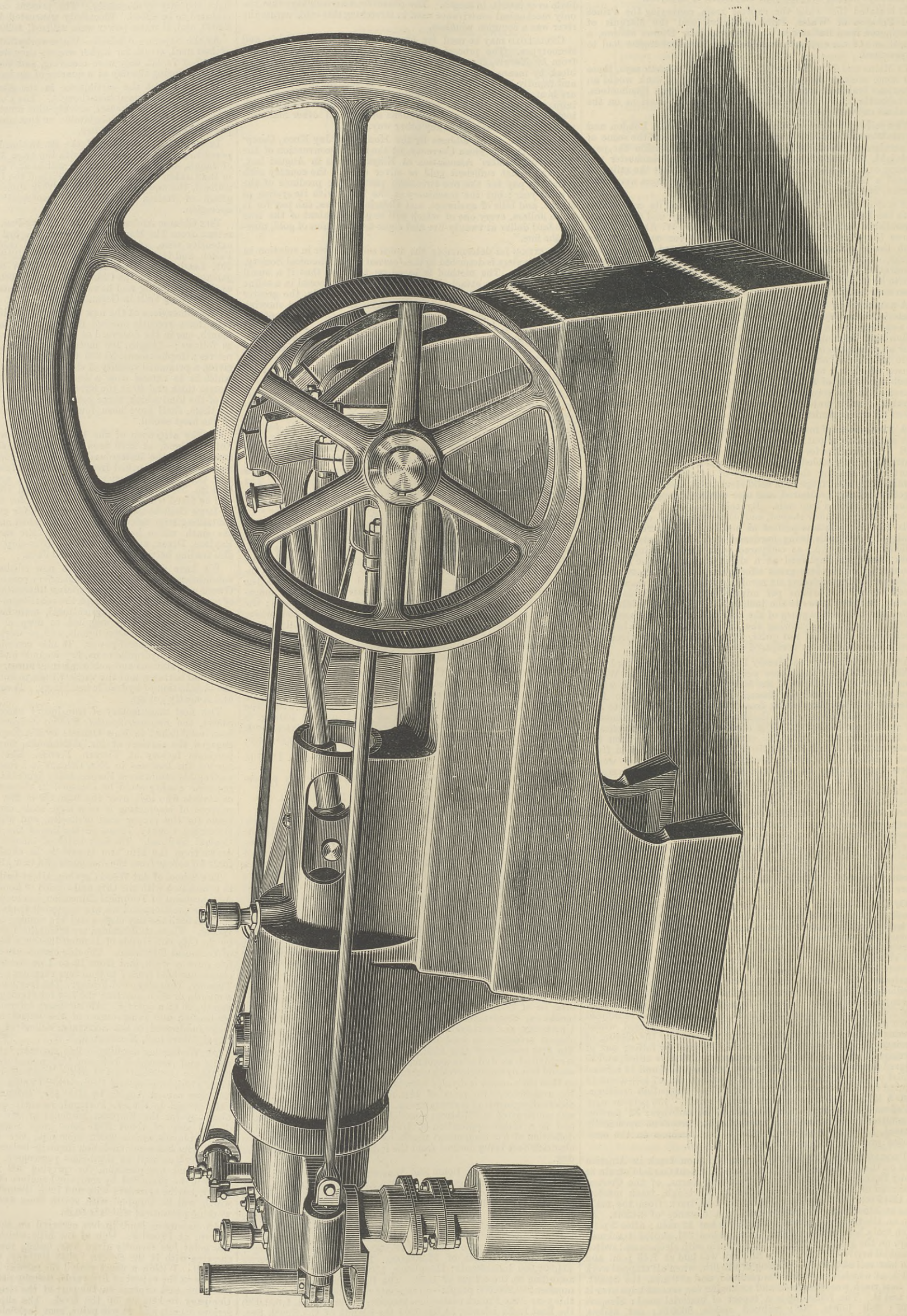
On Wednesday morning a fine steamer, intended to carry the mails and passengers between Lisbon and the Portuguese settlements, on the West Coast of Africa, was launched from the yard of Earle's Shipbuilding and Engineering Company, Limited, at Hull. She was named Angola by Mrs. Hy. Tatham, of London, and is sister vessel to the s.s. Portugal, recently completed by Earle's Company for the Empresa Nacional of Lisbon. She is a spar-decked ship of about 2000 tons gross register, built to class 100 A1 Lloyd's, and is 290ft. long p.p., 35ft. beam, and 25ft. 6in. deep. She has accommodation for 60 first-class and 30 second-class passengers, as well as third-class passengers. She is to be brig-rigged, and has provision for carrying 400 tons water ballast. She will be propelled by compound engines of 220 nominal horse-power, having cylinders 40in. and 72in. diameter and 45in. stroke, which will be supplied with steam from two large boilers, the working pressure of which is 80 lb.

An extensive landslip has occurred on the side of the river Severn, at Broseley. One of the hills which border the river at this point has recently given way, falling towards the river, and carrying with it the Severn Valley Railway, which runs through the hill. Within a short period the railway has been lowered by the slip to the extent of five yards, thereby necessitating continual attention and expense on the part of the Great Western Railway Company in keeping up the level. The slip has now assumed a serious aspect, and at one point, near Jackfield, the river has been so narrowed by the fall of earth as to be scarcely navigable. The fall continues daily, and is placing in jeopardy the buildings upon the hill. With the view of taking immediate measures for preventing loss of life, or any further damage to property, a trial shaft has been sunk for the purpose of ascertaining the depth of the slip, and it is thought probable that a scheme may be adopted to prevent the slipping of the hill. A report upon a slip at this point was made to the House of Lords some time since. The slip is 100 yards in breadth, and upon the land affected there is a church, as well as other buildings.

PARIS ELECTRICAL EXHIBITION.—CLERK'S GAS ENGINE.

CONSTRUCTED BY MESSRS. THOMSON, STERNE AND COMPANY, GLASGOW, ENGINEERS.

(For description see page 281.)



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TO CORRESPONDENTS.

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a* 1d. *postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

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Subscriber.—*Carey, Bird, and Co., Philadelphia, U.S.A.*

R. T. (Preston).—*Graham on "Steam and the Indicator," published by Spon.*

A. D. C.—*You will find a full account of the docks in our impression for the week of the opening, and the subsequent week in July,* 1880.

Strains on Crane Posts.—*We have in type a large number of letters on this subject, which we are compelled to hold over till next week because of the great length of our report of the proceedings of the Iron and Steel Institute.*

MOY'S BOILER.

(*To the Editor of The Engineer.*)

Sir,—In your notice of my patent boilers—No. 866, 1881—you have spelt my name incorrectly. My name is not May, but your obedient servant,

Thomas Moy.

37, Farringdon-street, E.C., October 8th.

BOOKS ON MILLING.

(*To the Editor of The Engineer.*)

Sir,—I shall be glad if you will allow me to ask in your columns where I can get useful practical books on milling. I have asked several booksellers, but they know of no works on the subject. Surely there must be some works of a practical character suitable for one who wants to start a mill in a new country, but who is a

Novice.

VELOCITY AND MOMENTUM.

(*To the Editor of The Engineer.*)

Sir,—Allow me to correct a mistake in the solution of the problem on velocity which appeared in a recent issue. The answer to the second question is wrong. This is my solution of it. Let t = time of body in falling, S = space described. Then in the case of the body S = $\frac{1}{2}$ft.^{2}, in the case of sound S = 1125 t. But by hypothesis these are equal.
$\therefore$ $\frac{1}{2}$ft.^{2} = 1125 t, and $f = g = 32{\cdot}2$ (accelerating force of gravity).

$$\therefore\ 16{\cdot}1\ t^2 = 1125\ t$$
$$\therefore\ t = \frac{1125}{16{\cdot}1}$$

Now S = $\frac{1}{2}$ft.^{2}

$$= 16{\cdot}1 \times \left(\frac{1125}{16{\cdot}1}\right)^2 = \frac{1125^2}{16{\cdot}1}$$

= 78,610·2ft. answer; or, finding t above to be 69·875, we have S = 16·1 × 69·875)^2, which gives same result.

In the above the resistance of the air is neglected.

H. Rolfe.

Brighton, October 12th.

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ADVERTISEMENTS.

DEATH.

On the 5th inst., at Valencia del Ventoso, Spain, of fever, Alexander Manson Rymer-Jones, Assoc. Memb. Inst. C.E., second son of the late Prof. T. Rymer-Jones, F.R.S., aged 36 years.

THE ENGINEER.

OCTOBER 14, 1881.

THE IRON AND STEEL INSTITUTE.

The members of the Iron and Steel Institute have every reason to be satisfied with the meeting which terminates to-day with an excursion to Newhaven and Brighton. The papers read have been very good. They were short, to the point, and eminently adapted for discussion, so time has not hung heavily within the hall of the Institution of Civil Engineers, courteously placed at the disposal for the nonce of the kindred society. It is, perhaps, to be regretted that but a few took part in the discussions; yet it cannot be denied that the metallurgical world is always glad to listen when Sir Henry Bessemer, Dr. Siemens, or Mr. Snelus or Mr. Riley speak. Both the first-named gentlemen sacrificed, we think, something of their dignity when they assailed on Wednesday, through Col. Maitland, successive English Governments, and Col. Maitland made a good point, and used an unanswerable argument, when he pointed out that everybody did not share Sir Henry Bessemer's confidence in steel twenty-seven years ago, and that Government Departments must have some consideration for taxpayers. The price of steel, even if it could have been obtained in quantity at the time named, would alone have sufficed to prohibit its use for guns until a cheaper material had been tried and failed. Mr. Bessemer's experience of steel was limited in the extreme a quarter of a century ago; and we may point out that for many years subsequently he failed to produce with regularity and certainty a material fit for guns. We can only deplore the fact that Sir Henry thought it desirable to accuse Sir W. Armstrong of pronouncing from unworthy motives, his steel unfit for guns. Sir Henry has enjoyed such a measure of success, and attained to such colossal fame and fortune, that he has not even a poor inventor's excuse for raking up accusations based on transactions which took place twenty-five years ago.

We willingly pass from this episode in the proceedings of the Institute to more genial topics. The paper read by Mr. Allan contains the most important and startling announcement which has been made in connection with steel since the basic process was first described by Messrs. Thomas and Gilchrist. The paper, and Sir Henry Bessemer's comments on it, must be taken as a whole, in order that they may be fully appreciated. It has been argued over and over again that steel is a perfectly homogeneous material. The steel makers have raved and torn their hair in their endeavours to persuade the public at large, and possible consumers of steel in particular, that they could supply a metal which was always and everywhere the same. It was interesting to hear Mr. Allan, representing a very large and important steel works, coolly ignoring all this, and asserting that steel ingots were like bad glass, with all the elements on which their quality depended irregularly distributed through the substance of the metal. Sir Henry Bessemer, following the same course, cheerfully told his hearers that it was so impossible to get uniformity of texture that one side of a table knife would differ from another. Thus, while engineers and physicists were racking their brains to account for the anomalies presented by steel—as, for example, in the case of the Livadia's boilers—it seems that the steel makers knew all along—some of them, at least—not only that the want of uniformity existed, but why it existed; nay, more, they knew how to cure the disease. All that is needed to produce fine cutlery steel is the incorporation of the metal and the metalloids, by stirring in the ladle. We have no reason to doubt that Mr. Allan's and Sir Henry Bessemer's statements on this subject are accurately correct; but the circumstance that although steel has been made on a large scale for nearly twenty years by the Bessemer process, no one found out till the other day that by stirring it when melted it could be deprived of its worst faults, is not complimentary to the intelligence of those who made it. In future it is to be hoped that the stirrer will be found in all Bessemer steel works; in some it is certainly much wanted. If it can be taken as proved that stirring will render Bessemer steel in future perfectly homogeneous, this particular form of the metal will rapidly rise in favour, and stirred Bessemer ingot metal will perhaps supersede steel made by the Siemens-Martin process. The stirring which the latter metal undergoes while in the hearth may perhaps have conferred on it the qualities in which it is apparently superior to Bessemer metal. The new system will, however, bring both on a level; and stirred basic steel ought to be made at a somewhat lower price than Siemens-Martin steel. Furthermore, once it is proved that this stirred steel is really and in all cases what it ought to be, once it has been shown that stirred steel is perfectly trustworthy, always and at all times, iron will have to give way absolutely, and a new era of construction will dawn on the world. We do not think we exaggerate when we say that the stirrer is, if Mr. Allan and Sir Henry Bessemer are right—and who shall say they are wrong?—competent to do more to popularise the employment of steel than any other invention brought before the world since Mr. Bessemer first blew a blast through molten iron. Nothing could be more emphatic than Sir Henry's statement that the stirred steel made by the Henry Bessemer Company is equal in all respects to the very best crucible steel ever made in Sheffield.

It may be urged, perhaps, that these and similar statements apply only to the case of highly carburised steels suitable for cutlery, but this cannot be so. The presence or absence of a little carbon settles the question of hardness; but soft steels require to have the silicon, phosphorus, sulphur, and manganese equally distributed through them. The manganese should be present everywhere to do good, while the concentration of any of the other elements in particular places should be prevented, for the same reason that the police in foreign towns will not allow even small crowds to assemble, namely, lest they should do mischief. No matter from what point indeed we examine this question, it appears to be equally clear that the stirrer is the one thing needed to solve many problems, to reconcile certain conflicting interests, and to relegate many perplexities, heart burnings, jealousies, and speculations to the limbo of the past. The only puzzle remaining will be, why did not someone long since use the stirrer? Another not less curious question is, why did not steel makers admit, before Tuesday, the 11th October, 1881, that the manganese and iron were not properly incorporated in the ladle or the ingot, that the gas was not perfectly driven out of the molten metal, and that because of this, steel played unheard-of pranks, and nearly ruined its reputation every now and then? If they had admitted this, a dozen or a hundred devices for stirring the metal would have been submitted to them for their adoption. We can hardly think that the steel makers have treated the engineers quite fairly in this matter; yet we can afford to let the present bury the past, if only the magnificent results indicated by Mr. Allan and Sir Henry Bessemer can be realised in the future.

ENGINEERS FOR INDIA.

In another page will be found two letters from engineers residing in India. These communications criticise sharply enough an article on Cooper's Hill College which appeared in this journal of the 22nd of July, and they deserve to be noticed. Courteously but precisely our correspondents deny the truth of our statements, and would have the world understand that Cooper's Hill men have given every satisfaction in India. In a word, while we have stated that Cooper's Hill College turns out educated and accomplished gentlemen, who are not engineers in the full sense of the word, Mr. Mallet and "Pew" assert that these gentlemen are in many respects competent engineers; and that even if they are not when they arrive, the course of training which they have undergone enables them rapidly to acquire the practical part of their profession. In proceeding to deal with these statements it will be well to point out that a great deal turns on the meaning attached to the more important words we have used. These are "engineer" and "competent." Unfortunately they admit of wide latitude of interpretation, and to the men whom our correspondents hold to be competent engineers we should perhaps not dream of applying the term. When, however, we examine his statements closely, it will be seen that while Mr. Mallet disputes the accuracy of our statements, and the pertinence of our arguments, he admits that Cooper's Hill men have much to learn when they get to India. This is precisely our contention, and if he concedes this he concedes all that we wish to demand.

The whole question is of considerable interest and importance. It ought to be clearly understood that Cooper's Hill was established not because engineers could not be got for India, but because they could not be got at the price which the Indian Government was willing to pay for their services. The training school for naval engineers is precisely the analogue of Cooper's Hill. The Admiralty will not pay enough to induce good men to serve as engineers in ships of war, so they proceed to train boys to ultimately fill the vacant berths. This appears to be a favourite device with English Governments, and so far it has not answered very well. Stripped of the adornments with which the scheme is decorated to attract public favour, we find that the principle involved is simple, and in many respects extremely objectionable. Lads who know nothing about what is before them, are put to learn to be naval engineers. Their parents know still less. The pupil's future is irrevocably fixed; and when he comes to years of discretion he finds himself, whether he likes it or not, a naval engineer for life, which is just what the Admiralty wanted. This is an attempt to steal a march on the public, and to pay men less than their services are really worth in the open market. The young men who went to Cooper's Hill and their parents had, perhaps, their eyes open, but specious promises have blinded them to the fact that Cooper's Hill College would have had no existence but for the fact that the Indian Government would not bid high enough for competent men. To all intents and purposes, however, Cooper's Hill College may perhaps be said to have ceased to exist, for the present at all events. We desire to be clearly understood to say that within its walls all was done that could possibly be done there to turn out engineers. We find no fault on this score. But we repeat that it is simply impossible for any course of college training to make a civil engineer. On this point a considerable amount of misapprehension seems to exist. It is held by a great many persons that engineers can be developed in libraries; and that lectures and class-rooms will teach all that an engineer needs to know. This theory is based on another—to wit, that the engineer has nothing to do but design works, and make calculations, and determine dimensions, and elaborate details on paper. This is a complete mistake. The engineer has to do all this, and a great deal more. He has, for example, to control men, to look after accounts, to attend to questions of transport, to consider wages, and, in short, to transact a great deal of administrative work which is not engineering at all in one sense, and the very highest type of engineering in another. Again, the unforeseen is continually turning up, especially in new countries; and it can never be dealt with properly for the first, or even for the twentieth time. Every time an engineer gets into and gets out of a difficulty, he learns a lesson of the utmost value; and nothing developes that quality known as resource so much as constantly drawing upon it. Men trained in colleges know nothing about administrative details. The best man ever turned out by Cooper's Hill College could not take charge of a large contract, manage his men, buy his materials in the cheapest market, arrange for the transport of them at the smallest cost, or attend to any one of a hundred different things which claim the constant attention of the competent and conscientious engineer. Our correspondents appear to think that we disparage Cooper's Hill men because we have implied that they are ignorant of much that the fully trained engineer has at his fingers' ends; but we do not blame the students for this. We do not blame the College. What we assert is that the system is not a good system, and that it was specially unsuitable to India.

We do not stand alone in making this statement, or in holding these views. It will hardly be disputed that Sir Andrew Clarke, R.E., is an eminent and trustworthy authority on Indian affairs. We have before us a report of a minute by this gentleman on the reorganisation of the Public Works Department of India. We reproduce his history of the supply of engineers to India. "I find," writes Sir Andrew, "that in the infancy of public works in India the whole of the engineers were drawn from the army, either from the local corps of military engineers, or from among the officers of other branches of the East India Company's army, the latter often being possessed of very slender qualifications. About 1852 the engineer establishment began to be recruited by the passed students of the Thomason College. In 1855, and again in 1859, a number of engineers of some experience in their profession were sent from England under agreement with the Court of Directors. In the latter year, too, commenced the annual supply of young engineers, generally known in this country as the Stanley Engineers, who were selected by competition at a professional examination, with the condition that they should have had some practical experience in their profes

sion under a recognised civil engineer in practice. The number of engineers, however, obtained from these sources was quite insufficient to meet the great expansion of the operations of the Department, and in 1867, at the repeated request of the Government of India, the Secretary of State caused to be selected from among candidates invited by advertisement, thirty engineers, of whom twenty-six were appointed in the third grade, executive engineers, and four in the fourth grade. Again, in 1868, fifty engineers were appointed in the same manner by the Secretary of State. At the same time the strength of the Royal Engineers in India had been increased by two battalions. In 1870 the Royal Indian Engineering College was established at Cooper's Hill under the orders of the Secretary of State, the first batch of pupils from which were to be ready by October, 1873. Meanwhile, probably in part owing to greater strictness in the examination, *but mainly owing to the insufficiency of the initial salary to induce good men to come forward*, the supply of Stanley Engineers all but failed. In September, 1870, only ten out of seventy-five candidates were found to be qualified, and again in September, 1871, only four were appointed from thirty-five candidates for twenty appointments. Thereupon, the Secretary of State requested the Government of India to take advantage of opportunities to engage in India eligible men who might have left, or be leaving, guaranteed railway companies. The Government in this country had already engaged a large number of engineers in India, and was now, until the supply from Cooper's Hill should begin, entirely dependent on these direct appointments, and on the supply from the Indian Civil Engineering College and the corps of Royal Engineers."

The italics are ours, and the words show very clearly why Cooper's Hill College was established. Sir Andrew's minute was written in 1878, and some changes have been made since, but they are few. His contention is that there are too many engineers in India ; but it appears that he does not hold that there are too many good engineers, and he suggests that a clearance should be made, and that the men who are incompetent or inefficient, either from bad health or other causes, should be sent home, say, on pensions. It is necessary to explain this in order that the quotations which we make from the minute may be quite intelligible. Speaking of Cooper's Hill men, he writes :—"In the first place I would at once address the Secretary of State, asking him to keep back for the present the supply of assistant engineers from Cooper's Hill. Appointments as assistant engineers on Rs. 350 per mensem are guaranteed to them, and must of course be given, but they should be kept in Europe for another term, *and detached to visit, and prepare notes and reports of, works in progress, and possibly be actively employed in them.* If the Secretary of State could in any way manage this, it would be to some extent a relief to us, *and it would moreover make them more valuable servants of Government when they do come to India, as it would give them some practical knowledge of their profession, and above all of how to arrange and control labour, a quality the absence of which forms the subject of frequent comment in the reports submitted on this class of engineers.*" Again the italics are ours. The words italicised supply the strongest confirmation possible of the accuracy of the opinions we have expressed. Further on Sir Andrew compares the Stanley engineers with those from Cooper's Hill. The former, he says, brought with them "*some* practical knowledge of their profession." "Those from Cooper's Hill, though possessed perhaps of a higher general education, and on the average a higher social status than the men from Thomason College, *have really no practical knowledge of their profession*, and for some time after joining the Department *are of very little use indeed.* My belief is that they have been led by injudicious friends to think too much of their attainments before they came to India. This will certainly wear off as they gain experience in life." This is tolerably plain speaking, and were it needful we could multiply quotations to the same effect. We have said enough, perhaps, to convince our correspondents that the opinions we hold are held by the most eminent authorities in India. Their own favourable experiences appear to be strictly exceptional ; or else they are easily satisfied. Experienced engineers would have had next to nothing to learn when they arrived in India.

The whole question, how best to educate a man so that he may become a competent engineer in the full sense of the term, is of great gravity. Its solution can only be reached by considering carefully, first, what an engineer must know ; secondly, what he can learn. Abroad great importance is paid to mathematical training ; but it is a fact well known to all civil engineers that a little simple trigonometry, plenty of sound arithmetic, and enough algebra to enable a formula to be read, is about all the mathematical knowledge required in practical everyday work. We have no desire to disparage mathematical training, such as is best acquired at college ; but we assert that it cannot be made to act as a substitute for practical experience. Let it be borne in mind that the greatest engineering works the modern world has produced have all been carried out by untrained men who never saw the inside of a college. George Stephenson carried a railway over Chat Moss, but he could do little more than write his name, and his mathematical information was of the feeblest description. Stephenson, Rennie, and a host of the earlier engineers, some alive to this day, got on with a surprisingly small amount of book learning. It may be said that their great talents compensated for the deficiency ; perhaps so, but we fear that the rule will not work the other way. Book learning will not compensate for want of brains. In India especially it would seem that the practical man is wanted, and a book-learned man out of place. If we are asked to define what we mean by a practical man, we must decline for the moment to enter upon an explanation which could not fail to be lengthy. We shall give instead a definition which we once heard, and which is quite to the point : "A practical engineer is the man who will pull on his boots and show a hundred workmen how to do that which they did not know how to do before, and having shown them how to do it, will make them do it, whether they like the job or not."

THE NORTHERN GAS MANAGERS.

