

THE MECHANICS' MAGAZINE.

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THE ANTHRACITE COAL-FIELDS OF PENNSYLVANIA.

IT is universally admitted that upon the quantity of coal found in a country depends mainly the facility with which it can produce iron. It is to the possession of large and accessible coal-fields, and their close association with the iron ores, that England owes her pre-eminence in this branch of manufacture. In Great Britain we have about 8,139 square miles of bituminous coal and 3,720 of anthracite, equal to one-tenth the whole area of these islands. France possesses but 1,719 square miles, or the 1-118th of the area. In Spain there are 3,408 miles, or the 1-52nd; in Belgium 518 square miles, or the 1-22nd. In America, however, the greatest coal deposits occur, British America having 18,000 square miles, or 2-9ths of its whole area; the United States 133,132 square miles of bituminous coal, or 1-17th of the area, and Pennsylvania 15,437 miles of anthracite, or 1-3rd of the whole area. The usefulness of anthracite coal in smelting operations was proved on the introduction of the hot blast, and it is now coming largely into use both in this country and America, where, as the above figures indicate, there is an immense deposit. The first attempt at the reduction of iron ores by anthracite was made by Mr. Crane, of South Wales, who was successfully followed by Mr. Budd, of the Ystalyfera Works. To these gentlemen we are indebted for having surmounted the obstacles which at one time forbade the employment of this fuel in smelting iron. But it is not with the getting or the using of this material that we now have to deal; our purpose is to notice the areas of the important anthracite coal-fields of Pennsylvania which are being worked at the present time, and to give some account of the yield and consumption of their products. These coal-fields are divided into three general districts, the first southern or Schuylkill coal-field; the second or middle coal-field; and the third northern, Wyoming and Lackawanna coal-field. The first southern field is again districted out into six divisions; the first is east of Tamaqua, and is for the most part covered by the lands of the Lehigh Coal and Navigation Company, who have three mines of considerable extent. The area of this district is somewhere about 16 square miles. The second division is Tamaqua to Pottsville, which covers 36 square miles; the third division is Pottsville, west to fork of Basin, which has an area of 55 square miles. The fourth is North Fork, Lyken's Valley Prong, equal to 16 square miles; the fifth, South Fork, Dauphin Prong, equal to 15 square miles; and the sixth, North Mine Hill range, equal to 8 square miles. The first, or Southern Field, therefore, presents an area of 146 square miles, or 93,440 acres. The second or middle coal-field consists of three subdivisions—the Shamokin district, extending over 50 square miles; the Mahanoy, equal to 41 square miles; and the Beaver Meadow, Hazleton, Big and Little Black Creek Basins, giving an extent of 35 square miles. The total of the second field is, therefore, 126 square miles, or 80,640 acres. The third northern, Wyoming and Lackawanna coal-field, presents an area of 198 square miles, or 126,720 acres. The grand total area of the anthracite coal-fields of Pennsylvania at present in operation is, therefore, 470 square miles, or 300,800 acres. This, it will be observed, forms a very small proportion of the whole extent of the deposit, which geologists set down at 15,437 miles, so that there is an apparently inexhaustible field for future supply.

During the past forty years the coal trade of this district has made rapid progress; in 1820 the amount mined was 365 tons. During

the ten succeeding years there were 359,191 tons mined; from 1830 to 1840, there were 4,819,751 tons mined; in the ten years to 1850 there were 19,513,009 tons, and to the end of 1860, 59,164,808 tons mined—the total amount wrought in forty years being 83,856,759 tons; and this yield was made up of 48,853,801 tons from the first coal-field; 12,933,318 tons from the second, and 22,069,640 tons from the third. These products have of course to find their way into the market, and it is interesting to trace the course of the mineral, through various main channels, to the points of final distribution. There are seven avenues by which the products of the first coal-field proceeded to market from 1820 to 1860. The Lehigh Canal bore away 7,608,042 tons; by the Philadelphia and Reading Railroad, 33,797,336 tons were sent; 16,718,094 tons proceeded by the Schuylkill Canal; 1,096,061 tons were carried on the Union Canal; Lykens's Valley Railroad took 987,493 tons; the Dauphin and Susquehanna Railroad 146,100 tons, and the Lehigh Valley Railroad 380 tons. This gives a total of 50,353,506 tons carried, just 1,499,705 tons in excess of the stated yield of the district, but on deducting this latter quantity—which is taken from Ashland in the second coal-field—the remainder gives 48,853,801 tons, or the total delivery from the first coal-field. The carriers from the second or middle coal-field are six in number. The Lehigh Canal has taken 8,235,636 tons; the Lehigh Valley Railroad, 1,685,717 tons; the Reading Railroad and Schuylkill Canal from Ashland, &c. (above referred to), 1,499,705 tons; the Shamokin Railroad, 1,023,318 tons; the Treverton Railroad, 456,288 tons; and the McCauley's Mount Railroad, 32,654 tons, giving a total tonnage of 12,933,318 tons from the second coal-field. The third or northern coal-field possesses five sources of distribution. By the Delaware and Hudson Canal 8,702,978 tons were transported; the Pennsylvania Coal Company's Railroad moved 4,835,469 tons; the North Branch Canal, 5,282,165 tons; the Delaware, Lackawanna, and Western Railroad, 2,764,437 tons; and the Lehigh and Susquehanna Railroad, 484,591 tons. These give a total of 22,069,640 tons, the stated yield of the third coal-field. We may observe with regard to the population of the United States and the consumption of anthracite coal that in 1820 the former numbered 9,638,131, whilst the consumption was only 365 tons. In ten years the population had increased by 3,227,889, and during that time the increase in the consumption was 353,826 tons. In ten years more the population had further increased by 4,203,433 persons, and the consumption of coal by 4,460,560 tons. Another decade gave 6,122,422 as the increase in the population, and 14,693,258 tons as that in coal consumption, and between 1850 and 1860 the population was augmented by 8,450,101, whilst the increase in the coal consumption was 39,651,799 tons. For the twenty years ending 1840 the consumption of anthracite was therefore 5,178,942 tons, and for the twenty years ending 1860 it was 78,677,817 tons, showing an increase on the production of this class of coal alone of 73,498,875 tons. Looking at home we find that the annual yield of the whole of the British coal mines has only been trebled during the last twenty years, and has not increased more than tenfold since the early part of the present century. The quantity of coal raised in the United Kingdom had, at the end of 1861, reached a total of 86,000,000 tons, and in the eight preceding years the average annual increase was found to amount to 2½ millions of tons. If we should ever be so unfortunate as to exhaust our own supply of coal before we have provided an efficient substitute, we still have America with her vast stores to look to for light and heat. In addition to the anthracite coal-fields of Pennsylvania, British America and the United States together show an area of 161,132 square miles of bituminous coal.

EXPERIMENTS IN GLASS MAKING.

FOR many months past M. Pelouze has been making a series of experiments on the manufacture of glass, and the results have been regularly published in *Comptes Rendus*. He has in the course of the present year made known the action of metalloids and sulphates on the glass of commerce, also the colouration of glass by selenium and by bichromate of potash. His experiments were, for the most part, performed in Siemens's furnaces, which are used for the manufacture of glass at Saint Gobain. These furnaces he found well suited for his purpose, because of the lengthy generators in which the combustible gases are produced, so that the crucibles are not liable to become filled with dust and cinders of all descriptions, and particularly fragments of pyrites which are thrown off from the coal. The crucibles he used were made of a very refractory white fireclay, of such a composition that for all practical purposes it might be considered of the same nature as the materials contained in the glass. The best clays in effect contain nothing but silica and alumina, and if the latter does not enter directly into the composition of glass, it can be introduced without sensibly altering its general properties. However, to avoid every source of error and not to run the risk of the clays containing fragments of pyrites, he often used a platinum crucible, protected outside by fireclay. By the side of the experimental crucibles he always placed others containing the ordinary constituents of glass, so as to obtain directly comparable results.

CARBON IN GLASS.—To obtain glass of a yellow colour by means of carbon, the following proportions were used:—

White sand	250 parts
Carbonate of lime	50 "
Carbonate of soda	100 "
Wood charcoal	2 "

After several hours in the furnace, the composition was melted, and the crucible taken out and allowed to cool. It contained a homogeneous mass of glass, of a deep yellow colour. To obtain a glass more refractory and less sensitive to atmospheric influences, it was necessary to increase the proportion of silica from 250 parts to 290 parts. It is generally admitted that the colouration by carbon is due to the minute quantity of this substance existing in the glass in a state of fine division.

THE EFFECT OF SULPHUR ON GLASS.—The proportions are the same as those given above, sulphur being substituted for carbon. The yellow colour also is so like that given by carbon that it is impossible to distinguish one from the other, if a sufficient proportion of sulphur be used. Because of its volatility, it is necessary to add six parts of sulphur to obtain the same effect as given by two parts of carbon. Many glass makers think that glass coloured by sulphur resists high temperatures and the action of the air much better than glass coloured by carbon. M. Pelouze could not, however, see the slightest difference between them. He kept the two glasses in fusion for forty-eight hours without producing any variation in their appearance.

SILICIUM AND BORON IN GLASS.—The following proportions were mixed and fused:—

White sand	250,00 grammes
Carbonate of soda	100,00 "
Carbonate of lime	50,00 "
Silicium	2,50 "

At the end of several hours the mixture was fused into glass of a yellow colour, which it was impossible to distinguish from the two preceding samples. Two grains of boron were next substituted for the silicium. Rapid fusion and incorporation were the result, the glass produced being of a beautiful yellow colour. The boron and silicium used were pure and crystallised.

PHOSPHORUS IN GLASS.—Amorphous and pulverulent phosphorus, even when added in

large proportion to the above composition, did not give any colour to the vitrified mass. All the efforts of M. Pelouze to obtain a positive result were failures, without doubt because the phosphorus was volatilised completely by the heat. Five or six grammes of phosphate of lime were, however, added to the composition, and the result was that the phosphorus ceased to escape, and again was a yellow glass produced.

ALUMINIUM GLASS.—The presence of even the smallest proportion of aluminium in the composition rendered the fusion and incorporation of the materials very difficult. However, after much time and trouble, a clear yellow homogeneous glass was given, very free from air bubbles. Thus the simple bodies which give a yellow colour with the white glasses of commerce are carbon, sulphur, silicium, boron, phosphorus, and the metal aluminium. It was found impossible to obtain a coloured glass with arsenic and zinc. It might be supposed that this constant yellow colour was caused in every case by silicium, which was necessarily present in all the above trials, but the following experiments prove that such is not the case.

ACTION OF HYDROGEN ON GLASS.—Hydrogen, rigidly purified, always colours glass yellow at a red heat. If hydrogen gas be passed through a porcelain tube containing a platinum capsule filled with fragments of white glass, and the whole is raised to a temperature which need not be very high, the glass will turn yellow. The colour is less beautiful and deep than with carbon and the other substances already mentioned; nevertheless it is very decided. It is rather strange that this action of hydrogen upon glass has never been noticed in the common experiments of the laboratory. In this experiment the reduction of silicium by hydrogen appears to be impossible, however great the heat applied. For several years M. Pelouze knew that sulphates were present in considerable quantities in all the glasses of commerce, and it at once appeared probable that the formation of a sulphide gave the yellow colour in question. Hydrogen was accordingly passed at a red heat over glass containing a very large proportion of sulphate of soda, a very deep yellow colour was at once produced, and the odour and taste of an alkaline sulphide were clearly perceptible.

As the most experienced chemists who had hitherto analysed glass had not noticed the presence of sulphur, M. Pelouze was careful in his experiments to avoid all possible sources of error. So many chemical reactions take place, and pharmaceutical preparations are made in contact with glass, that its composition, especially in analytical chemistry, is a matter of interest. The glasses in which without any doubt M. Pelouze found sulphur in the state of sulphate, were plate glass, window glass, drinking glasses, bottle glass, and a sample of ancient glass found at Pompeii in 1863. Plate glass gave diverse quantities of sulphate of soda, varying from 1 to 3 per cent. The operation of melting and cooling this glass lasts in general from eighteen to twenty-four hours. The glass of Pompeii contained 2 per cent. of sulphate of barytes. A fragment of Bohemian glass gave 2.2 per cent. of sulphate of potash. Window glass, bottle glass, and drinking glasses contain sulphate of soda, in quantities varying from 1 to 3.5 per cent. The carbonate of soda used in the manufacture of glass always contains a small proportion of sulphate, the pure carbonate being difficult to obtain. A glass containing no sulphates is not to be found in commerce, although there is no doubt that such a glass is more homogeneous and less changeable than any at present known. It would be found of value, especially for optical purposes. The sulphate of soda is without doubt in a state of liberty in the glass, and exists there as a kind of impurity, and cannot be dislodged even by the prolonged action of intense heat. This is the case not only in an industrial, but in a chemical point of view,

for after exposure to an intense heat in a platinum crucible, the sulphate of soda cannot be wholly expelled. Ten years ago M. Pelouze made it known that when glass was reduced to a fine powder by long trituration, it became very changeable, and when afterwards exposed for some time to the air, it would effervesce like chalk, on the addition of an acid. He also discovered that the same glass crushed for twenty-four hours on a plate of agate would at once give up all its sulphate of soda to water.

To return to the colouration of glass by carbon, silicium, and the other metalloids. If this colouration were always caused by the reduction of the sulphate of soda in the glasses, it should not be shown in pure glass, free from all traces of that salt. He accordingly employed as a flux carbonate of soda freed from all traces of sulphate by repeated crystallisations. The following composition was then melted in a platinum crucible in a gas furnace, to avoid any trace of alkaline sulphate:—

White sand	250 grammes
Pure carbonate of soda, dried 100	"
Pure carbonate of lime	50 "
Charcoal	2 "

The glass obtained from this composition was *perfectly white*. The same result followed in substituting boron, silicium, and hydrogen for the charcoal. These substances did not colour the pure glass, but, on adding to the mixture only .25 per cent. of sulphate, a slightly yellow colour is at once obtained. With .5 per cent., the tint is more decided, and with 2 or 3 per cent. it is deeper still; in fact, it is proportionate to the quantity of sulphate of soda thrown into the composition intended to melt into glass. For the same reason it is possible to determine approximately the quantity of sulphate of soda in any glass of commerce, by the noting the degree of colouration given after it is heated in contact with carbon. Pure glass is coloured yellow with sulphur alone, or by an alkaline or earthy sulphate. Instead, then, of making the yellow glass of commerce by the aid of carbon, that colour can be obtained direct by the use of sulphate of lime, but it must not be forgotten that the sulphate already contained in the carbonate takes up a small proportion of sulphur. It is, then, after this sulphate has been decomposed that the excess of sulphur colours the glass. In proof of this, let the following proportions be melted:—

White sand	250 grammes
Carbonate of soda	100 "
Carbonate of lime	50 "
Sulphate of lime	20 or 10 per cent.

This will give a deep yellow glass. Substitute 10 grammes of sulphate of lime, or 2.5 per cent., a much clearer and lighter yellow glass will be obtained, from which it will be at once perceptible that a notable proportion of sulphate of lime has been decomposed by the sulphate of soda contained in the impure carbonate. To the same proportions of other materials as above, add next 5 grammes of sulphate of lime or 1.25 per cent.; the resulting glass has no colour. With 5.5 grammes also no colour is given. With 6 grammes a feeble yellow colour is obtained, resembling that of the crystals of native sulphur. The extreme point of decoloration corresponds to 5.5 grammes, that being the total weight which disappears by oxidation. By attending to these facts the depth of colour given to any glass is always under control. It follows from these experiments that all the glasses of commerce contain sulphates; that glass made with fluxes free from sulphates is not coloured by carbon or the metalloids; that sulphur and the alkaline and earthy sulphates directly colour pure glass and the glasses of commerce; and that the colour given to glass by the metalloids is in consequence solely of their reducing power.

SELENIUM GLASS.—Among the later researches of M. Pelouze, he has discovered that selenium added to glass has the same effect

upon it as sulphur, which it so strongly resembles in its chemical properties. Selenium glass, however, has a redder tinge, in fact, a beautiful orange colour, when added to the glass in proportions varying from 1 to 3 per cent. The ordinary selenium of commerce gave the same results.

NOTICES OF BOOKS.

ONE of the most useful works we have seen for some time—speaking in a broad and general sense—is the report of the United States Patent Office,* which has recently been transmitted to us through the courtesy of the American Government. The compilation of such a work does no discredit to the department from which it emanates; on the contrary, the 752 pages of text in the first volume, and the 446 pages of illustrations in the second, convey a mass of mixed information relating to improvements in the arts and manufactures with singular clearness and exactitude. From time to time our own columns indicate the progress of scientific invention in America, but here in a very portable form is gathered up a whole year's proceedings in this direction, presenting every facility for immediate reference from text to plates. True, the report is only that for the year 1862—not for the past year, as a contemporary erroneously has it—but it is none the less valuable for that as a text book of American invention. The system is one which might with propriety be adopted in the same department at home, although we must admit that Mr. Bennet Woodcroft's admirable abridgements are beginning to supply a long-felt deficiency in this respect. The first volume of the American Commissioners' report contains an alphabetical index of the inventions or discoveries, with the name of each patentee and the number of each patent. Following this we have a list of patents which have expired during the year; a list of patents and designs re-issued; and then come the patents completed, to which the illustrations refer. The substance of the invention and claim is given in a few lines, the drawing being referred to by number. From the Commissioners' letter which accompanies the report we find there were 5,038 applications for patents during the year, 3,521 being the number granted. Of this latter number only 39 were granted to British subjects; 33 to subjects of the French empire, and 11 to subjects of other foreign governments. Glancing at the cash transactions we find the receipts to be about £42,000, and the payments about £37,000, which approximates somewhat to our own Patent Office returns. The balance in the American patent treasury, however, falls short of that in ours, inasmuch as they have only about £7,000, whilst we can boast of some £80,000. But what is this against the set-off America can show? She has a magnificent pile of buildings with every possible convenience both for the executive of the department and the public, whilst we grope and grovel amid dust and darkness in a gloomy passage dignified by the name of a library! There are certainly one or two corners besides, where daylight appears, but officials and public constantly jog and jostle each other in striving for the little here obtainable. But the whole thing is a shame and a reproach to the administrative. How long it is to continue so none can say, when it is remembered that the vaunted House of Commons proceedings resulted in absolutely nothing. We cannot conclude this notice without referring to the circumstance that Messrs. Stevens—through whose agency the United States Government forwarded the report under notice—are authorised to receive publications relating to the operations of the patent system, and to the progress of arts and manufactures. These are forwarded to the Patent Office and other public institutions in America at the beginning of

* "Report of the Commissioners of Patents for the year 1862—Arts and Manufactures." Washington: Government Printing Office, 1864. London agents: Stevens Brothers, Henrietta-street, Covent Garden.

every month, in exchange for their publications.

Twelve years ago the Clearing House Committee of Railway Managers reported upon the necessity of adopting means of communication between passengers and guards in railway trains. They have recently gone through a similar form of proceeding upon the same subject. Many points of difference, however, are to be found; for instance, in the former report the bell-and-rope system was pronounced to be adequate to the requirements of a good signal, but in the report recently published this is not even referred to. The first report—issued in 1853—states that the committee see no mechanical difficulty in the way of passenger communication, whilst the last, which has appeared during the present year, implies a doubt whether any really efficient appliance has been, or is likely to be, discovered. Of course twelve years shows a great stride in the development of mechanical and physical science, and although mechanism, from the peculiar nature of its application in this instance, has practically failed, there is no reason why we should not differ from the committee and affirm that there are other agencies by which the end may be, and is, effected. Captain Tyler had already stated this in his report, upon which, by the way, some portions of the Clearing House Committee's report was founded. He referred to and described the electrical apparatus of Mr. Preece, which was then and is now in use in trains on the South-Western Railway. In the pamphlet under notice* Mr. A. E. Brae—another inventor in this direction—however takes objection to Mr. Preece's system of coupling, and to the method of carrying the conductor beneath the carriages. First, he conceives that the electric couplings, in addition to the carriage couplings, must embarrass the porters; and, secondly, he states that the electric couplings by being placed so low down are not so well under supervision. That these objections do not practically apply is evident from the continued successful working of the system, and will be apparent to anyone who inspects the arrangement. We have said Mr. Brae is an inventor; hence the acumen he displays with regard to inventions of a similar character to his own. He does not, of course, leave the disease without attempting a cure, but proposes his own scheme as a remedy for the defects and shortcomings of all those which have preceded, or are likely to follow it. His conductor is composed of flexible metallic pendants terminated with iron tags or pins with corresponding sockets in the adjoining carriage, having quicksilver at the bottom to receive them. Mercurial junctions are thus formed, which are also used for break-joints to give the signal. The alarm consists of a steam whistle opened by the fall of a heavy armature through several inches, when released from the sustaining attraction of a powerful electro-magnet upon the circuit being broken at any of the break-joints. This arrangement of joint he has improved on by substituting for the iron pin a light plug covered with india-rubber, so as to fill and yet slide easily within the socket, the conductor being passed through the plug and protruding into the quicksilver. However well the conducting arrangements may be found to work out in practice, we cannot predict much success for the steam whistle alarm, which Mr. Brae prefers to any other signal. He argues that it is audible all over the train, and attracts the attention of guard and driver at the same moment. The driver receives directions from the guard by flag and gesture by day, and by lamp at night, or, at any time, by a repetition of the whistle signal. The fallacy of the whole arrangement, however, is so palpable as scarcely to require pointing out. How can the guard know whether passenger or driver has sounded the whistle? How is the driver

to watch for the conventional signals of the guard without exposing the train to danger? It reverses, too, the relative positions of guard and driver, the former becoming to some extent subject to the latter. There are, besides, many points we cannot stay to discuss, but this we will observe, that Mr. Brae's pamphlet affords much information as to what has been attempted with regard to electrical communication. In his concluding remarks the author observes that his strictures are not made in an invidious spirit or with any view to disparage Mr. Preece's invention (we should not have known this had it not been pointed out), but that they were evoked by the prominence given to the apparatus in Captain Tyler's report. As it is, then, we are left the only alternative of ascribing Mr. Brae's strictures to his chagrin at not finding equal prominence given to his own invention. This it might, and doubtless would have had, if it had been found to possess equal merit.

Most engineers are acquainted with the method of setting out curves with the theodolite according to Rankine's system, which is generally preferred as being the most simple and accurate. By Mr. A. Beazeley's new arrangement these tables* are further simplified and improved, much time being saved in the field by their use. In the system itself of course there is no novelty, but in Mr. Beazeley's special method of applying it there certainly is. The tables are printed on a pack of 48 cards, each measuring 3 in. by 1½ in., the pack being carried in a suitable case. Those who are accustomed to field work will at once appreciate the convenience of being able to place the required card on the theodolite, whilst both hands are at liberty for adjusting the instrument and signalling. This plan also allows the figures to be constantly under the inspection of the operator, and possesses the further recommendation of extreme facility of reference in use.

Quitting land, we will now take a look at marine matters; and the first thing arresting our attention is a second instalment of Mr. "Bourne's Treatise on the Screw Propeller."† We find our author where we left him—continuing his interesting historical account of the screw. Here we trace step by step its development from Shorter's screw propeller in 1803, to that of Bennet Woodcroft, of Manchester, in 1832. Shorter gave motion to his screw by a spar, which proceeded from the stern of the vessel obliquely downwards, until its end dipped into the water. The screw was fixed on the end of the spar, and was prevented from dipping too deep by a buoy attached to it. The spar was revolved by a horizontal shaft, through a universal joint. The "Doncaster" transport was fitted with this apparatus in 1802, and with eight men at the capstan, the vessel, though deeply laden, was propelled at the rate of one mile and a half an hour—a result which was considered satisfactory. Mr. Napier made a successful experiment on the Thames with a screw, the shaft passing through the stern of the boat below water line, as in modern vessels. This was at an early period in the history of steam navigation; but as Mr. Napier found his ideas anticipated by Mr. Shorter, he did not proceed further in the matter. Millington in 1816 slightly improved upon Shorter's plan, and about this time the Archimedian screw was applied as a submerged propeller. In the first volume of the *MECHANICS' MAGAZINE*, published in 1823, will be found an account of a spiral water-mill, invented some years previously by John Norton. In our second volume a correspondent, over the signature of "X. Y.," asserts that he had made a spiral water-wheel similar to Norton's twenty years previously. At page 33 of the same

volume, "J. Y." recommends an upright spiral working in a tube as a motor for water-mills, and suggests that wheels on this principle should be applied to vessels in lieu of paddlewheels. Two years later Jacob Perkins invented a screw, which consisted of two pairs of blades working in opposite directions, and with which very satisfactory results were obtained. Colonel Macaroni, in 1827, submitted a screw propeller to the Duke of Clarence, who ordered an Admiralty trial. The velocity of the screw, however, alarmed the authorities, who accordingly rejected the plan. At page 226 of the thirty-first volume of the *MECHANICS' MAGAZINE* some correspondence on this matter will be found. Mr. Bennet Woodcroft's invention, before alluded to, consisted of a revolving spiral paddle fitted longitudinally under the vessel near the stern. This brings us to 1832, and to the close of the second part of Mr. Bourne's treatise, which, besides woodcuts, has for its illustrations some finely-executed drawings, giving a cross section of the "Great Eastern," showing her paddle engines and wheels; a perspective view of the same engines; and an elevation of the engines of the "Shearwater" gun-boat.