The meeting of the members of the North of England Association of Gas Managers at West Hartlepool brought from the President—Mr. Thomas Trewhitt—some remarks on the area of the use of gas that are worth attention. Mr. Trewhitt expressed the opinion that gas would continue to be the "general illuminating power of the country," whilst he had strong convictions as to the probability of its growth for other uses. The chief of the methods thus indicated were the substitution of gas to some extent for steam and hydraulic power, and possibly also there was in view that use for purposes of fuel that is now steadily growing. "If you would work tramways," said the president, "economically, silently, and in every respect efficiently, I would individually recommend gas as the motive power." It may be that in this direction a large advance may be made, and it is tolerably certain that for power-procuring purposes the use of gas will grow ; but it is up to the present a fact to be noted that the chief demand, present and prospective, is for household purposes—that is to say, for house and shop lighting and warming, and cooking. The duty of the gas companies, then, is to stimulate this use, though adding to it all others that the nature of the light brings in their way. Mr Trewhitt, who is the manager and secretary of the Hartlepool Gas and Water Company, went on to claim for gas companies the need of further powers—especially "more control over the consumption" of gas than they now have. Attention was drawn to the inadequacy of the fittings often existing, to the smallness of the pipes for the burners, and the consequent complaints that arose as to inadequacy of supply. It was urged that the suppliers of the gas should have power to control the interior fittings, and "power to regulate the size and strength of pipes and other fittings beyond the meters, and up to the points of consumption." It is true that there may be a need for an occasional control, but it is scarcely likely that Parliament would give to the supplier the extensive power that is here claimed for him ; and though instances of pipes inadequate to the work to be done are given, yet it is to be borne in mind that the "lights" supposed to be supplied from a small pipe are rarely all lit at one time, and thus the apparent inadequacy of supply is less than it seems. At the same time there is need for some systematic inspection of gas fittings and of the working of meters, both on the part of the consumers and the suppliers. At the meeting in question much of the time was taken up with papers on the purification of gas, and the importance of it cannot be gainsaid; but the public interest at the present time is chiefly given to branches of the gas question that were only incidentally touched—how gas can be made cheaper and better, and how it can be made available for the fuller uses we have indicated, so that the rate of the growth of the consumption may not be checked by the intrusion of the electric light into the area of public lighting. It is now only a question of time when this use of gas will be lessened by the newer and more powerful light of the time, and the energy of gas managers might be most fittingly given to attempts to enlarge the area of the demand for their light by selling cheaper and better gas.

CHESTERFIELD UNDER THE ELECTRIC LIGHT.

Chesterfield has tested the suitability of the electric light for a town of some thirty thousand inhabitants—that is, so far as the illumination of public places is concerned. At nine o'clock last Saturday night the long expected test took place, and the town, after a month's darkness, luxuriated in all the brilliance that the electric lamp could give. Seven 2000-candle power lamps were placed in the principal squares and streets. The machinery was situated in the old Theatre Royal at the bottom of the market place, and the whole of the lights were worked on one circuit. The electricity was produced by one of Brush's 16-light dynamo machines, worked by one of Messrs. Fowler and Co.'s compound 8-horse power engines. The jets were encircled by opal globes, by which a very perfect diffusion of the illuminant was secured, and while glaring was successfully evaded, the lamps were so carefully regulated that very little oscillation was perceptible. The light was generally regarded as very pleasant to the eye, and gave great satisfaction to the crowds of spectators who had proceeded to Chesterfield to watch the experiment. The contractors, Messrs. Hammond and Co., have been applied to by leading tradesmen to have their premises similarly lighted. The time of the experiment is to be extended from a week to a fortnight, to give the public ample opportunity for judging the capabilities of this method of illuminating public thoroughfares.

LITERATURE.

The Mechanical Engineer's Office Book : Boiler Construction. By Nelson Foley, late Assistant Manager Palmer's Engine Works, Jarrow. London : Crosby Lockwood and Co. 1881.

Books of several kinds have been published with the object of facilitating the usual calculations which have to be made for different kinds of engineering work. It has not always been found that these books have afforded any of the promised facilities or saving of time. The book before us is designed to simplify all the principal calculations upon boiler work, the chief feature of the work being a series of diagrams intended to save all calculations for the quantities or values which are usually found by the use of the Board of Trade and of Lloyd's rules and formulæ. The rules and formulæ are given at length, so that the calculations may, if preferred, be made by these and checked by means of the curve diagrams, but a very little practice will soon enable any one to arrive at the results without the calculation; for the diagrams are for once such as may be understood and that easily, by others than the author. They represent the formulæ worked out for the diameter of shells, thickness of plates, strength of flat plates, furnaces, pitches and sizes of rivets, and pressure per square inch; taking into consideration the percentage of strength at joints, and different assumed factors of safety for iron and steel. These are all to be easily and accurately read off; and the diagrams are so arranged that the engineer will not feel that misgiving as to the values obtained which often, with similar calculating diagrams, has driven him to make the calculations just as though he had no diagrams at all. Usually only three quantities can be obtained, or rather represented, by co-ordinate curves, but Mr. Foley has combined co-ordinate scale curves with the main curve diagram in such a way that five quantities are represented without confusion ; the method having been originally suggested to him by Mr. Pirie, of the Bon Accord Engine Works, Glasgow. It has been very seldom indeed that curved diagrams for such a purpose have recommended themselves to us as of any real advantage, and often they have been of more trouble than profit. These curves are, however, at the same time comprehensive and simple, and will save a good deal of time in office work.

Throughout, the book is designed so that reference to any part of its contents can be instantly made ; and this is chiefly effected by cutting the edges of the pages like the index margin to a ledger or address-book, and printing the reference to the contents of the page on parchment slips. Thus, on opening the book the whole contents are displayed at a glance, and any page may be turned up without second reference, as to an ordinary index. The following are the heads of contents, as thus seen on opening the book-cover :—Board of Trade shells. Rivetting, butt straps, manholes, flat plates, stays, girder stays. Lloyd's shells, flat plates, stays, girders, furnaces. Rivetting, general. Decimal equivalents. Surface of tubes, areas, decimals. Circumferences, areas, squares, cubes, fourth powers. Circumferences and areas in feet. Screws, safe loads. Weights ; rivets, iron ; rivets, steel ; plates, bars, nuts, tubes, and L-bars. Diagrams 1 to 25. Rivets, diameter. Pitch, length. Coal consumed. The tables of areas, circumferences, and decimals are worked out from the smallest fractions accruing in practice, and advance by small fractions, so that the engineer, on turning to the tables does not find, as is often the case, that he has as much work to do in adding together the figures found in different tables as he would need to make the calculations for himself. The tables and the whole of the information are concise and well-arranged, and clearly printed. The diagrams, which are lithographs, are not well executed ; the lines are in many places much heavier than they need be, and they are not as clear as they might be by a great deal. The letters and figures on the diagram are moreover wanting in cleanness and neatness. This want of good draughtsmanship in the diagrams will not lead to error when they are used with proper care, as the value of a figure which is not clear, even if quite indistinct, can be verified by those contiguous. But this lessens the facility with which the figures might be read off if they were more like type than manuscript figures. The book is designed to be more especially the marine engineer's office book than for the general engineer, though it will be of great assistance to the latter. It is a book the matter in which is strictly confined to its subject as indicated by its title, and is one which may be confidently recommended as very useful.

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THE STRATFORD WORKS OF THE GREAT EASTERN RAILWAY.

These works, which were visited on the 13th inst. by the members of the Iron and Steel Institute, were originally laid out for the Eastern Counties Railway, then a small line, possessing barely 100 locomotives, and have been since expanded to keep in going order and repair the 550 odd engines, 2000 carriages, and 10,000 wagons which the Great Eastern Railway now possesses. It speaks well, however, both for the original designer of the works—Mr. Hunter—and for Messrs. Adams and Bromley, who have since carried out extensions and improvements, that the offices and principal shop—that for erecting—still serve their purpose, partly owing to a more methodical arrangement of the pits and cranes, partly to the greater durability of modern engines, and partly to the increased facilities afforded by the use of machine tools and standard sizes of parts. A standard boiler, for instance, which can be used for widely differing classes of engines, is always kept in stock, and an engine coming in for extensive repairs does not need to wait and take up shop room while a boiler is being made specially for it.

The erecting shop is interesting as being one of the earliest examples of the use of permanent cast iron wall plates for placing pulleys and countershafts at any convenient spot without disturbing the masonry. The travelling cranes are fine examples of trussed timber beams, and, like other cranes throughout the works, are driven by a cotton rope 1in. diameter, running at 1800ft. per minute. Portable drilling tackle and Stow's flexible shaft drills are extensively used, and do heavy work, for with the latter old longitudinal boiler stays 1½in. diameter can be more cheaply drilled out than unscrewed.

A complete system of 18in. tramways, with 21 lb. steel rails, runs through the works, and, by the use of 1-chain curves, a standard gauge locomotive and trucks can enter all the principal shops. Special shops, having suitable cranes, are provided for turning and boring tires and wheels, and putting them on their axles; for shrinking tires on wheels, and for taking tires off. The largest wheel lathe weighs 34 tons, has 8ft. 9in. face-plates; the loose headstock is driven by a 6in. wrought iron shaft. This lathe was made by Smith, Beacock, and Tannett, in 1880, and is one of the finest wheel lathes in existence. In the shop where the tires are put on, the handles regulating the different motions of the cranes are worked from the ground, thus saving a man, who can help to manipulate the wheel and tire when the crane is stationary. The furnace is remarkably economical, and a thick tire can be heated in about 4 min. 30 sec. The smiths' shop has a good wheel-making plant—new wheels being made and old wheels repaired, often having entirely new rims and spoke ends. The spokes are welded in their length, and not dabbed on the rim. The rims are closed up by a horizontal steam hammer, first used for this purpose by Mr. Bolas, of Messrs. Kitson. The olivers have C-springs, as used in old-fashioned chariots, the idea being taken from the Baldwin Works, at Philadelphia. These springs stand well, and the smiths say they are the next best spring to the old pole fixed to the rafters, which is objectionable, as it shakes the roof.

Locomotive boilers are not permitted to run at less than the standard pressure—140 lb. per square inch—but are used as stationary boilers at 60 lb. to 90 lb. as long as they are safe at this. The heating furnace upcasts deliver into the fire-boxes where the fire-bars originally were, and thus no expense is incurred for special stationery boilers. Great attention is given to springs. One man is responsible for testing all locomotive and tender springs, sees that they are right for camber within ⅛in., weighs and properly adjusts the engine on the weigh-bridge, getting not only the proper distribution of weight on the different wheels, but also the proper clearance above and below all the axle boxes, and levelling the engine fore and aft and crossways. During the last few years—since this has been done systematically—the number of broken springs has enormously diminished. The spring testing machine has a large horizontal steam cylinder, and the "fall" from a pair of pulley blocks being made fast to the ram the springs can be lifted in and out to be tested without any manual labour. Steam is, of course, not such an exact test as dead weight, but it gives approximately the modified blows which the springs receive when under an engine. All new springs are made with rolled eyes, plates cut off square—neither drawn or spear pointed—and ribbed and slotted. The machine for performing the latter operations is driven by ropes from a shaft some distance off: this mode of transmitting power being extensively used throughout the works.

The boiler rivetting, so far as possible, is done by a set of Tweddell's hydraulic rivetting plant. The boiler rings for the circumferential butt joints and the smoke-box angle irons are of steel rolled solid like a tire, and are driven by a machine made for the purpose. The pattern shop contains some special wood-working machinery, dimension saw, &c. Cast iron patterns are much used, all small standard patterns being on plates, and larger patterns being moulded in machines. The cupolas are unusually high, so as to obtain economy. The coppersmith's shop contains two tube-brazing furnaces; in one the tube is vertical, and in the other horizontal; in both the brazing is done by gas. The tubes are tested in an adjoining machine, being struck with a mallet while under hydraulic pressure. Iron tubes with brass ends are extensively used, and hence the importance of this plant. The different lines of shafting are driven by independent engines with 15in. by 22in. cylinders, originally made for locomotives since broken up. The space formerly occupied by the regulation pair of beam engines has been devoted to storing finished parts, which are here kept until wanted; standard cylinders, connecting rods, motions, brake work, &c. &c., being made for store and not for particular engines, time is saved.

Most of the heavy machinery, frame slotting, cylinder planing, &c., is in the side bays of the erecting shop; but the light machinery and brass lathes are in a separate shop, where a row of Hulse's winch lathes are noticeable. They were specially designed by Mr. Barrow, and have steel spindles running in hard steel bushes, instead of the usual brasses. When they first came they had no geared feed, under the idea that with a hand feed the boy would do the best the tool and metal was capable of, but a self-acting feed was afterwards added.

The general design of the shops is not precisely what would be adopted for entirely new shops on a convenient site, but the works will be fairly symmetrical, when, as ultimately must be the case, the running sheds are all shifted so as to be together, and the old sheds used for a carriage painting shop. The wagon shops, tender shop, engine painting shop, and running sheds will then be on one side of the line, and the engine and carriage shops, offices, stores, grease factory, and printing office on the other. The carriage and wagon shops being on different sides of the line necessitate two saw mills and two sets of wood-working machinery, which is objectionable, but unavoidable under the circumstances. Both carriage and wagon shops are tolerably complete and independent, each possessing stores for finished work, and machine shop and smithy; the foundry, however, before mentioned, is common to all three departments.

Two machines for finishing carriage panels are in use; in one made by Whitney, of Winchendon, Massachusetts, a perfect veneer is taken off the surface of the panel by a knife, leaving a perfectly smooth surface needing no hand finish. In the other, made at Stratford, a revolving cutter, with slightly obtuse angled blades, scrapes instead of cutting the surface of the panel.

The wagon shop possesses a fine saw-mill, the table being readily adjustable and having a quick return motion; it is supplied with timber by a travelling steam crane, made by Messrs. Appleby, and working on a gantry curved in plan to 15 chains radius, the wheels being, of course, of different diameters. The large wagon shop is a good example of cheap construction—galvanised sheets lined with boarding. It holds 100 wagons in all. By a little management on the part of the foreman, each row can be finished about the same time, and the whole row pulled out and replaced by another lot of wagons requiring repair. This shop is, of course, not large enough to keep 10,000 odd wagons in repair, but light repairs are done largely at out-stations, where wages and, in some cases, timber is cheaper, and the cost of bringing crippled wagons to London is thus avoided.

The new running shed is tolerably complete, with sheer legs, which are being cheaply roofed, sand furnace, tank with stoves, and men's supper-room underneath, and small machine and smith's shop, containing a wheel lathe, &c., so that running repairs can be executed without sending across to the main shops. Some vacant ground near, permits of much-needed future extensions to shelter the 130 engines now daily getting up steam.

The works, as a whole, are laid out in a remarkably business-like spirit, nothing seems to have been spent in any attempt to give a merely attractive appearance, but excellent adaptations of means to the end of economical production of work are everywhere apparent, and reflect great credit on the mechanical knowledge and economical acumen of successive locomotive superintendents and works managers, Messrs. Adams, Bromley, and Dykes who, in the course of a few years, without materially increasing the weekly expenditure, have more than doubled the amount of work turned out.

THE PARIS ELECTRICAL EXHIBITION.

No. IX.

We must leave the electrical apparatus for a while to describe a new gas engine exhibited by Messrs. Thomson, Sterne, and Co., of London and Glasgow. It is Clerk's gas engine, but in an entirely new form as compared with that exhibited at the Kilburn Show. Of this engine we give a perspective view, on page 278. All, or nearly all, the gas engines which have been successfully brought out have compressed the charge of gas and air, but have made only one ignition to every two revolutions. Clerk's new engine makes one ignition for each revolution. This, it need hardly be said, nearly doubles the power of the engine, though it adds a little to its weight.

The engine exhibited at Paris has a motor cylinder of 6in. diameter, and a light displacer cylinder, as it is termed, of larger diameter. The stroke of the piston is 12in., and it is connected to a crank by the usual rod; but the pressure in the displacer cylinder never exceeding about 5 lb. per square inch, the connections are very light, and it is driven from a pin on one of the fly-wheel arms. The displacer crank pin is in advance of the motor crank, and at a right angle thereto. When it moves forward the combustible mixture of gas and air is drawn into the displacer cylinder during the first half of the piston's stroke, at which point the gas is cut off, and only air admitted for the remaining part of the stroke. The displacer on its return stroke discharges its contents through a lift valve into the motor cylinder, the piston of which is hot at the outer end of its stroke, and has uncovered an annular port in the cylinder communicating with the exhaust pipe. When this part is uncovered the hot products of combustion discharge through it until the pressure in the cylinder has fallen to atmospheric pressure, when the air from the displacer entering at the back end, expels the remaining hot exhaust and passes in part through the exhaust pipe. The cylinder is now filled with fresh air, and when the combustible mixture enters, displacing in turn the air, the cylinder contains nothing but an ignitable mixture and air. The motor cylinder in its instroke compresses the mixture into a space at the end of the cylinder, the pressure rising to 45 lb. above atmosphere. Ignition then takes place, and the pressure rises to from 200 lb. to 250 lb. per square inch above atmosphere. The piston moving forward, the pressure gradually falls, and when the end of the stroke is reached the exhaust discharges at about 30 lb. above atmospheric pressure. This cycle of operations is repeated at every stroke. In larger engines, the terminal pressure before exhausting is, we are informed, very much less than 30 lb., sometimes as low as 5 lb., above atmosphere; but this is obtained by an arrangement which allows of a greater expansion. The volume swept through by the displacer piston is greater than the combined volume of the motor cylinder and space at the end of it into which the ignitable mixture is compressed; as half of its charge is fresh air, it follows that at every stroke of the engine the whole of the products of combustion are discharged and replaced by fresh cool air, before any combustible mixture is allowed to enter. This arrangement produces great certainty in the action of the engine. A great obstruction to progress in constructing large or powerful gas engines has hitherto been premature ignition, the combustible mixture entering the cylinder still containing products of the previous combustion, ignites at the wrong time either by flame still burning in the cylinder, or by sparks on the walls of the combustion chamber due to the ignited carbon from the decomposition of the oil used in lubricating. To secure freedom from these irregular ignitions, it is necessary first to clear out thoroughly any hot burned gases; and second, secure a sufficiently low mean temperature of cylinder surface and combustion chamber, so as to render the existence of sparks impossible. The object is attained by the use of the displacer cylinder, as the charge is not compressed in the cylinder, but merely passed into the motor cylinder at such a pressure above atmosphere as is necessary to lift the valve, and so discharge the exhaust. It follows that it may be made of any size found necessary to pass the volume of air for clearing and cooling.

This device is the essential feature of the engine. In previous gas engines it was sought to be attained by igniting but once in two revolutions, or even once every third revolution, to prevent premature ignition; but although this succeeds, success is purchased at the cost of a great loss of possible power. It is found by the prolonged experience of those using engines igniting every second revolution, that when working at full power they back ignite very often, and it is only when running light that they are free from this. The larger the engine the greater tendency to back ignition, and the less possibility of using the engine at its full number of ignitions. This seems to be so far prevented in Clerk's gas engine that it may be continuously worked up to its full power, igniting at every revolution without irregularity or stoppage.

The arrangements for admitting gas and air, for cutting off the gas at the proper time, for igniting, and for exhausting, are of a simple character. An automatic lift valve serves to admit the mixed charge of gas and air to the displacer cylinder; another similar valve passes the charge from the displacer to the motor cylinder. A small slide in the back of the engine, worked by an excentric on the main shaft, both ignites the charge at the proper time, and cuts off the supply of gas to the displacer at half its stroke. There is no exhaust valve. The piston uncovers the annular port at the outer end of its stroke, and the exhaust is discharged, and a fresh combustible mixture is passed into the cylinder by the displacer before it returns. The igniting arrangement differs from that ordinarily used in gas engines. This is necessitated by the much greater number of ignitions to be accomplished per minute. The arrangement used by Mr. Clerk is capable of making 300 ignitions per minute. The ignition slide has in it a small cavity, from each end of which is a port opening at opposite faces; at one end of this cavity there is a perforated plate, through which ignitable mixture passes from the motor cylinder, the communication being made by a small hole in the slide, and a gutter in the slide face, which is constantly on the hole in the port face leading to the combustion chamber. The mixture, after passing through the perforated plate or grating, is lighted by a Bunsen flame, and, burning at the grating, fills the cavity completely with flame and discharges at the port in the face. The movement of the slide causes this part to open on a small port in the port face, direct into the combustion chamber, causing the immediate ignition of the charge. The movement of the slide, of course, cuts off all communication with the atmosphere before communicating with the cylinder. The ignition port is extremely small, only ⅛in. by ¼in., so that the pressure necessary to keep the slide to its face is but slight, even at the high pressure of 250 lb. per square inch. By this arrangement the whole slide is of small dimensions, and there is no necessity for ventilating the port, as the mixture from the cylinder requires no exterior aid to support its combustion. The frequency of ignition, therefore, is thoroughly within control. The two automatic lift valves which, if used in the ordinary way, would cause considerable rattle, are rendered perfectly silent by a very simple arrangement of air cushions. The engine exhibited gives 6-horse-power on the brake at 145 revolutions, and indicates about 10-horse power. This is a higher power than that given off by other engines with similar cylinder capacity. Mr. Clerk's engine is well-designed, and promises to be highly successful.

THE EAMES DUPLEX AUTOMATIC VACUUM BRAKE.

On Thursday, the 6th inst., a series of trial stops and other experiments were made with the Eames Duplex brake, as fitted to a train of five vehicles and a light branch tank engine of the Lancashire and Yorkshire Railway. The brake has been at work on the vehicles about two years, so that the trials were made with a set of apparatus that had been well tested. The train consisted of—

	Tons.	cwt.	qrs.
One brake van, weighing	9	1	3
One composite carriage, weighing	9	10	3
One do. do. do.	9	10	3
One third-class do. do.	9	1	3
One do. do. do.	9	7	2
Total without engine	46	12	2

The train left Leeds at about 9 a.m., and proceeded to the Barnby Don branch of the Great Northern Railway, which is entered at Adwick Junction. There were present, Mr. F. W. Eames and others, including Mr. J. Shotton, of the Great Northern Railway; Mr. David West, District Locomotive Superintendent of the Great Northern Railway; Mr. George Gresham, of the Vacuum Brake Company; Mr. R. Robinson, Goods Manager of the Great Northern Railway; Mr. F. Attock

Superintendent of the Carriage and Wagon Department of the Lancashire and Yorkshire Railway Company; Mr. Charles F. Reynolds, Mr. Evans, and Mr. Mackay, Assistants in the Locomotive Department of the Lancashire and Yorkshire Railway Company; and Mr. Francis Campin, C.E., who, assisted by Mr. A. E. Schurr, recorded the results of the trials. The Barnby Don branch is level except a few hundred yards at about its mid length, where there is a considerable gradient for crossing the Midland Railway. As soon as the branch was entered a number of stops were made on the level and one on the gradient of 1 in 120 down. It was a dull, wet morning, and rained a good deal during the early runs, so that the rails were wet. It, however, became finer afterwards, and the rails soon dried and were in very good condition.

The speeds were taken by means of Stroudley's speed indicator driven from the second axle of the brake van next the engine. The distances were taken by means of a counter, which received its motion in a similar manner from the axle and through the medium of an intermediate grooved wood sheave driven by leather cord, the counter being arranged so as to be controlled by the vacuum actuating the brake. Thus it was held out of gear by a spring so long as the brakes were off, but the formation of the vacuum to apply the brake immediately put the counter into gear by means of a friction clutch. The counter gave the number of revolutions of the off wheel on the axle from which it was driven, this wheel having a circumference of nearly 127in., or 10·58ft., as found by running it over a rail and measuring the distance covered by a revolution. The time occupied in stopping the train was taken as being that from the moment the vacuum put the counter into gear to the moment when the backward jerk of the final stop was felt. It was taken by several observers. Though some improvements in detail have recently been made in the brake apparatus, it is nearly the same as when described by us with complete illustrations in The Engineer of the 9th July, 1880, and as commented upon—when tried with the Westinghouse and the Sanders brakes at Gisburn—in our impression of the 23rd July, 1880. The improvements which have been made do not alter the character of the brake; but as one prevents the leaking off of the brake—by the provision of a triple valve in the valve chamber—when any joints are defective from any cause, it is of importance, and we may illustrate it with the others in a future impression when more complete trials than those of the 6th inst. are made. It may be here stated that the light engine used on that day carried so small a quantity of water that a great deal of time was lost in re-supplying it, so that the trials were not so extensive or so complete as was intended.

The following are the figures obtained when the rails were dry and on the level part of the line :—

Results of experiments with Eames' Brakes, on the Barnby Don Branch of the Great Northern Railway, 6th October, 1881.

Table No. 1.

No. of Trial.	Speed in miles per hour.	Time occupied in Stopping. Seconds.	Distance run after application of the brake. Yards.	Equivalent time for a speed of 50 miles per hour.	Equivalent distance for a speed of 50 miles per hour.
10	54	14	218·6	11·9	185·8
11	43	10·75	171·0	12 50	231·20
12	49	20·00	280·3	20·15	291·85

These were all slip stops. The difference in the time and distance traversed in making a stop cannot be very well explained, except by slight difference in the state of the rails, for the vacuum obtained in each case was between 20in. and 21in. The rails must, however, be considered dry, except in stop No. 12, and where this was made the trees grow rather closer to the line and the rails were certainly not perfectly dry, but they could not be said to be wet.

The two stops which followed these were made, first with one and then with two of the india-rubber diaphragms cut with a knife for about three-fourths of the circumference, so that they hung down completely destroyed for brake purposes.

Table No. 2.

No. of Trial.	Speed in miles per hour.	Time occupied in stopping. Seconds.	Distance run after application of the brake. Yards.	Equivalent time for a speed of 50 miles per hour.	Equivalent distance for a speed of 50 miles per hour.
13	47	27	320½	25·80	362·72
14	45	30	380½	33·33	469·75

These figures are sufficient to show that the destruction of the most vulnerable part of the brake apparatus of any one coach, still leaves the brakes of the remaining carriages perfectly efficient. In the second of the above experiments, No. 14, the wheels of the vehicles with the unimpaired diaphragms were skidded by the brakes. The brake blocks were adjusted so that when off they were very close to the wheels.

After this the engine required a fresh supply of water, and as it was late no more runs were made. With the train standing it was, however, shown that with the plain brake disconnected from the engine and the pipe open from end to end of the train, the automatic brake would still act and maintain the brakes hard on the wheels, even when two diaphragms were destroyed. Other experiments were made to show that with the automatic pipes disconnected but with the plain brake pipes connected to the engine, the plain brake could still be applied to the two vehicles next to the engine and in front of the first vehicle with the destroyed diaphragm, though the plain pipe was open at the end of the train, and also to show that with the automatic part of the ejector wholly removed, as though disabled or knocked off by accident, the plain brake would act while the pipe was yet open at the end of the train, on the wheels of the vehicle next the engine, and on the engine. All these experiments are, as we have said, to be looked upon as preliminary to others to be made at an early date with more complete and automatic arrangements for registering the speed, time, and distance run, which, we believe, are being constructed under the supervision of Mr. F. Campin for the Eames Brake Company. That the Eames brake can make good stops has not, that we know, been questioned, and it is to show more accurately than hitherto what can be done by it that the new-recording apparatus is to be made. Meanwhile, the chief argument of Mr. Eames is that his brake is simple in its parts and answers all requirements, with the advantage that being a vacuum brake it may run with any other vacuum brake stock when a standard form of coupling has been adopted. This argument might, of course, be used in favour of any brake, and only applies somewhat more especially to the vacuum brakes, because there are several of them in use. It must be admitted that the experimental train of the 6th inst. was a very short train, a fact greatly in favour of the brake; the whole of the train, or as we may say for purposes of comparison, 100 per cent. was braked. Thus, if we turn to the Gisburn experiments, it will be seen that stop No. 10 above is about the best the Eames brake has here made, while stops 11 and 12 are not so good as the average made by this brake at Gisburn, though the percentage of train braked was then 88·1 only. The average of the stops made at Gisburn was as follows:—

	Yards.
Eames	251·3
Sanders	240·6
Westinghouse	184·8

It will thus be seen that the additions which Mr. Eames has made to his brake since then have not much increased its effectiveness in stopping a train, though they have decreased the number of contingencies under which the brake might be rendered powerless. It is an objection, however, to the modifications that they remove all claim to superior simplicity over air-pressure brakes, while they do not, as far as we can see, give any facility for putting the brakes on, on a slip train after they have been taken off, as, for instance, when a guard of a slip train finds he has brought or is bringing his train up short of the platform. Very large auxiliary vacuum vessels are used, but these will not permit the brake to be put on twice or thrice if wanted.

The following figures relating to stops made by the train previously to those already referred to, and while the rails were all wet, were taken as the train ran first to the trial ground by Mr. Campin and the engineers above mentioned. All, we are informed, were made on the level, except the last, which was on a down gradient of 1 in 120 :—

No. of Trial.	Speed in miles per hour.	Time occupied in stopping. Seconds.	Distance run after application of the brake. Yards.	Equivalent time for a speed of 50 miles per hour.	Equivalent distance for a speed of 50 miles per hour.
1	45	20½	249½	22·77	308·02
2	44	21	324½	23·86	419·03
3	44	19½	270¾	22·16	349·62
4	36	17	109½	22·61	210·84
5	35	12½	130½	17·85	266·32
6	34½	13	108½	18·84	227·26
7	34½	16	144½	23·18	303·08
8	36½	17½	177	23·97	332·14
9	30	14	108	23·33	300·00

We understand that the brake as fitted to the stock of the New York Elevated Railway, makes 69,277 stops every twenty-four hours, and has done this for some time without hitch of any sort.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents.*]

THE CITY OF ROME.

Sir,—It is to me no matter of surprise that the City of Rome has not attained a good speed. The steam pipes of the ship are far too small, being only 11in. in diameter each for a 46in. cylinder. They ought to have been at least 15in., seeing that they are very long and awkwardly bent. I have not seen the diagrams, but I shall not be surprised to hear that the boiler pressure, 90 lb., was not nearly reached in the cylinders. If the indicator shows 70 lb. I shall be surprised. Bex.

Liverpool, October 10th.

COOPER'S HILL COLLEGE.

Sir,—Should no more worthy correspondent come forward, I trust you will give me space to defend the College of which my remembrances are so pleasant. The first leader in your issue of 22nd July, 1881, is headed "Cooper's Hill College," but also contains a severe attack on almost the whole of the Public Works Department of India, to which I do not feel myself qualified to reply. In this article the conclusion is arrived at that Cooper's Hill has been a failure because it does not turn out finished practical engineers. I must protest against the supposition that it was ever expected to do so. I think this is sufficiently proved by the fact that all Cooper's Hill men enter the department as second or third grade assistant engineers, in which capacity all their work is done under the direction, and subject to the approval, of the executive engineer under whom they may be serving.

A man may expect to remain second grade for from three to six years, and the same time as first grade, so that he has had a fair experience by the time he commences to plan and work according to his own ideas. At present I am out in the jungle, so cannot state exactly how many Cooper's Hill men have reached the grade of executive engineer, but I can only remember one, and I think I shall be quite safe in saying there are not more than ten, so that it appears rather early to arrive at the conclusion that Cooper's Hill men "always have been, and always will be, men of theory." As we are constantly face to face with practical work, I trust, and believe, that this conclusion is without any substantial foundation.

Bombay, September 20th. Pew.

Sir,—Your issue of 22nd July last, in its article on Cooper's Hill College, seems to me to speak slightingly of the qualifications of the engineers whom the College has supplied to India, and in terms which are both discordant with fact and unreasonable in themselves.

When you say that Cooper's Hill men always have been, and always will be, men of theory only, if you mean that this is so on their leaving college, it is no doubt mainly true; but surely that proves nothing amiss in the men or in the College. How could it be otherwise with any young men, or with any college course? But if you mean—as the rest of the article shows you do mean—that Cooper's Hill men continue during their Indian careers to be merely men of theory, inquiry from those who know would be answered by an assurance to the contrary. I have myself had thirteen Cooper's Hill men as assistants, of whom nine are far above, and none are below, the average of men of their age and standing, as thoroughly practical engineers.

You say there are in India no contractors in the sense in which the word is used in England, and that the practical men of ability are here too scarce and busy to teach theorists. Does anyone really believe that any practical engineer was ever "taught" his knowledge by another? Like all other real knowledge, it must be taught to the owner by himself. And it would be a great mistake to suppose, as you seem to do, that India does not furnish an excellent field for acquiring the most practical knowledge of engineering. Here, it is true, we have few or no contractors in the sense in which you use the word in England; but their absence makes us all the more practical engineers, for we have to be our own contractors, to ourselves engage in the hand-to-hand struggle with nature in subduing her forces to our uses, and thereby we acquire a much more practical acquaintance with engineering than the engineer who, trained in an office, and only seeing and hearing how works are carried out by contractors, but not doing them himself, can possibly gain.

Here in India the engineer has himself to learn the arts of brick-burning, tile-making, and lime-burning; of the quarryman, stone-mason, bricklayer, blacksmith, founder, navvy, miner, and what not; and that most practically, for he has to *do* these things, and to show a good material and financial result when they are done; and he has often to teach these arts to untrained natives, who are ignorant of them. He, far more than the European engineer, has to devise his own methods, to adapt them to the rude appliances of the country, to improve upon these, and often to design and make his own tools and machinery or plant. The English engineer can command the services of skilled and experienced contractors, and through them of the most recently improved materials, appliances, and methods, and of old-established industries; but the complacent assumption that these advantages tend to make him a more practical engineer than he who has to extemporise these things for himself, seems rather amusing.

You say Cooper's Hill turns out "educated gentlemen, trained mathematicians, good linguists, admirable draughtsmen, but it does not turn out engineers in the full sense of the term." If you had added, as you might well have done, that it turns out men who have been well trained to rapidly become engineers in the full sense of the term, in the practical field open to them in India, you would have given the College the highest praise, from which the only deduction would be that it has been a success, and has done all that it could be ever expected to do.

At the same time, I do not believe that the founding of the College was rendered necessary by the absence of other sufficient places of engineering education. King's College, London, and the Engineering Schools of Trinity College, Dublin, if not of Oxford and Cambridge, could and did turn out in sufficient numbers just as good men as Cooper's Hill; and the only reason why the Government of India failed to secure their services was, because it did not offer the necessary inducements—which it afterwards did offer to its own men from Cooper's Hill.

R. T. Mallet, M.I.C.E.,
Superintending Engineer, Indian State
Simla, Punjab, Sept. 12th. Railways.

DRY COLD AIR MACHINES.

Sir,—In reference to Mr. Coleman's communication to you on this subject in your last impression, your readers will probably recollect an interesting letter which appeared in the *Times* of the 30th August ult., respecting the Orange establishment in Australia for freezing meat. In this account the correspondent, who speaks from what he actually saw, writes that no better meat is used in the colony than that which he saw there prepared for shipment per the ss. Cuzco.

This meat so referred to is the same as Mr. Coleman describes as being in an "imperfectly frozen state" when removed from under the influence of a refrigerator of our make, employed by the Orange Company, to that of a machine of his own; and if, as Mr. Coleman suggests, the meat became more frozen after being put on board the Cuzco, this should not be a matter of surprise, since our refrigerator was a small one, only delivering 15,000 cubic feet of air per hour, whilst that of Mr. Coleman produced 60,000 cubic feet of air per hour, or four times as much as ours.

Be this as it may, the fact which he mentions, that the slaughtering company at Orange have entrusted us with the manufacture of two new and more powerful refrigerators, argues very favourably for the efficiency ot the machines we have already supplied them.

As regards the P. and O. Company, to whom reference is made in Mr. Coleman's letter, we would beg to observe, so far as concerns ourselves, that it was not by reason of persuasion—as Mr. Coleman asserts—but as the result of the most careful and searching trials that we were favoured with instructions to fit with our improved dry cold air machine their latest ship, the Clyde, and have instructions from them to fit with similar refrigerators two more vessels shortly to be launched, viz., the Sutlej and the Ganges. J. and E. Hall.

23, St. Swithin's-lane, London, Oct. 13th.

CONTINUOUS BRAKES.

Sir,—I have been much interested with your article in last week's Engineer, in which you call attention to the Board of Trade report upon the performance of the various continuous brakes for the half-year ending June 30th last. It was no doubt the intention of Government that the half-yearly reports of the railway companies should be a faithful record of the working of the various brakes in order that a judicious selection might be made. If from any cause these returns cannot be relied upon, you do the public a great service by commenting upon them as "useless." It would occupy too much of your space to allude to the many failures of continuous brakes which have come under my notice, but that considerable doubt exists as to the validity of the railway companies' returns is evident from the letters which have lately appeared in The Engineer from the engine drivers of the Midland Railway. Those letters show that the brake which the Midland Railway Company has adopted cannot be worked upon heavy express trains without losing time. According to the testimony of the drivers, they are obliged to run between stations with brake shut off, and create the power only when approaching them. They further show that the brake after being applied rapidly leaks off, so that upon inclines the safety of their train depends upon the engine brake, with which alone they can be but partially controlled.

I find no mention of these defects in the returns of the Midland Railway; but, on the contrary, the report is particularly favourable to the brake they have decided to adopt, whereas, according to the testimony of the engine-men, it is an entire failure, either in case of emergency or break-away upon an incline.

If what the Midland drivers state be true, it is high time that their representations be inquired into, and the Midland Railway Company called to account for not including in their returns every instance in which the brake has failed or been unavailable.

The Board of Trade officials are required to inspect the signalling arrangements, and other means of safety before the railway companies are permitted to use them. They are also required to report upon accidents arising from the failure of the machinery employed in conducting the traffic; why therefore should they not be called upon to look into the practical working of continuous brakes, especially where the servants of a large and powerful company are representing to the public they have been supplied with a continuous brake which they cannot use, without increasing the dangers of travelling by irregular and unpunctual working.

A Traveller and Shareholder.

London, October 12th.

INDICATED HORSE-POWER FROM DIAGRAMS.

Sir,—The letter of "C. J. L.'s" was read by me with much interest, as was also the reply of "J. E." As a supplement to the latter, may I say that I think the root error of "C. J. L.'s" letter lies in regarding power as lost, which is simply held in suspension to be used with improving leverage by the crank as the piston advances to half stroke? J. C. S.

Ipswich, October 12th.

Brewers' Exhibition. — The brewing, distilling, licensed victualling, mineral water, and allied trades will hold their third annual exhibition and market at the Agricultural Hall during next week. The exhibition will open on Monday, and close on the following Saturday.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty :—H. E. Wingfield, engineer, to the Indus, additional, for service in the Audacious; William Ames, engineer, to the Pembroke, additional, for service in the Diamond; Edward Price, engineer, to the excellent, additional, for service in the Glatton, *vice* Ames; and W. H. Grant, assistant-engineer, to the Indus, as supernumerary for disposal, dated 19th September, 1881; Charles Salmon, chief engineer, to the Phœnix, on promotion; Chief Engineer: Edward Ingleden, to the Hibernia, additional for the Thunderer (when paid off.) Engineers: George B. Alton, to the Hibernia, additional for the Thunderer (when paid off); Felix Foreman, to the Alexandra, additional for the Bittern (when commisioned); George F. Smith, to the Asia, as supernumerary; Richard S. Hornsby, to the Hibernia, additional for the Thunderer (when paid off).

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

(From our own Correspondent.)

The ironmasters' quarterly meetings have been held this week. They have been characterised by great firmness in prices in all the branches, and by a "holding off" policy on the part of vendors in the belief that rates will continue to advance.

In Wolverhampton on Wednesday, 'Change assembled with the knowledge that the New British Iron Company—one of the two marked iron houses who for five or six months past have been quoting 10s. per ton above the bulk of the trade—had issued the following circular:—"We do not at present intend to make any alteration in our prices of 'Lion Iron,' but, with the rising price of raw materials, we fear that we cannot long continue to supply our friends without making some advance in the present very unremunerative prices."

The firm simultaneously advised that their present prices are:—Bar iron, £7 10s.; best, £9; double best scrap ditto, £10; plating bars, £8; best, £9 10s.; best turning bars, £11; best rivet iron, £9, and double best, £10; angle iron, £8 5s.; T-iron, £8 10s.; window sash iron, £10 10s.; slit rods, £7 10s., and best, £9; hoops, from 15 to 19 w.g., both inclusive, £8; hoops of 20 w.g., are: ⅞in., £9; ¾in., £10; ⅝in., £12; ½in., £14; and ⅜in., £16. Strip and fender plate iron is, £8 10s.; sheets, singles—to 20 w.g.—£9, and best, £10 10s.; boiler plates, £9, best, £10, and double best, scrap ditto, £11; chequered plates, £11 10s. This circular had in part led buyers to come together on Wednesday, not altogether unexpectant that bars might be declared up another 10s. per ton, making the Earl of Dudley's £8 12s. 6d., and those of the other houses £8. But the anticipations of such people were not realised, for Earl Dudley's bars remained at £8 2s. 6d., and those of the other houses at £7 10s. Sheets and plates of the same producers varied from £9 to £9 10s. Medium bars were not to be had at less than £7, and common bars were £6 10s. as a minimum. Hoops were £7 5s. to £7 10s. at the works, and makers were reluctant to book further orders, since some of them have already two months' work ahead. Strips for gas tube making were £6 15s. as a minimum, and ranged up to £7. Sheets of the descriptions purchased by the galvanisers, and largely also by merchants for export, were very strong. Some makers positively declined to quote, and were "practically out of the market." Their order books are filled quite as far ahead as they care for them to be. Singles were strong at £8 10s., and best houses attempted to get no less than £10 for doubles, and £11 to £11 10s. for lattens. Galvanisers were on Wednesday unprepared to book forward orders at the prices of last week, yet no specific advance was declared upon such rates as £14 10s., as the minimum for 24 w.g. in bundles delivered London or Liverpool; £16 10s. for 26 w.g., and £18 to £18 10s. for 28 w.g. Ironmasters announced that the mail advices received this week from Melbourne, Victoria, do not show that that market had, up to date of departure, begun to be affected by the advances at home. Even galvanised iron does not appear to have had any special demand.

The crucial quotations for pig iron were unaltered on Wednesday upon the advance of a fortnight ago.

Foreign pigs were all very strong. Hematites of Cumberland, Lancashire, and Welsh makers were especially so. Agents quoted 72s. 6d. to 75s. per ton, but buyers' offers were generally 2s. 6d. per ton behind these figures. Derbyshire and Northamptonshire pigs were too high to encourage business. Thorncliffe—South Yorkshire—pigs were quoted £3.

To-day's gathering in Birmingham confirmed Wolverhampton meeting. No alteration in crucial prices occurred, but numerous traders believed that early in November Earl Dudley coal will be further advanced 1s.; all mine pigs, 5s. to 2s. 6d.; and marked bars, sheets, and plates, 10s. Experienced producers hoped that this would not take place, fearing to retard the improved demand. Iron tubes further reduced in gross discount 2½ per cent.

The Balman's Hill Ironworks, near Bilston, formerly owned by Mr. Rose, have been disposed of by Mr. John Page, of the Monmoorlane Iron Company, to the Albion Sheet Iron Company, Westbromwich, for £10,000.

It is indicative of the improvement that characterises the demand for marked bars, that Lord Dudley's "New Forge," at Round Oak, was re-started on Monday night, after being inoperative for four or five years.

Ironstone commanded 1s. rise on a fortnight ago. South Staffordshire sorts varied from 10s. to 18s. per ton according to quality, and Northampton sorts were about 6s. to 6s. 3d. Best furnace coal was 10s., and forge coal 7s. 6d. to 9s. The Earl of Dudley's limestone is advanced about 6d. per ton, making his lordship's prices at the quarries: Gray crystalline, for blast furnace uses, 4s. per ton; and blue or brick red, for agricultural and masonry uses, 3s. 9d. per ton.

On Tuesday colliers' delegates met in Wolverhampton to discuss the wages question. The South Staffordshire delegates reported that it was with the greatest difficulty that the colliers could be persuaded to keep working, because they thought their advance ought to be doubled. A strike at Cannock Chase seemed to have been resolved upon if a request for a 3d. rise were refused. The Salop delegate said that the Shropshire men were looking for the customary rise now that pig iron was advanced. The North Staffordshire men were reported as determined in their demand for a 10 per cent. improvement. The meeting decided to contribute towards the support of the North Staffordshire men if they had to strike. It was also resolved that the South Staffordshire employers should be asked to alter the sliding scale in the men's favour, and that, in default of agreement, a three months' notice of termination should be given by the men.

The North Staffordshire ironworkers met *en masse* near Stoke, on Monday, and resolved to agitate for an increase in wages of 6d. per ton.

Hardwares are advancing in several branches.

Messrs. W. E. and R. G. Walker, galvanised ironmakers, of Dudley and Walsall, have been awarded a first-class order of merit and a gold medal for their exhibits of galvanised and corrugated sheet iron at the Adelaide Exhibition.

The chainmakers resumed work on Tuesday at wages on the basis of 4s. per cwt., an increase of about 20 per cent. on late prices.

The Birmingham and District Drainage Board decided, on Tuesday, to borrow the sum of £100,000 temporarily from the corporation of Birmingham to purchase land, and carry out works already decided on.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—In the iron trade here the market continues very firm, and although the upward movement in values has tended to check buying on the part of consumers, prices still advance. The activity amongst finished ironmakers necessarily involves a considerable consumption of forge iron, and in the pig market the demand is chiefly upon this quality, but foundry numbers are only in limited demand, as most of the users of this description of iron are at present well supplied.

There was only a quiet market at Manchester on Tuesday so far as the actual amount of business doing in pig iron was concerned, but prices were stiff and local makers were asking an advance upon last week's rates. At the prices which I quoted last week considerable sales of Lancashire pig iron have been made, and as local smelters have now booked more iron than their present make will cover during the remainder of the year, which is still as far as they will go with deliveries, and they have now to fall back upon stocks to meet their orders, they have put up their quotations for delivery into the Manchester district to 48s. for No. 4 forge and 49s. for No. 3 foundry, less 2½ per cent. At these figures small quantities of iron have been sold, but makers are not at all anxious sellers even at the advance.

Outside brands of pig iron are now only being offered here in comparatively limited quantities, and the prices asked average from 1s. to 3s. per ton above those quoted for local irons. Lincolnshire iron delivered equal to Manchester is quoted at from 49s. to 50s., and Derbyshire at 50s. 6d. to 52s. 6d. less 2½ for forge and foundry qualities, with g.m.b. Middlesbrough at 51s. to 51s. 3d. per ton net cash.

Finished iron makers all through the district are kept fully employed, and a good inquiry is still reported both for export and home consumption. Very few of the makers, however, were present at the Manchester market on Tuesday, and it was difficult to ascertain actual prices, as pending the anticipated advance at Birmingham to-day—Thursday—quotations as a rule were made subject to quarter-day rates. The general tendency of prices was to harden, and so far as they were quoted they were about £6 10s. to £7 for bars and light rails, £7 to £7 5s. for hoops, and £8 10s. to £8 15s. for sheets.

Manufactured metal goods have shown a decided advance during the week, copper and brass tubes, brass wire, and brass sheets having all been advanced ¼d. per lb., whilst in wrought iron, gas and steam tubes which have been in good demand, makers have reduced their discounts 2½ and 5 per cent. General wire makers, who have within the last few weeks put up their prices about 10s. per ton, are also tending towards a further advance in prices.

In view of the decided advance which during the last few weeks has taken place in the price of materials, I have made personal and pretty general inquiries amongst the chief consuming branches of industry to ascertain whether there is behind the upward movement in values a corresponding improvement in trade. The result of these inquiries leads me to the conclusion that trade is unquestionably better. Founders, tool-makers, boiler-makers, engineers, machinists, and locomotive builders all report an improvement. The chief activity is amongst tool-makers, who in every establishment I have visited are well supplied with orders. Marine engine and locomotive tools constitute a considerable portion of the work in hand, but for the general class of tools, such as lathes, drills, slotting machines, steam hammers, &c., there are numbers of orders which are being executed, partly for home buyers, but largely for customers in all parts of the globe. This may be taken as an indication of a general preparation for work, and amongst founders, who are also the pioneers of improving trade in other branches, there is more doing. Locomotive builders, engineers, and machinists report an increasing volume of trade coming in, and the complaint generally is now not so much that orders are scarce, but that the prices obtainable are still very low.

A good demand is maintained for coal at advanced prices, and the pits are kept going full time, but engine classes of fuel if anything are weak. The average prices at the pit mouth are about as under: Best coal, 9s. to 9s. 6d.; seconds, 7s. to 8s.; common coal, 5s. 9d. to 6s. 3d.; burgy, 4s. 3d. to 4s. 9d.; and slack, 3s. 3d. to 3s. 9d. per ton.

Coke continues in good demand at about 9s. to 10s. for common, and 11s. to 12s. for the better sorts at the ovens.

The wages question is in abeyance for the present, the miners holding over their notices for an advance until the end of the month.

Barrow.—The appearance of the hematite pig iron market is very reassuring, and from inquiries I have made, the better tone which has pervaded this industry for some time past has lost none of its activity; on the contrary, the signs of a renewal of better trade give evidence of its being a certainty that we shall experience a good demand for pig iron for some time. Not only is the demand of previous weeks maintained, but the last few days show greater willingness on the part of buyers to place their contracts in the hands of producers. In some cases makers are fairly well sold forward, and where this is the case they are asking for a shilling a ton more for iron. Samples of No. 1 Bessemer are selling 61s. 6d. per ton at makers' works; No. 3 forge is selling at 59s. and 60s. per ton. Makers are not in a position to contract for large deliveries to be made early; and of the output at the furnaces, two-thirds is going into direct consumption.