As experience goes on increasing and knowledge accumulating, so will the laws which govern the action of the more complex details of steam engines become more easy of exposition. And no small amount of credit is due to those who, having gained experience on any special point, will place it at the disposal of others. In the little work before us* Mr. Burgh proposes to present to the public his experience with respect to the slide valve. Having deduced all his remarks from practical demonstrations, and having rejected all assumptions, we are relieved from the fear of a mere theoretical descant. The author has carefully digested the rules relating to the equilibrium slide valves, and the treatise will be found most useful in directing the student to a comprehension of the use and action of the slide valve, which is the object aimed at by the author. The first chapter proposes to discuss the "antecedents of the slide valve and steam ports in the cylinder," although we fail to discover where, in the chapter, the said "antecedents" are alluded to. It refers chiefly to the mode of setting out the steamports, which our author observes has "often been a mystery to the many and thus known only to the few." It gives the true proportion of the ports in the cylinder, and explains the action of the slide valve on the same; rules are also given for the areas of the cylinder and the ports. On arriving at the second chapter we are struck by the similarity it presents to something we have seen and read elsewhere. These impressions become stronger as we glance at the three succeeding chapters, and a lurking suspicion arises that they must be reproductions. This suspicion is confirmed on turning to the pages of the *Engineer* for June, July, and August last, where we find chapters 2, 3, and 4 of Mr. Burgh's book appearing as letters to the editor of that paper, and chapter 5 as an article under the head of "improvements in the slide valves of the marine engine," and over Mr. Burgh's name. A comparison of the engravings shows that fourteen out of the fifteen which illustrate these chapters are produced from the same blocks that were used in the *Engineer*. When Mr. Colburn a few months since reproduced in a treatise on gas-works some articles written by him in that paper, he specially referred to the circumstance. It appears to us that some such acknowledgment is due by Mr. Burgh, and as either by an oversight on his own part, or an error on the part of his printer, this has been omitted, we here beg to supply the deficiency. As it is not our practice to review the articles of our contemporaries we will not pursue the subject of slide valves further. We would,

* "Electrical Communication in Railway Trains: the causes which have hitherto prevented its successful application." By ANDREW EDWARD BRAE. London: Kington Wilson, Royal Exchange, 1865.

† "Tables of Tangential Angles and Multiples for Setting out Curves, from 5 to 200 radius." By ALEXANDER BEAZELEY, M. Inst. C.E., London: Lockwood and Co., 1865.

† "A Treatise on the Screw Propeller, Screw Vessels, and Screw Engines as adapted for purposes of Peace and War." By JOHN BOURNE, O.E. New Edition. London: Longmans, Paternoster-row, October, 1865.

* "The Slide Valve Practically Considered." By N. P. BURGH, Engineer. London: E. and F. N. Spon, 16, Bucklebury, 1865.

however, observe that as the pith and marrow of the matter is contained in the four chapters above alluded to, and as those chapters can be had where they first appeared for sixpence each, two shillings is obviously a better investment than four shillings—the price of Mr. Burgh's work.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

INFLUENCE OF OTHER BODIES, AND OF HEAT, ON THE ALLOTROPIC CONDITION OF IRON.

M. DE CIZANCOURT, in his second memoir on ferrosium and ferricum, to which some allusion was made last week, asserts that the tendency of all bodies, in their action upon iron, is to cause the iron to pass into,—or, if it is already in such condition, to remain in,—that allotropic state in which it has the same atomicity as the respective bodies themselves. Thus, according to this gentleman, all bodies which combine with oxygen in the proportion of atom to atom, such, for example, as hydrogen and carbonic oxide, when they act upon iron promote in it the condition of ferrosium, or of that form of the metal the oxide of which consists of one atom of metal combined with one of oxygen; while all bodies which combine per atom with three atoms of oxygen, such as nitrogen, phosphorus, and arsenic, tend to bring iron into, or to keep it in, the state of ferricum, or of that form of iron whose oxide consists of three atoms of oxygen combined with one of metal, and all bodies which unite per atom with two atoms of oxygen, among which are carbon, silicium, titanium, and tantalum, tend to the production of a mixture of ferricum and ferrosium, and so to the formation of steel.—M. de Cizancourt, as the reader is already aware, regarding steel as being essentially a mixture, or alloy, of the two allotropic forms of iron, and attributing the different qualities of the different varieties of it chiefly to differences as regards the proportions in which they respectively contain these two supposed constituents. He adds that heat influences the allotropic condition of iron quite as distinctly as any known ponderable body, low temperatures and rapid cooling tending to the formation of ferrosium, high temperatures to that of ferricum, and medium temperatures to that of the various qualities of steel. He again promises the speedy publication of “a complete study of the facts of the metallurgy of iron, according to the hitherto unknown principles” which he conceives that he has discovered.

THE SIZE AND WEIGHT OF THE ATOMS.

Professor Loschmidt has just communicated to the Academy of Sciences of Vienna a most curious memoir on what has been in all ages by far the most fascinating of all the problems relating to the material universe,—that, namely, of the ultimate constitution of matter. One half, possibly, of contemporary speculators on this problem decline to believe that the “ultimate atoms” of matter are substantial entities, in any sense implying that they are anything other than “seats of force,”—points of space at which “force” is somehow located; but Professor Loschmidt belongs to the other half, who regard matter as being very material indeed, conceiving there to be about the same sort of difference between an “ultimate atom” and what they imagine that a mere “seat of force” must necessarily be that there is to ordinary conceptions between the solid globe on which we live and that mysterious “attraction of gravitation” which keeps it in its proper path through space. He has endeavoured to measure the ultimate atoms of atmospheric air,—or, rather, to calculate their size from certain theoretical data,—and he has come to the conclusion that the diameter of a molecule of that body is just about the one-millionth of a millimetre, or 0.03937 millionths of an English inch, being about one seven-hundredth part of the length

of a wave of red light. He has also calculated the amount of the distance which separates the atoms of air from each other, and he makes out that it is such that in a cubic millimetre of air,—which is about six ten-thousandths of a cubic inch,—there are 886 billions of atoms, which is at the rate of very nearly 216,000,000,000,000,000 per cubic foot. The ingenious professor has also estimated the weight of the atoms, and has satisfied himself that their unit of weight is just about the one-trillionth of a milligramme, or fifteen ten-thousandths of the trillionth of a grain! That is, he supposes an atom of hydrogen to weigh one one-trillionth of a milligramme, an atom of iodine to weigh one hundred and twenty-seven one-trillionths of a milligramme, an atom of bismuth to weigh two hundred and ten one-trillionths of a milligramme, and so on. Such are the latest results of inquiry, or rather of speculation, respecting the infinitely little. It is so impossible to either prove or disprove the correctness of the results that it were not worth while to go into particulars with respect to the process by which they were arrived at. Besides, even supposing the smallest atoms of things to be the sort of entities which Professor Loschmidt regards them as being, it is very difficult to think of them as having a definite size or weight at all. Professor Loschmidt may tell us, for example, that hydrogen is a body made up of atoms each of which is one one-millionth of a millimetre in diameter and weighs one one-trillionth of a milligramme, but the statement inevitably causes us to ask respecting the weight and size of the atoms composing those atoms themselves, and if this question could be answered we should be no whit further out of the difficulty,—we could but ask the question again, applying it to a still more minute order of entities. The fact is that upon the merely materialist theory an indivisible atom is inconceivable, since it is impossible that we can imagine anything so small that we cannot also imagine the half or any other fraction of it.

THE METALLOIDS NOT SIMPLE BODIES, BUT COMPOUNDS.

The new number of Poggendorf's “*Annalen der Physik und Chemie*” contains a paper by A. Mitscherlich, on the application of the spectroscope to the detection of very minute quantities of chlorine, bromine, and iodine, at the close of which the accomplished author makes the very remarkable “preliminary announcement” that his recent researches upon the spectra of the metalloids have convinced him that nearly all those bodies, hitherto regarded as elements, are really compounds. The opinion has long been growing that many of what are at present taken for elementary substances must eventually prove to be otherwise, and it would certainly seem that, of the sixty-six substances at present usually considered as elements, some, at least, are not unlikely to be removed from that category before long. Many a theory has obtained universal acceptance on very much slighter grounds than the facts which are known respecting ozone and antozone afford for the supposition that oxygen is a compound body; there are constantly arising seeming new proofs,—we recorded two in one week only a very short time ago,—of the soundness of the suspicion, first expressed by Berzelius, that nitrogen is not an element; and now one of the most profound of living chemists announces his conviction that scarcely one of the eleven other metalloids is a simple body. Shall we find at length, as was taught by Swedenborg, that there is only one really “simple,” “elementary” substance, and that the essential difference between one body and another is merely a difference of form,—in other words, that all the various kinds of matter are composed of the same kind of primary particles, but that in different substances these primary particles are differently arranged; or will it prove, as is perhaps more probable, that there

are two primary elements, one of them positive and the other negative?

THE ALLEGED COMPOUND NATURE OF NITROGEN.

Mr. Henry Kilgour, of Edinburgh, has published a very remarkable pamphlet* on the nature of nitrogen, which he believes to be an allotropic modification of carbonic oxide. His chief points are that carbonic oxide and nitrogen have exactly the same atomic weight and atomic volume, and very nearly the same specific gravity and specific heat; that they resemble each other in both being neutral bodies, having neither an acid nor an alkaline reaction, and capable in only a very few instances of entering directly into combination with other bodies; that neither of them has either colour, taste, or odour, or can support either combustion or respiration, or can combine with acids to form salts, but that both can combine with oxygen to form acids; and that their physical properties and action coincide remarkably, the two gases resembling each other very closely in their rates of effusion through an aperture in a thin plate into a vacuum, in their rates of transpiration through tubes of fine bore, in their rates of diffusion through a membrane into other gases, in their absorbability by charcoal, in their solubility in water, in their incapability of being liquefied, and in the degree in which they refract light. In all cases in which the two gases differ as regards the intensity of their action, carbonic oxide is the more active of the two, and Mr. Kilgour supposes that nitrogen is carbonic oxide which has had its activity diminished by the action of either heat, or electricity, or some other force not at present known. As affording what he conceives to be a parallel case to this supposed conversion of carbonic oxide into nitrogen he refers to the change which is effected in silicium by subjection to intense heat, which renders silicium, which before being heated will burn somewhat readily, so inert that it can no longer be made to burn. One of his further arguments appeals, perhaps, somewhat more to the poet than to the chemist, but it nevertheless has a certain weight of its own. It is that the theory that nitrogen is an allotropic form of carbonic oxide suggests a simplicity and consistency in the constitution of the universe which does not exist if that theory is not true. “The solid part of our globe,” he says, “is admitted to be an oxide—an oxide of metallic and non-metallic substances—mixed to a certain extent with other substances; its liquid part is also an oxide—oxide of hydrogen—also mixed to a certain extent with other substances;” while on his theory “its gaseous part is also an oxide—oxide of carbon—likewise mixed to a certain extent with other substances.” Still more weighty is the argument which he expresses thus:—“There are two great processes going on in nature, their importance being such that all other processes in nature may be held to be entirely subservient to them. The one process is that of vegetation; the other process is that of animal life—including the life of man himself. The process of animal life is based, either immediately or ultimately, on the process of vegetation. The process of vegetation is again based on the due supply of carbon on the one hand, and of water—that is, of oxygen and hydrogen—on the other, and that in equal, or nearly equal, proportions. An immense—it may be said, an infinite—supply of water is to be found in the great ocean which covers three-fourths of the globe to the depth of several miles, and in the atmosphere it exists in the average proportion of 1 part in 70. But while carbon is required in vegetation in an equal, or nearly equal, degree with water, it has not been attributed by chemists to a source of supply proportionally vast, but to a miserably small quantity of carbonic acid found in the atmosphere—the quantity of carbon so found being little more

* “Nitrogen shown to be Carbonic Oxide in an Allotropic State.” By HENRY KILGOUR. London: John Churchill and Sons.

than in the proportion of 1 part in 10,000 of atmospheric air. And the carbonic acid itself—so existing in the atmosphere—is not even held by chemists to be one of its primary constituents, but is attributed by them to merely incidental or secondary sources, and mainly to terrestrial fires and animal breath. Were any chemist to maintain that the water required in vegetation was exclusively derived from such sources, it would truly be held to be one of the most absurd doctrines ever heard of; but is there any good reason whatever for holding it to be less absurd with reference to the carbon required in vegetation? Can such miserable sources of supply be held to accord, in the slightest degree, with the glorious fullness and harmony of nature? If water is supplied so abundantly—supplied *ab initio* in the nature of things—why should carbon, equally necessary as water, and to as great an extent, not also be supplied in the same original and ample way? Why should we be dependent for its supply on such a small quantity of carbonic acid, and that caused by the operation of merely secondary and incidental causes?—a source of supply, I venture to say, utterly inadequate to the demands upon it, if we view these demands in all their vast totality. But when once nitrogen is seen to be the oxide of carbon, all difference in the mode, all inadequacy in the supply, of carbon to the vegetable and animal kingdoms, forthwith vanish; we have a vast gaseous ocean in this case, as we have a vast liquid ocean in the case of water, from which an unlimited supply can be drawn." Mr. Kilgour declares that he is "as certain of the substantial identity of carbonic oxide and nitrogen as Columbus was of reaching China by going westward, as Copernicus was of his view of the solar system, as Leverrier and Adams were of the existence of Neptune, though they had never seen it," and his eloquent and admirably-reasoned pamphlet will convince many readers that his confidence is not without foundation.

MANGANESE ORES IN NOVA SCOTIA.

From a paper by Professor How which appears in the just-published volume of the "Transactions" of the Institute of Natural Science of Nova Scotia, it appears that a very pure pyrolusite, containing from 84 to as much as 97 per cent. of binoxide of manganese, with frequently not more than 0.5 per cent. of oxide of iron, occurs in considerable abundance in that province. Apart from what is used in steel-making and in other branches of the iron manufacture, there are now consumed annually in Great Britain somewhere between 40,000 and 50,000 tons of manganese ores, the majority of which do not contain more than from 70 to 75 per cent. of manganic oxide, and are largely admixed with oxide of iron. To the bleaching-powder manufacturers, who are by far the largest consumers of manganese ores, obtaining their chlorine by the decomposition of hydrochloric acid by the binoxide of manganese, the association of oxide of iron with the manganic oxide does not matter very much, but to glass-makers it is of great importance that the binoxide of manganese they use should be as free from iron as possible. To them, these Nova Scotian ores, so much freer from iron than any yet found in Europe, will be a great boon.

MICROSCOPIC EXAMINATION OF ATLANTIC MUD.

A portion of the ooze or mud brought up from the bottom by the ropes and grapnels employed in the attempts to raise the Atlantic telegraph cable after it had parted has been carefully examined with the microscope by Mr. Sidebotham, of Manchester. He describes the mud as looking like "dirty clay," and remarks that "under the microscope it reminds one much of chalk from Dover; indeed it has all the appearance of being a bed of chalk in process of formation. It is composed entirely of organisms, chiefly in fragments." Mr. Sidebotham, aided by the members of the Microscopical Section of the Manchester Literary and Philosophical Society, proposes

to compile a complete list of the species to which these organisms belong.

POISONOUS PROPERTIES OF NITROBENZOL.

In the manufacture of the aniline dyes, the first step is the conversion of benzol, by treatment with fuming nitric acid, into the remarkable compound known as "nitrobenzol." This substance not only furnishes all the aniline of commerce, but is also largely used, under the name of "artificial oil of bitter almonds," in the production of perfumes for the toilet, and for perfuming soaps, &c., &c. All persons having to do with its manipulation in quantities ought, however, to know that it is exceedingly poisonous. So little were the jurors of Class IV. of the International Exhibition of 1851 aware of this fact that in their report on the perfumery section, in which nitrobenzol was exhibited as a novelty, they remarked that "this compound will probably be found capable of application in confectionery and cookery, as its flavour resembles that of bitter almonds, without containing any prussic acid." Before long nitrobenzol became in considerable commercial demand, and the workmen employed in its manufacture speedily found that its fumes had a stupefying effect upon them. In 1856 experiments on animals proved it to be a powerful poison, and in 1860 a workman who had chanced to spill a little of it upon his clothes, and was thereby caused to breathe some of its vapour, died within nine hours. Since then not fewer than five cases of poisoning by nitrobenzol have occurred. In the second volume, just issued, of "Clinical Lectures and Reports," by the Medical and Surgical Staff of the London Hospital, is a paper on the subject by Dr. Letheby, in which is pointed out the curious circumstance that the effects of a small dose of nitrobenzol are not developed until a considerable time after its administration. The animal to which the dose has been given seems to suffer some little discomfort at first, but this soon passes off, and for as much as three or four days afterwards the animal will be, to all appearance, perfectly well. It will then be seized with a kind of epileptic attack; paralysis of the hinder extremities, succeeded by severer symptoms, will follow, and the animal will at length die, perhaps not less than nine days after the poison entered its stomach.

LIVING BODIES DYED BY ANILINE.

In the living body nitrobenzol is transformed into aniline, and a portion of the aniline so produced becomes oxidised and imparts to the face a leaden hue, at the same time tinting the lips and nails with a bright "mauve." Aniline is itself an energetic poison, but its effects are not delayed, like those of nitrobenzol. It constitutes the only known instance of a poisonous base the salts of which are not also poisonous. The salts of aniline are quite innocuous; to a patient of the London Hospital Dr. Letheby recently administered nearly an ounce of sulphate of aniline, in the course of a few days, with no perceptible result but that of colouring the skin, gums, and nails purple. This colouration of the living body by aniline is not permanent, but disappears somewhat rapidly.

THE "WINOOSKI" AND "ALGONQUIN" TRIAL.

Our readers are already aware of the peculiarities of this engine contest, and also of the results obtained from the first part of the trial. The following from America gives the latest particulars, and explains the present position of the matter. It appears that the trial between the engines of the "Winooski" and those of the "Algonquin" was renewed on the 23rd ult., and continued until ten minutes past ten p.m., on the 25th, when Mr. Dickerson ordered the "Algonquin's" engine to be stopped. In the morning before the engine was stopped the counters showed, at the same time, 59,328 revolutions of the "Winooski's" wheels, and 60,566 of the "Algonquin's," making 1,238 revolutions in favour of the "Algonquin." In a note published by Mr. Dickerson explaining the reason why he stopped, he says that it was agreed that

the throttle of the "Winooski's" engine should be kept open throughout the trial, and that the engineers were evading this agreement by throttling off with the stop valves. He goes on to say that the "Winooski" had gained an advantage of more than half a turn a minute by reason of losing her buckets in a collision with a coal barge—a collision that was permitted to take place with the knowledge that it must strip off buckets, and so give a great advantage to the "Winooski," and which might have been prevented by stopping the engine for a moment.

In reply to Mr. Dickerson's effusion, Mr. Danby, President of the Board of Experts, before whom the trial was being made, has published a note in which he says that, about three or four hours before he stopped his engine, which was losing ground rapidly, Mr. Dickerson addressed the note in question to the members of the Board of Chief Engineers, demanding the stop valves of the boilers of the "Winooski" to be carried wide open, with a threat that he would stop his engine in case it was refused. Mr. Isherwood, in order to save the delay and great expense to the Government of repeating this trial, at once waived his right, and the stop valves were placed wide open. After they were opened, Mr. Dickerson ran his engine about an hour, when, finding he was losing at the same rate as before, he abruptly stopped his engine, and so foiled the purpose of the experiment. Mr. Danby further observes that since the stoppage of the "Algonquin's" engine the "Winooski's" has continued running about twenty-four hours, with the stop valves wide open, and with equally as good results as with them partially closed. During the last thirteen hours and a half the "Winooski" had gained 597 revolutions upon the "Algonquin."

Mr. Danby's version of the accident to the paddles is that, about forty-eight hours before Mr. Dickerson stopped his engine, a large coal barge belonging to private parties was drifted by the powerful ebb tide into the starboard wheels of the "Winooski;" but the damage extended no further than to fracture and splinter the projecting outer ends of the paddles. Soon after this accident happened—which was entirely unavoidable—Mr. Dickerson was given his choice whether the trial should be stopped or whether he preferred to go on. He examined the wheel carefully and the performance of the "Winooski's" engine, both before and after the accident, and preferred to continue—running forty-eight hours—when, seeing that he was rapidly losing, he makes it an additional excuse, in his letter, for his wholly unwarranted conduct in stopping. We should think that by this time both sides would have had enough of this farce, and that Mr. Dickerson would not desire it carried any further.

ENGINEERING ENERGY IN AMERICA.

A FEW months since the prophets of evil in this country expected an extraordinary and sudden collapse of the great American republic. The bubble was about to burst, and the mighty sham which boasted so much was about to go into a state of "everlasting smash." No doubt the wish was father to the thought in most instances, and the prophets, as Ben Disraeli says, are "baffled and mortified." It is not our province, however, to point out the errors of our countrymen, or to speculate on the political destinies of the American republic, but rather to utter a passing comment on the amazing industrial energies of Americans, as indicated by Sir S. M. Peto at Bristol, on the 13th inst. That prince of contractors went with others to America to endeavour to find fresh outlets for English capital. The newspapers have already informed us that wherever they went they were warmly and enthusiastically received. Sir Samuel, who is accustomed to see great engineering works achieved with rapidity, appears to be startled by the strong, buoyant, and multitudinous energies of our American cousins. He ascertained that when the Southerners destroyed the bridges throughout 150 miles of country, Gen. Sherman only allowed Gen. McCallum seven days to reconstruct them; that one bridge 1,200 ft. long and 15 ft. wide was constructed in three days and a half; that in six days General Sherman was moving the whole of his army over the 150 miles. Sir Samuel also states that on the termination of the war there were actually connected with the supply of the armies 2,500 miles of railway, 887 engines, 600 cars, and 70,000 employees. Well might the imagination of the speaker be almost

overwhelmed with the power which produced such a state of things. Sir Samuel further states that Chicago, which a few years ago was a mere village—a dot upon the map—has now a population exceeding a quarter of a million, “with public buildings surpassing anything he has ever seen in any provincial town in this country; while its bridges, its roads, its hospitals, its universities and public works were of the most magnificent description.” From Chicago Sir Samuel went to Boston, and he found that even since the commencement of the war the inhabitants of that city had expended five millions sterling in the erection of public buildings and the extension of public works. Were not the speaker a sober, common-sense Englishman, we should have thought he wanted to play upon our credulity. He, however, is particular in fortifying his statements by substantial evidence. As an instance how soldiers are absorbed into private life, he says that four months before he visited America the army amounted to 1,200,000 men. Gen. Grant told him that he had mustered out 870,000, and that shortly they intended to have only 30,000 men in active service. When at Chicago he went over a large printing establishment, in which forty-seven of the compositors had been soldiers. One was a captain, another was a lieutenant, and another was a sergeant, and they were all at work as if they had never left the compositor's desk. Not one of these men had a pension, and he would have felt insulted if he had been offered it. These statements of Sir Samuel Morton Peto are corroborated by indisputable authority. We may therefore, as a nation, well rejoice that the Americans have conquered their greatest difficulties, and that in all probability they will be purified and strengthened by the sufferings they have endured. At all events, even thoughtless and selfish Englishmen are not likely to speak of them so contemptuously as was the fashion a short time since.—*Building News*.

NEW METHOD OF BAROMETRIC REGISTRATION.

THE following suggestions on the above subject appear over the signature of “Edward Crossley” in the *Chemical News*:—Though I do not doubt that photographic registration of the barometer is capable of great accuracy, yet it seems to me that there is still another method by which, perhaps, as great accuracy may be obtained, without the uncertain friction of a float, less liable to get out of order, and, consequently, more useful in the hands of the public. The principle is that of an independent, vertically-moving rod, registering instantly the point at which it comes into contact with the mercury of the barometer by thus forming an electric circuit. As an ordinary modification, I would suggest that every hour the rod should be lowered through the whole range of the barometer by clockwork. On the formation of contact, an electro-magnet, by means of an armature, would cause a point carried along with the rod to be indented into the registering paper, or other material, on a revolving drum similar to those already constructed for the purpose, to go for a week at a time. For more accurate purposes still the drum might be made larger,—say 5 in. in diameter and 14 in. long, and divided vertically into 2 in. for every day. In this case the drum would have to be moved up on its vertical axis every time, through a division equal to the interval of registration,—1.12th of an inch for one hour, for instance—and the recording-point would remain stationary, except when acted on by the magnet. At the hour, a simultaneous motion would have to be given to the rod and the drum—the first vertical and descending, the other horizontal and revolving,—so that 14 in. of the one would be equal to 15 in. circumference of the other. The electric current, by means of the magnet as before, would, at the instant of contact, record the point at which this took place, and, consequently, the height of the barometer at that time.

England appears to be setting up in business in the oil line. On another page will be found an account of the petroleum works at Padeswood, Flintshire. The products of the canal coal there comprise:—First, the crude oil; second, the lubricating; third, the refined; fourth, the grease; fifth, paraffin in scales; sixth, paraffin in wax; seventh, coke. These products are exceedingly curious, and point to a new and much increased value in coal, as well as a new and profitable industry.

CALORIMETER SAFETY VALVE.

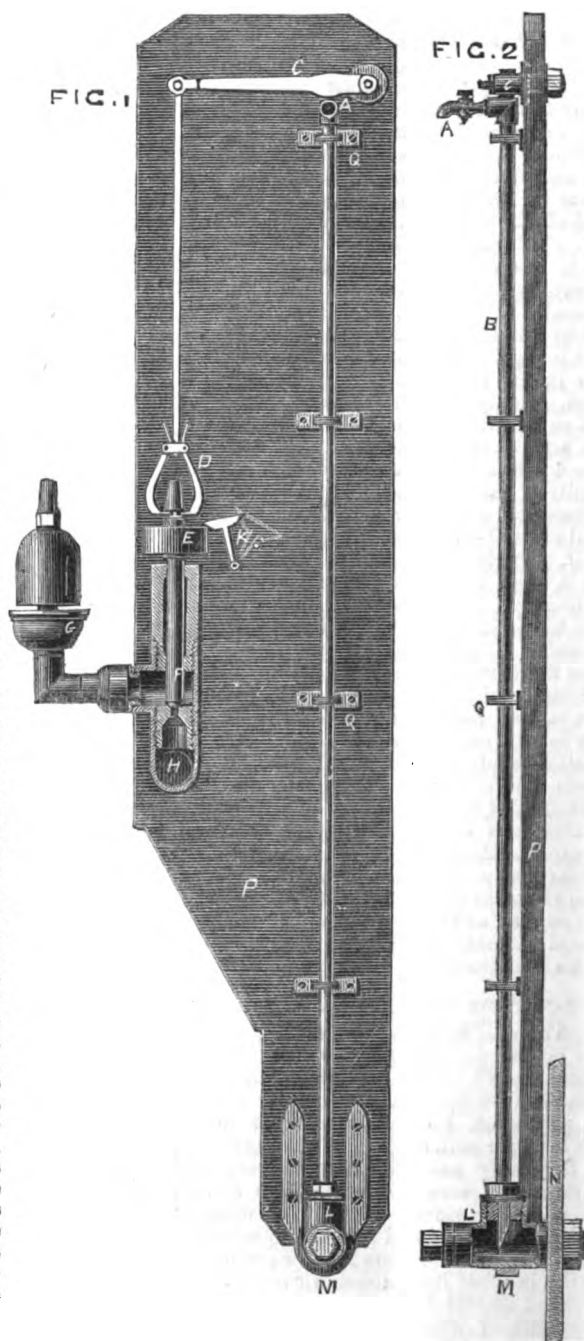
THE danger of explosions arising from boilers getting short of water has been ingeniously met by Mr. J. M. Courtauld, of Bocking, Essex, by an improved safety apparatus which he has just patented. The invention consists in the employment of a copper or other suitable metal tube carried through the upper part of the boiler and descending below the proper working water level therein, and in connecting to the upper part of the tube carried to a greater or lesser height from the top of the boiler a rod which, by the expansion of the tube, acts upon a safety valve when the water falls below the proper level and allows steam to escape from the boiler. Instead of carrying the tube through the top of the boiler it is sometimes made to dip in a pipe carried out from the boiler, as shown in the accompanying engravings, fig. 1 of which is a front and fig. 2 a side elevation of the safety apparatus. N is the boiler plate, L is a pipe extending from the lower part of the boiler, B is a brass tube carried through guides Q Q: the lower end of this tube passes through the top of the pipe L and communicates with the water in the boiler; A is a tap on the tube B, C is a lever centred at a and resting upon the top of the tube B. The long arm of the lever C has suspended from it a connecting rod carrying grip hooks D D which embrace a neck on a weighted valve spindle F free to rise and fall in a case; H is a pipe communicating with the steam space in the boiler, a passage in the case leads to a steam whistle G; K is a detector showing when the valve-spindle has been raised, E weight on the spindle, P is a frame carrying parts of the apparatus. When the steam is admitted into the tube L by the water being allowed to get below the proper level, the tube B expands and raises the lever C together with the valve spindle, and the whistle G is sounded. The whistle will continue to sound until the water is again above the mouth of the tube L, and for about half an hour after, unless stopped by the attendant.

This apparatus is of simple construction, is not likely to get out of order, and is easily tested by turning the tap A. It may also be employed to give alarm when the pressure of steam is becoming too great; for this purpose the valve should be so weighted as to lift a little before the main safety valve.

FRENCH ENGINEERING MANUFACTURES.

AMONG the French manufactures of which the Protectionists predicted the destruction by the commercial treaties with foreign countries was the iron trade. The prediction has not been verified. It is an ascertained fact that the trade has gone on increasing every year, and that it has now reached 2,000 millions of kilogrammes, the kilogramme being equivalent to 2 lb. 3 1-50z. According to the *Times* the importation for the present year will be about 80 millions of kilogrammes in iron and castings of all kinds, which is a trifle compared to the home production. It has, moreover, to be observed that, in one form or another, France will export nearly double that quantity. From the 1st of January to the 31st of August last there were exported in divers forms, such as tools, machines, bridges, rails, &c., 95,000,000 kilogrammes of iron work, and

there will probably be about 200,000,000 in the whole year. Workmen's wages and the profits realised on these exports will not be less than 200,000,000 francs, or £8,000,000 sterling. The French dockyards are now building two screw steamers for Russia, and at Havre for the same country a 2,400-horse power steam-engine. At Nantes a regular flotilla of iron lighters are in course of construction for foreigners; in Paris dredging machines for Egypt; at Bordeaux several plated ships have been ordered for the King of Prussia, and for the Italian Government a cuirassed frigate to be called the “Ancona.” A short time ago the “Palestro,” a cuirassed corvette, for the same Government, was launched at Seyne, near Toulon. At Seyne, also, there are building for the Turkish Government three cuirassed gunboats, and the Emperor of Brazil has ordered two cuirassed brigs, and a corvette with 250-horse power engines. The same firm is building two cuirassed steam corvettes, of 300-horse power each, for Italy, and three batteries for Turkey, besides a considerable amount of machinery for the Isthmus of Suez Company. Five or six millions' worth for sugar works are ordered for Egypt. From this list should not be omitted the seventeen locomotives which the ironmasters of the Creuzot are to send to England; those which the works of Alsace are preparing for a German railroad; and castings from the foundries of Marquise for England.



STEAM FERRY-BOATS FOR GLASGOW HARBOUR.

SOME time ago the Clyde Trustees resolved to have a steam ferry-boat built for the above harbour, and it became a question as to what arrangements would best secure safety, sufficient speed, quick turning capability, and simplicity of details. In order to have a choice of plans the trustees invited the principal shipbuilding firms of the Clyde to prepare and submit plans for their consideration. The result was the production of many models of great ingenuity, including screw, double screw, single and double paddle propellers, besides other novel modes of propulsion. The trustees, with the advice of Mr. Andrew Duncan, their engineer, decided on adopting the model and plans of Messrs. Hedderwick and Co., of Govan, being an adaptation of the water-jet propeller, and so arranged that, though there is nothing outside the hull—either propeller or rudder—the boat can be moved ahead or astern, or quickly turned to either side. The boat has been completed under the superintendence of Mr. Duncan, to whom the builders are indebted for many important suggestions; and the mechanism, of a very neat and substantial kind, was made by Messrs. James Howden and Co., Glasgow, and is a good example of beauty and finish. The boat has been tried several times lately, and has exceeded expectations in her performance. She can go at the rate of from four to five miles an hour, turn on a pivot if required, go ahead or astern, steer to the right or left much quicker than the ordinary rowing boats, and will transport forty people at once. She has been furnished with life-buoys; and has also been inspected by the surveyors for the Board of Trade, Messrs. M'Kinlay and Green. Her principal dimensions are—30ft. long by 12ft. broad; and she is fitted with four watertight compartments in the bottom; the engines are of four-horse power, and a steam whistle has been provided for alarm in case of danger. It is expected that all the rowing ferry-boats in the harbour will be superseded by steam-boats of this class, the absence of the dangerous and lumbering oars being itself a powerful argument in their favour. The boat was officially tried on the 9th inst. by the Lord Provost and other gentlemen of the Clyde Navigation Trustees, and was ordered to be put on the station at Clyde. It is considered by Messrs. Hedderwick and Co. that the same principle can be efficiently adapted to steam navigation in cases where outside propellers and rudders are unsuitable. Messrs. Gwynne and Co., of the Essex-street Works, London, have written to the *Glasgow Herald*, in which paper the above account appears stating that the machinery and application above described was patented by them in 1863 (patent No. 1,343), and that it was fully described and illustrated in the *Engineer* of 27th February, 1863.

PETROLEUM IN FLINTSHIRE.

THE discovery of petroleum in Flintshire has led to an examination of and report upon the district where oil has been struck. The report, which emanates from the pen of "A Looker-on," appears in *Ryland's Iron Trade Circular*, and we make the following extracts therefrom:—"A Looker-on" made his way to Padeswood, a small station about two miles from Mold, in Flintshire, and landed at once in the very heart of the Mineral Oil Region. He states that it appeared as if he had fallen asleep in the train at Chester, and (woke up among the "Oil Wells" at Enniskillen (Canada West), or Pennsylvania. There was the (identical mud, about the same quantity of smell slightly diminished in strength), the same run of land—the same rough people, the same sort of fires and furnaces, cauldrons, retorts, kettles, stowpans for oil, and distilleries—the same heaps of lime, and the same carboys of sulphuric acid—everything the same but the primeval forest, for the trees are all fast disappearing. Here were the "Oil Wells," in fact, with all their wealth of production, minus their uncertainty in production, and the never-failing crop of open cheating and miscellaneous roguery that springs up from the fattening soil all around them. The stuff they make here is actually petroleum. It has the green colour, the smell, and gives out, to the same treatment, the same products, saving that it is less rich in turpentine, or that the turpentine it contains has less volatile spirit. The taste is the same, and the effect of tasting it exactly similar. There it was, in Flintshire, running out of the receiver from the retort, unmistakably crude

petroleum; and this, in the writer's opinion, settles the question for geologists as to its character and the method of its original production in nature.

The report continues:—That they make a capital profit on this spot by its manufacture, there is tolerable evidence about us. I do not speak so much of the companies' works, that are belching out fire, and blowing and steaming and smoking away, but in the numerous single furnaces and distilleries that are dotted all over the three or four miles in view. Like the oil wells at first, it is a gold diggings to the "small man"—and you can trace its effects in the well-lined pockets, the well-filled shops, the general air of comfort, and the plenty-to-eat-and-drinkishness visible everywhere. The little men have been quietly making the money. Anyone that can buy a ton or two of coal, or get it from hand to mouth—no hard thing where coals are more plentiful than blackberries—can set to work and turn it into oil by sticking up a few bricks and a retort with a pipe. That gives the tar or petroleum. Another boiling does the "run over," that extracts from it the lubricating oil, which fetches £9 or £10 per ton. Now there are three kinds of cannel coal (first, the Curly Cannel, at 29s.; second, the Smooth, at 11s.; third, the Shale, at 9s.)—and there are certain mysteries in working these together, about which I am likely to know more in a few days. One ton of the best cannel coal will produce 80 gallons of crude oil, worth 1s. 9d. to 2s. per gallon, and 5 cwt. of refuse, which may or may not be used to light the furnace for another two batches. Each batch consists of half a ton, and occupies twenty-four hours in the crude distillation. In this condition the oil goes to the refiner, whose agent travels about to buy of the small men, and pick up bargains from the needy.

The oil is made up in barrels of 36 gallons, about 7½ of which go to a ton (at least they did so in Petrolia, but there we allowed for leakage), and a ton of rough oil—the first running off, not from the retort, but from this first distillation—sells for refinery purposes at about £10 10s. The barrels, which cost from 6s. to 7s. each—for they must be good—are charged to the purchaser. In these barrels lies the way—for some future inventive genius—to fortune. The Yankees and Canadians have tried all sorts of "dodges," but after all there is nothing like an oaken stave and an iron hoop. Iron, in casks, spoils the oil, and in soft wood, it will perspire itself right through. Some folks speak of enamelled iron for the purpose, but this is yet open to experiment, besides being a severe question of price. The "companies" of course refine their own oil, and herein lies—from but a small additional outlay—a large source of extra profit, as I shall proceed to demonstrate. The 80 gallons of crude oil—after re-distillation by two processes, and certain washings and re-washings, alternately with caustic soda and sulphuric acid (there are of course certain other pretended manipulations)—come out as follows:—40 gallons burning oil, 30 gallons heavy oil (lubricating), 8 gallons grease and pitch, 2 gallons refuse; total, 80 gallons. The value is improved 40 per cent.; the labour costs about 5 per cent.

According to the demand of the trade, or the season, or the skill of the operator, the 30 gallons of lubricating oil are made to produce railway grease, paraffin (by a freezing process), and what is known as "turpentine substitute." The railway grease sells at 15s. to 20s. per cwt.; the paraffin (for candles) at 4½d. per pound; and the turpentine substitute for from 2s. to 3s. per gallon wholesale. I will not tell you here what more skilful hands would do with much of this; but some will be able to judge how gold is running to waste, or, rather, the candle being burnt at both ends, in such a process of manufacture. Be this as it may, the place all around, for miles, is boiling over with coal-oil. The cannel—once so despised—that judges and juries and wise men were seven years trying to settle whether it was coal or not—is abundant everywhere just in this vicinity—and I rather think farther towards Shropshire—at any rate, I saw it in the Vale of Llangollen.

Charts of the storms which passed over the surface of France during the summer of the present year are being prepared in the meteorological department of the Paris Observatory, and will shortly be offered to the public at moderate rates, but the number of copies will be limited by the subscriptions made in advance. The publication is in the hands of the Scientific Association, which has its meetings at the observatory.

HIGH-SPEED COMPRESSED-AIR HAMMER.*

By MR. WM. D. GRIMSHAW, OF BIRMINGHAM.

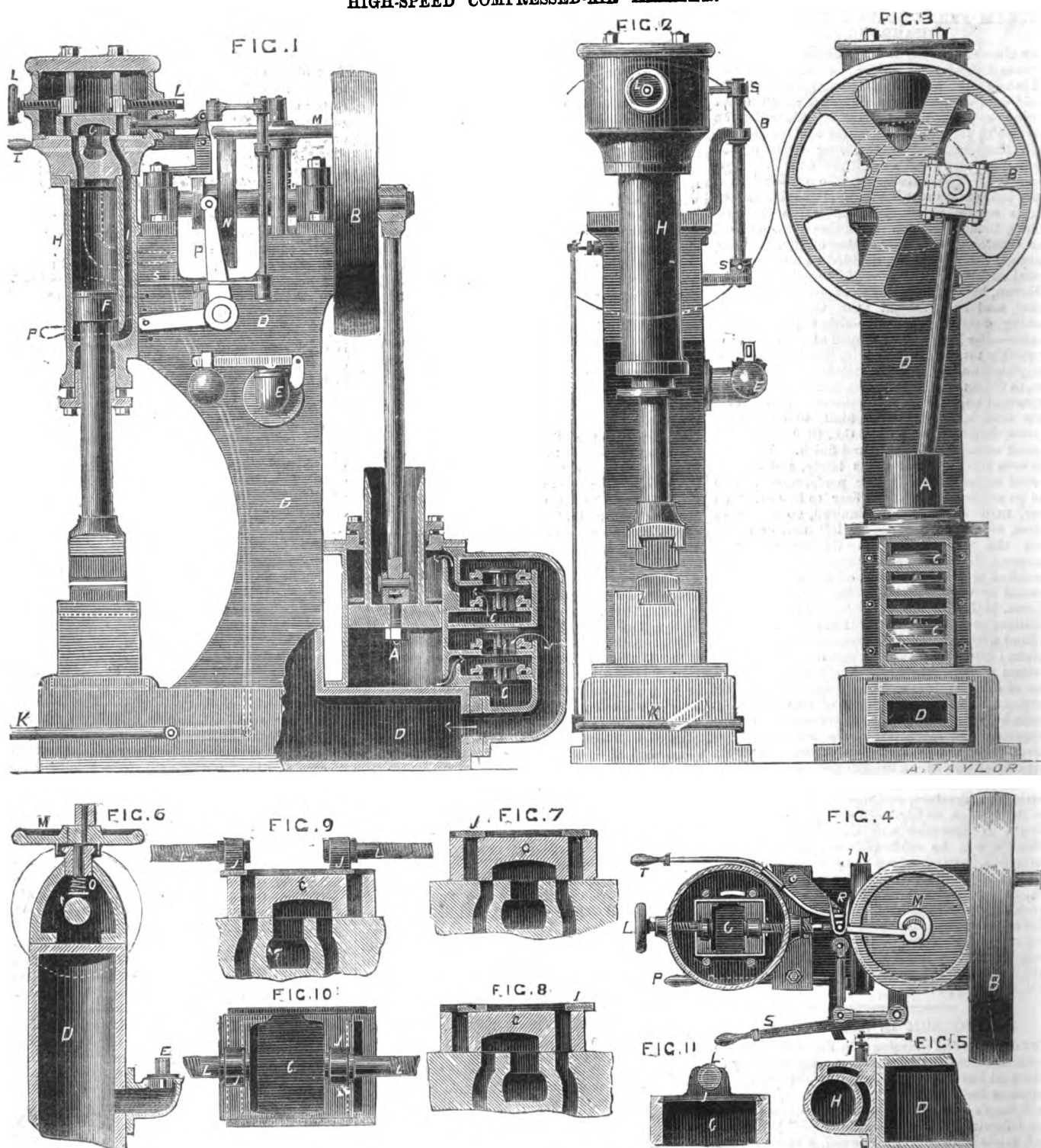
THE objects of this compressed air hammer are to obtain a self-acting hammer with a great range in the force and rapidity of the blows, so as to be suitable for light forging, tilting, and planishing; or capable of being worked by hand with heavy blows for stamping when required; and also arranged to be driven by a belt from a shaft, in order to be applicable where direct steam power is not available. The machine consists of a force pump supplying compressed air to a reservoir, and a working cylinder and piston with hammer similar to those of a steam hammer, but worked with compressed air instead of steam, and having arrangements for varying the action of the hammer as required, and increasing the rapidity of the blows considerably beyond the speed of revolution of the driving pulley. The hammer is shown in figs. 1 to 6, in the accompanying engraving. Fig. 1 is a side elevation of the hammer, partly in section; figs. 2 and 3 are front and back elevations; and fig. 4 is a plan, partly in section. The double-acting air pump A, fig. 1, is 8in. diameter and 8in. stroke, and is worked by a crank pin on the driving pulley B; it has a solid piston fitted with cupped leathers, and cast-iron suction and delivery valves C, which are circular with flat faces, and each fitted with a light spring on the top to close the valve promptly. The interior of the hammer frame D forms the reservoir, into which the compressed air is delivered by the pump, and the pressure is regulated by the safety valve E, with a sliding weight or spring balance to alter the working pressure of the hammer. The piston F of the hammer cylinder is 4½in. diameter, packed with cupped leathers, and has a full stroke of 10in. The compressed air is admitted below and above the piston alternately by the slide valve G at the top of the cylinder, and escapes by an exhaust port at the side of the cylinder H. The pressure of the air admitted to the cylinder from the reservoir D is regulated by the throttle valve I, worked by the foot treadle K; the throttle valve spindle is seen in fig. 5, which is a horizontal section through the hammer cylinder.

The slide valve G is of cast iron, and is shown separately to a larger scale in different position in figs. 7 to 11, fig. 10 being a plan and fig. 11 a transverse section. It is faced both back and front, with the ports passing through to the back; and two adjustable cut-off slides J J are placed on the back for altering the points of cutting off the air. These are regulated separately by screws L L, which pass through the side of the valve-box, and serve to hold the cut-off slides stationary in any desired positions. The slide valve G is worked by a crank pin on the horizontal disc M, figs. 1, 4, and 6, and this is driven by contact with the vertical wheel N upon the shaft of the driving pulley B; the disc M is pressed down by a spiral spring O upon the lower end of its spindle, as shown in the section fig. 6, which shows a vertical section through the air receiver, and the vertical wheel N is faced with leather on the edge, to give the required adhesion for driving it. This wheel N slides along the driving shaft upon a feather, and is shifted by the lever P, varying the speed of driving the disc M by acting upon it at different distances from its centre, and thereby giving a range of speed for driving the slide valve up to more than double the rate of revolution of the main driving pulley B. By means of the lever P, which is held in a series of notches, the number of blows of the hammer can thus be changed, without stopping it, from 150 up to 420 per minute, with the usual working speed of from 150 to 200 revolutions per minute of the driving pulley. The valve spindle is connected with the crank pin on the driving disc M by a connecting rod R having a forked end, as shown in the plan, fig. 4; and this can be at once disconnected by withdrawing the fork R by means of the handle S. The slide valve is then worked by hand or foot by means of the lever T, when the hammer is required to be used for stamping; and the lever T is removed by drawing it out of its socket when the hammer is required to be worked self-acting.

An efficient hammer worked by compressed air is found very advantageous in many situations, such as where there would be material loss of

* Read before the Institution of Mechanical Engineers.

HIGH-SPEED COMPRESSED-AIR HAMMER.



power by condensation in bringing steam from a great distance, or where the damp from leakage of steam or the dropping of condensed water on the anvil would be objectionable, as in shops where bright steel is exposed or where the planishing of bright work is carried on. The air hammer also meets the cases where horse power or other power than steam is alone available; and it has an advantage in being always ready for work, not having any accumulation of condensed water in the cylinder and passages as in the steam hammer. There is also a saving in lubrication and in wear of the working parts, from their not being exposed to the heat of high pressure steam. In this air hammer the force, rapidity, and quality of the blow can be changed with great promptness and accuracy. The force of the blow is regulated by shifting the safety valve weight E, or by means of the throttle valve I altering the pressure of air upon the top of the hammer piston; and the slide-valve motion admits of altering the rapidity of the blow instantaneously, giving also the means of obtaining a very high speed without involving any destructive tappet action, as the small slide valve G is

alone required to be worked at the high speed. The arrangement of the out-off slides J gives the means of regulating the quality of the blow, from a full stamping blow, to a sharp pick-up blow striking with any degree of lightness and well suited for such work as planishing and shaping hollow ware; and by the use of the hand or foot lever T the hammer is readily and conveniently worked as a simple stamp.

In the discussion which followed, Mr. Grimshaw observed, in reply to inquiries from the chairman and other members, that several of the hammers were now in use in Birmingham and the neighbourhood, employed for various stamping and forging purposes; also one at Glasgow for copper-smith's work, shaping and planishing vacuum pans for sugar refining, and one at Sheffield for steel tilting. The pressure of the air could be varied by altering the load on the safety valve, and the hammers had been worked at pressures from 7lb. to 30lb. per square inch; the ordinary pressure at which they were worked was about 20lb. per square inch. One of the hammers had been at work for more than seven months in a smith's shop for ordinary forging

work; and in that case it was employed also for blowing the fire in the intervals while the iron was being heated, by a connecting pipe being carried to the tuyere from the air reservoir. In stamping plate iron the hammer could be used for stamping the metal either hot or cold, as might be desired. The greatest speed at which the hammer had been worked was 800 strokes per minute, and it could be driven at any number of blows below that amount. It was usually worked self-acting for any speed above 100 blows per minute, but below this it was generally preferred to throw the self-acting motion out of gear and work it by hand; or in case the workman wanted both his hands free, the treadle gave the means of working the hammer by foot. The largest of the hammers yet put to work had a cylinder 8½ in. diameter and a stroke of 28 in.; he did not know what pressure it was working at, but the pressure might be adjusted to any amount from 5lb. up to 40lb. per square inch. The cost of such a hammer was about £180, and of a hammer of the size shown in the drawings about £50, the larger hammer requiring about 5-horse power to drive it, and the smaller about 1-horse power.

FAN BLOWERS.