During the winter the pig iron will be brisk, as the orders at present held are such as will keep makers fully employed. In the district there are from ten to twelve furnaces out of blast; but there is every likelihood of their being relighted at an early date. Contracts are being offered both in the pig iron and steel departments, and makers in both cases express themselves as unable to guarantee delivery during the current year. Steel makers are in the same good position with regard to work which I noticed last week, and the demand is well maintained. Now that breakages have been repaired the mills are in full go, especially in the merchant department. The inquiry for light tram sections shows much more energy.

Iron shipbuilders are in fair work, and anticipate booking some fair contracts shortly, as inquiries are being freely made. Engineers, ironfounders, boiler-makers, and other industries steadily employed. Raisers of iron ore are sold forward to a considerable extent, and new orders coming to hand are for forward delivery. Shipping very fairly employed.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

The liquidators of the Yorkshire Engine Company, Sheffield—Mr. Charles Harrison and Mr. R. S. Hampson—have paid the creditors their debts in full, as well as discharged a portion of their liability to the Bank. At one time it was scarcely anticipated the results would be so satisfactory. The company are at present doing a very brisk business, and the improvement in the coal trade cannot fail to favourably affect them still further.

Admiral Shestakoff, of the Russian Imperial Navy, attended by Captain Leontieff, Lieutenant Poretchkin, and Lieutenant de Ribas paid a visit to the Atlas Works—John Brown and Co., Limited—on the 6th inst. The visit was a very brief one, as the Admiral and suite were leaving the town the same afternoon; but there was time to witness the rolling of a compound armour plate on the Ellis system, and the party appeared both surprised and pleased with the elaborate and extensive arrangements now made for producing these plates, which are in important demand for the navies of home and foreign Powers.

Though there cannot be said to be any great stir in the iron and kindred trades, everything touching iron, steel, and coal is undoubtedly much improved. I had occasion to inquire into the affairs of over a dozen leading limited companies at the end of last week. I found of the fifteen stocks examined fourteen showed a rise varying from 1/16 to 5½ per cent., and only one a fall—½ per cent. Parkgate Iron Company has advanced 5½ in a week; John Brown and Co. 3 per cent., and this week they are up again another 2½ per cent.; Jessop's have touched par, having advanced 2 per cent.; Cammell's, Ebbw Vale, Tredegar, are all firm at a decided improvement.

Messrs. Davey Brothers, Park Ironworks, are at present very actively engaged on a large order for the Tredegar Company, in South Wales. I believe this order is for Bessemer plant, including everything necessary for the production of steel rails, from the Bessemer converter to the tools requisite for finishing the goods. Mr. Charles Markham, of Staveley, and Mr. H. D. Pochin, of Conway, are interested in the Tredegar Company, and it is rather significant of the future of the steel rail trade in Sheffield, that although these gentlemen are also largely connected with Sheffield companies, they appear to prefer laying down plant at the coast to having the rails manufactured in the Sheffield district. It is pretty clear that these shrewd judges regard rail-making as more an industry for the coast than for the midlands.

The Scranton Steel Company, of Philadelphia, has, I hear, placed an order of some magnitude with a local engineering firm for steel rail plant. Our American rivals are rapidly increasing their output of steel rails, being encouraged thereto by the great weight of rails which, in spite of the heavy tariff, is still sent to the States by German and English producers.

At the Park Ironworks the electric light is being introduced. The Brush system will be applied in the mills, and Swan's lamps in the draughtsmen's rooms. The Nunnery Colliery Company, which has used the electric light for screening coal for some months, is about to discontinue it in favour of a new application of Sugg and Bray's burners. The managing director informs me that the electric light is more expensive than gas. The Nunnery Company, I understand, is supplying the Sheffield Gas Company with coal.

The American statistical year terminated on the 30th of September last. The figures for the first three-quarters ending December, 1880, March, 1881, and June, 1881, I have already given you. For the last quarter they show a total of £340,509, an increase of £30,000 on the corresponding quarter of 1880. The total value for September was £124,417. Steel shows a falling off as compared with the corresponding period of last year of nearly £26,000, while cutlery has increased by nearly £7000. On the year there is an increase of £157,000. As the increase on the quarter is chiefly in steel rails and heavy goods, it is not so gratifying as appears at first sight. The falling off in steel is serious.

Messrs. Steel, Tozer, and Hampton, of the Phœnix Bessemer Works, the Ickles, Rotherham, have contracted with Messrs. Hammond and Co., of London and Middlesbrough, to have their premises illuminated by the electric light on the "Brush" principle. Messrs. Hammond and Co., are the firm who have successfully experimented at Chesterfield this week.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

Last Tuesday was the quarterly meeting of the Cleveland iron trade, and it was held, as usual, in the Middlesbrough Exchange. It happened also to be the first day of the Iron and Steel Institute meeting in London, with the result that most of the leading members of the trade were in town. This naturally robbed the Middlesbrough meeting of its customary animation. The condition of the trade may be characterised as steady. The reduction of output of pig iron has been largely carried out, and the effect has become apparent in the diminution of stocks. Connal's Middlesbrough stores now contain 2396 tons less than they did a week since, the total amount being 182,587 tons. The shipments for the first six days of the month, and including the returns of Monday last, are 32,785 tons, being at the average rate of 5451 tons per day. This is 2000 tons per day more than usual, and certainly is most encouraging from the producers' point of view. It must not, however, be forgotten that it is evidence of increased distribution, and not of necessity of increased consumption. It may only be due to the tendency to hoard material at their ironworks by consumers when they think prices more likely to rise than to fall. Besides, being near the end of the shipping season, it is only natural that efforts should be made to ship as much as possible before navigation becomes impeded by ice or by stormy weather. There is no evidence of any increased consumption of pig iron having taken place during the last two months, and therefore the rise of price has not been produced by what is perhaps the only healthy cause. Indeed, consumers have been somewhat less pressing for delivery of late. On the other hand, the desire to contract for forward delivery both on the part of merchants and consumers, shows little if any abatement, and, therefore, the rise may be said to have originated and to be maintained entirely by the speculative demand.

The price of No. 3 g.m.b. iron was on Tuesday about 43s. per ton f.o.b. Middlesbrough. Curiously enough warrants commanded only 42s. 9d. per ton, notwithstanding that the cost of making a warrant, that is, of conveying to the store, unloading, booking, and so forth, is about 1s. per ton. Warrants are, therefore, 1s. 3d. per ton below their normal relative value, and this indicates a general desire on the part of warrant holders to realise, which is tantamount to a nervous apprehension lest lower prices should be imminent.

The manufactured iron trade is steady. For ship-plates, £6 10s. per ton in trucks at Middlesbrough less 2½ is now being given by merchants and bridge builders for forward delivery. East coast shipbuilders still, however, hesitate, and do not offer more than £6 5s. at works. Whether they will be forced to give more or not is not yet clear. Their trade is, however, brisk, several new orders for ships having been recently placed, and it is not likely they are fully covered for their requirements. The Sunderland strike is practically at an end, and that circumstance will alone occasion a largely increased consumption of shipbuilding material. Angles and bars command now about £5 15s. at works. Signs of activity have commenced at the old West Hartlepool works, which have been bought by Messrs. M. Gray and Co. They are preparing to sell off the surplus plant and to start the plate mill. They have engaged, it is said, Mr. Percy Gibson, formerly of the Skerne Ironworks, as manager. It is thought, however, that a considerable time must elapse before they can be in the market.

The Cleveland ironstone miners have sent a letter to the Mineowners' Association lamenting the restriction of output which is taking place, and pointing out the effect it is having upon their interests. They say that 180 miners have already received their notices, and they consider this contrary to the spirit of the sliding scale arrangement which was mutually agreed to. They demand that the notices should be withdrawn. This is another instance that when economic laws are interfered with by any class, there is no telling how far the wave of disturbance may not go in all directions. It is not yet known how the employers will meet the application of the men.

It is understood that preliminary steps are being taken to establish a Board of Arbitration to settle the differences between shipbuilders and their workmen. So constant and troublesome have been the disputes in this trade that it is said in some cases the profits which would otherwise have been made have entirely disappeared, and in some cases losses have accrued.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

The Glasgow warrant market was strong until Friday last, when on account of a number of holders realising and the prospect of dearer money, the prices somewhat gave way. Shipping brands have not been in so ready demand, and the past week's shipments being considerably short of those of the preceding week, there has been less disposition to purchase in the open market. This week, therefore, both warrants and makers' irons were quoted at rather lower prices. There is a probability that the shipments will bulk more largely for the next two weeks; soon after which they will very likely diminish, owing to the close of the continental and Canadian trades. At present a very good business is being done with the Continent, and the freights have advanced to an extraordinary extent. But this state of matters will last only a few weeks, and then the foreign demand for pig iron will of necessity be considerably smaller. The consumption in the forges and foundries at home is large. As yet the damping out of sixteen blast furnaces has had very little effect upon the accumulation of stocks in the public stores. In the course of the week, fully 3000 tons were added to the stock in Messrs. Connal and Co.'s stores, bringing it up to about 599,000 tons. The arrivals of pig iron from Cleveland have been larger that in the preceding week, and also compare favourably with those of the corresponding week of last year.

Business was done in the warrant market on Friday forenoon at

51s. 6d. cash, and 52s. 7d. to 51s. 8d. one month, the afternoon quotations being 52s. to 51s. 6½d. cash, and 52s. to 51s. 8d. one month. On Monday morning transactions were effected at 51s. 6d. to 52s. 2d. cash, and 52s. 3d. fourteen days; and in the afternoon from 52s. 2d. to 52s. 3d.; and back to 52s. 2d. cash, and at 52s. 4½d. one month. Business was done on Tuesday at 52s. 1d. cash The market was very unsteady on Wednesday, but a good business was done between 51s. 2d. cash and 51s. 11d. one month. To-day—Thursday—the market was stronger, with business at 51s. 9d. to 52s. 4½d. cash, and 52s. 6d. to 52s. 4d. one month.

The following quotations of makers' iron are a shade under those of last week:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1., 62s.; No. 3, 53s.; Coltness, 63s. and 54s.; Langloan, 68s. 6d. and 54s.; Summerlee, 61s. 6d. and 52s.; Calder, 68s. and 54s.; Carnbroe, 55s. 6d. and 51s. 6d.; Clyde, 54s. and 51s.; Monkland, 53s. 6d. and 51s.; Quarter, ditto, ditto; Govan, at Broomielaw, 53s. 6d. and 51s.; Shotts, at Leith, 63s. and 54s.; Carron, at Grangemouth, 53s. 6d.; and 52s. 6d.; Kinneil, at Bo'ness, 52s. 6d. and 51s.; Glengarnock, at Ardrossan, 56s. and 52s.; Eglinton, 53s. 6d. and 49s. 6d.; Dalmellington, 53s. and 50s.

The different branches of the manufactured iron trade are experiencing steady employment, although in a few cases there appears to be some apprehension of trouble from the workmen, who are beginning to think that the upward movement of prices entitles them to an advance of wages. Angle iron is quoted at £6 10s.; plates, £7 5s.; steel ship plates, £10; angles, £9; and boiler plates, £11.

There is still a very good export demand for coals of the different qualities generally shipped, and the home trade also keeps satisfactory. Prices have moved slightly upwards, the quotations now being—main coal, 6s. 3d. to 6s. 6d. per ton f.o.b.; splint, 7s. to 7s. 3d.; ell, 6s. 9d. to 7s.; and steam, about 8s. per ton. There is a very brisk export demand in Fifeshire, and in most cases the amount of business there appears to be limited only by the railway and shipping facilities.

The question as to whether the miners will get an advance of wages remains uncertain. The sale coalmasters would, it is understood, very cheerfully meet the wishes of the men if they could obtain a permanent increase in quotations; but whether they will be able to do so remains doubtful. Some of the employers who were waited upon said they anticipated they might be in a position to concede 6d. a day by the 1st November; but the men desire the advance on the 17th current, although it is not likely they will obtain it on that date.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

We are now entering upon the last quarter of the year, and if the vigorous condition of the coal trade of Wales be sustained in that quarter, the total for the year will be superior to anything known in Wales.

Both the large ports, Cardiff and Swansea, are going in for improvement. A movement has been set on foot at Cardiff by the Corporation to buy the dock property of the Marquis of Bute, but it is now understood that he will not sell it, but instead make a new drain and dock on the foreshore to the east of the low-water pier, such new dock to admit the largest vessels of modern construction. What is wanted by the Marquis is a guarantee that the shippers will ship from the new dock two million tons of coal per annum. Bills will be brought before Parliament next session and a vigorous beginning soon made.

Swansea is determined to have its share of the coal traffic, and is going on heartily for railways to Rhondda, and a new scheme is on foot to form a harbour of refuge in Swansea Bay. It is proposed to get powerful dredging machinery, and remove entirely a large and dangerous shoal known as the Inner Green Grounds. Two breakwaters would be required, one at Plymouth and another in extension of the Mumbles Point. Mr. Vivian is the promoter. In all quarters there is a great deal of effort being put forward, and the next session will show yet further enterprise.

I have rarely seen so much coal development as is now going on. Prices, too, are firm, with an upward tendency, and large contracts continue to be secured.

In iron and steel there is brisk trade being done, and so satisfied appear buyers that higher prices are looming, that a good deal of activity is shown in trying to place orders.

The apprehended strike at Treforest Tin-plate Works has been avoided.

The Great Western Railway Company has been successful in coal mining near Maesteg. Coal has been reached in the Avon Valley at a depth of 472 yards. Thickness of seam, 4ft. 6in. Quality excellent. Messrs. Galway and Kerwick were the contractors, and 330 yards were sunk in the course of little more than twelve months.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

4th October, 1881.

4291. Scissors, D. Peres, London.
4292. Malt Liquors, A. E. Wood, Wavertree.
4293. Gas, &c., C. D. Abel.—(*A. L. Roach, U.S.*).
4294. Lamps, A. G. Schaeffer, Newcastle-on-Tyne.
4295. Steam Engines, H. Newton.—(*J. Ericsson, U.S.*)
4296. Conduits, C. D. Abel.—(*L. A. Brasseur and O. Dejaer, Brussels.*)
4297. Asphalte Apparatus, B. D. Healey, Brighouse.
4298. Securing Bolts, &c., W. R. Lake.—(*G. Taylor, J. Wood, and B. S. Clark, U.S.*)
4299. Fountain Pens, F. Wirth.—(*Hannover Gummi Kamm Company, Hannover.*)
4300. Pipes, F. des Vœux.—(*M. Marx, U.S.*)
4301. Locomotives, F. des Vœux. (*J. F. Roy, Paris.*)
4302. Bicycles, J. E. Surridge, Windlesham.
4303. Paper Folding Machines, R. Cundall, Thornton.
4304. Dynamo Machines, H. Aylesbury, Bristol.
4305. Lamps, H. J. Haddan.—(*L. Somzée, Brussels.*)
4306. Furnaces, &c., G. Eyre, Codnor.
4307. Serving-Mallets, &c., W. Griffiths, Port Madoc.
4308. Sole Plates, J. R. Alexander, Edinburgh.
4309. Batteries, F. Wirth.—(*Dr. J. Stebbins, U.S.*)
4310. Secondary Batteries, A. Laurie, Duddingstone.
4311. Lamps, J. H. Johnson.—(*C. A. Faure, Paris*)
4312. Treating Sewage, J. Hanson, Wakefield.
4313. Surveying Apparatus, G. H. Stephens and H. Wilmer, London.
4314. Drying Machines, R. Milburn, London.
4315. Converters, J. Lloyd, Shropshire.
4316. Stoppers, H. R. Landon & G. Legrand, London.
4317. Bicycles, &c., T. Warwick, Aston.
4318. Vermin Trap, G. M. Gates, Tunbridge Wells.
4319. Bicycles, J. A. Lamplugh, Birmingham.
4320. Photographic Camera, W. Brookes, Manchester.

5th October, 1881.

4321. Screw Propellers, J. Jones, Liverpool.
4323. Cutting Glass, A. Cowan, Bayswater.
4323. Photographic Changing Box, C. Sands, London.
4324. Fluid Meters, A. Wightman, Sheffield.
4325. Cleansing Hollow Vessels, C. Davis, London, and H. T. Arthy, Brentwood.
4326. Stop Valves, &c., J. Margerison, Preston.
4327. Silk Shoddy, C. Dawerdt, Berlin.
4328. Paper Wires, &c., M. M. Whiting, Manchester.
4329. Projectiles, H. Simon.—(*F. Vetterli, Paris.*)
4330. Needles, W. R. Lake.—(*S. Peberdy, U.S.*)
4331. Artistic Articles, W. Beck.—(*H. Starcke, Paris.*)
4332. Mortice Locks, E. de Pass.—(*A. Elliott, Paris.*)
4333. Cabinet, G. Nobes, London.
4334. Lamps, A. W. Calvert, Leeds.
4335. Harbours, &c., W. R. Kinipple, London.
4336. Treating Raw Hides, D. Galbraith, Edinburgh.
4337. Propelling Ships, W. R. Kinipple, London.
4338. Looms, J. Leeming, Bradford.
4339. Achromatic Lenses, N. Lazarus, London.
4340. Gas-motor Engines, C. T. Wordsworth, Leeds, and T. Browett and H. Lindley, Salford.
4341. Umbrella Furniture, T. Haddon, Birmingham.

6th October, 1881.

4342. Gas Stoves, T. Fletcher, Warrington.
4343. Fire-extinguisher, J. Dutton, London.
4344. Pianofortes, H. Springmann.—(*W. Fischer, Dresden.*)
4345. Transshipping Apparatus, J. Rigg, Chester.
4346. Checking Apparatus, J. T. R. Proctor, Dundee.
4347. Fire-boxes, J. Shepherd, Manchester.
4348. Looms, G. Kirk, Huddersfield.
4349. Strings, &c., J. Turner and C. M'Bride, Glasgow.
4350. Shovels, &c., T. Titley, Leeds.
4351. Sewing Machines, H. Simon.—(*F. B. Köhler, Chemnitz.*)
4352. Axle-boxes, G. E. Vaughan.—(*H. Cristin, Paris.*)
4353. Preparing Wool, &c., J. Tatham, Rochdale.
4354. Screw Propellers, J. Carr, Heaton.
4355. Boots, &c., W. H. Stevens, Leicester.
4356. Shelling Rice, &c., A. G. Fraser, G. Smith, and L. W. Harvey London.
4357. Vacuum Pans, W. R. Lake.—(*C. Wahl, U.S.*)

7th October, 1881.

4358. Cleaning Cotton, J. Bayley, Aston, and T. Bayley, Staleybridge.
4359. Speed Indicator, D. Young, London.
4360. Snow, F. N. Mackay, Liverpool
4361. Shirtstuds, P. F. Allen, London.
4362. Boring Apparatus, A. Upward, London.
4363. Knitting Machines, H. J. Haddan.—(*The Universal Knitting Machine Co. of Ontario, Lim., Toronto.*)
4364. Velocipedes, A. Phillips, Birmingham.
4365. Assisting Vision, P. Adie, London.
4366. Brake Apparatus, G. Westinghouse, London.
4367. Dwelling-houses, S. E. Simpson, Birmingham.
4368. Propulsion Apparatus, J. R. Purssell, London.
4369. Treating Nitrogenous Substances, W. and H. Marriott, Huddersfield.
4370. Density Apparatus, E. Jones, London.
4371. Brooch, &c., Fastenings, E. Jones, Bridgewater.
4372. Cutting Shives, E. J. Heal, London.
4373. Mills, W. R. Lake.—(*J. FitzGerald, U.S.*)

8th October, 1881.

4374. Exhibiting Photographs, &c., R. Love, London.
4375. Timekeepers, &c., H. B. James, London.
4376. Constructing, &c., Roofs, J. Carter, Uxbridge.
4377. Clutch, &c., J. Hardinge, London.
4378. Railway Signals, H. Cuthbert and G. H. Smith, Manchester.
4379. Rolling, &c., Wire, J. Westgarth, Warrington.
4380. Measuring Apparatus, J. Watson.—(*A. Champy, Antwerp.*)
4381. Printing, F. Wirth.—(*J. Ribbert, Hohenlimburg.*)
4382. Perambulators, C. H. Brassington, Manchester.
4383. Electric Bridges, St. G. L. Fox, London.
4384. Basic Bricks, &c., S. G. Thomas, London.
4385. Bicycles, &c., J. S. Edge, jun., Birmingham.
4386. Utilising Compressed Air, A. M. Clark.—(*C. W. Cooper, Brooklyn, U.S.*)
4387. Regulating Heads, &c., R. Riley, Keighley.
4388. Extracting, &c., Caloric, C. Tellier, Paris.
4389. Dyeing, &c., Compounds, R. H. Neville, Lincoln.
4390. Trimming Apparatus, W. R. Lake.—(*D. C. Knowlton, Boston, U.S.*)

10th October, 1881.

4391. Attaching Door Knobs, B. Spittle, Wednesbury.
4392. Knitting Machinery, S. Fingland, Hawick.
4393. Safety Valves, C. Shields, Manchester.
4394. Bas-reliefs, E de Pass.—(*W. Guillebaud, Paris.*)
4395. Corkscrew Covers, &c., A. Bolt. - (*R. T. Dittert, Newstadt.*)
4396. Carbons, J. James, London, and J. C. F. Lee, Ravenhead.
4397. Magnesia, T. Twynam, London.
4398. Secondary Batteries, A. W. L. Reddie.—(*E. Volckmar, Paris.*)
4399. Feeding Apparatus, J. & A. Leadbeater, Morley.
4400. Pads, W. Reynolds, London.
4401. Steam Kettles, &c., W. B. Dewhirst and G. Barker, Manchester.
4402. Motor Engines, G. Weatherhogg, Birmingham.
4403. Fire-lighter, A. G. Elliott, London.
4404. Bessemer Converters, A. L. Holley, London.
4405. Electric Light, A. Clark.—(*J. de Changy, Paris.*)

Inventions Protected for Six Months on deposit of Complete Specifications.

4248. Lamp Burners, B. Schwartz and R. Huppertsberg, Berlin.—1*st October*, 1881.
4249. Umbrellas, J. Minière, Boulevard de Strasbourg, Paris.—1*st October*, 1881.
4267. Exhibiting Apparatus, W. R. Lake, Southampton-buildings, London.—A communication from T. L. Jones, St Louis, U.S.—1*st October*, 1881.
4289. Harrows, A. M. Clark, Chancery-lane, London.—A communication from T. Haxton and G. Beattie, Gore, New Zealand.—3*rd October*, 1881.
4293. Gas and Oil, C. D. Abel, Southampton-buildings, London.—A communication from A. L. Roach, Indianapolis, U.S.—4*th October*, 1881.
4297. Asphalte Apparatus, B. D. Healey, Brighouse.—4*th October*, 1881.
4303. Paper-folding Machines, R. Cundall, Thornton. 4*th October*, 1881.
4330. Needles, W. R. Lake, Southampton-buildings, London.—A communication from S. Peberdy, Philadelphia, U.S.—5*th October*, 1881.
4352. Axle-boxes, G. E. Vaughan, Chancery-lane, London.—A communication from H. Cristin, Paris.—6*th October*, 1881.
4357. Vacuum Pans, W. R. Lake, Southampton-buildings, London.—A communication from C. Wahl, Chicago, U.S.—6*th October*, 1881.
4363. Knitting Machines, H. J. Haddan, Kensington, London.—A communication from the Universal Knitting Machine Company of Ontario, Limited, Toronto.—7*th October*, 1881.