FIG. 1

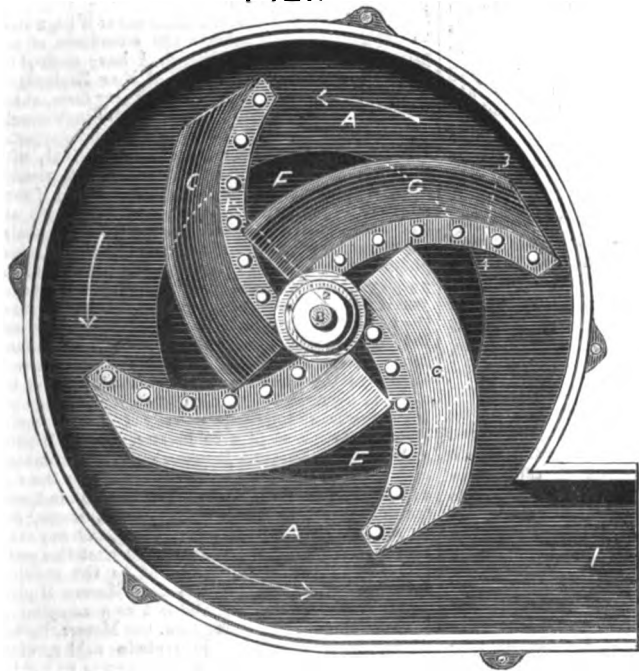


FIG. 2

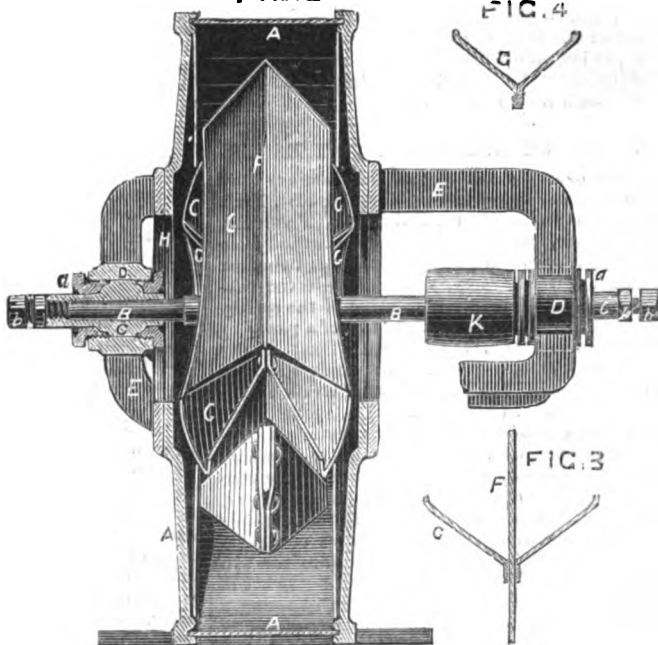


FIG. 4

FIG. 3

Mr. E. H. Carbutt thought the air hammer was not as suitable for steel tilting, and would not be able to compete with the steam hammer for that purpose, since its power was not to be compared with that of the steam hammer. The greatest advantage of the air hammer he considered would be for stamping small articles, in place of hand labour. Several steam hammers of from 4 cwt. to 10 cwt. were working in Sheffield, with which 500 to 600 blows per minute could be struck if required; and they were regularly working at 300 blows.

Mr. Grimshaw observed that in reference to tilting steel there was one of the air hammers now at work in Birmingham which was employed in drawing down steel; a bar of steel 4 in. long and 1/2 in. square was drawn down to a length of 14 in. or 15 in. with a regular taper, and thirty-six of these were produced by the hammer in nineteen minutes in the ordinary work, which he believed it would be impossible to accomplish by any steam hammer at present employed. The average speed of the air hammer for that work was about 340 blows per minute in regular working, and that was as fast as the man could turn his hand for turning over the mould between each blow; the speed could, however, be increased whenever desired up to 600 or even 800 blows per minute. When the drawing of the steel was finished, the hammer could be stopped instantly, with a promptness which could not be attained with the steam hammer.

Mr. W. Richardson thought all that had been performed by the air hammer in steel drawing and other work could be accomplished equally well by ordinary steam hammers, as regarded both the rapidity and force of the blows. The main advantage he considered to be gained by the use of the air hammer would be preserving the die always dry and free from liability to droppings of condensed steam; there were many kinds of work in which a dry die was a matter of great importance, and for such cases the air hammer appeared admirably adapted; but for general work he did not think it could compete with the steam hammer.

Mr. Grimshaw mentioned that the steam hammer had been abandoned for steel tilting at some of the works in Sheffield, and the air hammer adopted instead, as it was found preferable for the purpose. At Messrs. Sanderson's works one of the air hammers had been at work for a considerable time for bolstering and forging knife blades, &c.; and at another steel works a shop was going to be built to contain six of the air hammers.

Mr. C. H. Adams said that he used to employ steam hammers for planishing hollow ware at his works in Birmingham, but had been obliged to abandon them for bright iron work, on account of the droppings and moisture from the steam;

and he had now put up for the purpose one of the air hammers described in the paper, which had been at work for ten months and had proved very successful and had shown, he considered, a decided economy as compared with steam. He accordingly intended to remove two steam stamps of large size at present in use, and replace them by air hammers, which he was satisfied would answer well.

The Chairman remembered an air hammer being made by the late Mr. John Hague about thirty-five years ago, which he believed was one of the earliest air hammers that had been made. It was worked as a vacuum hammer, by exhausting the air, instead of by compressed air, and was constructed for the purpose of planishing frying pans; and it worked with such an extraordinary rapidity that it was impossible to see where the hammer was in working, and the effect seemed more like giving one continuous pressure. That hammer was, however, wanting in the elegant contrivance for regulating the blows that was shown in the hammer now described; and he was particularly pleased with the mode of working the slide valve by the neat arrangement of the friction wheel and disc running in contact with each other. He inquired how the surfaces of the wheel and disc had been found to stand in work, and whether there was much liability of their slipping; and what amount of repairs had been required to any of the hammers.

Mr. Grimshaw replied that in the first of these hammers that was put to work the surfaces of the friction wheel and disc for working the slide valve were merely iron against iron, and worked in that condition for seven months with only an occasional slipping when a little oil from the bearings happened to get upon the surface of the disc. Afterwards the bearing of the disc had been recessed, and formed into an inverted cup, to prevent any risk of oil getting upon the rolling surface; and the friction wheel had been faced with leather to increase its hold upon the disc and diminish the wear. No repairs had yet been required to any of the hammers at present at work, and the only accident that had occurred to any of them had been that the cylinder bottom got broken through an accident in the first hammer, which had been put up mainly with a view to testing the cost of working and the actual wear and tear of the several parts.

FAN BLOWERS.

THIS invention relates to a peculiar construction of fan blower, whereby a greater power of blast is obtained than by the fans hitherto in use. It has been patented by Mr. Wilson Ager, of America, now residing at the European Coffee-

house, London. According to one modification, the blades of the fan are carried by a disc wheel which is keyed or otherwise secured to the fan spindle. Each fan blade is curved outwards and backwards as regards the direction of revolution, and is throughout its entire length of a V-form in transverse section, the hollow or trough being on the front side of the blade; the disc wheel is situated in the centre of each blade, so as to intersect it longitudinally, one half or side of the blade being on each side or face of the disc. One end of these blades extends nearly to the centre of the disc, while the outer end projects some little distance beyond the periphery of the disc. The trough or channel of each blade is both broader and deeper at the inner end than at the outer extremity, and it is preferred to remove or bevel off the corner of each side of the trough or V at its outer end. According to another modification, the disc wheel may be dispensed with, and the curved V-shaped blades may be each carried by a separate arm on a boss fast on the spindle of the fan. In both arrangements the revolving blades are enclosed between a pair of discs which are secured to the sides or lateral edges of the blades, and are open in the centre, and converge towards each other at their peripheries, these discs forming, in fact, a portion of the revolving part of the fan; the whole is enclosed in an ordinary fan casing shaped to conform to the taper of the blades.

In the engraving fig. 1 represents a side elevation of one arrangement of the improved fan blower with the side of the fan casing removed to show the internal arrangement; fig. 2 is a corresponding vertical section of the same, showing the revolving blades and disc in edge view; and figs. 3 and 4 represent transverse sections of one of the curved trough-shaped blades taken along the lines, 1, 2 and 3, 4 respectively in fig. 1. A is the outer casing of the fan; B is the fan spindle working in tapered adjustable collar bearings C C contained inside the bosses D D which are fitted to each side of the fan casing by means of screws passing through the arms E E and into the side of the casing. The spindle and collar bearing are, by preference, slightly tapered, so that by adjusting the bearings longitudinally along the spindle by means of the screwed glands a a, the bearing can be tightened up, and compensation for wear of the spindle and bearing is thus obtained. b b are set screws and nuts, for adjusting the longitudinal position of the spindle B in its bearings, and ensuring the exact central position of the fan itself between the two sides of the casing. F is a disc keyed or otherwise secured on to the longitudinal centre of the spindle B, and to each side of this disc are riveted or otherwise secured the two sides or halves of the curved trough or V-shaped fan blades G G. These blades may be either of uniform depth and width through-

out, or they may be slightly reduced in depth and width towards their outer extremities, as shown by the two transverse sections at figs. 3 and 4, the casing being shaped to conform to the taper of the blades, as shown in fig. 2. H H are the lateral apertures for the inlet of the air; I is the air outlet, and K the rigger keyed on to the spindle B for driving the fan.

UTILISING THE HEAT OF THE EARTH.

At the ordinary meeting of the Literary and Philosophical Society, held October 31st, 1865, R. Angus Smith, Ph.D., F.R.S., &c., President, in the chair, the following communication from Sir J. F. W. Herschel, Bart., F.R.S., &c., honorary member of the Society, was read:—In the proceedings of the ordinary meeting of the society on the 3rd inst., I observe a notice of a paper by Mr. Greaves, "On the Internal Heat of the Earth as a Motive Power," in which the high temperature of the carboniferous strata at the depth of 4,000ft. (120 deg. Fah.) is spoken of as likely to oppose an insuperable obstacle to the extraction of coal from that depth. On reading this it occurred to me that by employing condensed air, conveyed through conducting pipes, as a mode of working machinery at that depth—provided the air immediately on its condensation, and before its introduction into the pit, were drained of the heat developed in the act of condensation by leading it, in pipes exposing a large external surface, through a sufficiently large supply of cold water (or in winter time of snow)—the workings below might be sufficiently reduced in temperature by the re-expansion of the air on its escape, when given out below in the act of working the machinery, to admit of workmen remaining there in comfort; at the same time that ventilation would be supplied. Water at 120 deg. Fah., or even much higher, would, I fear, afford but an inefficient moving power unless some means could be devised (without the expense of more power than the gain expected) of concentrating the heat of a large quantity of warm water into a smaller. This might perhaps be done through the intervention of air alternately rarefied and condensed.

Mr. Binney, F.R.S., F.G.S., said that at the present time little is known as to the difficulties we should experience in working coal mines at a depth of 4,000ft. from the surface. The exact increase of temperature in deep mines is not by any means well ascertained. All we can say is that no great difficulties have been found in working at a depth of 2,100ft. It must always be borne in mind that the deeper a mine is the greater will be the natural ventilation, that is the current caused by the air of the mine, at say a temperature of 80 deg. Fah., ascending the upcast shaft, while the air at the surface, of 40 deg., descends by the downcast shaft. No doubt a mine might be cooled by the expansion of compressed air, but it could not, so far as at present known, be done economically. In most deep mines a considerable cooling of the air takes place by the expansion of the compressed gas (light carburetted hydrogen) as it escapes from the coal, where it has been long imprisoned under great pressure; and this has not always been allowed for by observers of temperature in such places. In newly-opened mines this pent-up gas forces off large pieces from the face of the coal, and it sometimes makes a noise like water rushing over a weir. In sinking a deep shaft at Wigan some years since, the compressed gas in the coal forced up about four yards of strong bind and made its way through it into the shaft. The rising of the roof of the coal as the shaft approaches it is well known to sinkers in deep and newly-opened coal fields.

THE "AFFONDATORE."

In our last we briefly noticed the launch of this vessel from the premises of the Millwall Ironworks and Shipbuilding Company, who are her constructors. We now give some particulars of this iron-clad cupola frigate, which has been built for the Italian Government. Her length is 298ft., breadth 40ft., and depth 18ft. 4in. Her builder's tonnage is 2,306 tons, and her engines, which have been constructed by Messrs. Maudslay and Co., are of 700-horse power nominal. The "Affondatore" is furnished with a projecting bow, shaped like the breast of a swan. It is expected that her engines will propel her at the rate of at least fifteen knots an hour, so that

there would be but little chance of escape for any ship against which her ponderous prow was driven. She is fitted with two turrets, one at each end of the vessel. These are provided with one 10-ton gun each, and are upon Captain Coles's principle. That portion of them standing above the upper deck is protected by armour plating 5½in. thick. Between decks the turrets are encased by circular armour-plated bulkheads of 5-in. iron, within which the turning gear is worked. The vessel is protected at the sides by armour extending from the maindeck down to 7ft. below the load water-line. This plating is 5in. thick, except the lower strake, which is 4in. thick. The main deck is protected by plate iron 2in. in thickness. On this deck there is also a rifle tower, or conning-house, which stands 9ft. above the upper deck, and is covered with armour 5in. thick right down to the main deck. This affords protection to the captain during action, and also to the steering wheel. The whole of the skylights and ladder ways on the main deck are provided with strong iron gratings, which slide between the beams when not required, and which can be worked from below. The masts, which are of iron, are telescopic, and act as ventilators to the ship. The catheads and fish-davits are so made that they will turn down during action, as well as the bulwarks, so that a circular range is obtained. The stern of the vessel is so made as to protect the rudder head and the screw propeller. Throughout the entire length of the vessel there is a wing passage fitted, which, as well as the double watertight bottom, is provided with doors, sluice-valves, &c., so that with the transverse bulkheads the vessel is divided into a large number of water tight compartments, from any one or all of which the water can be taken with great facility. Special ventilating machines to be worked by hand are provided for the magazine and handing rooms. The "Affondatore" is finely modelled, and reflects great credit on the yard from which she has been turned out.

A NEW METALLIFEROUS ORE.

CONSIDERABLE interest has been recently evinced in Birmingham among the ironmasters by an exhibition of specimens of manufactured iron, from the works of Messrs. D. Hipkins and Sons, of West Bromwich, in forms comprising rods, sheets, hoops, and bars. These specimens, which according to the *Birmingham Daily Gazette* have undergone official tests sufficient to prove tensile power of a high order, appear the more remarkable because the pigs from which they were made have not the smallest fragment of English ores in their composition. They are simply produced from the titaniferous iron sand of New Zealand, which, as is well known, abounds in almost inexhaustible quantities over the whole of that island. This sand, in its natural state, has the appearance of fine steel filings, and, on a magnet being dropped upon it, and taken up again, the instrument is found thickly coated with the iron granules. Emigrants to the New Zealand colony have frequently complained in their letters to friends in England, of the blinding effects of this fine black metallic powder, the presence of which, in a smart sea breeze, necessitated the wearing of veils by all travellers along the seashore. This iron sand is found along the shores of New Plymouth, in Taranaki, and abounds more especially along the base of Mount Egmont, an extinct volcano,—the deposit extending several miles along the coast, to the depth of many feet, and having a corresponding breadth. It has been assumed by geologists that at some time or other this granulated metal has been belched forth from this volcano into the sea, and there pulverised. At any rate, although discovered many years ago, it has until recently been regarded merely as a geological curiosity, and no endeavours were made to turn it to practical account.

On the authority of analyses, made by several metallurgists of repute in this country, it has been found that this is the purest iron ore that has yet been discovered—the following being the result of an analytical test, viz.—Peroxide of iron, 88.45; oxide of titanium, with silica, 11.43; loss .12.—Total, 100. It is stated that, taking the sand as it lies on the beach and smelting it, the produce is 75 per cent. of iron of the finest quality; or, if the sand be submitted to the cementation process, the result is a tough first-quality steel, which in its properties bids fair to surpass any other description of that metal at present known. As all adopts at metallurgy are aware, if titanium is mixed with iron, the character of the steel is greatly improved, though from the scarcity of titanium such mixture has hitherto been far too costly for the production of manufactured iron for ordinary purposes. The colonists of New Zealand, however, find both these metals on a large scale ready to their hands. The credit of the

successful treatment of this ore in the manufacture of iron is due to Mr. Charles Martin, C.E., of London, who, in the early part of this summer, imported about one hundred tons of the iron sand from New Zealand. Mr. Martin says: With a view to practically demonstrate the soundness of my process for smelting it (which I have secured by letters patent for the colony of New Zealand), I erected a small furnace of the ordinary form, at the works of Thomas Butlin and Co., Wellingborough. The result has exceeded my most sanguine expectations, for I think I may venture to say that, with such appliances, such results could not possibly have been obtained from any English ores; if even wrought iron could have been made at all. The ore (iron sand) as will be seen from the analysis, is pure, not containing a trace of sulphur, phosphorus, &c. The fuel used for smelting should be pure also, i.e., charcoal; but as my furnace was too small for such, I have been obliged to use coke; the hearth of my furnace is only 17in. diameter and 10in. deep; blast produced by one of Lloyd's fans, 22in. in diameter, and with this (comparatively speaking) toy I can make a ton of metal with a ton of fuel; average make, about two tons of pigs per day—fourteen tons per week. I have supplied about five tons of pigs to Messrs. David Hipkins and Sons, of Victoria Ironworks, West Bromwich, and to these gentlemen I am indebted for the considerable trouble and pains taken by them in manufacturing it into bars, rods, sheets, hoops, &c., which I think will bear comparison with any other make. It must not be overlooked that this material is as unique in its treatment in the puddling furnace as in the smelting; that Messrs. Hipkins puddled these pigs alone, and not as a sampling, as with English ores. Some 1½in. bar Messrs. Parkes, of Tipton Green, made into chain cables, which stood a test of fifty tons, and then gave way at the weld; Lloyd's test for this size cable is eighteen tons fifteen hundredweight.

An important element in the above process is that the cost of production does not exceed that of English ores—a ton of fuel producing a ton of metal. It is interesting to note that the conversion of the titaniferous sand is by one operation. The *modus operandi* followed by Mr. Martin enables the smelter to dispense with protracted intermediate processes necessary to the conversion of ordinary iron ores into steel. Here, as we understand it, the furnace is charged in the ordinary way, the molten metal runs at once into ingot moulds, thus producing a pure alloy of titanium and iron, 5 per cent. of which added to the material of which our common steel is made will produce steel of first-class quality. The fitness of this description of steel for the manufacture of the finest cutlery is established by the fact that some of the sand turned into steel has been formed into surgical instruments and the finest articles of cutlery, with results as regards keenness of edge, fineness of polish, &c., superior to most of the best cutlery steel made in the ordinary way. It is generally admitted—apart from its value as a base of iron and steel making—that the use of this granulated ore will, at least, prove an immense pecuniary saving in the "fettling" of furnaces. In the South Staffordshire district the material at present used is pottery mine, at a cost of 22s. per ton delivered at the works; and if the titaniferous iron sand tends, as it certainly does, to improve the yield, and can be brought here cheaply, there is no doubt it will soon come into favour with our ironmasters, as it is certain to do, from the facilities it affords for working, with the puddlers themselves.

Correspondence.

SOFTENING CLAY.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—Your last week's number contains a note on the softening of clay for modellers, by means of glycerine,—will you allow me to point out to each of your readers to whom it may be of use a cheaper method of effecting the same object? Some year or so ago I had an apparatus at work in my laboratory, parts of which required at intervals to be removed, replaced, and reluted. The mixing of fresh pipe-clay and water every day or each time it was necessary became a bore, so I mixed a quantity once for all, using a solution of chloride of calcium of about 1.350 specific gravity instead of water. I found that I had fully achieved my object, inasmuch as my luting kept good during the whole course of the experiments, and, further, the other day I picked up in a bye corner of the laboratory a piece of this very same luting as soft, as plastic, and evidently as fit for use as ever. I may add that at the time it struck me that I had read that it was necessary for modellers to keep their clay in a soft state, but I also thought it was necessary that it should be capable of being dried—which when mixed with chloride of calcium it would be impossible to do.

I remain, yours, &c.,

PETER HART.

Ardwick Bridge Chemical Works,
Manchester, November 18.

"SAFETY" LUCIFER MATCHES.

RESPECTED FRIEND,—Having noticed a letter in the MECHANICS' MAGAZINE of the 17th inst., signed "Inquisitor," on the above subject, we shall feel obliged if a small space can be afforded us to offer a few remarks thereon. We thankfully accept the admission that the "invention is faultless in its ingenuity," and that it has one distinct advantage, namely, its "incombustibility except in connection with its own box." It probably did not occur to "Inquisitor" that there is another class besides consumers who are deeply interested in this question,—we refer to those employed in the manufacture of lucifer matches, who are the victims of a terrible disease connected with the use of common phosphorus, viz., necrosis, or decay of the lower jawbone, from which those engaged in the manufacture of our patent safety matches are wholly exempt; we have recently seen a report which states that thirteen cases of this dreadful disease have been admitted into one hospital in New York in six months. Whilst it may occasion no surprise that an "Inquisitor" should estimate but lightly the torture to which hundreds of his fellow countrymen are exposed, we venture to hope that the public do attach some importance to an invention which, if generally adopted, would banish one of the most loathsome diseases with which humanity is afflicted from the land. We also think that but scant justice has been done to the safety match by "Inquisitor" when it is considered in how reckless a manner matches are used. This may be illustrated by stating that at a moderate computation one hundred millions of matches are used daily in this country—an overwhelming majority of these, we regret to admit, are of the old poisonous and dangerous kind. Now, supposing only one per cent. to be carelessly used or dropped (and we believe five per cent. would be nearer the truth), there is daily one million of matches strewn broadcast throughout the country, from the attic to the cellar, in manufactories, warehouses, workshops, stables, &c. Is it not, then, a serious reflection that even one of the million (or five millions) of matches thus daily scattered, by being accidentally trodden upon and in a variety of other ways, may become the instrument of originating a conflagration in which both life and property may be sacrificed? Whilst we are not so sanguine as to expect that our patent special safety matches will very speedily supersede the common lucifer (unless the sale of the latter should be prohibited by legislative enactment), we are fully justified in believing that on sanitary grounds as well as on account of the protection they afford against accidental fires, they will be increasingly appreciated by that portion of the public to which the appellation of prudent may be properly applied.

We are, respectfully,
BRYANT AND MAY.

Fairfield Works, Bow, E.,
November 21.

SIR,—I have for some time discarded all lucifer matches from my house except Messrs. Bryant and May's. As it would appear now that I am clearly in error in having done so if your correspondent "Inquisitor" is correct in his criticism, will you allow me to say why I cannot agree with his views on the subject? His first charge against these matches is that if struck against the prepared paper the head of the match is liable to fall off red hot or blazing on the floor. I have never seen or heard of a single instance of this accident, and, besides, these matches never should be struck on the prepared paper. The head of the match should always be pressed down on the paper before it is drawn along to light it, and if the head is placed within one-eighth of an inch of the edge of the paper and then drawn off the edge, this will be found quite enough to light it. If this is attended to, the paper on one of the boxes will light all the matches in two boxes, and it is quite a mistake to strike the match on the paper, or to drag it along the whole length of the paper.

As to the fact that you must have the box to light the matches on, that I humbly believe to be the great excellence of the invention. It saves your walls, furniture, &c., from being used as a "rough surface" to light the matches on, and it renders it impossible that accidents should happen from the matches being spilled about and trodden on. Now this was and is the real danger of all matches which ignite by friction. It is not the deliberate act of lighting lucifer matches which involves danger, though of course in careless hands lighting anything may be dangerous, but the accidental ignition of matches which have been left lying about is a very common cause of fire, and this cannot happen with the safety matches made by Bryant and May. Unless I hear better reasons than those of "Inquisitor," I shall continue to prefer these matches to all others.

Yours, &c.,
PATERFAMILIAS.

[We have for some time past used Bryant and May's safety matches with satisfaction, and have recently put them to severe tests. We, therefore, willingly endorse opinions expressed in the foregoing communications on the subject.—ED. M. M.]

COMPRESSED MOIST HOT AIR ENGINE FOR MARINE PURPOSES.

SIR,—On Saturday last, in accordance with the advertisement which appeared in the previous number of the MECHANICS' MAGAZINE, the trial of a boat propelled by my portable moist air engine, came off on the Thames, at Lambeth, and I beg to forward you the following particulars. The boat into which the engine was placed, without any fitting, is 22ft. 6in. long, by about 5ft. 6in. beam, and 2ft. deep, and is capable of seating from fifteen to twenty persons. The engine has one cylinder 4in. diameter and 12in. stroke, driving a pair of light paddle-wheels, 8ft. diameter, about eighty revolutions a minute. The power of the engine is about 1-horse, and the weight of the boiler and engine is about 300lb. The maximum speed attained through the water was six miles an hour, but the average speed was about five miles an hour. The consumption of fuel in three hours' work was a peck of gas coke which cost (retail) 1½d., coals (4lb.) 1d.; total cost for three hours, 2½d. As the boat is capable of carrying 1½ tons of coal, it would be equal to a voyage of between 3,000 and 4,000 miles, without further fuel. The reason of the extraordinary economy of fuel arises from the use of the latent heat of the steam as a motive power, but which is wasted in all other steam engines. The engine, when not required for the boat, is easily lifted out and may be used either as a light road engine or as a fixed engine of 1-horse power, working for less than 1d. an hour for fuel. Half the fuel and two-thirds the space might be saved in all steam vessels with the same speed or a much higher speed obtained than has been hitherto accomplished.

I am, Sir, your obedient servant,
Lilford-road, Camberwell. J. PARKER.

THE FRENCH GUN OF THE FUTURE.

SIR,—It would occupy too much of your space to reply fully to Major Palliser's letters of the 10th and 17th; I shall, therefore, confine myself to those points which bear upon the question discussed in your article headed as above, and content myself with saying generally that I dissent from nearly all the rest, and that I deny having copied from, or infringed, his patent, and that I think your journal is not a suitable place in which to discuss such questions. I certainly do not attach any special value to a coiled tube; but as it was known and described in combination with a cast-iron outer casing, by Haddar's 1855 patent, I had a full right to use it without specifying it in my 1860 patent, and, therefore, Major Palliser's proposing it two years and a half after, as a speciality, afforded no grounds for the War Department depriving me of my invention and handing it over to him, so that Haddar's patent does affect the question at issue between the War Office, Major Palliser, and myself. Moreover, I can show that I did contemplate its use before I knew of Major Palliser's experiments or proposals, and I do mention it in my 1862 specification (page 6, line 15); and I simply quoted my 1855 patent to show I recognised its value even then. It is useless to discuss what Major Palliser could do by removing 2in. or 2 tons of metal, &c., &c., from his guns; the true test is *what has been done*; and it is nonsense saying his 68-pounder is longer than my 30-pounder, as it is also larger at the reinforce by more than 4in.; and I maintain that to equal mine it ought to have borne the same test in proportion to its size and weight. The actual weight of my French gun, which Major Palliser questions, was 3,087 kilogrammes before alteration, which was increased to about 62 cwt.—a little over 3 tons, certainly; but, surely, in speaking of it in general terms, it was fair to call it a 3-ton gun, as I also called his a 5-ton gun, when it exceeded that weight by 4 cwt.

I now come to Major Palliser's four propositions. He says by his (A) proposition, my gun had radical defects, which he illustrates by the accident which happened to the 10½-inch Armstrong gun, which blew out its breech screw. This was caused by the explosive gas, instead of being confined to the bottom of the bore, a surface of 86 square inches, escaping past the plug, and exerting its force on the larger area of the breech screw of 248 square inches, thus increasing the strain on it to nearly three times the amount intended. Now I have clearly and expressly provided against such an occurrence in the specification of my patent of June, 1862, which was five months prior to Major Palliser's patent. In all the drawings, I show the inner tube closed by a separate screwed plug of its own, and another breech screw behind it, in the surrounding tube, and I use these words in description,—“The tube has a breech plug D of its own, in addition to the breech plug C, which secures it in its place. I consider this desirable in order to prevent the explosive gases from getting between the end of the tube and the breech plug C, which secures it, and by acting on its larger area endangering its security;” and had the 10½-inch gun been constructed in this way it would not have failed.

Major Palliser, in his (B) proposition, in attempting to show how this assumed defect was remedied, makes several incorrect statements respecting my

French gun, which I must ask his pardon for contradicting. I therefore beg distinctly to say that the A tube was not introduced from the muzzle end, nor did the B tube overlap it at the breech end, as Major Palliser states, nor could it be the case, as the A tube was likewise inserted into the B tube through its breech end, and this would also necessitate the threads of the screw being sunk into the B tube, as they were, and not made in relief, according to Major Palliser's specification, and I am sure either Mr. Hughes, Mr. Alexander, or Mr. Hoskin, who were engaged at the Millwall Ironworks at the time the tube of my French gun was made, will corroborate these facts. It is true the inner tube had a solid end, but this, I maintain, is the same in effect as if it had been plugged, and the gun certainly had some additional improvements, which no doubt contributed to its extraordinary endurance, but its construction was exactly in accordance with my specification of 1862, and so far as that invention went it embraced all its important features.

Major Palliser next asserts in his (C) proposition, that in my 1863 patent I infringed and copied his patent of November, 1862, in using separate screws to the different tubes, and in making the threads of the screws in relief, and the metal around them thicker than the other part of the tube. Now, instead of my copying from him, if there has been any copying at all, it is Major Palliser who has copied from me, for, as I before stated, in my 1862 specification I have shown and described separate screws in the different tubes, and by means of these screws a portion of the longitudinal strain is transferred to the outer tube or casing. This, however, Major Palliser has also omitted; let me quote what I say:—“It is, however, essential that the ends of the lining tube B should bear well against the shoulder or end of the recess at S, into which it is fitted and against the face of the breech screw C, so that being compressed between the shoulder at one end and the breech screw at the other, any strain thrown on the lining tube B tending to elongate it will be transferred to and resisted by the cast iron body of the gun,” so that this patent not only contained the separate screws, but something more, viz., confining the ends of the inner tube between the screw and the end of the recess—a really efficient arrangement for taking the longitudinal strain, whereas Major Palliser's, only using a screw at one end without anything at the other, would not effect the object intended; it would be like attempting to hold the parts of a structure together by screw bolts having nuts at one end but no head at the other.

As to that part of Major Palliser's patent relating to making the threads of the screws in relief, and the barrel thicker. I say that neither in my French gun, nor in my 1863 specification, as respects the increased external diameter round the breech screw which I describe, do I copy or infringe it. The principle that he considers was never clearly defined until he made his miniature bolt experiments, only shows how little he knows of engineering practice, as the facts that Major Palliser demonstrated, viz., that a bar would break at its weak part, and stretch more if of uniform size than if not, have long since been known and applied by engineers in various ways. But Major Palliser has made a great mistake in applying the results of his experiments to my design, as in his bolt experiments the strain applied in all cases exceeded the elastic limit of the metal, whereas, I beg to say my gun was designed to bear, and it did sustain, the heaviest charges without being strained up to the elastic limit. Then, again, Major Palliser is wrong when he says that the longitudinal stretch will be confined to the weak spot; the stretch will certainly be greatest at the weakest point, but extension will also take place in the other parts of the bar, and the amount at each point will be in the inverse ratio of their respective sectional areas. In Major Palliser's bolts, the difference in sectional area between the body and the bottom of the thread was more than double, whereas the difference of areas between the metal around and close beyond the breech screw in my guns hardly amounts to 3 per cent., and then in consequence of its conical form the area of the metal around the reinforce decreases so that at a short distance it becomes less than the area of the metal around the breech screw to the bottom of the threads. As this was shown in the specification drawings of my 1862 patent, Major Palliser could not of course claim making the sectional area through the metal surrounding the screw the same or greater than other parts of the tube, and he confines himself in his provisional specification to making the diameter of the screw less than the diameter of the bore. Now, as in my 1863 specification I propose to make the sectional area of the metal around the reinforce nearly the same throughout, I provide for the area of metal round the screw retaining its proper proportion by increasing the external diameter. Major Palliser, in his November, 1862, patent, proposes one way of doing what was shown in my previous patent, and I, in my 1863 patent, propose another—his would be totally inapplicable to my system of construction, in fact, it would prevent its being put in practice; I could not,

if I were to use his plan, get my tubes into one another, and, therefore, he need not fear I shall ever pirate it; mine is altogether preferable, and it is a natural development of my 1863 invention, the only plan applicable to it, and I intend, no copy from or infringement of his. Apologising for occupying so much of your valuable space.

I am, Sir, your obedient servant,
P. M. PARSONS.

Blackheath, November 21.

[In fig. 4 of the engravings in Major Palliser's last letter the screw threads of the inner tube are shown as cut out of the substance of the tube, whereas the screwed portion should be smaller in diameter than the bore of the tube. With the above letter this discussion is closed.—ED. M. M.]

COMBUSTION OF COAL IN FURNACES.

SIR,—I should be obliged if some of your practical readers would give their opinions upon the following point:—Is not the combustion of 25lb. to 29lb. of coal per square foot of grate per hour, evaporating 8lb. of water per pound of fuel, too dangerous for common practice—would not such a combustion burn out or destroy the plates of the boiler above the bridge in less than a month? In such combustion I have seen intense blue flames at the back of the grate, while the tubes were black, without flame, or the least appearance of flame, within them.

Yours, &c.,
ENQUIRER.

Meetings for the Week.

Mon.—Royal Geographical Society.—The following papers will be read:—1 "Overland Journey from Rockhampton to Cape York, Australia," by Messrs. P. and A. Jardine. 2 "Discovery of a Route between Rockingham Bay and the Valley of Lagoons," by Mr. G. E. Dalrymple. 3 "Boat Voyage of 1,600 miles along the Coast of Northern and Western Australia," by Mr. J. P. Stow, 8.30.

Tues.—Institution of Civil Engineers.—Renewed discussion on Sir C. T. Bright's paper, "The Telegraph to India, and its Extension to Australia and China," 8.

TO CORRESPONDENTS.

The *MECHANICS' MAGAZINE* is sent post-free to subscribers of 21 ls. 8d. yearly, or 10s. 10d. half-yearly, payable in advance. Post-office orders made payable to Mr. E. A. Brooman, of 166, Fleet-street, E.C.

Advertisements are inserted in the *MECHANICS' MAGAZINE* at the rate of 6d. per line, or 5d. per line for 6 insertions, 5d. per line for 13 insertions, 4d. for 26 insertions, and 4d. a line for 52 insertions. Each line consists of about 10 words. Woodcuts are charged at the same rate as type. Special arrangements made for large advertisements.

All communications should be addressed to the Editor, 166, Fleet-street.

To insure insertion in the following number, advertisements should reach the office not later than 5 o'clock on Thursday evening.

We must absolutely decline attending to communications unaccompanied by the name and address of the writer, not necessarily for insertion, but as a proof of good faith.—R. M. M.

RECEIVED.—W. S.—R. S.—W. W.—P. H.—W. S.—W. W.—J. H. S.—H. M.—J. H. P.—J. F. E.—O. G. and Co.—W. R.—S. O.—J. W. P.—T. A.—C. J. R.—W. de R.—P. M. P.

ENQUIRER (Cape of Good Hope).—We cannot open our columns to a discussion upon the motions of the moon; the subject was exhausted some four years since.

Miscellaneous.

An occasional correspondent who has just returned from America states that, while there, he examined in details nearly every monitor, and he pronounces them truly wonderful craft. The 16-inch gun also, he says, is a powerful weapon, superior to anything we have—though before examining it and firing it himself some dozen rounds, as he was permitted to do, he did not think so. He adds, it is lamentable to see the way we are wasting time and money on favourites of the Government and their abortions.

W. S. writes us to say that Mr. James Bruce's statement that oxygen would be liberated in the stomach by alternately swallowing sugar and aquafortis, is probably not correct (see *MECHANICS' MAGAZINE*, October 27). W. S. has submitted the statement to one of our leading chemists, and the reply is, "We do not believe that any reaction would take place under the circumstances, but if any did no oxygen would be evolved."

We understand that the improved petroleum boiler at Woolwich Dockyard was started last week, and performed admirably. It vapourised about 3,000lb. of water at the rate of 13½lb. to 1lb. of fuel, in about three hours. The lowest class of English coal oil was used. The flame is not so intense as that of coal, but there is very much more of it. The whole of the tubes, almost their entire length, were repeatedly filled with bright yellow flame.

A new steam fire engine named the "Olint," has just been constructed for the Liverpool Fire Brigade, by Messrs. Merryweather and Son. The engine is on the same principle as the "Sutherland." It has double cylinders, each being 6½in. in diameter, and 18in. stroke, placed horizontally on the frame. At the trial recently made in London steam was raised to 100lb. pressure in eight minutes from the time of lighting the fire, and projected a 1½-inch stream to a distance of 216ft. from the nozzle, and a 1½-inch jet 178ft. The quantity of water pumped per minute accurately measured was 434 gallons. At a subsequent trial in Liverpool steam was raised to 70lb. pressure in nine minutes from the time of lighting the fire, and an inch and a half stream of water was projected from the nozzle to a height of 130ft.

One of the last ships built by Mr. Lungleigh on his own account has just been launched. The vessel was the iron-cased twin-screw gunboat "Vixen," which presents an interesting experiment of the combination-of-wood-and-iron principle. Her 4½in. armour-plates are sheathed with wood, so that she can be coppered, and thus not have her speed retarded by the foulness to which iron ships are liable, while she is quite their equal in strength. The "Vixen" is 160ft. in length, 32½ft. in breadth, 18½ft. in depth, and her builders' measurement is 740 tons.

Referring to recent observations in our columns on the waterproofing power of paraffin, "A Policeman" inquires the proportion in which it must be mixed with other substances, to render boots or shoes waterproof. Perhaps some of our readers will kindly supply the information; pending which we offer the following:—Melt together ½ pint of boiled linseed oil, 2oz. of suet, ¼oz. of bees wax, and ¼oz. of resin. We have found this most useful in rendering shooting boots impervious to wet.

The Tribunal of Commerce of Havre, in a case relative to some pig iron sent to that town from Glasgow, recently decided that it is the usage of Havre that the cost of delivery and of weighing goods shall be at the exclusive charge of the seller; also, that he must pay for warehousing up to the moment of delivery.

It is stated that the sandbank in front of Heligoland rock has been lately inhabited by rabbits, whose burrowings threaten to undermine the ground and make it a prey of the waves. The sandbank is not only the bathing-place of the numerous visitors who resort to Heligoland in summer, but also a most valuable protection of the shady rock against the sea.

Captain F. J. Bolton, the inventor of the new code of day and night signals, recently described and illustrated in our columns, has just completed a lengthened series of experiments and trials with the invention in various parts of England and Ireland, extending over a period of some months; some of the results of which we hope shortly to place before our readers.

The shipbuilding trade of the Clyde continues to be moderately employed. There is still, however, a considerable falling off in the number of vessels launched as compared with the same period during the past two years. The total number of vessels launched during the month and ten months ending 31st October for the past three years was as follows:—1863. October, 20 vessels, 17,000 tons; ten months, 127 vessels, 102,100 tons. 1864. October, 17 vessels, 13,410 tons; ten months, 133 vessels, 146,400 tons. 1865. October, 16 vessels, 11,400 tons; ten months, 149 vessels, 110,600 tons.

The steel-plated steam corvette "Belliqueuse," armed with a spur, launched a short time since at the dockyard of the Mourillon, at Toulon, is now being plated, and the work is carried on with the utmost expedition.

Thirty-five British-built iron steamers, most of them monster ones, will be added to the fleets of the mail steam packet companies this year, viz., five to Cunard's and five to Inman's, three to the Pacific Mail, four each to the Royal Mail, Peninsular and Oriental, and National Steam Company, and five to the Union Mail, three to the German Lloyd's, and two to the Hamburg and American Companies. Thirty of these steamers are screws, and five paddle-wheels. Twenty-four are already afloat, and eleven are building. Twenty-one have been built, or are building, in the Clyde, six in London, four at Southampton, and one at Liverpool.

The locomotive requirements of the East Indian Railway Company appear to be rather considerable just now, contracts having been let for thirty to the Avonside Engine Company; twenty to Cross and Co., St. Helen's; twenty to James Morrison and Co., Newcastle-on-Tyne, besides several to Messrs. Kessler, of Karlsruhe.

The King of Denmark has granted a concession to James Wyld, Capmann, and Co., for laying a telegraph line between England, Norway, and North America by way of Greenland. The concessionaires are bound to have the line between England and Norway completed in one year, and that to America within three years.

Petroleum is becoming king in Western Canada. The oil fever seems to be rapidly spreading. It is almost impossible to keep trace of all the new places where wells are commencing, or of which it is asserted they have "struck oil."

The superiority of iron over wooden sleepers is manifest on the Madras Railway; all the sleepers on the North-West line are iron, and consequently the cost of maintenance is found to be less than on the South-West line, where the sleepers are of wood. The Company propose to renew half the South-West line with iron sleepers; the other half passes through a district where teak and other timber fit for sleepers are obtainable, so that iron need not there be used.

The Malta and Alexandria telegraph cable has again broken down in the old place where it has so often proved defective—namely, between Bengasi and Alexandria. The mishap is to be the more lamented at the present moment, as the telegraph steamer "Hawk" is not available to repair the injury, being away in the Adriatic for the repair of the cable between Otranto and Corfu.

The formal opening of the Indian Tramway Company's line between Arcunum and Conjeveram took place on the 30th September. The cost of the line has been something less than five and a half lacs of rupees, or, in round numbers, 30,000 rupees a mile, and its construction is said to be excellent in every respect. Branch lines of this kind are calculated to be of great advantage to the country through which they pass, as well as to benefit the main lines of railway by serving as feeders to them.

Oil has been extracted from the jet rock or shale which overlies the ironstone beds in the Cleveland district. This is a most important discovery for Cleveland, owing to the fact that the shale is in great abundance, and, in many cases, crops out to the surface. On the coast north of Whitby the jet rock or shale is very rich in oil, and can be worked at a mere nominal cost.

A plan is likely to be brought before the public in a few days, and before Parliament next session, for building a bridge across the river Mersey, at a point two or three miles above the town of Liverpool. This bridge it is proposed to construct with a railway, a carriage road, and footways for passengers. It is stated that it will be of sufficient height to enable large vessels to sail under it, and that it will be placed so far above the docks, harbour, and the Sloyne as to offer no obstacle to the trade and commerce of the port. The author of the plan is Mr. Brunlees, C.E.

The second of the series of lectures to working men on the chemistry of coal took place on Monday last at the Museum of Practical Geology, Jermyn-street; the subject being the "Elementary Constituents of Coal." The lecturer, Dr. Frankland, after a brief introduction on the component parts of water, illustrated by experiments how the two elements, hydrogen and oxygen, could be divided by a current of electricity, and reconverted into water. He also explained how light and heat are generated by potassium, nitric oxide, and phosphorus. The lecture was well attended by working men, who evinced their satisfaction in a marked manner.

The Inspector General of the Spanish Mines reports that the inhabitants of Rio Tinto, a place in Andalusia celebrated for its copper mines, have hitherto been perfectly free from cholera, although surrounded by the pestilence. This is attributed in the country to the sulphurous acid gas which is evolved from the copper ore exposed to the operation of roasting, and this opinion is so prevalent that the people of El Madrono, situated two leagues distant from Rio Tinto, some time ago sent for a cart-load of ore, in order to roast it on the public square, in the hope of putting a stop to the epidemic.

Mr. T. Heelis, F.R.A.S., has just called the attention of the Literary and Philosophical Society to the proceedings of a scientific commission recently issued by his Highness the Viceroy of Egypt, who had succeeded in finding a tertiary coal basin in the valleys between Mount Olympus and the Bay of Oraniska, in the Gulf of Salonica, and also on the mainland of Asia Minor, near the Island of Samos; and mentioned some particulars of the coal there found, such as its specific gravity, in which it slightly exceeds the ordinary coal of the coal measures, and the results of experiments upon its combustion, which gives 30 per cent. of ash.

The most remarkable proof of the success attending the efforts of the Cotton Supply Association to promote the growth of cotton is to be found in the fact that, from the accidental reception of a handful of Sea Island cotton seed in the year 1863, between thirty and forty acres in the neighbourhood of Naples are now planted with it, from which a crop of about 40,000lb. of seed-cotton, equivalent to a yield of 10,000lb. clean cotton is expected this year. The handful of seed planted in 1863 produced about 80lb. of uncleaned; and with the seed of this quantity two acres and a half were sown in 1864, which yielded a bale of 750lb. of clean cotton.

Patents for Inventions.

ABRIDGED SPECIFICATIONS OF PATENTS.

The Abridged Specifications of Patents given below are classified, according to the subjects to which the respective inventions refer, in the following Table. By the system of classification adopted, the numerical and chronological order of the specifications is preserved, and combined with all the advantages of a division into classes. It should be understood that these abridgements are prepared exclusively for this Magazine from official copies supplied by the Government, and are therefore the property of the Proprietors of this Magazine. Other papers are hereby warned not to produce them without an acknowledgment.

AGRICULTURE AND FURNACE.—1152, 1180, 1186, 1187, 1189, 1204.

BUILDINGS AND BUILDING MATERIALS.—1143, 1164, 1170, 1179, 1204.

CHEMISTRY AND PHOTOGRAPHY.—1161, 1171, 1174, 1184.

CULTIVATION OF THE SOIL. including agricultural implements and machines.—None.

ELECTRICAL APPARATUS.—1223.

FIBROUS FABRICS, including machinery for treating fibres, pulp, paper, &c.—1144, 1155, 1156, 1159, 1160, 1169, 1193, 1200, 1202, 1219.

FOOD AND BEVERAGES, including apparatus for preparing food for men and animals.—None.

FURNITURE AND APPAREL, including household utensils, time-keepers, jewellery, musical instruments, &c.—1151, 1165, 1166, 1167, 1175, 1188, 1194, 1199, 1201, 1205, 1213, 1216, 1217.

GENERAL MACHINERY.—1172, 1176, 1179, 1189, 1190, 1191, 1192, 1203, 1210.

HEATING, HEATING, AND VENTILATING.—None.

METALS, including apparatus for their manufacture.—1153, 1154, 1183, 1206, 1208, 1221.

MISCELLANEOUS.—1145, 1147, 1148, 1149, 1166, 1173, 1181, 1187, 1196, 1198, 1214, 1224.

ROADS AND VEHICLES, including railway plant and carriages, saddlery, and harness, &c.—1188, 1163, 1222.

SHIPS AND BOATS, including their fittings.—1167, 1182, 1215, 1216.

STEAM ENGINES, &c.—1150, 1195, 1212.

WARFARE.—1146, 1177, 1178, 1182, 1197, 1207, 1209, 1211.

1143 J. J. PARKES. *Improvements in apparatus for making communications from one part of a building to another.* Dated April 24, 1865.
In communicating or signalling from one part of a building to another, the patentee employs wire and cranks somewhat in the ordinary manner, and makes the audible and visible signals by bells or gongs and numbers represented on tablets, but instead of pulling the number up by the wire, as is ordinary, he detaches the tablet and allows it to drop, and so exposes the number as desired. He effects this detaching and dropping of the tablet by peculiar appliances, and he further effects communication between the gong or bell with the wires by a peculiar contrivance, hereafter described. The numbered tablets are arranged in rows or series (by preference in vertical rows in suitable slides and frames), in which the numbers are exposed through openings when the tablets are dropped. A pull apparatus is applied to each vertical row to raise the tablets after being dropped; this pull is arranged to lift one or the whole number of tablets at the same time, so that, supposing several of them happen to be dropped at the same time, they can be again readily set by the attendant after the signals have been attended to. *Patent completed.*

1144 W. CLARK. *Improvements in washing or steeping and bleaching textile or fibrous materials.* (A communication.) Dated April 24, 1865.

This invention relates to the steeping and bleaching of all kinds of textile matters by means of ammonia. The patentee states that he has found by experiments that ammoniacal water, if employed in a heated state at a pressure of from five to six atmospheres, has no effect on the tenacity of the textile materials, while, at the same time, from its energetic action, it surpasses all other fixed bases hitherto employed for washing or steeping the said matters. *Patent completed.*

1145 A. ATKINS. *A new or improved shoe or sandal for facilitating the art of swimming.* Dated April 24, 1865.
Shoe or shoe, light fabric, sole of gutta percha, &c., a paddle under sole of two rings acting on hinges made of metal. *Patent abandoned.*

1146 J. F. O. CARLE. *Improvements in breechloading needle guns for military and other purposes.* Dated April 24, 1865.

This invention is not described apart from the drawings. *Patent completed.*

1147 W. E. NEWTON. *Improvements in penholders or pens.* (A communication.) Dated April 24, 1865.

This invention has for its object to construct the instruments in such a way that they always maintain the same external appearance, and that the slot and ring whereby the pen is pushed out when it is required for use may be dispensed with. *Patent completed.*

1148 O. G. WARREN. *Philosophical examination into the alleged spirit manifestations, consisting of a lamp and a close room.* Dated April 24, 1865.

This invention relates to means for determining the truth or fallacy of alleged spiritual manifestations. The inventor constructs a closed room, and uses a peculiar light therein. He paints the walls, floor, and ceiling with care, and filters the light that is used. The room must be close, and have no open door or window. It should be airtight, though some air may be admitted for ventilation, but it is better to have a reservoir of air held under pressure in a tank in the room, to be allowed, on turning a faucet, to escape into the room for comfortable breathing. It will issue from the room through unavoidable apertures. The light used may be that from the combustion of hydrocarbon, but it should be made to pass through a liquid coloured blue, black, or violet. So little light should appear through it (however much gas may be burned) that the room will seem entirely dark at first, but the person about it will grow to perceive the light, and objects in the room will become visible. In such a room, with this light there will be a chance, if any chance exist, that spirits may become distinctly visible. The reason that spirits are not seen, it may be assumed, is that the light is too coarse; it passes through them, and does not reflect from the surface. In order to see them at all, it would, therefore, appear that the light must be exceedingly minute, and, therefore, it must be filtered. The kind of paint proper for painting the walls, floor, and ceiling of the closed room is that which in chemistry is known as being akin to carbon. Dolomite or magnesite, properly prepared, is good. Spirits of turpentine or alcohol may be employed for mixing the paint. *Patent abandoned.*

1149 N. SIBLY. *Improved apparatus for pouring and discharging liquids.* Dated April 25, 1865.
This invention consists, mainly, in so arranging the vessels employed that the air which must be contained therein in order to impel the outflow of the liquid shall enter at or near the extremity of the spout, so that the aperture of the spout being placed at the point or level to which the liquid is desired to rise, the influx of air will be stopped by the rise of the liquid to such point or level, and the further outfall thus prevented. *Patent abandoned.*

1150 T. WALKER. *Improvements in means or apparatus for measuring the flow or passage of liquids, which improvements are also applicable in obtaining motive power.* Dated April 25, 1865.