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

3880. Sewing Hat Linings, W. L. Bigelow, Southampton-buildings, London.—3*rd October*, 1878.
3914. Transmitting Motion, W. H. Baxter, Leeds.—4*th October*, 1878.
3959. Umbrellas, &c., J. Willis, Stocksbridge Works, near Sheffield.—8*th October*, 1878.
3967. Potassi, &c., J. Imray, Southampton-buildings, London.—9*th October*, 1878.
4040. Washing Apparatus, E. Gardner, Lord-street, Liverpool.—12*th October*, 1878.
3935. Refrigerating Apparatus, J. Harrison, Gowrie-road, Battersea, London.—7*th October*, 1878.
4421. Knitting Machinery, J. W. Lamb and S. Lowe, Nottingham.—1*st November*, 1878.
3952. Gig Machines, A. M. Clark, Chancery-lane, London.—8*th October*, 1878.
4138. Purifying Apparatus, F. Thompson, Wakefield, and W. H. Williamson, Leeds.—17*th October*, 1878.
3958. Bricks, &c., J. Ryder, Openshaw.—8*th October*, 1878.
3966. Bobbins, &c., J. W. Wilson, Barnsley.—9*th October*, 1878.
3977. Packages for Cigarettes, &c., C. G. Emery, Brooklyn, U.S.—9*th October*, 1878.
3978. Cigarettes, C. G. Emery, Brooklyn, U.S.—9*th October*, 1878.
4049. Opening, &c., Skins, A. J. Le Blanc, Paris.—12*th October*, 1878.
4226. Electric Currents, T. A. Edison, Menlo Park, New Jersey, U.S. 23*rd October*, 1878.
3950. Torpedoes, C. A. McEvoy, Adam-street, Adelphi, London.—8*th October*, 1878.
4000. Meat-mincing Machines, A. Barr, Glasgow.—10*th October*, 1878.

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

3443. Sleeping Berths, T. Johnson, Poplar, London.—8*th October*, 1874.
3390. Telegraphing, H. C. Mance, Manor-road, Brockley.—3*rd October*, 1874.
3393. Marine Engines, D. Rankin, Greenock.—5*th October*, 1874.
3400. Ventilating Sewers, &c., E. G. Banner, Billiter-square, London.—5*th October*, 1874.
3448. Earthenware Bottles, H. Codd, Grove-lane, Camberwell, London.—8*th October*, 1874.
3573. Caissons, &c., W. R. Kinipple, Victoria-street, Westminster.—17*th October*, 1874.
3426. Cutting Files, M. Mondon, Boulevard de Clichy, Paris.—7*th October*, 1874.
3495. Working Railway Signals, J. S. Farmer, Canterbury-road, Kilburn.—12*th October*, 1874.
3569. Working Railway Points, &c., J. S. Farmer, Canterbury-road, Kilburn.—17*th October*, 1874.
3471. Compressing Apparatus, E. Körting, Manchester.—9*th October*, 1874.
3485. Pulping, &c., Machinery, J. Patterson, Belfast.—10*th October*, 1874.
3507. Furnaces, &c., E. Körting, Manchester.—12*th October*, 1874.
3473. Lamps, F. H. Smith, Peckham-rye.—9*th October*, 1874.
3493. Overhead Sewing Machine, J. Laing, Dundee.—12*th October*, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 20*th October*, 1881.

2411. Transmitting Motive Power, J. Aylward, Birmingham.—1*st June*, 1881.
2415. Fabrics, J. Cocks, Upper Norwood, London.—1*st June*, 1881.
2421. American Organs, W. E. Evans, Highgate, and R. W. Jarrett, London.—1*st June*, 1881.
2425. Ordnance, W. Palliser, Earl's-court, London.—2*nd June*, 1881.
2431. Railway Signalling, T. M. Ford, Great St. Helen's, London.—2*nd June*, 1881.
2441. Calculating Apparatus, H. H. Lake, London.—Com. from H. Beaucourt.—2*nd June*, 1881.
2451. Stylographic Fountain Pens, J. Nadal, Southampton-row, London.—3*rd June*, 1881.
2452. Operating Fans, E. J. C. Fear, Redland, near Bristol.—3*rd June*, 1881.
2467. Fixing Wheels, &c., upon Axles, R. A. Hansell, Sheffield.—6*th June*, 1881.
2468. Neckties, &c., W. R. Lake, London.—A communication from J. H. Fleisch.—6*th June*, 1881
2476. Mouthpieces for Musical Instruments, W. R. Lake, London.—A communication from P. Thomson.—7*th June*, 1881.
2511. Horse-rakes, J. Huxtable, Brayford.—9*th June*, 1881.
2581. Preparing Stains, C. M. Sombart, Germany.—A communication from G. Glafey.—14*th June*, 1881.
2606. Electric Accumulators, A. Muirhead, Regency-street, London.—15*th June*, 1881.
2628. Dressing, &c., Stone, W. W. Beaumont, London, and J. Welman, Poole.—16*th June*, 1881.
2734. Gas-burners, W. J. Brewer, Rood-lane, London.—22*nd June*, 1881.
2771. Screw-cutting, &c., A. M. Clark, London.—Com. from Messrs. Baville & Monlebout.—24*th June*, 1881.
2805. Rope Attachments, H. J. Haddan, London.—A communication from W. P. Healey.—27*th June*, 1881.
2863. Dye Products, A. M. Clark, London.—A communication from C. Collin.—30*th June*, 1881.
3384. Indicators, J. C. Mewburn, London.—A communication from C. H. Pond.—4*th August*, 1881.
3629. Baths, C. Drake, Battersea, London.—20*th August*, 1881.
3797. Bottle-washing Machines, D. C. Foster, Hull. 31*st August*, 1881.
3871. Dynamo-electric Machines, H. A. Harborow, Circus-street, London.—6*th September*, 1881.
3895. Horseshoes, T. Brown, Regent Works, Sheffield.—8*th September*, 1881.
3911. Reflectors, J. Wetter, London.—A communication from W. Wheeler.—9*th September*, 1881.
3917. Hot Forgings, &c., A. Storer, Clapham Park, London.—9*th September*, 1881.
4233. Weighing Wool, H. J. Haddan, London.—Com. from J. Gebhart.—30*th September*, 1881.
4289. Harrows, A. M. Clark, London.—A communication from T. Haxton and G. Beattie.—3*rd October*, 1881.

Last day for filing opposition, 1*st November*, 1881.

2318. Counteracting the Expansion, &c., of Signal Wires, H. Whitehead, Bucknall.—26*th May*, 1881.
2448. Substitute for Malt, E. Martin and R. Benns, London.—3*rd June*, 1881.
2470. Dishes and Basins, C. Russell, Garforth.—7*th June*, 1881.
2474. Boilers, A., J. T., and R. Anderton, Accrington.—7*th June*, 1881.
2475. Fastener for Driving Belts, F. Redaway, Pendleton.—7*th June*, 1881.
2477. Belt Clasp, A. M. Clark, London.—A communication from W. M. Whiting.—7*th June*, 1881.
2483. Self-acting Feeding Apparatus, A. C. Henderson, London.—A communication from J. A. Demoncy-Minelle.—8*th June*, 1881.
2489. Fishing, &c., W. Laughrin, Polperro.—8*th June*, 1881.
2503. Grinding, &c., P. M. Justice, London.—A communication from J. E. Holmes.—9*th June*, 1881.
2512. Bottle Wrappers, H. J. Haddan, London.—A communication from B. D. Marks.—9*th June*, 1881.
2513. Bottle Wrappers, H. J. Haddan, London.—A communication from B. D. Marks.—9*th June*, 1881.
2514. Hatchway Doors, H. J. Haddan, London.—A communication from G. M. and H. L. Eames and J. Stever.—9*th June*, 1881.
2524. Purifying Gas, J. H. Johnson, London.—Com. from A. M. H. T. du Montcel.—10*th June*, 1881.
2580. Drilling, &c., G. F. Wynne, Minera, near Wrexham.—10*th June*, 1881.
2531. Breech-loading Small-arms, E. James, Birmingham.—10*th June*, 1881.
2539. Chimney-top, &c , M. Delmard, Plumstead-common, Kent.—10*th June*, 1881.
2545. Frames, F. Wirth, Germany.—A communication from F. Roeder.—11*th June*, 1881.
2550. Type-writing Machines, A. D. Furse, Rome.—A communication from La Société Clavigraphique Maggi et Cie.—11*th June*, 1881.
2559. Drilling, &c., G. F. Wynne, Minera, near Wrexham.—13*th June*, 1881.
2565. Tricycles, &c., E. J. Lewis, Reading.—13*th June*, 1881.
2567. Regulating the Speed of Marine Engines, E. P. Alexander, London.—A communication from C. Ziegler.—9*th June*, 1881.
2575. Baryta, W. E. Gedge, London.—A communication from E. J. Maumené.—14*th June*, 1881.
2618. Governing Dynamo-electric Machines, J. Jameson, Newcastle-upon-Tyne.—16*th June*, 1881.
2686. Parquet Flooring, A. Damman and A. Cassard, Brussels.—20*th June*, 1881.
2690. Sewing Machines, E. P. Alexander, London.—A communication from G. C. Desprin.—20*th June*, 1881.
2713. Combing Machines, J. C. Walker and J. E. Stephenson, Shipley.—21*st June*, 1881.
2739. Distributing Electricity, H. E. Newton, London.—Com. from M. A. Gravier.—22*nd June*, 1881.
2750. Depositing Metals upon Iron, &c., G. Bower, St. Neots.—23*rd June*, 1881.
2787. Drying, &c., Substances in Pieces, J. C. Mewburn, London.—A communication from F. Stroehmer and W. H. Eales.—25*th June*, 1881.
2821. Supplying Air to Lamps, C. W. Torr, Birmingham.—28*th June*, 1881.
2824. Ratchets, C. Geddes and P. Sword, Liverpool.—28*th June*, 1881.
2876. Cleansing, &c., Sugar, H. E. Newton, London.—A communication from La Compagnie de Fives-Lille.—1*st July*, 1881.
2882. Preparing Vegetable Substances, R. G. Perry, Rathdowney.—2*nd July*, 1881.
2889. Combined Bed, &c., C. W. Torr, Birmingham.—2*nd July*, 1881.
3035. Metallic Fabric, G. W. von Nawrocki, Berlin. Com. from Messrs. Schütz and Juel.—11*th July*, 1881.
3145. Producing Heating Gases, H. Haug, Strassburg, Germany.—19*th July*, 1881.
3275. Gas Motor Engines, R. Ord, Devizes.—26*th July*, 1881.
3595. Pianofortes, C. Collard, Camden Town, London.—18*th August*, 1881.
3665. Steam Boilers, J. W. de V. Galwey, Warrington.—23*rd August*, 1881.
3694. Safety Gear, J. Musgrave and A. W. Walsh, Bolton:—24*th August*, 1881.
3708. Formation, &c., of Floors, A. C. McLeod, Shrewsbury. —25*th August*, 1881.
4168. Governing Apparatus, W. P. Thompson, London.—A communication from Prof. J. W. Langley.—27*th September*, 1881.
4293. Producing Hydrocarbon Gas, C. D. Abel, London.—Com. from A. L. Roach.—4*th October*, 1881.
4297. Asphalte Apparatus, B. D. Healey, Brighouse.—4*th October*, 1881.
4352. Axle-boxes, G. E. Vaughan, London.—A communication from H. Cristin.—6*th October*, 1881.
4363. Knitting Machines, H. J. Haddan, London.—A communication from the Universal Knitting Machine Company.—7*th October*, 1881.

Patents Sealed.

(List of Letters Patent which passed the Great Seal on the 7th October, 1881.)

1550. Protecting Magnetic Needles, J. S. Gisborne, Manchester.—9*th April*, 1881.
1554. Platen Printing Presses, A. Godfrey, Median-road, London.—9*th April*, 1881.
1564. Treating Sewage, &c., R. Wild, Littleborough, and H. Ledger, Leek.—11*th April*, 1881.
1570. Treating Refuse, R. Pease and T. Lupton, Bradford.—11*th April*, 1881.
1572 Combined Comb and Hair Brush, W. Brierley, Halifax.—11*th April*, 1881.
1574. Compound for Burns, &c., E. Harris, Holloway-road, London.—11*th April*, 1881.
1575. Railway Brakes, G. W. von Nawrocki, Berlin.—11*th April*, 1881.
1576. Slide-bolt, W. E. Gedge, Wellington-street, London.—11*th April*, 1881.
1580. Wetting the Gummed Flap of Envelopes, F. H. F. Engel, Germany.—11*th April*, 1881.
1593. Injectors, A. Budenberg Manchester.—12*th April*, 1881.
1595. Portable, &c., Railways, E. Leahy, Kensington, London.—12*th April*, 1881.
1597. Gas Burners, H. H. Doty, Strand, London.—12*th April*, 1881.
1608. Sifting, &c., Flour, R. W. Dobing, Durham.—13*th April*, 1881.
1619 Lamps, &c., W. J. Brewer, Bombay.—13*th April*, 1881.
1620. Fusible Plugs, H. Adams, Queen Victoria-street, London.—13*th April*, 1881.
1625. Metal Pipes, &c., S. Fox, New Wortley, Leeds.—13*th April*, 1881.
1634. Looms, W. Morgan-Brown. Southampton-buildings, London.—14*th April*, 1881.
1637. Obtaining Colouring Matters, T. Holliday, Huddersfield.—14*th April*, 1881.
1638. Producing Azo Colours on Cotton, &c., T. Holliday, Huddersfield.—14*th April*, 1881.
1669. Type-setting, &c., Apparatus, H. Springmann, Berlin.—16*th April*, 1881.
1776. Vapour Gas, H. Springmann, Berlin.—25*th April*, 1881
1875. Winding, &c., Yarns, G. Bernhardt, Radcliffe.—2*nd May*, 1881.
2237. Displaying Articles, W. P. Thompson, High Holborn, London.—23*rd May*, 1881.
2308. Railway Signalling, J. King, Pinxton.—26*th May*, 1881.
2427. Wagons, J. C. Martin, Bengal.—2*nd June*, 1881.
2981. Middlings Purifiers, E. G. Brewer, Chancery-lane, London.—7*th July*, 1881.
3140. Fac-simile Telegraphs, E. G. Brewer, Chancery-lane, London.—19*th July*, 1881.
3171. Gas, W. P. Thompson, High Holborn, London.—21*st July*, 1881.
3231. Commutators, E. G. Brewer, Chancery-lane, London.—23*rd July*, 1881.

(List of Letters Patent which passed the Great Seal on the 11th October, 1881.)

1603 Speed, &c., Recording Gauges, M. B. Edson, Brooklyn, U.S.—12*th April*, 1881.
1615. Sewing Machines, J. G. Wilson, London.—13*th April*, 1881.
1618. Latches and Locks, G. E. Wilson, Leeds.—13*th April*, 1881.
1626. Umbrellas, W. R. Seaton, Manchester.—13*th April*, 1881.
1627. Carpets and Rugs, G. Holloway, Kidderminster.—13*th April*, 1881.
1633. Separating, &c., F. J. Drechsler, Eden-street, London.—14*th April*, 1881.
1635. Boxes, J. Darling, Glasgow.—14*th April*, 1881.
1646. Sanitary Appliances, H. P. Holt, Park-row, Leeds.—14*th April*, 1881.
1663. Sewing Machines, L. Silvermann, London, and R. Cumming, Ilford.—14*th April*, 1881.
1665. Combined Air and Gas Burners, J. Lewis, London.—14*th April*, 1881.

1677. Coke Ovens, J. Hunter, Hedley Hope Colliery, near Towlaw.—16*th April*, 1881.
1682. Regulating the Supply of Water, L. Wall, London.—16*th April*, 1881.
1687. Ventilating Apparatus, H. H. Lake, Southampton-buildings, London.—18*th April*, 1881.
703. Nailing Boxes, B. J. B. Mills, Southampton-buildings, London.—19*th April*, 1881.
1725. Preparing Colouring Agents, J. Young, jun., Kelly.—20*th April*, 1881.
1728. Bases for Artificial Teeth, A. M. Clark, Chancery-lane, London.—20*th April*, 1881.
1731. Sulphate of Alumina, A. A. Croll, Coleman-street, London.—21*st April*, 1881.
1735. Coupling Apparatus, J. M. Head, Reigate.—22*nd April*, 1881.
1771. Valve Motions, D. Greig and M. Eyth, Leeds.—23*rd April*, 1881.
1797. Halter Heads, J. Goodrick, jun., Birmingham.—26*th April*, 1881.
1799. Bicycle Lamps, G. Burt, Birmingham.—26*th April*, 1881.
1803. Producing, &c., New Types, L. Weiss, Vienna.—26*th April*, 1881.
1837. Coke Ovens, H. Simon, Manchester.—28*th April*, 1881.
1893. Absorbing, &c., Sulphuric Acid, C. D. Abel, London.—2*nd May*, 1881.
1961. Magneto-electric Machines, P. Higgs, New York.—5*th May*, 1881.
1972. Acoustic Instruments, F. Wirth, Germany.—6*th May*, 1881.
2081. Fluid Meters, B. D. Healey, Blackburn.—12*th May*, 1881.
2093. Corn Mills, A. E. F. Chattaway, Wixford.—13*th May*, 1881.
2169. Distilling Shale, &c., G. T. Beilby, Mid Calder.—18*th May*, 1881.
2521. Boots and Shoes, J. Keats, Bagnal, near Stoke-upon-Trent.—9*th June*, 1881.
2733. Rails and Sleepers, A. Browne, Southampton-buildings, London.—22*nd June*, 1881.
3131. Shoes for Horses, &c., W. R. Lake, Southampton-buildings, London.—18*th July*, 1881.
3221. Scouring, &c., Pile Fabrics, J. Worrall, Ordsall, Salford, and J. Kershaw, Halifax.—23*rd July*, 1881.
3263. Skate Attachments, H. J. Haddan, London.—26*th July*, 1881.
3287. Governors, F. W. Durham, New Barnet.—27*th July*, 1881.
3333. Ice, W. P. Thompson, High Holborn, London.—2*nd August*, 1881.
3367. Engines, M. P. W. Boulton, Tew Park.—3*rd August*, 1881.
3381. Holding, &c., Forgings under Steam Hammers, A. Mure, Glasgow.—4*th August*, 1881.
3421. Making Cigarettes, W. R. Lake, Southampton-buildings, London.—8*th August*, 1881.
3477. Type Distributing Machines, H. J. Haddan, London.—11*th August*, 1881.

List of Specifications published during the week ending October 8th, 1881.

5061, 2d.; 770, 4d.; 873, 6d.; 877, 6d.; 897, 8d.; 904, 6d.; 913, 6d.; 921, 6d.; 925, 6d.; 935, 6d.; 941, 6d.; 942, 6d.; 943, 6d.; 944, 2d.; 945, 6d.; 947, 2d.; 948, 6d.; 952, 6d.; 953, 6d.; 954, 6d.; 955, 2d.; 956, 2d.; 957, 2d.; 958, 2d.; 960, 2d.; 961, 4d.; 962, 2d.; 963, 2d.; 971, 4d.; 972, 6d.; 973, 2d.; 974, 6d.; 975, 6d.; 976, 6d.; 978, 6d.; 979, 6d.; 980, 2d.; 981, 6d.; 983, 6d.; 984, 2d.; 985, 2d.; 986, 2d.; 988, 8d.; 990, 8d.; 991, 2d.; 993, 2d.; 995, 4d.; 996, 6d.; 997, 6d.; 998, 6d.; 999, 4d.; 1000, 6d.; 1001, 6d.; 1002, 4d.; 1003, 2d.; 1004, 2d.; 1005, 2d.; 1006, 2d.; 1007, 4d.; 1008, 2d.; 1009, 6d.; 1010, 6d.; 1011, 6d.; 1012, 8d.; 1014, 6d.; 1015, 6d.; 1018, 2d.; 1019, 2d.; 1020, 6d.; 1022, 2d.; 1025, 2d.; 1026, 2d.; 1027, 4d.; 1028, 8d.; 1030, 6d.; 1032, 10d.; 1033, 6d.; 1034, 2d.; 1035, 6d.; 1037, 6d.; 1038, 8d.; 1039, 2d.; 1040, 6d.; 1041, 4d.; 1043, 2d.; 1044, 6d.; 1045, 4d.; 1047, 4d.; 1048, 2d.; 1051, 4d.; 1053, 6d.; 1054, 2d.; 1055, 2d.; 1059, 6d.; 1061, 2d.; 1062, 6d.; 1063, 2d.; 1065, 6d.; 1067, 8d.; 1068, 2d.; 1070, 6d.; 1072, 6d.; 1075, 6d.; 1077, 6d.; 1128, 6d.; 1129, 10d.; 1176, 6d.; 1178, 6d.; 1212, 4d.; 1222, 6d.; 1225, 4d.; 1239, 6d.; 1299, 2s.; 1332, 2d; 1705, 6d.; 2030, 4d.; 2836, 6d.; 2852, 6d.; 2942, 6d.; 3058, 6d.; 3086, 6d.; 3137, 6d.; 3160, 6d.

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ABSTRACTS OF SPECIFICATIONS.

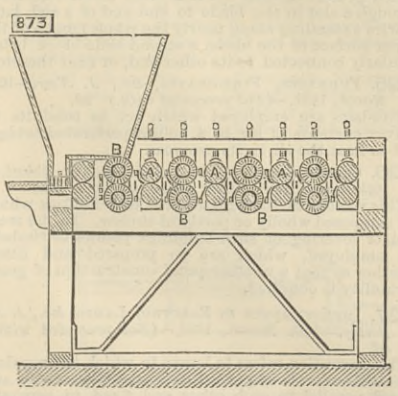
Prepared by ourselves expressly for The Engineer *at the office of Her Majesty's Commissioners of Patents.*

770. Bottles, *A. Savage.*—23*rd February*, 1881. 4*d.*

Some part of the neck is contracted to very small dimensions, and attached to a wire is a sponge or other absorbent material of such size that in being drawn through the contracted line of the neck of the bottle so much of the contained liquid will be expressed as will leave the sponge charged only with the required quantity.

873. Apparatus for Cleaning, &c., Metal Plates or Sheets, *T. H. Morgan.*—1*st March*, 1881. 6*d.*

This consists in a suitable framing divided into compartments or spaces, in each of which are alternately or otherwise placed a pair of rolls A running in suit-



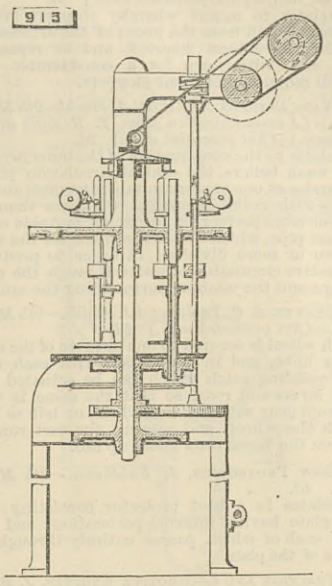
able adjustable housings and a pair of brushes B. The top bearings or housings of each pair of rollers or brushes are mounted in vertical guides ending near the top, so as to be easily removable.

877. Gas-light Apparatus for Buoys, Lighthouses, &c., *W. R. Lake.*—1*st March*, 1881.—(*A communication from J. M. Foster.*) 6*d.*

This relates to a beacon having a gas burner or light in combination with a clock or timepiece and mechanism operated by the clock and operating the cock of the burner, whereby the beacon may be automatically lighted and extinguished.

913. Twisting and Lapping Wire and other Materials in the Manufacture of Ropes and Cables, *W. T. Glover and G. F. James.*—3*rd March*, 1881. 6*d.*

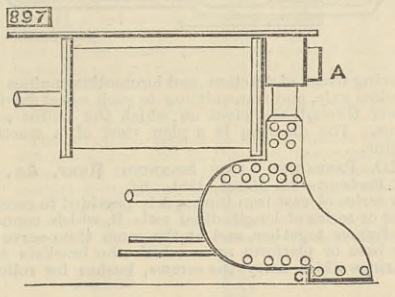
The wire or other material is first wound upon a bobbin, which is then mounted upon a horizontal stud carried by a vertical spindle. This bobbin has on one of its sides or edges a series of pins or projections. An anchor or escapement is also mounted and capable of oscillating to and fro upon a horizontal stud carried by the vertical spindle, and is provided with a suitable claw or catch, which is designed to come in contact with each of the pins or projections upon the bobbin in turn, and so prevent such bobbin revolving faster than one pin at a time. This anchor or escapement also carries a roller, over which the wire passes in being drawn off its bobbin on its way to the spindle.



This wire also passes through a slot formed in the vertical spindle, which is hollow, and is fitted internally with a weighted drop rod having a pulley at its upper extremity, round and beneath which the wire has now to pass before it can emerge from the point of the spindle. An arm branching from the escapement also passes through the slot and rests upon the top of the weighted drop rod.