This invention relates to means or apparatus for measuring the flow or passage of liquids in which vanes or fans are applied in an angular or inclined direction upon the periphery of a disc, cylinder, or cone, or upon other suitable surface applied in a cylindrical or other suitably formed case, so that the action of the liquid on such vanes or fans (forming a rotator) in its flow or passage may cause the axis of them to revolve, and thereby give motion to suitable wheelwork and index apparatus by which the quantity of liquid passed may be indicated. *Patent completed.*

1151 G. DAVIES. *Improved apparatus for securing buttons to fabrics.* (A communication.) Dated April 25, 1865.

This invention consists in certain mechanism for securing buttons to fabrics by means of metal rivets, the stems of the latter being first passed through the fabric, and then through the buttons on to which they are riveted. *Patent completed.*

1152 R. A. BROOMAN. *Improvements in smoke consuming furnaces.* (A communication.) Dated April 25, 1865.

The object of this invention is to construct furnaces in which the smoke is burnt at the moment of, or immediately after, its formation. The invention mainly consists in the employment of supplementary fireplaces of special construction, in which the combustion is effected by air forced in by a fan or otherwise, and in the formation of lateral air chambers or arches, by which the air is introduced to facilitate combustion, and to inflame the gases at the upper part of the supplementary fireplaces. *Patent abandoned.*

1153 J. N. BROWN and T. D. CLARK. *Improvements in the manufacture of iron, and in preparing fuel to be used in the manufacture and melting of iron.* Dated April 25, 1865.

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

1154 J. N. BROWN and T. D. CLARK. *Improvements in paints or compositions for coating and preserving metallic and other substances from oxidation and decay.* Dated April 25, 1865.

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

1155 J. WILKINSON, jun. *Improved means or apparatus for printing felts, floorcloths, carpets, and woven fabrics.* Dated April 25, 1865.

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

1156 C. JACQUELIN, jun. *Improved means or apparatus for gaining or acquiring motive power.* Dated April 25, 1865.

We cannot here give space to the details of this invention. *Patent abandoned.*

1157 W. ELDEN. *Improvements in steering ships or vessels, and in the machinery or apparatus connected therewith.* Dated April 25, 1865.

This invention has for its object the means of steering ships by machinery actuated by means of a piston working in a cylinder, which piston is moved preferably by steam, although water, compressed air, or other suitable medium for producing pressure may also be used. *Patent completed.*

1158 J. T. BUCKHILL. *Improvements in the construction of railway rails and wheels.* Dated April 25, 1865.

In order to enable locomotive engines to draw trains up steep inclines, the patentee makes the heads of the rails wedge-shaped or inclined at the sides, and flat on the top or table. The tyre of each of the driving wheels of the locomotive engine he makes with a groove corresponding with the form of the head of the rail, so that the driving wheels rest on the sides of the rail, and do not bear on the top or table. The two sides of the groove in the wheel thus nip the head of the rail, and in this manner a greatly increased adhesion is obtained. *Patent completed.*

1159 J. C. WICKHAM and A. E. DUNN. *Improvements in the manufacture of waterproof fabrics and in apparatus to be employed therein.* Dated April 25, 1865.

In performing this invention the inventor takes vegetable gum of the class to which gutta-percha or india-rubber belong, and reduces the same in a masticator to small pieces, dissolve the same by bisulphuret of carbon, and add thereto from 1½ to 2 per cent. of chloride of sulphur. The clear solution is run into an airtight chamber, in the ends of which are horizontal slots; these slots are covered by guide boxes fitted with pairs of nipping rollers between which the fabric is passed. The fabric passes into the chamber, off a cloth beam, under and over guide rollers in the chamber, and out thereof at the other end, passing between nipping rollers which express the superfluous solution from the fabric. The fabric now passes to a heating chamber, where the solvent is volatilised. There are other details. *Patent abandoned.*

1160 W. OXLEY. *Improvements applicable to rollers of machinery for preparing and spinning fibrous substances, which improvements are also applicable to other rollers which are pressed towards each other.* Dated April 25, 1865.

This invention is not described apart from the drawings. *Patent completed.*

1161 W. CLARK. *Improvements in the manufacture of soluble and assimilable superphosphates of lime by the application of phosphoric acid and acid phosphates.* (A communication.) Dated April 25, 1865.

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

1162 W. HUSBAND. *Improvements in securing or fastening wooden planking to iron frames in ships or vessels and also to the outside of iron ships.* Dated April 25, 1865.

This invention consists in tapping on the interior side planking, parallel screw heads extending to a sufficient depth to ensure a firm hold to the frames by the insertion of screws formed parallel throughout their length. By previously tapping the planking, the parallel screws are readily inserted, and will give a much greater holding power. Taper screws may, however, be used, if desired, without tapping; but this plan is inferior in strength and holding power. Copper or metallic sheathing may thus be applied to a flush wooden surface, and, consequently, galvanic action will be prevented. The inventor likewise proposes to apply wooden planking to the hulls of iron vessels by tapping the planking as before, and boring or tapping the iron plating, and securing the wood to the iron from the inside by parallel screws, or by taper screws. In this case, also, no galvanic action can arise with the sheathing. He proposes to galvanise or tin the points or screws of copper or patent metal bolts so as to avoid contact and electrical action between the copper or composition and the inner frames in ships. *Patent abandoned.*

1163 R. ECOTLE. *Improvements in railway chairs and in the mode of securing rails thereto.* (A communication.) Dated April 25, 1865.

In performing this invention the inventor shapes one of the inner sides of the railway chair to fit one side of the rail, and there is a groove forming the segment of a circle on the other inner side of the chair. When the rail is placed on the chair to be fixed in it, he inserts a block between the rail and the part of the chair where the groove is, one edge of such block being formed to fit the shape of the rail, and the other edge of it having a groove, forming the segment of a circle. When this block is placed in the required position the two grooves form a concentric channel. In order to fix the rail in the chair, he inserts a bar or clamp of eccentric form in the concentric channel, so that, by turning it by means of a spanner or wrench, the rail is firmly held in the chair. A small wedge is then inserted through a hole in the upper part of the chair to pass through a notch or slot in the eccentric bar, and thus preserve it in its required position. *Patent abandoned.*

1164 T. D. WHITEHEAD. *Improvements in fire escapes and portable ladders.* Dated April 25, 1865.

We cannot here give space to the details of this invention. *Patent abandoned.*

1165 C. W. HEAVEN. *A new or improved fastening for fastening articles of dress, which said fastening is also applicable to the joining of belts and bands and to other like purposes.* Dated April 25, 1865.

The patentee claims a fastening having elastic sides, the free ends of the said elastic sides being hook shaped, and either plain or pointed, the engagement of the fastening with the article to be connected to it being effected by the expansion of the said elastic sides, and the disengagement of the compression of the said sides, as described. *Patent completed.*

1166 J. and W. FAIRWEATHER. *Improvements in sewing machines.* Dated April 25, 1865.

The object of this invention is to obtain a motion for the bottom needles that will prevent incorrect stitching; also to be capable of using one or two needles at the top or bottom. For these purposes the inventors work the top needles by a lever and eccentric, the said eccentric being placed on the driving shaft, and they fix on the same shaft a seam to give a reciprocating motion to a worm shaft, which motion is transmitted to the bottom needles by a worm and worm-wheel. This invention further consists of

the needles being adjustable to different widths of work. *Patent abandoned.*

1167 G. MUMBY. *Improvements in machinery for sewing and embroidering.* Dated April 26, 1865
We cannot here give space to the details of this invention. *Patent abandoned.*

1168 F. D. P. J. OJANSSON. *Improvements in apparatus for disintegrating vegetable and animal substances.* Dated April 26, 1865

For disintegrating as perfectly as may be, and in a very short space of time, the different materials capable of producing paper, and especially the green wood, a portion of the filaments of which are capable of producing fabrics and the remainder paper, according to one arrangement, the apparatus is composed of two vertical cylinders capable of bearing a high pressure, say ten atmospheres; they are made by preference of sheet iron, and fitted with safety-valves, and with apertures for the introduction and exit of the materials to be disintegrated. Two boiler tubes made of sheet steel, are held in a furnace, and are put in communication with the first cylinders by pipes which in consequence of the heat establish a circulation of liquid between the first cylinders and the boiler tubes, for the boilers are heated to the desired temperature in order to obtain a like temperature in the cylinders containing the materials to be disintegrated. *Patent completed.*

1169 R. A. BROOMAN. *A new or improved method conditioning or preparing fibres, threads, and fabrics, and apparatus to be employed therein.* (A communication.) Dated April 26, 1865

This invention consists in conditioning or preparing filamentous substances by impregnating them preparatory to, or during or after, the ordinary manipulations they undergo, with air moistened by being forced through or over a pure liquid, or a liquid containing any desired chemical agent or principle. The invention also consists of an apparatus in which the air is moistened and applied. This apparatus consists of a tank or chamber containing in the lower part a simple or compound liquid; the tank is closed at bottom, except for a pipe leading from an air-pump; plates extend across the tank with perforations at alternate ends, to cause the air to travel in a zigzag direction and through a large extent of the liquid. At some distance above the level of the liquid is an open work tray for supporting the filamentous substance to be moistened. The tank is closed at its sides and top, and is provided with doors to allow of the substances being placed upon and withdrawn from the tray; and pipes fitted with stopcocks are attached to allow of the escape of air as may be required, or to lead the moistened air to be applied in other vessels. *Patent abandoned.*

1170 J. CUNNINGHAM. *Improvements in the construction of fireproof buildings.* Dated April 26, 1865

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

1171 J. A. ROWLAND. *Improvements in photographic cameras.* Dated April 26, 1865

This invention relates to a novel mode of constructing cameras so that large pictures or panoramic pictures may be taken with lenses of moderate size. *Patent abandoned.*

1172 J. DODGE. *Improvements in file cutting machines.* Dated April 26, 1865

This invention consists, firstly, in the use of apparatus whereby the motion of the machine is arrested when a faulty cut has taken place. Another part of the invention consists in a method of arranging the standards or guides for the cutter. *Patent abandoned.*

1173 G. T. BOUFFIELD. *A new resinous gum.* (A communication.) Dated April 26, 1865

This invention consists in the use and adaptation of a new material for the production of a peculiar kind of gum or balsam. The material used is the common grass tree of the Australian colonies, and the article produced from it it is proposed to call "balsam ambroine." *Patent abandoned.*

1174 W. H. SMITH. *Improvements in photographing on wood, and in the preparation of wood, canvas, silk, glass, and other substances for the purpose of receiving and retaining impressions.* Dated April 26, 1865

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

1175 J. W. LOWTHER. *Certain improvements in apparatus for lubricating frictional surfaces and in the lubricant to be employed therewith.* Dated April 27, 1865

This invention relates to the lubricating of rotating or horizontally-sliding frictional surfaces, by means of an improved apparatus in combination with a certain description of lubricant, whereby a tremulant motion, which is given to the same by its frictional contact with the shaft, axle,

or surface to which the apparatus is applied, causes the lubricant to flow and gradually supply the parts requiring lubrication, that is, during the time such parts are in motion. *Patent completed.*

1176 J. TANGYE. *Improvements in hydraulic pulling jacks.* Dated April 27, 1865

This invention consists in arranging the parts of hydraulic pulling jacks in such a manner that great compactness and efficiency of action are secured. We cannot here quote the details. *Patent abandoned.*

1177 J. CARR. *Improvements in breechloading firearms and ordnance, and in projectiles.* Dated April 27, 1865

We cannot here give space to the details of this invention. *Patent completed.*

1178 H. W. WOOD. *Improvements in machinery for reducing friable substances to powder.* Dated April 27, 1865

This machinery consists of a polygonal case or chamber provided with trunnions supported in bearings to admit of the case being made to rotate, and furnished on the inside with one or more, by preference two rollers, which are inserted and work in a line parallel or nearly so to the axis of the case. A door for admitting the substance into and withdrawing it from the case is fitted at some part of the rim. The reduction of the substance to be operated upon, after being placed in the case with or without the addition of liquid, is effected by imparting rotary motion to the case, when the substance will be continually turned over and over, and will be subjected to the action of the rollers, and by continuing the operation for a period depending upon the nature of the substance, it will be reduced to fine powder. *Patent completed.*

1179 S. HANLEY. *Improvements in machinery for cutting or shaping masts, spars, and other beams and articles of wood.* Dated April 27, 1865

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

1180 A. FRANCIS. *An improved apparatus for condensing steam and feeding boilers with the products therefrom.* Dated April 27, 1865

This invention consists in utilising steam after having produced its effect in steam cylinders by causing it to pass through an apparatus consisting of one or more cylinders, each containing tubes filled with cold water and air, continually renewed by fresh air driven in by a pump or fan. The steam is more or less condensed by contact with the cool pipes, and by suction and force pumps is returned into the boiler. *Patent abandoned.*

1181 J. F. FULTHAM. *An improvement in mallets used in the game of croquet and other similar games.* Dated April 27, 1865

The object of this invention is to provide a soft face to the mallet in order to prevent injury to the ball on being struck by it; at the same time to increase the wear of the mallet and prevent the jar on the ball being struck to the hand and arm of the player. This invention consists in covering both faces of the mallet with a soft material or substance, by preference with stout leather blocked to the shape of the face of the mallet and extending round the sides; the edges of the leather are covered by or held in a metal collar and the whole secured by pins, screws, or nails; or the collar may be dispensed with. Instead of leather, vulcanised caoutchouc, gutta-percha, or other like suitable material may be used. When using cork the patentee fits it in a ring round the face of the mallet. The patentee also sometimes fits a block of vulcanised rubber in the same way, the ring being tapered to prevent the block flying out. *Patent completed.*

1182 R. A. BROOMAN. *An improved apparatus for charging and closing cartridge cases.* (A communication.) Dated April 27, 1865

This invention consists in constructing apparatus as follows:—Upon a bed plate the patentee mounts a vertical rod, on which a charger is pivoted. This charger consists of a tube flanged at bottom and fitted inside another tube, so that on pressure being applied to the charger or inner tube it is pushed down within the outer tube; when the pressure is removed a spring returns the charger to its normal position. The charger carries a cup at the top. The bed plate also supports a carriage free to slide to the right and left within a certain limit in a groove; a cylinder for containing the cartridge-case is hinged to one end of this carriage and is capable of assuming both a vertical and a horizontal position. A horizontal lever carrying a block at about its middle and formed with a handle at its outer end, is pivoted so that it may be turned to bring the block against the end of the cylinder when in a horizontal position; a corresponding handle is fixed to the front of the apparatus. A cartridge closer is fitted to the apparatus at the end opposite the lever; the face of the closer is formed to receive the end of the cartridge and a winch handle is fitted thereto by which it is caused to rotate when required. *Patent completed.*

1183 W. BALE. *Improvements in furnaces used for smelting and melting iron and other metals.* Dated April 27, 1865

This invention is especially applicable to those classes of furnaces which are worked continuously, and are only stopped when parts are burned or worn out, such as blast furnaces employed in smelting iron or other ores, and the invention consists in applying rollers at those parts of furnaces which are most liable to wear or to be burned out. These rollers are arranged to be capable of being turned so that the surfaces which have formed part of the interior of

a furnace for a time and become thereby burned and worn are turned away from the interior, whilst other parts of the rollers which are new or have been restored or re-made are at the same time turned inwards. *Patent abandoned.*

1184 A. GRAINGER and C. M. GIBLER. *Improvements in the production of portraits or likenesses on certain materials by means of photography.* Dated April 27, 1865

This invention relates to the production of photographic likenesses on porcelain or other ceramic ware, and consists in producing the photograph or likeness of a person or thing on to the ware itself, instead of taking representations on paper or other materials and then transferring it to the earthenware to be afterwards burnt and glazed, as heretofore. *Patent completed.*

1185 W. E. NEWTON. *Improvements in artificial arms and hands.* (A communication.) Dated April 27, 1865
This invention is not described apart from the drawings. *Patent completed.*

1186 D. SIMPSON. *Improvements in furnaces.* Dated April 27, 1865

This invention relates to improvements in furnaces used for puddling and boiling iron, and consists in placing a second chamber beyond the ordinary puddling chamber, thus producing a furnace having two puddling or boiling chambers instead of one, as heretofore. *Patent abandoned.*

1187 T. C. MARSH. *Improved contrivances to facilitate the arrangement of flowers and leaves.* Dated April 28, 1865

This invention consists in attaching a number of glass tubes to a base in such manner that they shall radiate outwards in different directions from the centre, and by their position, height, and different water level give a particular direction, as well as firm support, to the flowers and leaves inserted within them. *Patent completed.*

1188 E. MOORE. *Improvements in the manufacture of dress shirts and dresses made by means of the stocking frame.* Dated April 28, 1865

This invention relates to a previous patent dated April 30, 1862 (No. 1264), and consists in combining with or inserting in shirts and dresses made by the process of framework knitting, fronts, collars, and wristbands of linen or cotton, woven in the ordinary manner with welt and wof, the shirts and dresses being manufactured in the frame with selvege courses at the required parts, to which the fronts, collars, and wristbands can be connected or attached in the usual way by needle and thread, or by the sewing machine, or by any other suitable means. *Patent completed.*

1189 A. C. HENDERSON. *Certain improvements in water wheels.* (A communication.) Dated April 28, 1865

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

1190 E. M'NALLY. *Certain improvements in machinery or apparatus for rolling or shaping metallic articles of irregular form, such as "file blanks" and similar articles.* Dated April 28, 1865

This invention relates to mechanism designed for the purpose of rolling and shaping metallic articles of irregular, and especially tapering, form, such as spindles, skewers, file blanks, &c., and the object of the invention is effected by increasing or diminishing the pressure of revolving rollers acting upon the metal during the process of formation. *Patent completed.*

1191 J. BERNARD. *Improvements in apparatus for raising water and other fluids, and in raising and lowering such apparatus.* Dated April 28, 1865

This invention relates to the pumping apparatus ordinarily employed in mining, wherein a series of lifts is employed, and consists, firstly, of a novel and improved clack and door piece, the door being so connected to the piece that it is at the same time free to move on such connection. Secondly, the invention consists in so arranging and disposing the several corresponding parts of the door, and those immediately connected with it, as to come into exact and proper position in relation to the flange fastenings or other part to or by which the said door is secured, and which is effected by so placing the door upon the hinge, stud, or joint that the fastenings will take into corresponding slots or apertures, and find their exact position by the mere movement of the door. Thirdly, it relates to the mode and means of fastening or securing employed, and consists in the application and use of studs, bolts, and nuts partially and permanently fixed in the door, and parts to which it is connected and permanently fixed. Fourthly, it relates to the mode and means of making tight or packing the joint between the door and the flange. *Patent completed.*

1192 J. BERNARD. *Improvements in boring or excavating and blasting rocks and minerals and in the treatment of the tools employed therein.* Dated April 28, 1865

This invention relates, firstly, to the use and employment of a novel cartridge for containing the blasting charge employed in blasting rocks and minerals, and consists in so forming the cartridge that the explosive agent employed is protected from the possibility of being crushed or pressed vertically, and is at the same time rendered waterproof. Secondly, the invention relates to and consists in the means and method employed for shaping and treating tools intended for cutting and boring rocks and hard formations, which operations he performs by means of suitable dies shaped as may be required. This is effected by placing or securing such die or dies in a suitable seat or rest, and pressing or striking the tool to be operated upon until it assumes its proper or required form. *Patent completed.*

1193 E. FERRIE, J. MURRAY, and A. WILSON. *Improvements in dyeing yarns.* Dated April 29, 1865. This invention is not described apart from the drawings. *Patent completed.*

1194 W. H. TUCKER. *Improvements in locks and lock furniture.* Dated April 29, 1865. We cannot here give space to the details of this invention. *Patent abandoned.*

1195 A. WILLIE and J. M'F. GRAY. *Improvements in steam engines, relating to valve motions, governors, and drain pipes.* Dated April 29, 1865. We cannot here give space to the details of this invention. *Patent completed.*

1196 C. GAMMON. *Improvements in tablets, tickets, or instruments to be used when drawing lots and prizes, and for rack like purposes.* Dated April 29, 1865.

The inventor proposes to employ tablets, tickets, or instruments composed of two discs or tablets of metal, ivory, slate, cardboard, or other suitable material, either hinged or pin pointed together. On the adjacent surfaces of the discs or tablets of which such instruments are composed, the numbers of a lottery, the numbers of horses, or other desired signs or marks may be engraved, printed, stamped, or indicated in other suitable manner. *Patent abandoned.*

1197 L. W. BROADWELL. *Improvements in breechloading guns.* Dated April 29, 1865.

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

1198 T. WHITE. *Improvements in apparatus employed in the burning of animal charcoal.* Dated April 29, 1865.

These improvements consist in forming on the inside of cylinders, placed horizontally or nearly so, a series of scoops or buckets, which, on the cylinders being made to revolve either continuously in the same direction, or partly in one and partly in the reverse direction, pick up, disperse, and transfer the black from one end of the cylinder to the other. The cylinders are heated, and motion is communicated to them in the usual manner. The patentee prefers to employ more than one cylinder, the cylinders being placed over one another; and the outlet from one being made to open into the inlet of the cylinder next below it, and so on. The invention also consists in the employment of a cooling cylinder made of thin metal, into which the black is received after being sufficiently burnt, and in travelling through which it is cooled. *Patent completed.*

1199 G. A. HUDDART. *An improved manufacture of buttons.* Dated April 29, 1865.

This invention relates to the manufacture of that class of button which admits of being attached to a garment by the simple application of pressure. In order to simplify the manufacture of metal buttons and cloth, or covered buttons constructed on this principle, the inventor inserts a loose stud within the shell of the button, which shell is composed of two circular pieces or discs of metal connected together by the faces overlapping the edge of the back-piece. The stud he forms out of thick sheet metal by a stamping press, which, while stamping out a small circular piece, throws up the centre in the form of a hollow cone. The backplate of the shell is stamped with a hollow pierced boss, which forms a recess for the loose stud, and the hollow end of the shank of the button, which shank is intended to expand under the pressure employed to attach the button to a fabric or garment. To facilitate, or rather ensure, the expansion of the shank is the object of the loose stud, which takes the pressure of the inserted end of the shank, and causes its hollow end to spread under the pressure applied to the buttons, and thus attach itself firmly to the backpiece. *Patent abandoned.*

1200 G. P. DODGE. *Improvements in pickers for looms.* Dated April 29, 1865.

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

1201 W. OLARK. *Improvements in locks and other fastenings.* (A communication.) Dated April 29, 1865.

This invention consists, first, in improvements in locks and keys, whereby to indicate, either together or separately at a single glance or inspection, the position of the bolt, or whether singly or doubly locked, this being effected by the aid of appendages or movable indices with which the lock and key are provided, which are actuated either by the turning of the key in the lock, or by the bolts or other parts of the same. Secondly, in so constructing locks that, when an ordinary key without the addition of parts, as above described, is withdrawn from the lock, it is a proof that it is securely locked, it being otherwise impossible to remove the key. This object is attained by the application of parts to the lock, preventing the key from being withdrawn. *Patent completed.*

1202 P. A. LE C. DE FONTAINEMOREAU. *Certain improvements in apparatus for spinning silk and other fibrous substances.* (A communication.) Dated April 29, 1865.

This invention consists in the construction of an apparatus or spindle for spinning all kinds of thread, but is chiefly intended for doubling silk thread. The spindle revolves in a direction contrary to the bobbins which it carries, in order to produce the first spinning, and the threads are united at the upper extremity of the spindle for the doubling. The chief advantage of this invention is, that in one operation it spins and doubles the threads coming from the dapien and other cocoons. These threads drawn from the copper in several ends at the same time are wound on bobbins which are at once placed on the small spindle of the said thrower. The spindle or thrower constructed in larger dimensions can be employed for the manufacture of ropes and cables in silk, or of any other fibrous substance. *Patent completed.*

1203 W. LEATHAM. *Improvements in machinery or apparatus for working or cutting coal or minerals, and for compressing or exhausting air to be employed therein, or*

for other purposes, some parts of which apparatus are also applicable to upright shafts and other parts for regulating the flow or discharge of steam or other elastic fluids. Dated April 29, 1865.

We cannot here give space to the details of this invention. *Patent completed.*

1204 F. GREGORY. *Improvements in machinery or apparatus employed in breweries and distilleries.* Dated April 29, 1865.

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

1205 J. GETTMANN. *Improvements in spectacles, opera glasses, telescopes, and similar apparatus.* (A communication.) Dated April 29, 1865.

This invention consists in adapting to opera glasses and telescopes a small lens fixed at the centre of the eye-glasses, or when the opera glasses or telescopes are of very small size, and their glasses very near each other, in forming the eye-glass of two-thirds of a concave glass, and one-third of a magnifying glass, the sections being made from surface to surface. The object of both these arrangements is to suppress the prismatic glasses which serve for correcting the images. The improvement in spectacles consists in adapting at the place of the ordinary glasses small twin opera glasses, made as above, which like ordinary opera glasses may be regulated by a screw rack or other mechanism. *Patent abandoned.*

1206 D. Y. STEWART. *Improvements in making moulds for casting.* Dated May 1, 1865.

This invention is not described apart from the drawings. *Patent completed.*

1207 E. DELLA-NOCE. *Improvements in firearms.* Dated May 1, 1865.

We cannot here give space to the details of this invention. *Patent abandoned.*

1208 H. BEESMER. *Improvements in the manufacture of pig iron or foundry metal, and in making and treating castings of such metal.* Dated May 1, 1865.

The object of this invention is the production of a superior pig iron or foundry metal that may be purchased by the iron founder in a state suitable for his own use when remelted in an ordinary furnace, either alone or mixed with a further portion of pig or cast iron, so that he may at will produce from his ordinary furnace the required kind or quality of metal without the erection of the plant and machinery required to manufacture steel or malleable iron by the Bessemer process. In carrying this invention into practice the patentee prefers to employ molten, crude, or cast iron as it comes from the blast furnace, and to effect the improvement in its quality consequent on the admixture therewith of malleable iron or steel before such crude or cast iron is formed into pigs. *Patent completed.*

1209 G. JOHNSON. *Improvements in iron fortifications, such improvements being applicable to the construction and protection of ships and floating batteries.* Dated May 1, 1865.

The patentee claims, first, the construction of oblique-sided casemates, which casemates project from and are in conjunction with shelving breastworks. Second, the adaptation of the traverse port for the protection of guns in broadside batteries; also the principle of turning the traverse port round by the application of the recoil of the gun, by effect of which the port is instantly closed. Third, the process of joining together the armour plates and other portions of ships' batteries and forts by the means of opposite dovetail or other undercut grooves and molten metal. *Patent completed.*

1210 C. E. HARPST. *Certain improvements in pumps.* (A communication.) Dated May 1, 1865.

This invention is not described apart from the drawings. *Patent completed.*

1211 J. BLACKIE, JUN. *An improvement in igniting the fuses of shells.* (A communication.) Dated May 1, 1865.

This invention consists in fitting on the front of shells and round the fuse a corrugated or plain hood kept at a slight distance from the face of the shell for the purpose of directing the flame from the powder to the fuse to cause the ignition thereof. *Patent abandoned.*

1212 D. RANKIN. *Improvements in marine steam engines.* Dated May 1, 1865.

This improved arrangement of steam engines comprises one or more oscillating cylinders, each piston being fitted with two piston rods in a plane at right angles to the crank shaft. A crosshead is fixed on the two piston rods, and on the side next the cylinder this crosshead is formed to receive bearing brasses, and a cover for connecting it upon the crank pin. With this arrangement the cylinder can be placed so nearly to the crank shaft that the crank pin will have only the thickness of the bearing brass with its cover, and a slight clearance in addition between it and the cylinder cover, whilst the stuffing boxes for the piston rods can without inconvenience be made of the extra length, well known to be desirable with oscillating cylinders. *Patent abandoned.*

1213 J. C. DAVIS. *Improvements in knife cleaning machines.* Dated May 1, 1865.

According to this invention each strip of leather is supported by fixing to the disc immediately behind each of the leather strips a blade of horn, or it may be of whalebone; the horn or whalebone does not come up to the top of the leather strip, but sufficiently high to give it support. *Patent completed.*

1214 W. T. W. JONES. *An improved croquet stand.* Dated May 1, 1865.

We cannot here give space to the details of this invention. *Patent abandoned.*

1215 M. W. RUTHERFORD. *Improvements in propelling vessels.* Dated May 1, 1865.

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

1216 W. E. WILEY. *Improvements in everpointed pencils.* Dated May 1, 1865.

We cannot here give space to the details of this invention. *Patent completed.*

1217 W. WATTS and J. J. COOPER. *Improvements in mangles.* Dated May 1, 1865.

These improvements are applicable to the ordinary description of mangle, in which the articles to be mangled are placed on a flat bed, and rollers pressed downwards by a weighted box are moved to and fro over them. In constructing mangles according to this invention, the inventors form them in such a manner that, when out of use, the surface of the mangle may be used as a table. *Patent abandoned.*

1219 W. E. NEWTON. *An improved manufacture of waterproof fabrics.* (A communication.) Dated May 1, 1865.

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

1221 T. F. CASHIN and J. F. ALEXANDER. *Improvements in the means of puddling iron.* Dated May 1, 1865.

We cannot here give space to the details of this invention. *Patent abandoned.*

1222 J. F. ALEXANDER and T. F. CASHIN. *Improvements in fasteners for driving bands, straps, belts, harness, or other such like purposes.* Dated May 1, 1865.

In lieu of the present mode of connecting the ends of driving bands or straps for machinery by riveting or sewing them together, the inventors propose to connect them by a fastener. This fastener consists of a metallic plate to be attached or riveted to one end of the strap; the plate is formed with lugs or ears, into or between which is fixed a fluted eccentric roll, suitable for the purpose required. The roll turns freely in the lugs, and when it is so placed that the shortest radius of the eccentric is opposite the plate unattached end of the band, it can be passed beneath it, when the roll is turned with it, so that as the radii become longer it presses upon and secures the band the more tightly by the greater the strain that is upon it. *Patent abandoned.*

1223 J. H. JOHNSON. *Improvements in self-acting alarms for indicating excess of heat or cold, parts of which improvements are applicable to the transmission of messages.* (A communication.) Dated May 2, 1865.

This invention is not described apart from the drawings. *Patent completed.*

1224 R. FENNER. *Improvements in embossing presses to facilitate the operation of relief colouring on envelopes, note paper, and other similar articles of stationery.* Dated May 2, 1865.

This invention consists in replacing the horizontal die by a vertical one mounted on a shaft working in plunger blocks, and having the devices engraved or punched on the edge of it, instead of on the plane. *Patent completed.*

1225 T. H. CAMPELL. *Improving and strengthening shields of steel, iron, or other material, for ships, fortifications, and other constructions.* Dated May 2, 1865.

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

1226 T. RUSSELL. *Improvements in valves for liquids, steam and gases.* Dated May 2, 1865.

This invention consists of certain improvements in valves for liquids, steam, and gases, whereby the valve is raised from and lowered on to its seat by means of a hand-wheel or collar working on the body of the valve, the axis about which the said hand-wheel or collar rotates being coincident with the axis of the valve. *Patent abandoned.*

PROVISIONAL PROTECTIONS.

Dated July 20, 1865.

1896 A. V. NEWTON, Chancery-lane, mechanical draftsman. *Certain improvements in envelope machines.* (A communication.)

Dated August 30, 1865.

3237 J. O. Green, Green Lanes, Islington. The improvement of the permanent way of railways, and carriages for the same.

Dated October 13, 1865.

2841 G. Rousset, Rue St. Apolline, Paris, mechanician. A new method of obtaining and applying water as a motive power for propelling ships by means of paddlewheels inside and outside.

Dated October 18, 1865.

2834 T. H. P. Dennis, Oshelsford, horticultural builder. Improvements in greenhouses.

Dated October 21, 1865.

2719 I. Bagga, Chancery-lane, electrical engineer. Improvements in the manufacture of inflammable gases, and in their application to useful purposes.

2732 S. P. Matthews, Wolverhampton, furniture dealer. An improved method of hanging or suspending blinds from blind rollers, and improvements in the manufacture of such rollers.

Dated October 23, 1865.

2725 M. Julien, sen., Rue de Richelieu, Paris. An improved mode of transmitting motion to the styles or hands of the dials of counters used for indicating and registering the distances, public vehicles or private carriages travel.

Dated October 26, 1865.

2756 T. R. Orampton, Great George-street, Westminster, civil engineer. Improvements in the construction of roadways, floors, and other surfaces.

2760 J. Johnson, Stoke-upon-Trent, engineer. Certain improvements in "crossings" to be employed on railways or tramways.

2762 H. Wilde, Manchester, engineer. Improvements in the construction and working of electric telegraphs and in apparatus connected therewith, partly applicable to other purposes.

2765 W. Smith, Gutta Parcha Works, Wharf-road, electrical engineer. Improvements in testing and working submarine electric telegraph wires.

2766 L. Bennett, Worcester. An improved needle.

Dated October 27, 1865.

2768 S. Sequella, Camden Town. Improvements in the purification and preparation of animal and vegetable wax, tallow, spermaceti, paraffin, and other solid, waxy, or fatty substances.

Dated October 28, 1865.

2775 T. B. Jordan, Milton Cottage, South Lambeth, mechanical engineer. Generating steam in combined vertical cylinders.

2783 J. Buckingham, Westmoreland House, Walworth Common, engineer. Improvements in lathe chucks. (Partly a communication.)

2788 H. Larkin, Torriano Cottages, Leighton-road, N.W. Improvements in lamps for the combustion of magnesium, and in preparing magnesium for burning.

2787 J. and J. Hinks, Birmingham, manufacturers. Improvements in lamps for burning paraffin oil, and other volatile liquid hydrocarbons.

Dated October 30, 1865.

2788 J. Stanley, Nottingham-street, Sheffield, iron-founder. Improved knickerbockers or leggings.

2792 A. Braque id, Paris, carpet manufacturer. A new kind of doubled face carpets or tapestry with similar or different patterns on each face.

2794 R. Girdwood, Edinburgh. Improvements in envelopes and in the construction thereof.

2796 W. E. Newton, Chancery-lane, civil engineer. Improvements in the construction of mining picks. (A communication.)

Dated October 31, 1865.

2798 D. P. G. Matthews, Newport, Monmouthshire, engineer. Improvements in means or apparatus for preparing, spinning, twisting, doubling, or winding cotton, wool, flax, or other fibrous material.

2807 D. Barker, St. James's-street, Piccadilly. Improvements in the manufacture of bricks and artificial stone and marble.

2811 H. Hides, Mortimer-street, Cavendish-square, surgeon. An improved splint for surgical purposes.

2813 F. G. Bennett, M.R.C.S., Grand Parade, Brighton. Improvements in apparatus for facilitating the walking of invalids.

2814 G. A. Smith, High-street, Bloomsbury, billiard ball maker. Improvements in the manufacture of cushions for billiard tables.

Dated November 8, 1865.

2817 C. Mole, Pembroke-terrace, Regent's Park, boot maker. Improvements in the manufacture of boots and shoes.

2819 J. A. Rainé, Oalhorpe-street, Gray's Inn-road. Improvements in locks and such like fastenings.

2821 N. Beard and J. Maiden, Hollinwood, Lancashire. Certain improvements in mechanism or apparatus to be employed for lubricating the cylinders of steam engines or other similar frictional surfaces.

2823 J. Eastwood, Blackburn, Lancashire, machine maker. Improvements in machinery or apparatus employed for sizing yarns.

2824 T. Westley, machinist, and W. Bibby, currier, Preston. Improvements in ships' and pulley blocks for general purposes.

2825 C. Oochrane, Woodside Ironworks, near Dudley, Worcestershire. Improvements in apparatus for separating dust from the gases evolved from blast furnaces.

2826 W. D. Allen, Sheffield, steel manufacturer. Improvements in casting hoops of steel suitable for making tyres.

2827 J. B. O. Lassus, Crescent, Minorities, engineer. Improvements in the means of renewing the teeth of worn out files.

in machinery or apparatus for reeling silk, cotton, or other fibrous threads in the form of skeins.

2827 W. E. Dolson, Nottingham, lace dresser. Improvements in dressing lace or other fabrics.

2829 L. Pebevre, Rue du Four St. Germain, Paris. An improved apparatus for burning petroleum and other volatile oils.

2830 G. Bartlett, Plymouth. Improvements in artificial manure.

2831 C. F. Henwood, East India Avenue, City. Improvements in projectiles.

2832 E. Clark, Great George-street, Westminster, civil engineer. An improved method of sheathing iron vessels.

2833 J. Webster, Birmingham, engineer. Improvements in generating and applying certain gases, and in apparatus to be employed therein.

Dated November 3, 1865.

2834 R. O. Lilly, Birmingham, jeweller. An improved penholder.

2835 H. Bossemer, Queen-street-place, New Cannon-street. Improvements in the manufacture of iron and steel, and in apparatus employed in such manufactures.

2838 J. B. Elkington, Newhall-street, Birmingham. Improvements in the manufacture of copper from copper ores.

2839 R. Smith, jun., Unity Flour Mills, Belper, Derbyshire. Improvements in mounting and driving millstones.

2840 G. Wilson and W. K. Hydes, Sheffield. An improved arrangement of buffing and drawing apparatus for railway carriages.

2841 A. H. Brandon, engineer, Rue Gallon, Paris. Improvements in machinery for transmitting and receiving signals. (A communication.)

Dated November 4, 1865.

2845 H. Radcliffe, Adam-street, Adelphi. Improvements in apparatus for effecting communications between the passengers, guard, and engine-driver in railway trains, and for giving notice to engine-drivers in cases of accidents. (A communication.)

2849 P. B. O'Neill, St. Mary's Villa, Fulham. An improved self-acting boiler feeder or apparatus for supplying steam boilers with water.

2850 J. King, Endell-street, bag frame maker, and A. Watson, Ely-place, City, commercial traveller. Improvements in the frames and fastenings of carpet and other bags.

2852 W. Gardner, Queen-street, Cheapside, safe manufacturer. Improvements in locks.

2853 J. Thys, Grove-road, Mile End. An improved non-conducting composition for preventing the radiation or transmission of heat or cold.

2855 F. Campbell, Duke-street, St. James's. Improvements in treating or curing the leaf, and in apparatus employed therein.

2856 J. Whitworth, Manchester, engineer. Improvements in preparing the ammunition or charges for rifled ordnance and rifled firearms.

Dated November 6, 1865.

2859 A. Paraf, Manchester, chemist. Improvements in printing and dyeing textile fabrics and yarns.

2860 R. O. Mansell, Ashford, engineer. Improvements in the construction of wheels for engines and vehicles used on railways.

2861 R. Flude, Leicester, loom builder. Improvements in means and apparatus for finishing the soles of boots and shoes.

2862 W. Heddon, Mortimer-road, De Beauvoir-square, Kingland. Improvements in machinery for measuring woolen and other cloths.

Dated November 7, 1865.

2863 M. J. Roberts, Pendarren, near Orickhowell, Brecknockshire. Improvements in means or apparatus for preparing, spinning, twisting, doubling, or winding cotton, wool, flax, or other fibrous material.

2867 D. Barker, St. James's-street, Piccadilly. Improvements in the manufacture of bricks and artificial stone and marble.

2871 H. Hides, Mortimer-street, Cavendish-square, surgeon. An improved splint for surgical purposes.

2873 F. G. Bennett, M.R.C.S., Grand Parade, Brighton. Improvements in apparatus for facilitating the walking of invalids.

2874 G. A. Smith, High-street, Bloomsbury, billiard ball maker. Improvements in the manufacture of cushions for billiard tables.

Dated November 8, 1865.

2877 C. Mole, Pembroke-terrace, Regent's Park, boot maker. Improvements in the manufacture of boots and shoes.

2879 J. A. Rainé, Oalhorpe-street, Gray's Inn-road. Improvements in locks and such like fastenings.

2881 N. Beard and J. Maiden, Hollinwood, Lancashire. Certain improvements in mechanism or apparatus to be employed for lubricating the cylinders of steam engines or other similar frictional surfaces.

2883 J. Eastwood, Blackburn, Lancashire, machine maker. Improvements in machinery or apparatus employed for sizing yarns.

2884 T. Westley, machinist, and W. Bibby, currier, Preston. Improvements in ships' and pulley blocks for general purposes.

2885 C. Oochrane, Woodside Ironworks, near Dudley, Worcestershire. Improvements in apparatus for separating dust from the gases evolved from blast furnaces.

2886 W. D. Allen, Sheffield, steel manufacturer. Improvements in casting hoops of steel suitable for making tyres.

2887 J. B. O. Lassus, Crescent, Minorities, engineer. Improvements in the means of renewing the teeth of worn out files.

PATENTS APPLIED FOR WITH COMPLETE SPECIFICATIONS.

Dated November 8, 1865.

2880 J. H. Johnson, Lincoln's Inn-fields. A mode or modes of inserting glass or other transparent plates in the fabric of umbrellas or in other pliant fabrics. (A communication.)

Dated November 11, 1865.

2901 D. Slater, Kettering, Northamptonshire, cabinet maker. Improvements in cabinet furniture.

Dated November 13, 1865.

2921 H. O. Davis, Boston, U.S. A new and useful improvement in nail machines or the feeding mechanism thereof. (A communication.)

Dated November 14, 1865.

2924 H. A. Bonneville, Porchester-terrace, Baywater. Improvements in apparatus for threading needles. (A communication.)

LIST OF SEALED PATENTS.

Sealed November 17, 1865.

1396 W. Eddington, jun.	1437 G. Brav
1398 J. Armstrong	1447 J. A. Heinrich
1404 J. Shand	1461 T. Binell
1409 R. Müller, A. T. Weld, and J. F. Powell	1468 H. Mosley
1414 A. Hett	1477 W. Smith
1412 T. Bonland	1480 J. Hibell
1420 J. Dale and A. Paraf	1527 O. Taylor
1425 J. Ransbottom	1570 H. B. Fox
	2180 J. Stevenson

Sealed November 21, 1865.

1427 D. Welsh	1488 L. Martin
1429 D. Law and J. Bennet	1501 F. and J. G. Richmond and H. Obandler
1430 R. A. Brooman	1516 J. Nuttall
1432 W. Madders	1604 J. Griffiths
1448 R. Canham	1647 J. H. Johnson
1449 G. Elliot and E. P. Clark	1719 W. E. Newton
1450 C. B. Spaeth	1786 J. H. Johnson
1452 O. Frazer	1890 C. H. Simpson
1453 S. Sequella	2378 H. Venable
1452 L. Diele	2406 J. Goulding
1453 G. G. Bussey	2517 W. E. Newton

NOTICES OF INTENTION TO PROCEED WITH PATENTS.

From the London Gazette, November 21, 1865.

1799 H. D. P. Cunningham. Training gun.	
1806 W. Goulding. Ornamental fences.	
1826 E. Hineson. Food for horses.	
1827 H. Fearnley and O. Smith. Washing clothes.	
1830 F. Massey. Ships' logs.	
1839 S. B. Howlett. Anemograph.	
1840 A. Denayrouza. Equipments for persons under water.	
1841 H. Blair. Gases.	
1847 W. Meddowcroft. Window blind rollers.	
1848 J. B. Chatterley. Ornet frames.	
1850 D. and J. Fulton. Mandrels.	
1853 S. Tripp. Securing envelopes.	
1855 A. E. Molin. Separating gold from ores.	
1863 S. Dammers. Mattresses.	
1864 R. A. Brooman. Pumps. (A communication.)	
1880 J. G. Rowe. Alarm apparatus.	
1887 T. H. Ince. Shoeing horses.	
1921 R. A. Brooman. Operations in the throat. (A communication.)	
1939 E. Spicer. Compositions similar to gunpowder. (A communication.)	
1969 J. Swinburne and J. Laming. Retarding railway carriages.	
1979 A. V. Newton. Currents of electricity. (A communication.)	
1980 A. V. Newton. Refining petroleum. (A communication.)	
2106 F. A. E. G. de Massas. Cotton seeds.	
2200 G. T. Bonafelt. Folding machines. (A communication.)	
2294 J. M. Hart. Iron safes.	
2405 W. Watkin. Furnaces.	
2532 W. A. Lake. Sewing machine. (A communication.)	
2677 A. H. Hassall. Meat for food.	
2756 T. R. Orampton. Roadways.	
2803 R. Cassels and T. Morton. Furnaces.	
2872 G. A. Jasper. Bleaching sugar.	
2884 T. Westley and W. Bibby. Pulley blocks.	
2921 H. O. Davis. Nail machines. (A communication.)	
2925 H. A. Bonneville. Threading needles.	

The full titles of the patents in the above list can be ascertained by referring back to their numbers in the list of provisional protections previously published.

Opposition can be entered to the granting of a patent to any of the parties in the above list who have given notice of their intention to proceed, within twenty-one days from the date of the *Gazette* in which the notice appears, by leaving at the Commissioners' office particulars in writing of the objection to the application.

PATENTS ON WHICH THE STAMP DUTY OF £10 HAS BEEN PAID.

3068 W. H. Andrew	3104 H. J. F. Marmet
3081 W. H. James	3105 J. Chalmers
3096 E. P. Houghton	3124 W. Bottomley

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

2681 M. A. Muir and J. M'William	2680 T. S. Creesey
2625 W. Marshall	2638 W. Oles
	2640 H. Jordan

LIST OF SPECIFICATIONS PUBLISHED

For the Week ending November 18, 1865.

No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.
77	10	82	8	86	10	90	4	94	0	98	4
78	0	83	10	87	6	91	6	95	1	99	0
79	0	84	9	88	4	92	0	96	1	100	10
80	4	85	10	89	10	93	8	97	0	101	8
81	0										

NOTE.—Specifications will be forwarded by post from the Great Seal Patent Office (publishing department) on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post Office Order, made payable at the Post Office, High Holborn, to Mr. Bennett Woodcroft, Great Seal Patent Office, 25, Southampton-building, Chancery-lane.

THE MECHANICS' MAGAZINE.

LONDON: FRIDAY, DECEMBER 1, 1865.

OUR NATIONAL DEFENCES.

IN another part of our columns we have given a detailed account of the trials at Shoeburyness of the granite casemates with iron embrasures, erected at a cost of £8,000, by the War Department. This structure was supposed to embody the latest development of the science of military engineering; and it was decided some three months ago that all our great national defences were to be constructed on this plan, and, as we are informed, extensive contracts were entered into for the supply of granite for the purpose of vigorously pushing the works at Spithead, and the great Montreal and Quebec fortifications—that is, before the trial of this casemate was made, or any knowledge of results attained, these contracts were entered into, and the Government pledged to what is now proved a useless expenditure of public money. What forethought! What wisdom! Now, looking at the results of this trial, we are bound to declare they present a most lamentable and pitiable failure. The casemate was rendered untenable after the first ten rounds, and, although but eighty rounds have been fired, the work is a ruin; the granite and brickwork inside the casemate lie in confused fallen masses, 300 tons or 400 tons in weight; one shield was broken and destroyed by four shots, but the other, Mr. Chalmers', has withstood ten or twelve blows successfully, four shots of which having been delivered from the 10-inch gun, of 280lb. and composed of steel. On the other hand, the steel shells penetrated completely through the massive granite piers, 14ft. thick, and so destroyed them that, had any upper tiers of casemates been built over this one—as are proposed to be built at Portsmouth—the whole would have fallen on the crushing of the lower piers.

Now, who, may we ask, is responsible for this disastrous failure? The War Department and Colonel Jervoise, R.E., were warned five or six years ago that such would be the result of any attempt to combine granite and iron, and they were supplied with drawings and plans of fortifications entirely of iron; but from that day to this no attempt has been made to test these plans, either in the form proposed or any other. It has always been granite! granite!! granite!!! forsooth, because the Royal Engineer Department of the War Office possesses full working drawings of all classes of fortifications built of granite, and have officers well accustomed to the work, with a schedule of prices defined, and laid down; so professional routine knows no other mode, and no man in high official circles was bold enough or had genius enough to endorse the adoption of iron for defences. What an opportunity lost to found a name that would have shone as European in the world of scientific engineers! but the man was wanting!! At the same time, let us mark the policy followed by continental engineers—Totleben, Braemont, Niel, all declare for iron and iron alone. Year after year they are adopting, and at great expense practically carrying out, this dominant principle. And we learn that there is at least one Royal Engineer officer, Captain English, who does admit the truth—*vide* his paper on Iron Defences read at Chatham last year. We ask again, How has this great blunder happened, and who is responsible? A yet more serious question. Parliament voted some year or two since many millions for fortification purposes. Is this large sum to be misspent in carrying out the crotchets of the men who now advise the War Department, or is it not time to seek by open competition and the offer of a liberal reward—say, £5,000 or £10,000—the best plans and designs that the genius of the country

can supply for iron fortifications? Such a course is taken in all public buildings, why not in this matter also? The present method has proved itself wasteful, cumbrous, and behind the times, and only serves to foreign nations as a mark of wonder and ridicule. We were the first to draw attention to the great Elswick job, and to point out the costly failure. The War Department in the House of Commons, by Mr. Baring, denounced our statements as untrue; yet they have since been shown to be correct to the letter. We now appeal to the nation on this second huge War Department blunder, and express our firm conviction that, unless the Secretary of State for War, the Chancellor of the Exchequer, or the Parliament intervene, the nation will have to regret thirteen millions spent in vain, the mortification of finding fortifications built useless against modern artillery, and to become the bye-word of all foreign nations.

ARMOUR PLATING.