897. Safety Guards or Fenders for Wheels, *A. M. Clark.*—2*nd March*, 1881.—(*A communication from F. Folacci, fils*). 8*d.*

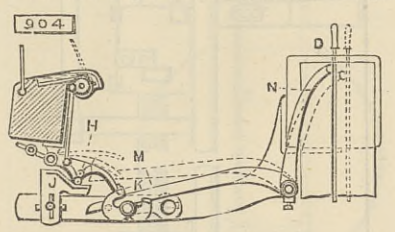
This consists essentially in the arrangement of safety guard, shield, or fender for the wheels of loco-



motives constructed of metal of the form shown recessed at G, and attached by frames to the guard irons A.

904. Looms, *J. Hollingworth.*—2*nd March*, 1881. 6*d.*

This consists, First, in the combination of the incline J with the tumbler K, placed in such position that if the weft is present the detector H will pass



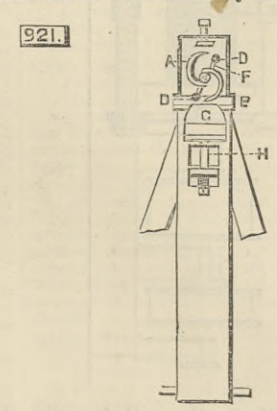
clear of the said tumbler without actuating it; Secondly, in the combination of the detector H, incline J, and tumbler K in such manner as to act upon the levers M and N for the purpose of knocking off or disengaging the lever D.

918. Producing Audible Signals on Railways by Electricity, *E. Tyer.*—3*rd March*, 1881. 8*d.*

The inventor places a gong, having its hammer worked by the armature of an electro-magnet, at or in advance of the distant signal, the coil of the electro-magnet being acted on by battery currents, which are intermitted by means of a rotating commutator caused to revolve by clockwork. An electrical contact apparatus is arranged at the side of a rail some distance in advance of the gong, with which it is in electrical connection, so that on a train passing this point it effects contact by the depression of a trigger or deflection of the rail. When contact is thus momentarily made by the train, a polarised contact at the gong is made to close the circuit of an electro-magnet at the clockwork which releases a detent, and the clockwork at once starts the intermittent commutator, so that the gong is sounded. When the clockwork has been in motion long enough—say, from half to three-quarters of a minute—it, by its own movement, replaces the detent and stops itself, leaving the electrical connections in place for another start; the replacing of the detent also causes a momentary reversal of current, which moves the polarised contact of the gong and breaks the circuit, which remains broken until the passage of another train. The apparatus is also made to depend on the position of the signal lever in the signal-box.

921. Working Skins and Leather, *A. M. Clark.*—3*rd March*, 1881.—(*A communication from La Société Anonyme des Brevets Réunis.*) 6*d.*

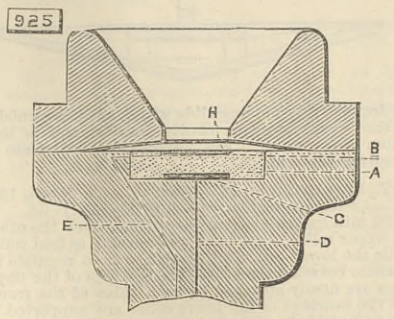
In machines for shaving skins in which an emery wheel is used so much electricity is generated as to



impair the skins. To obviate this a machine is employed consisting of two knives A and B curved to an arc of a circle, and in front of each and on a level with the cutting edge a roller D is placed, and serves to smooth the skin which rolls over its surface, such rollers being journalled in the ends of arms F fixed on collars upon a shaft. The skin is placed on a marble support G, which can be adjusted by screw H. Upon the top bar of the machine above the cutters is placed a sharpening plate, also adjustable by a screw. The knives A and B have a horizontal motion imparted to them by cams, as well as being caused to rotate.

925. Improvements in Telephone Transmitters, *C. Moseley.*—4*th March*, 1881. 6*d.*

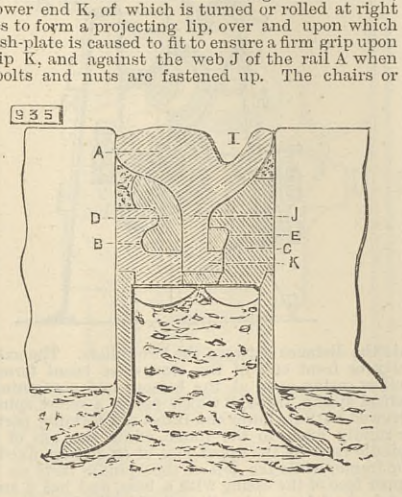
The inventor makes use of the sulphide of copper known as Cu S, either powdered or in a compressed state, to intensify the sounds by lessening the resistance in the transmitter. The drawing shows the method of using it in the powdered state. B and C are electrical conductors, which may be made of the compressed proto-sulphide of copper, or of carbon, and which are



connected to the battery wires D E; the diaphragm, is marked H. The cavity A is filled with the powder, which, being in contact with B and C, forms part of the circuit. In all cases the inventor prefers to make the contacts with the proto-sulphide of copper by means of a conducting material, such as platinum, between which and the copper no chemical reaction can occur. Other methods of using the compressed copper are described in the specification.

935. Tram Rails, *E. Thompson and S. Tomkins.*—4*th March*, 1881. 6*d.*

The rail A has the usual wheel flange I and web J, the lower end K, of which is turned or rolled at right angles to form a projecting lip, over and upon which the fish-plate is caused to fit to ensure a firm grip upon the lip K, and against the web J of the rail A when the bolts and nuts are fastened up. The chairs or



cheeks B C are fitted to the sleepers at intervals, the sleepers being perforated for the reception of studs, which are rivetted down upon the under side. The cheeks or chairs are shaped, one B to receive the wedge D, and the other C to receive the key E, which is placed in from the side and driven home to put the several parts in contact.

941. Mechanism for Delivering Consecutively Numbered Tickets in Public Vehicles or Places of Amusement, *M. Bebro.*—4*th March*, 1881. 6*d.*

This consists of a box designed for containing a length or roll of consecutively numbered tickets and apparatus for delivering the same intermittently. A punch is employed for defacing each length of ticket delivered from the box.

942. Manufacture of Fig Powder, *F. Pool.*—5*th March*, 1881. 6*d.*

The figs are first dried and then pressed into cakes or blocks and placed on shelves to season. They are then cut into thin slices and placed in a revolving wire sieve and heated and dried therein, and are afterwards roasted and ground to a powder.

943. Roasting Coffee, Cocoa, or Chicory, *H. Faulder.*—5*th March*, 1881. 6*d.*

This consists, First, in providing the apparatus with a burner, which can be removed or placed in position as required; Secondly, providing the casing enclosing the revolving cylinder with a lining of a non-conductor of heat; Thirdly, the connection of the chimney with the lower end and side of the casing; Fourthly, constructing the revolving cylinders of steel in lieu of iron.

944. Combination Snap and Joint for Bracelets, Rings, &c., *A. and E. Downing.*—5*th March*, 1881.—(*Not proceeded with.*) 2*d.*

This consists in forming a snap action fastening and hinge pin joint combined in one.

945. Automatic Apparatus for Playing Pianos, &c. *J. Imray.*—5*th March*, 1881.—(*A communication from L. E. J. Thibouville-Lamy.*) 6*d.*

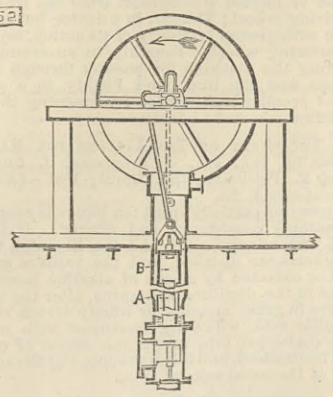
The stroke of each key hammer is effected by the movement of a pneumatic lever worked by exhaustion of air.

947. Looms, *F. O. Tucker.*—5*th March*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to self-acting apparatus employed in stopping the loom when the weft is absent.

952. Pump, *D. McLachlan.*—5*th March*, 1881. 6*d.*

This relates to a pump for raising liquids by suction



and forcing or delivering such liquids, and also to a modification for exhausting and blowing or compressing elastic fluids. The drawing shows the improved pump, which differs from ordinary pumps in having no solid working plunger, is simple in construction, and designed to reduce the friction of moving parts. The barrels are each formed of two tubes A fitted concentrically one within the other, with a space between them, in which works the tubular plunger B actuated by a crank or other means, and its lower end always being immersed in mercury contained in the annular space.

948. Meat Chopping or Mincing Machine, *W. A. Barlow.*—5*th March*, 1881.—(*A communication from W. V. Krause.*) 6*d.*

The knife holders are blocks or plates provided with slots, in which are disposed the knives arranged in a row. These holders are placed in a bed or recess in the chopper mincing box, and when the boxing is closed are held by the hinged cover, one on each side of the central revolving spiked drum or cylinder, the spikes whereof carry the material to be chopped or minced against the inwardly projecting knife blade.

953. Brakes for Carriages, &c., *E. G. Brewer.*—5*th March*, 1881.—(*A communication from P. Prat.*) 6*d.*

This consists of a brake formed of two shoes or skids, or of a single band embracing the naves of the wheel, and operated either by the driver of the vehicle, or by the animal itself harnessed to the vehicle, when he advances or goes backwards.

954. Paving Blocks for Roadways, &c., *J. Taylor.*—5*th March*, 1881. 6*d.*

This consists in fitting or securing to wood paving blocks a piece or pieces on a stud or studs made of metal or other suitable material, so arranged and applied that the wood block is prevented from wearing away.

955. Ascertaining and Indicating the Density and Pressure of Steam, *L. Boye and E. Müller.*—5*th March*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to means and apparatus for ascertaining and indicating at one operation the density and pressure of steam.

956. Self-lighting Match-box, *W. P. and C. E. Cherry.*—5*th March*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to boxes in which the match is lighted by withdrawing it from the box, which is lined with sand-paper.

957. Cushions for Railway Carriages, &c., *S. Newington.*—5*th March*, 1881.—(*Not proceeded with.*) 2*d.*

Within the cushion is enclosed an elastic bag or capsule charged with air or water for the purpose of preventing the vibration to which the spine is ordinarily exposed.

958. Cupola Furnaces, &c., *W. R. Lake.*—5*th March*, 1881.—(*A communication from P. A. Fauler.*)—(*Not proceeded with.*) 2*d.*

The furnace is chiefly characterised by the fact that it is constructed with a number of superposed cylinders or rings, any one of which may be removed and replaced when deteriorated or rendered defective by use. Means are provided whereby the blast is admitted around the entire circumference in the form of a continuous or unbroken sheet, *i.e.*, not by tuyeres only.

960. Mining or Safety Lamps, *J. R. Jones.*—7*th March*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to the construction of a mining lamp (or safety lamp used for other purposes), so that any attempt at opening it shall at once extinguish the light; also such arrangement of the wick that a miner or other person cannot raise the same to an undue height to obtain a light for his pipe.

961. Metallic Bedsteads, *C. S. P. Wood.*—7*th March*, 1881. 4*d.*

This consists in manufacturing the ends of the bedsteads and the sides and ends of cots of a suitable skeleton frame, covered on each side with metal sheets ornamented and decorated as required.

962. Signalling Apparatus for Railway Trains, *H. J. Haddan.*—7*th March*, 1881.—(*A communication from C. F. Ventzke.*)—(*Not proceeded with.*) 2*d.*

A vertical spindle secured to the top of the carriage carries at its upper end a horizontal disc or a pair of wings, to which is attached a string connected with a steam whistle or other signal placed on the locomotive, or on the guard's van, so that by turning the said disc or wing the signal is sounded. The spindle is turned by a spiral spring enclosed in a casing and set in action by disengaging a ratchet wheel mounted on the axis of the spindle, and locked by a ratchet lever click connected with a string which passes into the interior of the carriage over rollers and within the reach of the passengers. The ratchet lever has a lateral guide, and is caused to lock with the wheel by a helical spring when not counteracted by the pull of the string, which is actuated by a passenger.

963. Dry Copying Ink, *H. J. Haddan.*—7*th March*, 1881.—(*A communication from S. L. Grünwald.*)—(*Not proceeded with.*) 2*d.*

The ink consists of white syrup, alcohol, distilled water, glycerine, with a small addition of acetate of uranium.

970. Submarine and Safety Mining Lamp, *F. Foster and H. A. Fleuss.*—7*th March*, 1881. 6*d.*

This relates to the combination of a spirit lamp, a lime, and an adjustable oxygen jet with a reservoir of compressed oxygen.

971. Packing Cases for Metal Plates, &c., *D. Grey.*—7*th March*, 1881. 4*d.*

This consists in making the packing cases for the metal plates entirely of tinned plates, terned plates, black plates, or of other sheet metal, and in such manner as not to require the use of nails in fastening the parts together.

972. Tricycles, &c., *C. G. Hawkins.*—7*th March*, 1881. 6*d.*

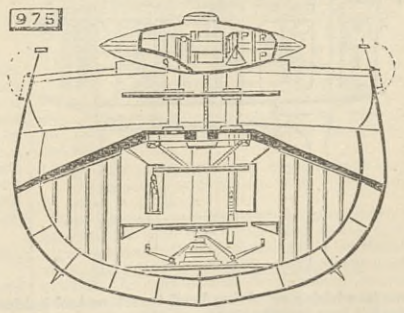
This consists, First, in the construction of velocipedes with a non-rigid frame arranged to prevent jolting when the wheels pass over obstacles; Secondly, in the construction and arrangement of velocipede treadles which vary the leverage by the lever moving past the fulcrum; Thirdly, in the arrangement and application of a relief action to cranks of velocipedes.

974. Gas Brackets for Lighting the Interior of Bakers' Ovens, &c., *F. W. Thorn.*—7*th March*, 1881. 6*d.*

The joint is so constructed that the parts will move freely notwithstanding that the bracket is subjected to great heat, and at the same time the light is automatically raised and lowered by simply turning the arm into and out of the oven.

975. Ordnance, &c., *J. H. Johnson.*—7*th March*, 1881.—(*A communication from N. B. Clark.*) 6*d.*

This consists, First, in the gun carrying frames



pivotted adjacent to the gun ports in the turret or shield, whereby inclination and recoil of the gun are secured without enlargement of the ports; Secondly, in a radius bar or inclined plane devices whereby the sliding breech block of the gun is automatically inserted and withdrawn by the force due to the extension and recoil of the gun; Thirdly, in the loading

apparatus comprising essentially the ammunition elevator P¹, tilting tube P, and hydraulic rammer R; Fourthly, in supplementary deflectors applied to the projecting portions of the guns to protect the latter from injury by side shots.

973. Eye Shade, *G. W. von Nawrocki.—7th March*, 1881.—(*A communication from Dr. C. von Cohausen.*) —(*Not proceeded with.*) 2*d*.

Pieces of coloured glass or gelatine are inlaid in the fan, shade, or screen in any suitable manner as will ornament the same, and may be of any suitable shape.

976. Securing Hose or Flexible Pipes upon their Couplings, &c., *W. R. Lake.—7th March*, 1881.—(*A communication from J. H. Hubbell and F. F. Raymond.*) 6*d*.

One of the devices consists of a strap or band forming a clamp or fastening for hose stamped or punched out of sheet metal in one piece, and having perforations and corresponding tongues or projections.

978. Operating Fog Bells or Gongs, *W. P. Thompson.—8th March*, 1881.—(*A communication from the International Fog Bell Company.*) 6*d*.

This consists in the combination of a suspended bell shaft rotating in one direction only, and operating a striker with a float and connecting mechanism subjected to the action of the waves or tide, and transmitting motion to the shaft and striker.

979. Displaying Clothing in Shop Windows, &c., *F. McIlvenna.—8th March*, 1881. 6*d*.

This consists partly in the manufacture of umbrella or stick stands or frames for exhibiting umbrellas in shop doorways and other like places, constructed with two bars arranged to fit round the handles of the articles exhibited, one of which bars is movable and capable of swivelling out of the way to allow of withdrawing the articles, and yet capable of being locked or securely fastened in a moment.

980. Manufacture of Soda, *W. Weldon.—8th March*, 1881.—(*Not proceeded with.*) 2*d*..

This consists in transforming chloride of sodium into bicarbonate of soda by a certain reaction, and in combining the application of that reaction with a certain method of continually regenerating one of the agents employed to effect it.

981. Pottery and Earthenware, *T. Willett.—8th March*, 1881. 6*d*.

A table is arranged capable of turning on a central vertical axis, and round this table suitable recesses are formed to receive the moulds, and this table is caused to have an intermittent revolving motion, whereby it remains stationary whilst the articles are being made, and then has a partial revolution given to it to bring the next set of moulds under the revolving tools.

984. Cranes, Leads, Hoists, Capstans, &c., *C. R. Parkes.—8th March*, 1881.—(*Not proceeded with.*) 2*d*.

This consists in using the end of a chain on any crane, lead, hoist, capstan or other machine, which is usually fixed, and is called the standing end or fixed end of the chain for obtaining an additional power for use by the said machine.

985. Appliances for Facilitating Turning Over Leaves of Music, Books, &c., *A. G. Morgan.—8th March*, 1881.—(*Not proceeded with.*) 2*d*.

In the case of a piano where the usual frame for holding music is situate a frame, to which is attached by any suitable means arms or levers fixed at one end to a rod or arm at the centre of the frame by spring, spiral, or otherwise, so that as each arm is released the same turns, carrying with it the music.

986. Soles of Foot Coverings, *H. J. Haddan.—8th March*, 1881.—(*A communication from V. R. Hervochon.*)—(*Not proceeded with.*) 2*d*.

The sole is composed of three principal parts, viz., a thin sheet of leather, which comes in contact with the foot; a strong sheet of leather, which forms the base and touches the ground; and a sheet of tinned iron or copper or other flexible material placed between the outer and the inner sheets of leather.

988. Wheels for Velocipedes, &c., *E. C. F. Otto.—8th March*, 1881. 8*d*.

This consists in the construction of elastic wheels applicable to velocipedes and other vehicles, and having elastic tires and elastic spokes, the latter placed in compression.

990. Writing Slates, *E. J. J. Dixon.—8th March*, 1881. 8*d*.

This relates to machinery for the manufacture of writing or school slates, and in the machinery for and method or methods of attaching the several parts or pieces of the wood forming the frames of writing slates to each other, or to the slates themselves, or to both, so as to give to the said frames when complete greater strength and durability, with a firmer hold upon the slate.

991. Galvanic Batteries, *G. F. Redfern.—8th March*, 1881.—(*A communication from S. Marcus.*)—(*Not proceeded with.*) 2*d*.

The object of this invention is to do away with the porous pots of the ordinary battery, and to construct a permanent cell equally applicable for military and domestic uses.

993. Cylinders of Compound Engines, *T. Spiller.—8th March*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to a cylinder consisting of three parts, one cylinder for the use of steam at high pressures, and two of larger calibre for using the steam as low-pressure steam.

995. Artificial Fuel, *G. Walters and W. Morgans.—8th March*, 1881. 4*d*.

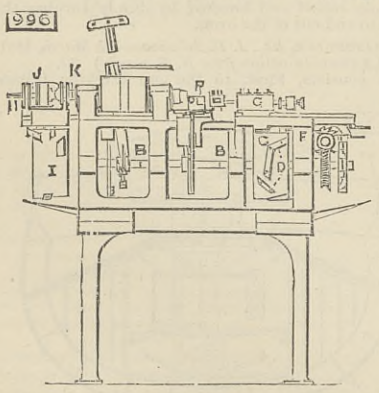
This consists in the employment in the production of artificial fuel of lime mixed with coal, coke, or breeze.

998. Landaus and Landulets, *J. Lewis and T. Hammond.—9th March*, 1881. 6*d*.

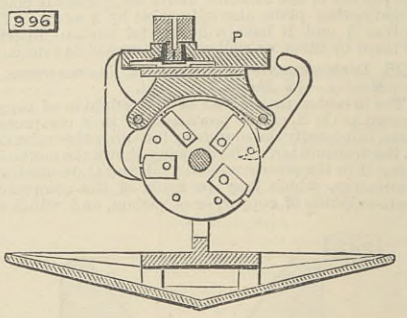
This relates to the construction of landaus and landulets with doorways of equal width by constructing the pillar tops so that they do not overhang the doorways as at present. It also relates to improvements in top pillar hinges.

996. Turning and Screw-cutting Lathe, *O. Jones.—9th March*, 1881. 6*d*.

This relates to turret lathes or screw-cutting ma-



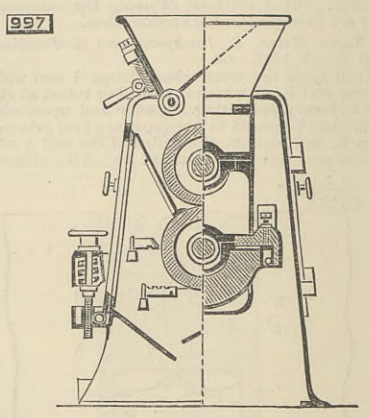
chines in which a revolving head turret or tool holder supported by a longitudinally reciprocating carriage is employed in combination with a transversely moving slide with a tool, whereby the screws are cut successively from a rod. The frame carries a cam shaft B, on which is mounted the cylinder C, carrying cams D, to impart by means of roller F the longitudinal movements to slide G carrying the tool holder, so as to cause the tools to act during the forward movement of the slide on the end of rod H. The cylinder I also mounted on shaft B carries cams to alternately move the gripping device J and sleeve K to ensure the feed of the rod, the motion of which can be reversed. P is



the transversely moving slide which advances quickly to the work, operates slowly thereon, and is then drawn back quickly. Fig. 2 shows the mechanism for actuating this slide.

997. Roller Mills, *H. J. Haddan.—9th March*, 1881. —(*A communication from J. G. Koerner.*) 6*d*.

The mill has two rollers placed one over the other, the upper roller being fixed and serving as feed roller, while the lower one is adjustable so as to regulate the distance between the two. The bearings of the upper roller are firmly attached to both sides of the frame, and the bearings of the lower roller are supported by two adjustable transverse levers secured to the frame, each of these beams or levers being pivotted at one end to a fixed bolt by means of a bearing open at the bottom and having a steel jamb which rests on the said bolt, and can be adjusted from the top of the bearing by a set screw, so as to lift or lower the transverse beam together with the lower roller in order to regu-



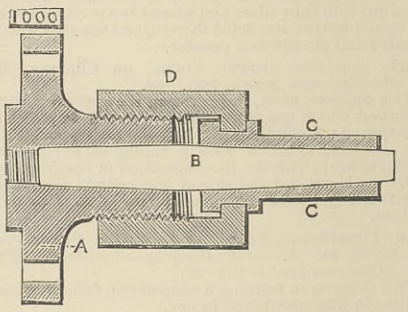
late the distance between the two rollers. The extremity or front end of the transverse beam forms a hollow casing open at the bottom and containing a helical spring, through which passes a screw spindle screwed with its lower end into a nut forming part of or rigidly fixed to the frame, while the top of the spindle rests on the upper face of or rigidly fixed to the frame, while the top of the spindle rests on the upper face of the casing with a boss, and has a small hand wheel for turning the spindle, which is also provided with a movable nut placed at the bottom of the spring casing, and serving to regulate the tension of the spring, so as to obtain the required pressure between the rollers.

999. Dyeing Cotton Yarns, *F. A. Gatty.—9th March*, 1881. 4*d*.

This consists in the use or employment of alcohol, wood spirit, acetone, ether, or the derivatives of the same, to convey mordants and dyeing materials to all parts of cotton yarn when in the cop, on bobbins, spools, or in other compact form, in order to dye the yarn.

1000. Expanding Mandril, *J. Harrison.—9th March*, 1881. 6*d*.

On the outside of the flanged boss A a screw thread is cut, and through the centre a taper screw hole is formed and receives the taper plug B projecting beyond the boss, where it is also tapered and receives



the dies C. There are three dies and they form together the portion of the mandril on which the wheel or other article to be turned is held. The dies are flanged, the flanges resting inside the rim of a cap D, screwed on the boss. The flange of the boss is secured to the face plate on the lathe, and the plug is countersunk so that the lathe centre may fit in it.

1001. Velocipedes, *R. C. Fletcher.—9th March*, 1881. 6*d*.

This relates more particularly to tricycles, and consists, First, in an improved method of steering the machine; Secondly, in a device for changing at will the rate of motion transmitted from the treadles to the driving wheel; Thirdly, in a device for applying a brake with greater certainty of its action, especially upon steering wheels; Fourthly, in an arrangement for folding the machine for passing through narrow doorways and the like; and Fifthly, in a gearing wheel of peculiar construction for lessening the noise and friction.

1002. Treatment of Tan Liquors for Manufacture of Ink, &c., *T. Priestman, J. Longshaw, and G. Priestman.—9th March*, 1881.—(*Not proceeded with.*) 2*d*.

The spent or partially spent tan liquor is evaporated to a suitable consistency and filtered. It is then treated with mineral acids, and the liberated volatile organic acids are distilled, and the vapours are condensed or collected by means of alkaline bases. The residues in the distilling apparatus, after the volatile acids are in great measure or wholly driven off, contain gallic acid, which by treatment with metallic iron is converted into ink, or the excess of mineral acid is neutralised, and ink is produced by the addition of any of the usual salts of iron.

1003. Condensing and Preserving Milk, *F. Wirth.—9th March*, 1881.—(*A communication from P. F. Gaupp.*) 2*d*.

The milk is heated in a suitable vessel to 60 deg. Reaumur, and then pumped into a vacuum apparatus, where its bulk is reduced by 75 per cent. The milk is then, whilst hot, put into tin boxes or cans, and the latter are hermetically closed. When the boxes are thus filled and closed they are placed into a bath of chloride of calcium, and heated to 85 deg. Reaumur.

1004. Stoppers for Bottles, *N. Thompson.—9th March*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to means whereby stoppers may be readily withdrawn from the necks of the articles into which they have been inserted, and be repeatedly inserted and withdrawn for a considerable time, while still remaining efficient stoppers.

1005. Wash Boilers or Kiers, *A. Specht—9th March*, 1881.—(*A communication from T. Hasbeck and A. Hasperg.*)—(*Not proceeded with.*) 2*d*.

This relates to the construction of the inner arrangement in wash boilers, the central circulation pipe of which carries at one or more suitable distances annular shoulders with radial openings. On these shoulders rest one or more perforated partitions, movable on the circulation pipe, which divide the space for the washing in two or more divisions, in order to produce a more effective circulation of water through the circulation pipe and the washing surrounding the same.

1006. Brakes, *S. C. Taylor and J. Wilde.—9th March*, 1881.—(*Not proceeded with.*) 2*d*.

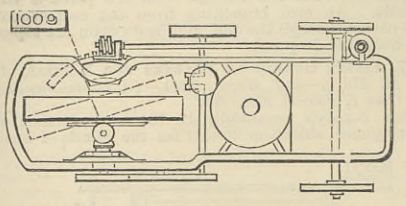
A catch wheel is secured to one or more of the wheel bosses or hubs, and in connection with each catch wheel is a sliding catch which can be actuated by a series of levers and rods, so that the same is withdrawn from gear with the said wheel, or left so as to gear with the wheel, and prevent the cart running back when the horse rests going up hill.

1007. Boot Protectors, *J. Fieldhouse.—9th March*, 1881. 4*d*.

This relates to a boot protector consisting of a metallic plate having internal perforations and edge recesses, each of which passes entirely through the thickness of the plate.

1009. Traction and Locomotive Engines, *J. Braby.—9th March*, 1881. 6*d*.

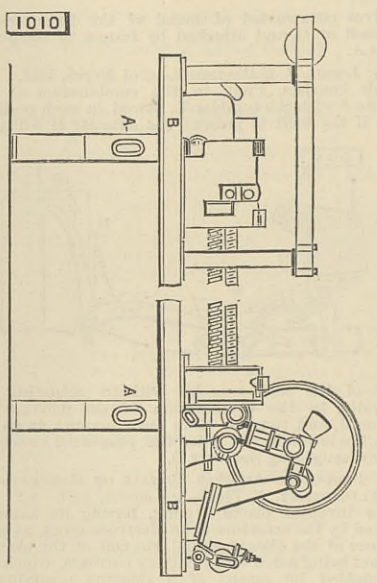
This consists, First, in converting the central steering wheel of traction and locomotive engines into a driving wheel; Secondly, in mounting the central



steering wheel of traction and locomotive engines on a radius axle, and transmitting to such wheel driving power through the pivot on which the radius axle turns. The drawing is a plan view of a traction engine.

1010. Preparing and Spinning Hemp, &c., *J. Barbour.—9th March*, 1881. 6*d*.

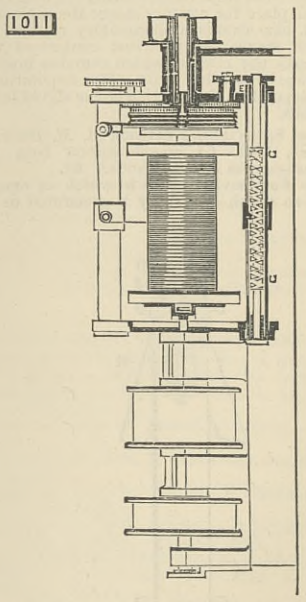
A series of cast iron frames A is provided to receive a set or series of longitudinal rails B, which connect the frames together, and at the same time serve as the base or platform upon which the brackets and bearings which carry the screws, bushes for rollers,



and the usual fixings for a screw gill frame are bolted. The Second part consists in an arrangement for adjusting the pressure on the drawing rollers. The Third part consists in the method of carrying and driving the spindles and flyers. The Fourth part consists of an arrangement for "dragging" or retarding the bobbin.

1011. Spinning or Twisting Coarse Yarns, *A. Combe.—9th March*, 1881. 6*d*.

This consists in the method of traversing the yarn upon the bobbins, which are concentric with the flyers;



The drawing is a side elevation partly in section of a horizontal spindle and flyer fitted with right and left handed screws G for traversing yarn guide pulleys o eyes from end to end of a stationary bobbin.

1008. Weaving Leno, Gauze, &c., *R. Ecroyd.—9th March*, 1881.—(*Not proceeded with.*) 2*d*.

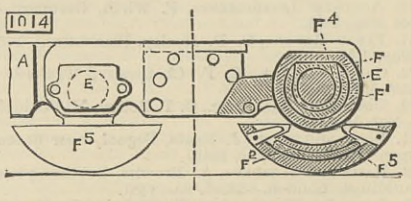
The warp threads are passed through a reed constructed as a heald, such reed having an eye, metal, or other dent, reaching half way up the said reed heald, through which the warp ends required to form the loop are passed. The other warp ends pass between the half and the full dents, and have motion imparted to the same, which passes the latter ends alternately to each side of the half dents when required to cross the same for forming the pattern of leno or gauze fabric.

1012. Furnaces, *B. R. Huntley.—9th March*, 1881. 8*d*.

This consists in forming a furnace of brickwork, preferably with a wrought or cast iron shell or casing. The receptacle for the fire is in the form of a basket, with open sides and bottom, which greatly facilitates the supply of air to the fuel to promote combustion.

1014. Endless or Portable Railways, *A. Dunlop.—9th March*, 1881. 6*d*.

This relates to improvements on patent No. 657, dated 21st February, 1874, and consists in making the rails A with oblong holes and sliding bushes in the wide outmost ends, as well as in the narrow inner ends of every link or rail A, giving thereby greater facility in the angling or bending of the rails laterally at the joints E; and further, in making the holes and bushes



which slide in them with the upper corners preferably rounded a little and fitted with a large cover over the outside of these recesses and bushes in the wide ends of each rail. The Second improvement consists in inserting a layer or layers of elastic material as F¹ and F² respectively, both in the eye F, under the bush F⁴, and also between the flange and the upper segmental surface of the bearing shoe or rim F⁵.

1015. Heels for Boots and Shoes, &c., *W. Brewster.—9th March*, 1881. 6*d*.

The heel is constructed by preference of metal, and consists of a shell formed to suit any desired pattern of heel. Within this shell is provided a cross-piece or web, which serves to strengthen the shell. This heel is attached to the in-sole by means of a flat-headed bolt or stud, which passes through the centre of the cross-piece or web into a wearing plate, which serves as a nut for the bolt, and also as an ordinary heel-plate.

1018. Manufacture of Compound Packing Material, &c., *J. A. Turner.—9th March*, 1881. 2*d*.

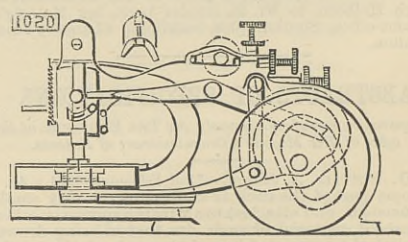
This consists of two or more sheets or lengths of fabric cemented together in such a manner as to leave the sheets separate from each other along the edge of the compound material.

1019. Controlling the Speed of Steam Engines, *F. W. Durham.—9th March*, 1881.—(*Not proceeded with.*) 2*d*.

In the stern of the ship is provided a tank containing water connected by a pipe to an air vessel situated near the ship's engine, which air vessel also communicates by a pipe with a cylinder or vessel having a diaphragm or piston connected to the lever of the steam supply valve; thus, on the rising of the ship's stern, the tank being raised in a corresponding manner relatively to the air vessel, water will flow from the former into the latter to an extent corresponding to the increased head, and the consequent increased compression of the air in the air vessel and diaphragm vessel will cause the diaphragm to operate the steam supply valve, so as to cut off the steam supply more or less.

1020. Sewing Machines, *J. B. Robertson.—9th March*, 1881. 6*d*.

This consists, First, in connecting the head carrying the needle slide to the shuttle race by a rigid frame, which, being mounted by an elastic or universal joint



receives lateral and longitudinal movements determined by suitable cams; Secondly, in a sewing machine adapted for ornamental stitching, the combination of a double-pathed cam with double adjustable bearing studs or rollers on one feed lever.

1022. T-Squares, *J. Corp.—10th March*, 1881.—(*Not proceeded with.*) 2*d*.

At the outer edge of the stock is fixed a spring, which presses against a small slide block connected through a slot in the blade to one end of a rod, lath, or wire extending along nearly the whole length of the upper surface of the blade, a second slide block being similarly connected to its other end, or near thereto.

1025. Furnaces, Fire-grates, &c., *J. Teer.—10th March*, 1881.—(*Not proceeded with.*) 2*d*.

Fire-bars are employed which act as conduits to convey currents of air to a hollow perforated bridge, and to heat the air in its progress.

1026. Construction of Buildings, &c., *S. Rideal.—10th March*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to the construction of buildings which are composed wholly or partly of timber. In the erection or covering of such buildings planks or timbers are employed, which are so prepared and fitted together as that a weather-proof construction of great durability is obtained.

1027. Improvements in Electric Lamps, &c., *J. A. Berley.—10th March*, 1881.—(*Not proceeded with.*) 4*d*.

This invention refers to lamps in which the regulating mechanism is dispensed with, and the carbons are placed parallel to each other and fixed in separate holders, one being fixed and the other made to approach or recede from this one to produce the arc. The invention consists in the substitution of a strip of flexible material such as metal for the hinge pivot or oscillating contrivance for approaching the one carbon to the other, the movable carbon is also attached to an armature. The invention also relates to an automatic method of lighting a fresh pair of carbons, when the first pair are consumed.

1030. Appliances in Connection with Musical Instruments for Reproducing Tunes Played thereon, *T. Paterson.—10th March*, 1881. 6*d*.

This consists in electrical and mechanical arrangements by which the action of a pianoforte, organ, or other keyed instrument, when played upon, produces such a modification of a mechanism combined with it that a piece of music once played upon it may at any time be repeated by the automatic mechanism set in motion by electricity, clockwork, or other means.

1028. Motive-power and Pumping Machinery, *J. and G. Weir.—10th March*, 1881. 8*d*.

In one modification shown in the drawings a motive-power cylinder to be worked by steam or other fluid under pressure, and a pump cylinder or barrel, are

placed vertically with the motive-power cylinder uppermost. The steam is made to act on the compound system, each quantity first entering beneath the piston and operating on a smaller area, and then being transferred to the upper end of the cylinder to act on the larger area. The pump and its passage and

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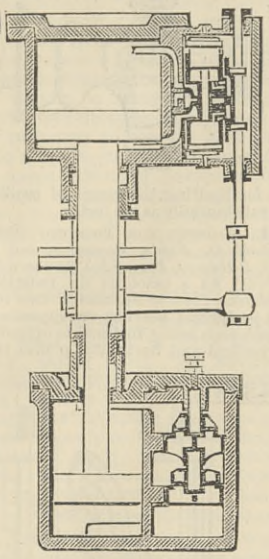
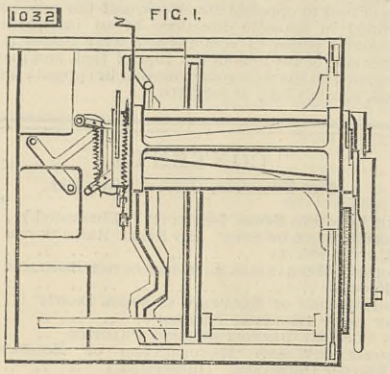


valves are arranged so that the water is first drawn in below the piston, then transferred to the upper end of the cylinder, and afterwards passed from the latter into the discharge pipe.

1032. Sheaf-binding Mechanism, *J. Howard and E. T. Bousfield.*—10*th March*, 1881. 10*d.*

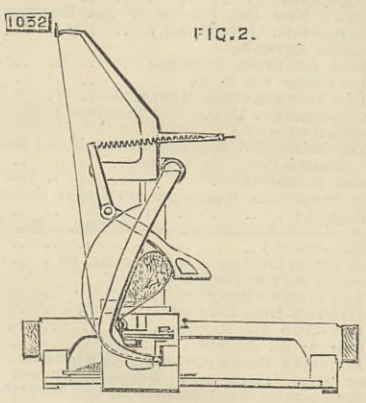
This consists, First, of an endless vibrating rack operated by a toothed wheel or pinion in such a manner as to impart the required movements to the binder arm and table (or to the binder arm when a fixed table is used); Secondly, of the knotting or knot-tyeing mechanism, consisting of an outer sliding and rotating tubular hook or cord-retaining device, and an inner sliding hook, combined and operating to tie the knots in the cord or string; Thirdly, of the string gripping and cutting device, consisting of a movable jaw

1032 FIG. 1.



urranged between two fixed plates or jaws (one of which forms or is furnished with a cutting edge), and fixed on a lever which is controlled and actuated by means of fixed surfaces or stops, or otherwise, in such a manner that the said device operates in combination with the hooked bar (or other means for pulling back

1032 FIG. 2.



the string), to grip, release, and cut the string or cord. Fig. 1 is a plan of the sheaf-binding mechanism, with the sheaf table removed to permit the parts below the same to be seen; and Fig. 2 is a front elevation, partly in transverse section.

1033. Apparatus for Consuming Smoke in Furnaces, *G. Hunter.*—10*th March*, 1881. 6*d.*

This consists, First, essentially in the arrangement and combination of hollow arch M and air chamber C

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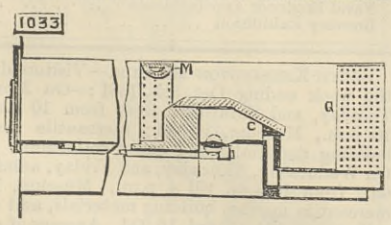

and parts connected therewith, for regulating the admission of air into flues; Secondly, in the arrangement and application of perforated pillars Q and parts connected therewith.

1034. Generators of Steam, &c., *F. Duray.*—10*th March*, 1881.—(*Not proceeded with.*) 2*d.*

The heating surface is increased in its greatest part by a boiler tube or flue which envelopes the tubes throughout their length; besides this tubular envelope with the tubes are extended to the front of the fireplace and to the back or smoke-box end, and is thus exposed to better receive the heat, and so forms a hearth and tube envelope.

1035. Cleaning and Polishing Knives, *H. Courteen.*—10*th March*, 1881. 6*d.*

This consists in the application and use to and in knife cleaning machines of two cleaning rollers of different diameters revolving in the same or opposite directions without being in contact with each other, the smaller roller being so arranged as to enter and clean the hollow or curved part of the bolster or shoulder of the blade, and also to form a fulcrum or bearing whereby the blade can be applied by hand on to the surface of the larger roller with any desired amount of pressure, by raising or depressing the handle.

1037. Packing Material, and Boxes, Cases, or Wrappers made thereof, *W. R. Lake.*—10*th March*, 1881.—(*A communication from R. H. Thompson and H. D. Norris.*) 6*d*

A packing material is composed of corrugated paper, having a backing or layer of paper or other fabric secured to one or both sides by means of adhesive substance.

1038. Water-closet Apparatus, &c., *W. R. Lake.*—10*th March*, 1881.—(*A communication from A. Edwards.*) 8*d.*

This relates to improvements on patent No. 4037, dated 6th October, 1879, and consists, First, of a vertical movable pan or bowl, and the means for raising and lowering the same; Secondly, of a section C in combination with a vertically movable pan or bowl and a cap E which closes down over the said bowl when

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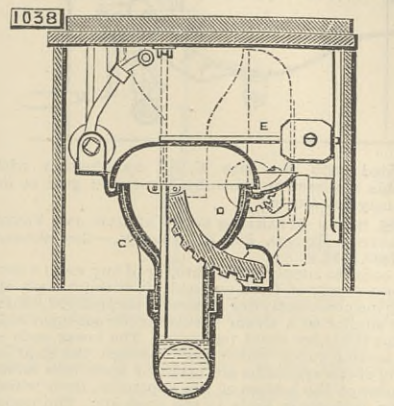

the latter is lowered, and forms with the section a seal or joint; Thirdly, in combination with a stationary section, a vertically movable pan or bowl D, having a neck formed integral therewith, and serving as a connection or conduit between the said section and bowl when the latter is elevated.

1039. Writing Instrument, *J. Nadal.*—10*th March*, 1881.—(*Not proceeded with.*) 2*d.*

A rod extends from the point through the holder, and at the other end of the same has a knob, or is otherwise provided with means for its convenient manipulation, to move it to and fro, and thereby clear its point of any obstruction. The lower part of the rod is provided with a flange, which rests upon a recess inside, and in the lower part of the reservoir when the pen is not in use. The upper end of the tubular holder is closed by a screw stopper, and an inner central tube passes through this stopper and extends to within a short distance of the point of the pen to conduct air to the lower part of the reservoir.

1040. Electric Lamps, *A. A. Common and H. F. Joel.*—10*th March*, 1881. 6*d.*

The invention relates to improvements in arc light regulators, and also in the Joel incandescent lamp patented in 1879, No. 5157. Several variations in the method of regulation are shown, of which we describe the following:—Referring to the figure, when an electric current is sent through the thick wire coil it passes through the carbons E, and back to its

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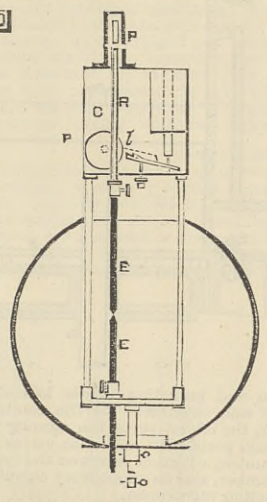


source; the core C is drawn into the coil and raises the lower end of a lever, causing the other end to move on the pivot, grip a disc, and turn the pinion P, this raises the rack R with carbon E attached, and so strikes the arc. When the latter becomes too long the action of the coil is weakened, and the shunt coil strengthened; the core drops again, releasing the lever from the disc and allowing R to fall. As R falls glycerine from the cylinder P1 falls with it, and retards and regulates its fall as described in A. A. Common's patent No. 368, 1870. The improvements in the incandescent lamp described in the specification refer chiefly to causing good contact between the carbon pencil and the other electrode.

1041. Dram Flasks, Drinking Flasks, &c., *J. Hall.*—11*th March*, 1881. 4*d.*

This consists in so forming the neck of the flask or bottle as that it can be readily used for drinking from.

1043. Dyeing, *C. T. Bradbury.*—11*th March*, 1881.—(*Not proceeded with.*) 2*d.*

This consists in first passing the cotton piece goods to be dyed through a liquor containing logwood or other similar or suitable extracts of dye woods, chlorate of potash or other oxidising agent, acetic acid, acetate or nitrate of chrome, or other suitable substances. The pieces are then passed between rollers or other apparatus to remove the excess of liquor, and are then dried. They are then subjected to the action of steam, and afterwards passed through prepared chemical solutions, consisting chiefly of oxidising agents.

1044. Apparatus for the Cure of Smoking Chimneys, &c., *R. and J. Douglas.*—11*th March*, 1881. 6*d.*

This relates to the employment of whirligigs.

1045. Arranging Parts of the Flues from the Furnaces of Steam Boilers, &c., *G. Love, jun.*—11*th March*, 1881. 4*d.*

A stopping or bridge is formed in the upper part of the flues to stop the too free progress of the heated products from the furnaces to the chimney or stack.

1047. Appliances for Preventing the Efflux of Gases from Drains, *C. S. Rolfe.*—11*th March*, 1881.—(*Not proceeded with.*) 4*d.*

This relates to improvements in stench traps, whereby the outside air can freely enter the drain without destroying the seal of the trap, and in the event of pressure arising in the drain an increased depth of seal is produced to oppose it, whilst a large freeway is provided for the passage of solid substances.

1048. Manufacture of Maltose, *J. Imray.*—11*th March*, 1881.—(*A communication from A. P. Dubrumfaut.*—(*Not proceeded with.*) 2*d.*

A paste is made of starch with twelve to fifteen times its weight of water at a temperature of about 160 deg. Fah., and this paste is mixed with an exhaustive infusion of malt.

1051. Hydrocarbon Cooking and Heating Stoves, *F. Arnold.*—11*th March*, 1881. 4*d.*

This consists essentially in the use and adaptation of dual burners with a single slotted cone for heating and cooking purposes.

1053. Manufacture of Lozenges, *J. Rough and J. Hurry.*—11*th March*, 1881. 6*d.*

This consists in the arrangement and combination in a machine for manufacturing lozenges, of a stamping and printing press and devices, with cutting apparatus, under which the lozenge dough is carried or fed forward intermittently by a web, and actuated by mechanism arranged to operate the various parts in the requisite sequential order.

1054. Brakes for Railway Vehicles, *A. Houghton.*—11*th March*, 1881.—(*Not proceeded with.*) 2*d.*

The concussion or running together of the vehicles of the train is caused to be effected in effecting the actuation of the brakes through the instrumentality of the spring buffers.

1055. Apparatus for Brushing or Clearing Tram Rails, *T. S. Hardeman.*—11*th March*, 1881.—(*Not proceeded with.*) 2*d.*

This consists principally of a pair of brushes mounted upon an axle which is driven by a crossed strap or chain from a pulley, keyed on the axle of the running wheels of the car, the width of the brushes apart being equal to that of the rails.

1059. Gas Lamps or Lanterns, *W. T. Sugg and R. Pierson.*—11*th March*, 1881. 6*d.*

This consists in the use of perforated hollow or trough-shaped metal ribs, whereby the ventilation and light-diffusing power of the lamps or lanterns are improved.

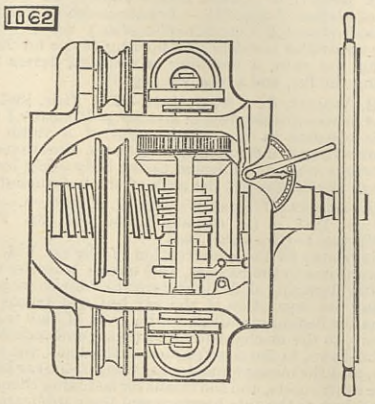
1061. Furnaces, *E. Brook.*—11*th March*, 1881.—(*Not proceeded with.*) 2*d.*

The steam jet blowers are arranged to draw all or part of the necessary air from or out of a covered hopper or hood provided over the charging hole or holes, so that any smoke or gases that may be escaping around the plug that closes the charging hole may be drawn in along with the air and economised.

1062. Steam and Hand Steering Apparatus, *W. R. Cooper and J. Taylor.*—11*th March*, 1881. 6*d.*

This consists, First, in a steam and hand gearing gear of the application of an excentric brush operating a clutch and bevel wheel for connecting and disconnecting the steam and hand gear respectively;

1062



Secondly, in a steering apparatus, either steam or hand, of the application of springs by which the chain wheel sheave or barrel is controlled in such a manner as to neutralize the shock of a heavy sea or other body striking the rudder and prevent it being communicated to the gearing or breaking the chains. The drawing shows a plan.

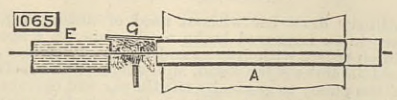
1063. Treatment of Ores, &c., *J. H. Johnson.*—11*th March*, 1881.—(*A communication from S. Philippart.*)—(*Not proceeded with.*) 2*d.*

This relates to means of treating the ores in such a manner as to place the metal in chemical or mechanical suspension in a liquid, and subsequently to place this liquid containing the metal in suspension in a battery, in order to separate the metal by the direct action of the battery.

1065. Manufacture of Hardened and Tempered Steel Wire, *W. F. Bateman.*—11*th March*, 1881. 6*d.*

The object is to prevent the oxidation caused by the atmosphere acting on the heated wire, and to produce a bright smooth hardened steel wire. This is accomplished by enveloping the heated wire from the point of exit from the heating chamber A to its entrance

1065

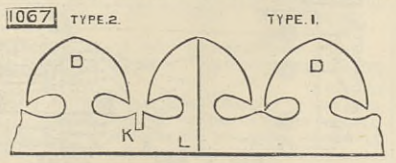


to the hardening bath E. The wire passes through a tube in the furnace, the end of which is closed by asbestos or cotton waste so as to prevent air entering, and a gas flame is directed against the wire as it leaves the tube, the shield G directing the flame downwards on to the wire.

1067. Apparatus for Breaking or Preventing Double Twist in Spinning, *A. M. Clark.*—11*th March*, 1881.—(*A communication from C. P. Maillard.*) 8*d.*

This relates, First, to the device acting directly on the yarns for breaking the double twist; and Secondly, to the mechanism for operating such device and producing its repeated action at the proper moments, variable at will during the outward run of the mule carriage. The drawing represents the device, which consists of a dentated bar L, having teeth D corresponding in number and position to the intervals between the yarns, and of such form that in the upward movement the double yarns, with which alone the curved sides of the teeth will come in contact, will slip down the curved edges past the lateral barbs of the teeth and enter lateral recesses in which they are imprisoned, so that on the descent of the bar they

1067 TYPE.2. TYPE.1.



will be broken, whilst the other yarns which have not run double are only acted on during the upward motion by an obtuse V point at the middle of each interval between the teeth, from which they escape during the downward motion, and are caused by the effect of their own tension to return to their normal positions in line with the centres of the intervals between the teeth. One half of the bar is shown with slits K formed at the centre of the space between the teeth, so as to obviate the strain caused by the obtuse points.

1068. Air Engines and Pumps, *E. Major.*—11*th March*, 1881.—(*Not proceeded with.*) 2*d.*

According to one arrangement this engine consists of a paddle wheel made to revolve inside a suitably shaped chamber.

1070. Railway Signals, *J. Snowball and C. Warren.*—12*th March*, 1881. 6*d.*

This relates to means for keeping the signal wires at a uniform tension, and it consists of a pivotted lever C, with two pulleys D at its upper end. The lower end of this lever contains a weighted rod E capable of sliding up and down, and at the bottom of it is a grooved plate H. The chain passes over one pulley D,

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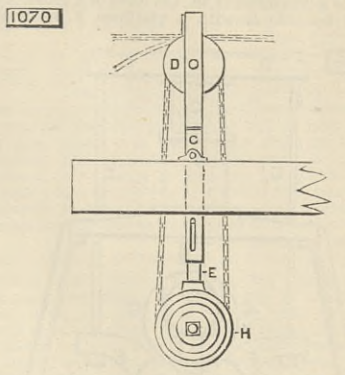

down over the plate H, up over the other pulley D, and then to the signal.

1072. Railway Switches, &c., *A. E. McDonald.*—12*th March*, 1881. 6*d.*

This relates chiefly to "stub switches," wherein the end of the main track is left free on the sleepers for some distance, so that it can be made to coincide with the ends of the divergent tracks, and it consists of means for preventing the movable rails becoming fixed by expansion or leaving a gap by contraction; also of a lock to prevent displacement by unauthorised persons, and a signal to indicate the position of the

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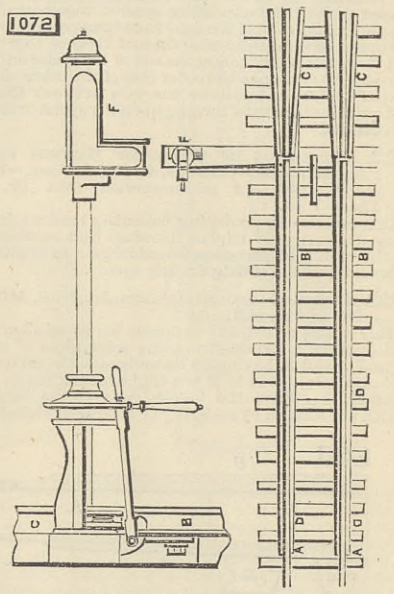


switch. A is the main track; B the movable ribs; and C the divergent tracks. Plates D extend under and beyond the rails B, and under the tracks A and C, to the rails of which they are fastened. The movable rails B are made much longer than usual, so as to give a greater amount of elasticity. Fig. 2 shows the signal F, which is connected with the switch so as to be moved at the same time with it.

1075. Caps for Spinning, *D. Butterfield.*—12*th March*, 1881. 6*d.*

This consists in the manufacture of improved caps having steel hoops and cast iron bodies, made with a rim or projecting circle to give the required strength to firmly secure the steel and iron together.

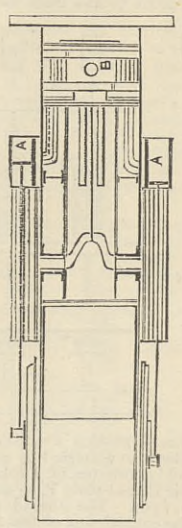
1077. Looms, *J. Shimon and J. Whyte.*—12*th March*, 1881. 6*d.*

This relates to the arrangement of a dobby or shedding apparatus for actuating the heddles of looms.

1128. Locomotive and Traction Engines and Boilers, *F. W. Webb.*—16*th March*, 1881. 6*d.*

This relates to means for enabling locomotives to work compound or simple, and obtaining the adhesion of the two pairs of wheels for traction without the usual coupling rods. Three cylinders are preferably used, two A driving the hind wheels, and the third B

1128



connected with the axle of the other pair of wheels. The steam acts first in cylinders A, and can then be directed into the low-pressure cylinder B. The second pair of wheels can assume a radial position, so as to facilitate working round curves. The Second part of the invention consists in giving a slight cross movement to slide valves while working, so as to vary the position at each stroke, and thus prevent the grooving of the faces; and the Third part consists in forming one or more open-sided gussets to give elasticity, and allow the fire box to expand and contract with the tubes.

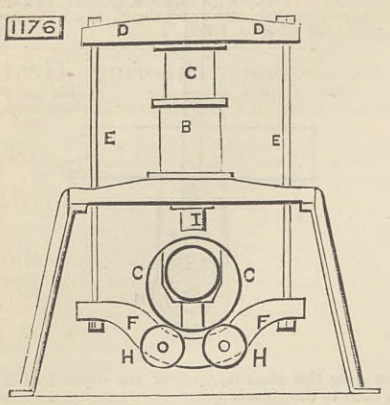
1129. Steam Boiler and other Furnaces, *W. P. Thompson.*—16*th March*, 1881.—(*A communication from O. D. Orvis.*) 10*d.*

This consists essentially in the combination with a furnace and with each other of a steam and air inlet pipe opening into the furnace in a horizontal plane above the burning fuel and at an oblique angle to and towards the rear end of the furnace, an air supply pipe, a vacuum chamber or globe, a horizontal steam jet entering the vacuum chamber and a steam supply pipe, said pipes and globe being arranged upon the outside of the furnace.

1176. Welded Iron and Steel Tubes, *J. C. Johnson.*—17*th March*, 1881. 6*d.*

A vertical, hydraulic cylinder B is supported on a

frame, and through its upper end works a ram C attached to a crosshead D in the form of a cross, and connected by rods E with a platform F below the



hydraulic cylinder for supporting the tube G on the rollers H ; I is the welding tool secured to the frame.

1178. Tab Connectors of Braces, *T. Walker.*—17*th March*, 1881. 6*d*.

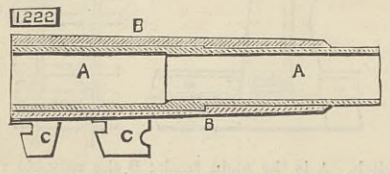
The tab connector consists of a folded or doubled piece or blank of sheet metal, having disc-shaped ends constituting a spring clip, one of the disc-shaped arms of the clip being furnished with an eyelet or tubular stem, and the other disc-shaped arm with a hole for receiving the end of the eyelet or stem, the disc-shaped arms of the clip being secured together after the perforated ends of the tabs have been passed on to the eyelet or stem by closing the said arms of the clip and rivetting or expanding the end of the eyelet on one disc-shaped arm upon the outer face of the other disc-shaped arm, so as to secure the tabs between them, and permit of the tabs turning upon the eyelet or stem as a centre.

1212. Production of Colouring Matters from Para-nitrobenzaldehyde, &c., *J. A. Dixon.*—19*th March*, 1881.—(*A communication from Dr. O. Fischer.*) 4*d*.

This consists in producing colouring matters from those derivatives of triphenylmethan that are formed by the action of para-nitrobenzaldehyde on aromatic bases in presence of dehydrating agents.

1222. Breech-loading Small-arms, &c., *W. H. Monks.*—19*th March*, 1881. 6*d*.

This relates principally to double-barrel small-arms, and consists in forming from one solid piece of steel a band or coil B, having on its underside the lumps C, and also holes bored in it at a slight inclination to one another to receive the breech ends of the barrels, which are secured by soldering or brazing or shrinking



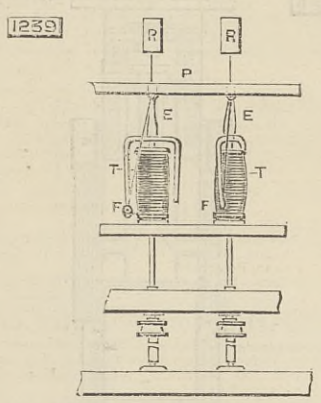
the coil on the barrels. Machinery is described for giving great truth of figure to the barrel externally, and it consists of a cutting tool or emery wheel fixed on the rest of the ordinary lathe, and at the back of the bed a guide having the figure of the exterior of the barrel to be made is fixed, the rear end of the rest bearing against such guide. A travelling stay is employed to prevent the springing or yielding of the barrel.

1225. Manufacture of Colouring Matters for Dyeing and Printing, and Preparation of a new Mono-sulpho Acid of Beta-naphthol, &c., *J. A. Dixon.*—21*st March*, 1881.—(*A communication from C. Rumpff.*) 4*d*.

This consists in the preparation and separation of a new mono-sulpho acid of beta-napthol, and of colouring matters therefrom by nitration, or by causing the same to re-act on diazo compounds.

1239. Flyers for Spinning and Winding Machinery, *D. Frazer.*—21*st March*, 1881. 6*d*.

This relates to means for reducing the friction of the thread in its guides when being wound on to the bobbins. One improvement consists of small guide rollers F of metal or delf, substituted for the guiding wires usually fixed to the ends of the limbs of the



flyers, the thread passing over the rollers on to the bobbin T. The flyer spindle E is continued up above the limbs, and terminates in a conical top fitting an opening in the thread-plate P, so as to prevent vibration of the flyer. The thread passes through an opening in the conical top of the flyer spindle, and is guided vertically over the centre of the flyer by nipping rolls R.

1299. Machinery for Making up Packets of Powdered Materials, &c., *G. Pritchard.*—23*rd March*, 1881. 2*s*.

This relates to machinery to be used for filling at one operation a series of bag-like wrappers or cases with powdered materials and other commodities, and for pressing or consolidating the material or commodity placed in the said wrappers or cases ; also for folding, closing, or creasing the open ends of the bag-like wrappers or cases after the filling and consolidating operations, and perfecting the figure of the packets, and also for labelling the packets.

1332. Compound for Preserving Organic Substances, *F. S. Barff.*—25*th March*, 1881. 2*d*.

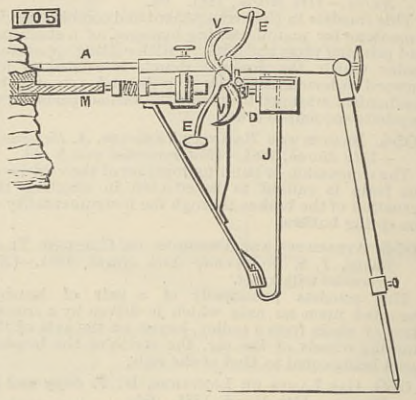
This consists in the employment and use of the compound of boracic acid and glycerine.

2030. Colouring Matters for Dyeing and Printing, *J. A. Dixon.*—10*th May*, 1881.—(*A communication from C. Rumpff.*) 4*d*.

This consists in the preparation of colouring matters of various shades suitable for dyeing or printing, by causing mono-sulpho-acid of beta-naphthol, or its sodium, or other equivalent salts, or the further substitution compounds thereof, with the nitro-amido-halogen, hydroxyl, or carboxyl groups to react on or be reacted on by various bodies or substances.

1705. Portable Hand-power Drilling Machines, *H. F. Parsons.*—19*th April*, 1881.—(*Complete.*) 6*d*.

A is the steadying bar with a pad at one end, against which the workman pushes while operating



the cranks E on shaft D. The cams V move the drill holder backwards, and the spring J projects it forward, so as to cause the tool M to pierce the rock or other substance. The tool is partly revolved after each stroke.

2804. Attachments to Mining Cages or Lifts, &c., *F. W. Haddan.*—27*th June*, 1881.—(*A communication from S. Henrard.*)—(*Complete.*) 6*d*.

This consists of a system of wedges which in the case of breaking of the rope or of the chain that connects the rope to the cage, will press with their vertical surface against the guides, and cause the cage to gradually stop without detriment to the guides, and even without shock, such effect being produced by a counterweight, which by special disposition drops when the rope or chain breaks, and acts upon levers which cause the wedges to rise and to press against the guides.

2836. Removing Coarse Hairs from Fur, *W. R. Lake.*—28*th June*, 1881.—*A communication from F. Lambert and J. Kokesch.*)—(*Complete.*) 6*d*.

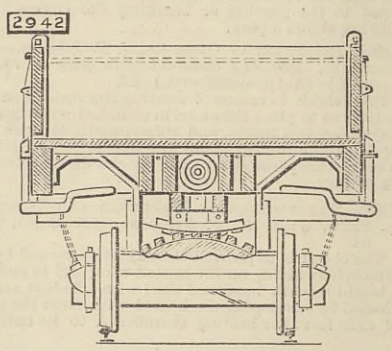
The apparatus consists of a holding device for supporting the skin, a brushing or combing device for opening the fur, and a removing agent.

2852. Violins, &c , *W. R. Lake.*—29*th June*, 1881.—(*A communication from E. Berliner.*)—(*Complete.*) 6*d*.

This consists in the construction of a violin or similar stringed instrument, so that the vibrations of the strings are communicated to the body solely by or through the bridge and the neck of the instrument.

2942. Railway Tipping Wagons, *G. F. Redfern.*—5*th July*, 1881. — (*A communication from M. Van Wormer.*)—(*Complete.*) 6*d*.

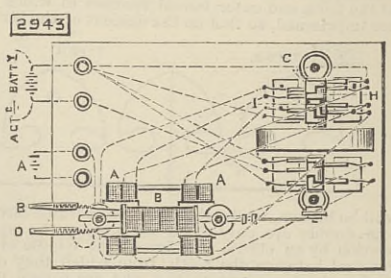
This relates to the construction of the car bed, to the transoms to the rockers, and means whereby the car after dumping shall right itself; to a device for preventing the separation of the car bed and truck, to means for fastening pulleys to the ends of the truck timbers, to the mechanism for fastening and unfastening the doors, to the construction of the doors, the end posts, and the means for fastening them to the car bed ; to the centre posts, and the means for fastening them to the car bed, to the side bearings and their application, so as to keep the car bed in position, and to prevent undue friction while the car is moving round curves ; and it further consists in combining with the draw bar a rocker, whereby the dumping may take place with the



ordinary draw bar without need of uncoupling the car ; in an improved brake mechanism, in a special clutch pulley with grooves and sockets to receive and hold the links of the chain, and whereby the revolving of the pulley to gradually tilt the car will operate the chain and prevent its slipping, in means for dumping slowly or suddenly as desired, in special guide rollers for the chains, in combining the shaft of the clutch coupling pulleys and their chain, and its guide pulleys, with a worm gear or screw lever for operating the same. The drawing is a transverse section of the wagon.

2943. Improvements in Electro-Magnetic Motors, *S. Pitt.*—5*th July*, 1881.—(*A communication from M. G. Farmer.*) 6*d*.

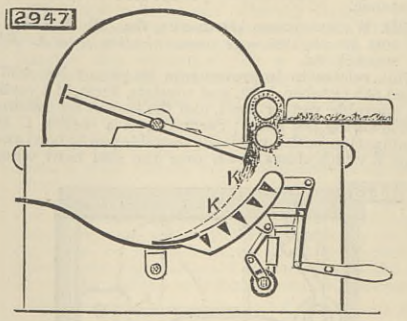
This invention relates to improvements in electro-magnetic motors, in which the ends of an electro-magnetic coil are united just before the connection between the helix and the electrical generator is broken, whereby the spark due to the discharge of the induced current from the coil is prevented. In the figure the helices A are arranged so as to act on the armature B, which forms the core of the four helices, and this latter is free to move to and fro under the attraction of one or other of the helices. These helices are connected with the generator by means of the automatic commutators G, H, I, &c., as shown in



the figure, so that during the movement of the armature in either direction, the two helices which are thus simultaneously in action are included in the same circuit, and exert their attractive forces in the same direction upon the armature ; while at the completion of the stroke the terminals of the pair of helices are first united, so as to form a closed circuit before the battery current is cut off from them, and the commutators are so arranged with reference to the terminals of the helices, that when thus united the connections are such that the induced current generated within them by the magnetic discharge of the core or armature tends to traverse the respective helices in opposite directions. Thus the induction currents in each helix of the pair neutralises the other, and the effect on the armature is inappreciable. A constant current traverses the armature B from the battery O, which thus becomes a permanent magnet.

2947. Machinery for Cleaning and Opening Fibrous Materials, *W. R. Lake.*—5*th July*, 1881. —(*A communication from C. A. Dresser.*)—(*Complete.*) 6*d*.

This consists essentially of a separator grate, or grid,



provided with the bars K, in combination with suitable mechanism, whereby the entire grid or its bars may be adjusted.

4008. Steam Apparatus for Warming and Ventilating Houses, &c., *G. Jennings.*—2*nd October*, 1880. 6*d*.

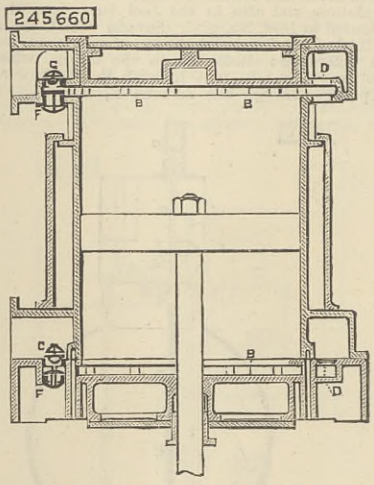
In order to supply to the interior of any room a continuous supply of fresh warmed air without such air being inconveniently dry apparatus is employed, somewhat similar to a steam tubular boiler set upon end, so that the tubes stand vertically. The lower ends of the several tubes which pass through the shell or casing of the apparatus are made to open into an air chamber at the bottom of the apparatus, from which a pipe or passage leads to the open air. The upper ends of the tubes project for a few inches above the top end plate of the shell or casing of the apparatus. This plate is also a few inches below the top edge of the shell or casing, so that there is formed above the top end plate a shallow pan or trough, which may be kept filled with water ; the upper ends of the tubes rise up through the pan, and when heated heat the water contained in it.

SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

245,660. Blowing Engine, *Edwin Reynolds, Milwaukee, Wis.*—*Filed March* 17*th*, 1881.

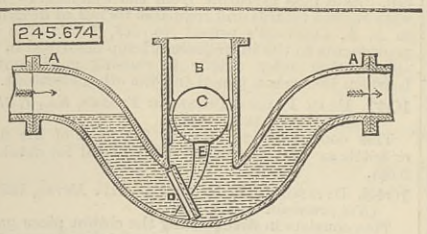
Claim.—(1) In a blowing engine, eduction and induction valves located outside of and in close proximity to the cylinder in annular series. (2) In a piston blowing engine, the combination of a cylinder and an annular chamber surrounding the same and communicating therewith, with lateral ports and



eduction and induction valves located in opposite sides of said chamber. (3) The combination of the cylinder, the lateral ports, the annular chamber into which said ports open, induction valves on one side of said chamber, eduction valves on the opposite sides of said chamber, and an air delivery chamber into which the eduction valves open.

245,674. Trap, *John T. Titus, San Francisco, Cal., assignor of one-half to Michael J. Donovan, same place.*—*Filed March* 10*th*, 1881.

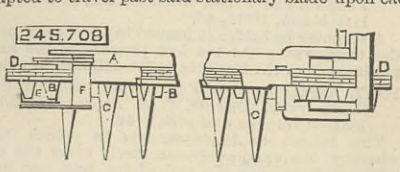
Claim.—In a side sewer, drain, or waste-pipe A, the semicircular bend or water trap K, having the vertical tube or chamber B above its lowest part and provided with a valve seat around the opening which connects the house side of the sewer with the chamber, in com-



bination with an angular valve, stopper, or plug D, which is connected with a ball or float C by a stem E, by means of which the float is dropped and held upon its seal in an angular position across the passage, so that it will be opened automatically by water passing from the house to the main sewer, but be pressed more firmly upon its seat by any pressure coming from the main sewer, substantially as described.

245,708. Mowing Machine and Harvester, *Léon O. Dion, Natick, assignor to George S. Trowbridge, Trustee, Newton, Mass.*—*Filed July* 5*th*, 1881.

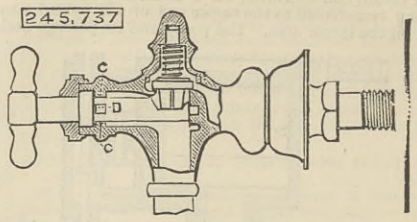
Claim.—(1) The gathering fingers C, provided with the stationary or fixed cutter-plate D, in combination with an endless belt or chain cutter, arranged and adapted to travel past said stationary blade upon each



side thereof, and in opposite directions, substantially as described. (2) The combination of the endless chain D, provided with the cutters B, bar A, fingers C, stationary blades D, division-plate E, casing G, drum C, pulley E, and guide rolls F and F1, substantially as described.

245,737. Self-closing Cock, *Edward W. McCormick, New York, N.Y., assignor to Charles Harrison, same place.*—*Filed June* 11*th*, 1881.

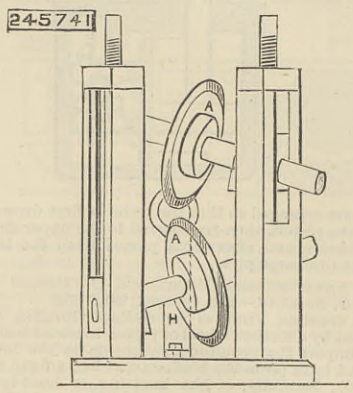
Claim.—In a self-closing cock substantially of the character described, a retracting spring valve and an oscillating spindle carrying a rocking lever or flattened face for operating such valve, and provided with the radially projecting tooth D, in combination with the



stops C2, for limiting the range of oscillation of the spindle, substantially as set forth.

245,741. Machine for Twisting Drill Blanks, *Parshall D. Nicols, Sewickley, and Theodore W. Webb, Pittsburg, Pa.*—*Filed February* 28*th*, 1881.

Claim.—(1) In a machine for twisting drill and similar blanks, the combination of two rolls arranged to take a peripheral bearing on opposite sides of the blank, such rolls being inclined in opposite directions to both vertical and horizontal planes through their



line of feed, and gear mechanism for imparting to the rolls rotary motion in opposite directions, substantially as set forth. (2) Two rolls, A A1, arranged to take a peripheral bearing on opposite sides of a blank, the directions of such bearing being inclined across the line of feed in opposite directions, and the rolls being inclined in opposite directions to an intermediate horizontal plane, in combination with guides H on either side of the rolls in the line of feed, and means for giving to the rolls rotary motion in opposite directions, substantially as set forth.

CONTENTS.

The Engineer, October 14th, 1881.