THE vast national importance of the question concerning the method of construction of ships of war, with regard to the necessities of the innovation of armour plating, has attracted to the consideration of the subject perhaps as vast and varied an amount of ability as was ever before concentrated on the consideration of any matter. The most eminent naval architects, engineers, and mechanics of the world, the intellects of the press, kings, and rulers, all may be found concentrating their thoughts on, and endeavouring to solve, this great question. Yet this vast array of ability, this gigantic force of science, reason, and learning, has for ten years pondered, suggested, and experimented, without setting the question definitively at rest, or even indicating its probable result. The important effect of the innovation on maritime warfare, and perhaps even on the relative status of nations, has caused the public to take a most extended and serious interest in it, while the practical nature of its consideration, the numbers of experiments, and their varied results, have maintained a general and comprehensive interest, even among those possessing no scientific or special knowledge in the matter. The recent increase in the power of artillery seems not to place opposition by any means beyond the ambition of our naval architects, whose constructions still keep pace with the performances and promises of the artillerists. It seems to be beginning to be matter of doubt whether there is a distinct constructive limit either to the possible powers of offence or of defence, whether guns may not be made of almost any desired size, and ships armoured to any required degree of strength. The limits to size seem to be imposed by other considerations than those of construction. Existing theory seems hardly perspicuous enough to indicate even a possible result or eventual definitive status, which shall terminate the present transition state. During the ten years which have now elapsed since armour-clad ships were first used in modern warfare, the ships have changed from the very imperfect specimens of naval architecture, protected by 4in. plates, which were used during the war with Russia, to the full engine-powered and sea-going vessels, coated with no less than 9in. of solid iron, strongly backed, of which some are now under construction in our dockyards. The guns have in the same time changed from 32-pounders and 68-pounders to 150-pounders, 300-pounders, or 600-pounders. Increase of power is still continually added on both sides, and, although obstacles are constantly being advanced on either side, which appear to indicate a cessation of the possibility of progress, these are merely temporary checks, which, when cleared away, seem to show more than ever the possible distance of a state of stability. The theoretical investigation of the nature of the strains which occur in a structure under the action of dynamical force is difficult and uncertain, but there are a great many points in the effect of artillery on armour

which may be explained theoretically with advantage to future action, while theory may of course sometimes also predicate quite independently the methods of construction which should be either utilised or avoided. It enables failure and success to be attributed to their right cause, and the particular element of either to be picked out from the rest and used as the basis of a general rule for future guidance.

Dynamical force is measured either by its cause or by its effect. By its cause as PS , the amount of force which acts through a certain distance, and which is termed the "work done;" and by its effect as WV , where W represents the weight of the body, and V the velocity induced in it, and this is termed the *vis viva*.

A shot in motion with a certain velocity, to be impeded or stopped, must be opposed by a force P acting in the opposite direction to its motion through a certain distance S , P being here taken as the mean force in action, when such force is not constant; and PS representing the whole amount of force exerted in impeding the shot. In the case of a shot impinging on an armour-plate, this force may perhaps be regarded most simply as one exerted in compressing the disc of armour impinged on, and at the same time tending to separate that disc from, the surrounding armour. It is necessary to take this latter element into consideration, as by its support of the material towards the front of the plate, it relieves the disc very considerably from compressing force. If it were not so, the disc by its compression would nearly mark correctly the force in action on the armour, and would act in some ways as a dynamometer. Besides the compression and separation of the disc, another effect is produced on the plate, it being "buckled," or bent and deflected to a certain extent round the locus of impact. The distance through which the retarding force acts on the shot may be considered as the distance through which its centre of gravity moves subject to this pressure, and it is afforded by the compression of the shot, the compression and separation of the disc, and the general deflection of the plate. These various elements exist in various proportions with different natures of construction of armour and projectiles, so that $S = a + b + c + d$, when S represents the distance through which the retarding force acts on the shot, and the other side of the equation shows the elements of distance afforded as mentioned above. It has been stated that a certain amount of energy, or *vis viva*, is absorbed in the striking body, when this exhibits after impact any permanent change of form; and that this energy is abstracted from the destructive effect which it should produce on the target. The shot has in it a certain amount of *vis*, WV^2 , in the direction of its motion, and as the force producing injury to the shot is evidently exerted in a direction opposite to this, it would seem incorrect to assert that it is deducted from that stored up in the shot, as such an assertion might at all events induce an erroneous view of the matter. Any change of shape in the shot, however, if permanent, undoubtedly influences the force deduced in the armour to resist penetration, as it affords an increase of distance for the action of the retarding force on the centre of gravity, and this increase lessening the effect of the blow represents the loss of a certain amount of *vis viva*. Since $PS = \frac{WV^2}{2g}$ represents the amount of retarding force due to P acting through the distance S , it is apparent that as S increases P decreases, and *vice versa*. To diminish P , then, $S = a + b + c + d$ should be made as large as possible. This consideration indicates the advantage of employing hard shot so that a may be as small as possible; while the other elements require that the armour-plate itself should be made of ductile material, for they are of course dependent on the compressibility and extensibility of the material. The value of any nature of iron for

armour-plate will be indicated by the product of the extension of the material multiplied by the forces producing such extension, if a proper mean force and mean extension be taken. A consideration of the qualities of some of the kinds of cast steel now being so largely used seems to indicate that they possess properties of the sort referred to, which would well qualify them for the construction of armour plating. The dynamical force of cast steel has recently been attested by its successful employment in the construction of ordnance, and perhaps, ere long, it may be used most efficiently for armour construction.

There are two methods of attack by ordnance on armour generally recognised. Some theorists assert that shot, or if possible shells, should be contrived to penetrate by clean holes to the interior of the ship. Others wish to shake the whole structure, cause the plates to fall off, and to follow such an effect by the use of large shells; or to make large smashing holes through the target, carrying in great masses of iron with an avalanche of bolts and splinters, and opening apertures for the admission of water too large to be closed. Perhaps different methods of attack may be best suited to different natures of armour. Where the plates are very thick and consequently offer great resistance to penetration, the general racking of the target may be the best course open, while, if the plates be comparatively thin with respect to the penetrative power brought against them, their "punching" by shot or shell may be the most effectual plan. It is certainly a mistake to steer an uncertain course between the two methods, and, while failing to effect penetration by punching, to use projectiles of a nature better calculated for that method than for generally damaging the structure and detaching the plates. The way in which the damage is effected in these two methods of operation being distinct, the means best calculated to either will also be distinct. The resistance to penetration by "punching" will depend on the size of the hole made, which will be proportionate to the size of the shot. In such a case a disc is cut out of the plate, and driven through the side in front of the shot, and as this disc is attached to the body of the plate by the cohesive force round its circumference, the force required to detach it will vary with the amount of the circumference, that is, with the diameter of the shot. This of course indicates the advantage of employing for such a purpose shot of small diameter, and shows an advantage to be obtained by the use of elongated shot. The destructive effect will then depend on the *vis viva* of the shot and portion of the plate and backing driven through the side. If a shell be forced through, to these means of destruction will be added the explosive effects of the bursting charge. When the object is not to penetrate the armour but to shatter or "rack" it, and to cause the force of the blow to be spread destructively over a considerable amount of surface, partial penetration is objectionable, as it diminishes the general force of the blow by allowing a greater distance for the action of the retarding force, so that there will be advantage in using shot of large diameter. As, too, the effect of dynamical force is due both to its amount and to the time which it is in action; the greater the velocity with which a body traverses a certain resisting medium the less time is the force in action, and consequently the less total energy will it absorb where there is complete penetration. This indicates the advantage of employing shot moving with high velocities for the purpose of punching, and with low comparative velocities for "racking" and smashing.

To prevent penetration by punching, a plate is necessary, and as the resistance to penetration of a plate is proportionate to the square of its thickness, a solid plate is preferable. To avoid the buckling and smashing of the plate, and to cause distribution of the blow over as large a portion of the side of the ship as possible, and so to prevent the ribs being broken

and driven in, depth of structure is desirable, since the resistance to deflection of beams or stringers varies with the square of their depth, though only simply with their breadth. Depth of the beams and stringers is, therefore, advantageous in the backing to prevent smashing, &c. As the strength in resisting deflection of iron is, weight for weight, more than twice that of teak wood, it might be thought that there would be a gain of strength for weight in the use of iron stringers in place of wooden beams. They were tried with some success in the well-known Chalmers target, but it was found that, by preventing the indentation of the back of the plate when a shot struck over a stringer, they considerably increased the shattering force of the blow by lessening so materially the distance through which the retarding force on the shot could act. Perhaps if three or four inches of wood were interposed between the plate and the stringers this difficulty might be overcome.

PROTECTED GUNPOWDER.

ONLY a few months since a considerable amount of excitement was caused by the announcement of Mr. Gale's invention for rendering gunpowder non-explosive and restoring it to its normal condition at will. Kings and princes, lords and commons, learned bodies of every shade, and the public in general, were equally interested in the astonishing fact, and anxious for the utilisation of the invention. And no wonder either, when we remember how many thousands of our species are located in the vicinity of vast magazines of this explosive compound. Still less room for wonder when we call to mind the fact, that during the last twelve years upwards of fifteen serious explosions have been recorded in the public journals, by which more than six hundred persons have been killed and many thousand persons wounded, whilst property to the extent of more than two millions has been destroyed. Such an invention as that of Mr. Gale would indeed be a boon to the public when practically carried out, and much credit is due to the genius that discovered, and will be due to that which shall perfect, the protection so as to make it available under all ordinary circumstances where gunpowder is used. We make this reservation because the practical application of the invention appears to be by no means accomplished as yet. Mr. Hearder, in a recent lecture at Plymouth, demonstrated that a good shaking restored the protected powder to its explosive condition. Against this, we have Mr. Handel Cossham's testimony, that he trudged after Sir Morton Peto all through America with a box of Gale's protected powder, and on bringing it back to England he found it as completely protected as when he took it away. We, however, leave the settlement of the point to those more interested in this part of the question than we are at the present moment. Our part just now is to show that there is another and prior invention so closely resembling Mr. Gale's that it may be reasonably doubted whether that gentleman is really the first and true inventor of the system, however much he may believe himself so to be.

Lieutenant-Colonel J. S. G. Ryley has given some attention to the subject, and after various experiments extending over a considerable time, he succeeded in discovering a most efficacious, simple, and inexpensive method of rendering gunpowder non-explosive. The principle of the invention consists in filling up the interstices of the gunpowder, and thus thoroughly isolating the grains with a non-combustible medium, which is required to be of very fine powder, so as to be readily and quickly sifted out again when the gunpowder is required for use. This officer commenced his experiments in rendering gunpowder non-explosive before he left India in 1855, by mixing it with finely powdered wood charcoal, which, though combustible, rendered the gunpowder far less dangerous, as it filled up the interstices and caused it to burn when fire was

applied to it like a squib. Subsequent experiments, however, led Colonel Ryley to conclude that bone dust was a more suitable material, but the presence of gelatine was objectionable; so bone ash was ultimately resorted to and adopted with success. By this means the explosive power of the gunpowder was reduced to the lowest degree, and the powder when required for use could be restored to a serviceable condition without the least difficulty. This discovery was communicated at the time to several gentlemen of scientific eminence; and, with the view of giving the public the full advantage of the invention without the restriction of a patent, Colonel Ryley offered it to the Government through the Ordnance Select Committee in November, 1864, and through the War Office in the following month. In order that the efficacy of the proposed plan might be judged, some experiments were made by Dr. Stevenson Macadam, the results of which have just been communicated to the Royal Scottish Society of Arts by Colonel Ryley. With cannon powder and bone ash as the ingredients, a proportion of one to one was found to give an explosive mixture, no powder being left after firing. A proportion of one ounce of powder to two of ash gave a rapidly combustible mixture, tending to explosion, a few grains of powder being left. One to three was partially combustible, many grains of powder being left. One to four was partially combustible, but the powder only fired when in contact with a red hot iron, a large quantity of powder remaining intact. Cannon powder and glass tried agreeably to Mr. Gale's process, in proportions of one to four, gave a similar result to that arising from a mixture of one of powder to three of bone ash. The same results followed from experiments with large grained blasting powder and bone ash, and with large grained sporting rifle powder and bone ash, as were experienced with the cannon powder, the same proportions being observed. The result of experiments under Mr. Gale's process corresponded also, whatever kind of powder was used. The final test was the placing of a packet of gunpowder mixed with bone ash in a furnace, when it is stated that it did not explode.

Now all these experiments, excepting, of course, those made with Mr. Gale's mixture, were successfully performed by Colonel Ryley, and again by Dr. Eddy, of London, prior to the tender of the invention to Government, and the authorities were well certified of the capabilities of the mixture. However, the result was that on the 16th January, 1865, the Secretary of State for War directed General St. George, Director of Ordnance, to inform Colonel Ryley that his method had been duly considered, but that it was not found to possess sufficient advantage to warrant its adoption. The natural inference was, that the authorities of the War Office did not look with favour on this or any similar plan for protecting life or property against gunpowder explosions. This being the case, we are certainly surprised to find that eight months subsequently a similar process was considered sufficiently novel and efficacious to command the unqualified praise of the War Secretary, and the attention of Royalty. But this is not all. Mr. Gale's provisional protection bears date 14th July, 1863, just eight months after the communication of Colonel Ryley's plan to the War Office. Finding, then, that all the credit was given to Mr. Gale as the discoverer of the method originally proposed by Colonel Ryley, the latter again communicated with the War Office authorities, claiming priority. Instead, however, of acknowledging Colonel Ryley's right in this respect, the Secretary of State for War evaded the point by informing the Colonel that neither the plan proposed by him, nor that brought forward by Mr. Gale, for rendering gunpowder non-explosive, possessed any novelty, experiments having been made for testing the value of similar proposals in the year 1848. However this may be—no imputation on the veracity of the department—the matter was a

secret known only to the War Office, and we are at a loss to reconcile the statement with the encouragement and patronage extended to Mr. Gale. The year 1848 was certainly one of so revolutionary a character, both at home and abroad, that the injunction "keep your powder dry" may have suggested the idea of protecting it from fire as well as water, to some inventive genius. But there are no records of such a plan of effecting the object as that now under discussion, and we have recently been introduced to Mr. Gale through the public press as the inventor, originator, and discoverer of the process. Why did not the authorities undeceive Mr. Gale as to his position, which they certainly could have done with truth and propriety, considering they were in possession of the similar process of Colonel Ryley? If the official memory could bear taxing for events seventeen years prior to Colonel Ryley's application, surely it was not too much to expect that an event only eight months old should be communicated to Mr. Gale and that gentleman relieved from a false position. But we ought to have become accustomed to these Government eccentricities, they are of such constant occurrence. We, however, come to the conclusion that the protected gunpowder of 1848 is a myth and a fanciful creation of the overtaxed brain of the War Department. Such being the case, and seeing that Colonel Ryley has virtually substantiated the foregoing facts and figures, it follows that that gentleman's priority is established in regard to the novelty of rendering gunpowder non-explosive by mingling it with a medium which isolates the grains, and thus interrupts communication between the particles when brought in contact with fire.

BOULTON AND WATT.*

THERE are two names which beyond all questioning have become—and to the end of time will remain—identified with the development of steam power and its practical application. Those names are Matthew Boulton and James Watt. Others had preceded them in the path of discovery, and, partly by accident and partly by thoughtful research, the steam engine had become an accomplished fact. But the degree of perfection attained was comparatively a very low one, and was embodied in Smeaton's celebrated Chacewater engine. Here the principles of action apparently precluded the attainment of a higher degree of practical usefulness, and it remained for a brighter genius and a more original mind to grapple with and understand its defects. As left by Smeaton the steam engine was merely a pump impelled by the force of fire, its solitary function being that of raising water; and even for this purpose it could only be beneficially employed where coal was to be obtained at a nominal cost. It was at the best a rude implement, the work of transforming which into the modern steam engine was effected by James Watt, and there does not exist a parallel example of the achievement of so magnificent an improvement by a single individual. The steam engine came to Watt as but little more than a crude idea; he, however, grasped it, and by opening up a new path of discovery proved the steam engine to be a social power of rare value, and placed it in the high position it now occupies. But our purpose is not so much to pursue the solitary history of this illustrious man, or to follow the remarkable steps in the records of his marvellous creations by themselves, as to note his career in connection with the life and labours of Matthew Boulton, of Soho, as depicted by Mr. Smiles in the volume before us. And here we may state the reason for the appearance of Mr. Smiles's present work, in the face of Mr. Muirhead's excellent life of Watt. It was our

author's intention to follow the life of George Stephenson by one of James Watt, and he had collected materials for that purpose, but abandoned the intention on learning that Mr. Muirhead was engaged on a similar work. But having recently examined the extensive collection of Soho documents and original correspondence Mr. Smiles concluded—and rightly too—that the story of Watt would well bear to be told again in conjunction with that of his partner Boulton. Hence the present volume, in which new points of interest are brought out and new features necessarily appear, and in which, too, the life of Boulton is published for the first time. The bulk of the work treats of the two partners, although there are, besides, memoirs of inventors who have at various times laboured at the invention and application of the steam engine. Amongst the rest is an interesting account of William Murdock, which has been compiled from the Boulton papers, and which probably contains all that is likely to be collected respecting this ingenious man.

No work on the steam engine appears to be considered orthodox unless it commences by an account of the performances of Hero, De Caus, and other patriarchal inventors. On the same principle we suppose the history of Boulton and Watt would not be complete without a notice of all those who had preceded them in developing the power of steam. As it will be less edifying to our readers than interesting to the general public, for whom it is more especially intended, to pursue the subject from Hero down to Smeaton, we pass over the first four chapters, which are devoted to the history of the ancient worthies. The fifth chapter opens with a description of the birthplace of James Watt and traces his lineage. Our author has had unprecedented facilities for obtaining correct information regarding all the incidents of the life he so ably delineates, and it is not surprising to find circumstances with which we were previously unacquainted. We are to some extent led to look at the life of Watt in a new light under the able pen of Mr. Smiles, and shall, therefore, briefly notice our author's account of his early career, as compiled from sources of undeniable authenticity and accuracy. Watt's grandfather was a teacher of mathematics at Cartsdyke, near Greenock, in which calling he prospered. He died in 1734, leaving two sons, John and James; the former was trained by his father as a mathematician and surveyor, and he made the first survey of the river Clyde. The latter, who was the father of the engineer, served his time with a shipwright at Cartsdyke, and afterwards set up in business for himself at Greenock, where he attained a highly respectable position. His son James was the survivor of five children who died young, and was himself of an extremely fragile constitution. His mechanical genius showed itself at an early age in the construction of new toys out of portions of old ones with the aid of a few tools from his father's shop. There is a story of young Watt when only some six years old being reproved by his aunt for idleness in catching the steam from the kettle in a cup and watching its condensation. Mr. Arago views the child thus engaged as "the great engineer, preparing the discoveries which were soon to immortalise him." These are extreme views of the case, and of the two we incline to the opinion of our author, that the judgment of the aunt was the truest, and that in common with other children he was simply amused with the phenomena presented. School time soon came, and here Watt progressed chiefly in mathematics, his spare hours being devoted to making models in his father's workshop. When about eighteen years of age he was sent to Glasgow to learn the trade of mathematical instrument maker, which business he subsequently studied in London. Of his return to Glasgow, his instalment in the College as mathematical instrument maker, and his experiments with Savery's and Newcomen's engines, all are well acquainted. For several

years he continued his experiments on steam under many disadvantages, but at last he hit upon the separate condenser and soon embodied his ideas in a working engine. This, however, proved only a partial success, although it verified his expectations and placed the advantages of the invention beyond the reach of doubt. A second attempt on a larger scale was more successful, and resulted in an engine having a cylinder 6in. in diameter with a 2ft. stroke. On setting the apparatus to work, however, it leaked in all directions, owing to want of accuracy in the finish, the cylinder, the best that could be had, being only hammered. Nevertheless the engine readily worked with a pressure of 10½lb. per square inch, and the piston lifted a weight of 14lb. Want of time and means, however, prevented him perfecting his invention, and so, after neglecting the mathematical instrument business for the engine, we find him obliged to give up the latter and to turn surveyor. He was soon engaged on various surveys and other similar works; he designed Hamilton Bridge and supplied plans for a dock and pier at Port Glasgow and for a harbour at Ayr.

At length Watt became acquainted with Dr. Roebuck, who aided and encouraged him in prosecuting his experiments with the condensing engine, which was completely patented in 1768—the year in which Arkwright patented his spinning machine. Watt, in his specification, viewed the subject of the production of power by steam in all its bearings, and, although a large one, he thoroughly grasped it. That he foresaw all that steam was capable of accomplishing is illustrated by his early plan of working steam expansively by cutting it off at half stroke, as well as by his proposal to employ high-pressure steam where cold water could not be used for condensing. After a while Watt's cherished schemes were brought to a standstill by the failure of his friend Roebuck, who had speculated in some coal mines which proved his ruin. This and many other troubles pressed sorely upon poor Watt, and rendered that the darkest time of his life. But a ray of hope at last appeared, the turning point in his fortunes arrived, for Matthew Boulton, of Birmingham, was persuaded to take up the invention on which Watt had expended so many of the best years of his life. Boulton was thoroughly accomplished in chemistry and mechanics, and was a man of keen business habits. He was a large manufacturer of Birmingham ware, and being possessed of considerable taste, his work became noted for excellence in design, as well as honesty in execution, for his determination was, as far as he could, to get rid of the "Brummagem" reproach. He carried on a very extensive business at Soho, and managed, at brief intervals of leisure, to prosecute the study of several important branches of practical science. But the subject which most deeply engrossed his attention was the improvement of the steam engine which ultimately led to his introduction to Watt. The exigencies of his manufacture set Boulton thinking how to supersede the expensive item of horse power by a Savery or a Newcomen "fire-engine," and he pursued the subject so far as to have a model engine made, and this, too, at about the same time that Watt was occupied with his invention at Glasgow. Dr. Roebuck, who was a friend of Boulton's, informed him of Watt's invention, in which Boulton naturally took considerable interest. A visit to Birmingham made by Watt in 1768 led to his introduction to Boulton, who afterwards discontinued his steam experiments pending the results of Watt's researches. In the course of time Watt took up his quarters at Soho, and the engine upon which Watt and Roebuck had spent so much time and money was also brought hither. There it was refitted and set to work with much more satisfactory results than had previously attended it, which was a source of great satisfaction both to Boulton and Watt, who had now become partners.

* "Lives of Boulton and Watt, principally from the original Soho MSS.; comprising also a History of the Invention and Introduction of the Steam Engine." By SAMUEL SMILES. London: John Murray, Albemarle Street, 1865.

By this time, six years out of the fourteen for which the patent was originally granted had expired without anything more resulting than the erection of the experimental engine at Soho. As it was probable that the patent-right would expire before such a demand for engines would arise as should remunerate Boulton and Watt, it was decided to apply to Parliament for an extension of time. After considerable opposition from the mining interest, which hoped to secure an early reversion of the right to the free use of Watt's patent, an act was passed extending Watt's right for the further term of twenty-four years. After this, renewed experiments were made with the Soho engine. It was fitted with an 18-inch cast-iron cylinder, in place of its previous tin one, and several other improvements were introduced which led to very satisfactory results in the working of the machine. The partners were now in high spirits, and arrangements were at once set on foot for carrying out the manufacture of engines upon a large scale. Applications for terms, followed by orders, soon came in from the mining districts, and before long the works at Soho were alive with the manufacture of steam engines for all parts of the world. The first engine made by Boulton and Watt was ordered by John Wilkinson, the great iron-master, of Broseley, to blow the bellows at his works. This Wilkinson was the constructor of the first iron ship, to which fact we have recently drawn attention; he was a man of inventive term of mind and was the first to produce machinery for boring cylinders and cannon. Everything of course depended upon the success of the first engine, and the partners spared no pains to render it perfect. When all was ready at Soho the materials were packed off to Broseley, Watt going with them to superintend the erection. The engine was fixed and ready for use about the beginning of 1776, and when started the result of the extreme care taken in its construction and erection was manifested in its performance. It worked admirably, and established the fame of Boulton and Watt in the midland counties. This engine proved useful to the partners in another way, by facilitating the production of cylinders for their other orders, for Wilkinson's castings were at that time the largest attempted, and the boring machinery which he invented was the best of its kind.

But although success was attending the firm at every step of their proceedings, and orders were pouring in from all quarters, the engine was not without its detractors. The invention which had been perfected only through one long struggle was not yet destined to pursue its way in peace. The Society of Engineers, not the society now meeting in Exeter Hall, but its prototype, which held court in Holborn, and of which Smeaton was the great luminary—this society had settled it that neither the tools nor the workmen existed that could manufacture so complex a machine with sufficient precision. So it went forth from this learned body that all the skill and ingenuity of Soho had been unable to conquer the defects of the piston. The Bow engine, however, was erected soon afterwards, and if its working did not convince, it at any rate silenced, its detractors. All that even Smeaton himself, after witnessing its performances, could say against it was that it was too complex for practical use. In Cornwall, too, there were still mining engineers who stuck to the old Newcomen engine. Jonathan Hornblower naturally regarded the patentees with jealousy, for their success would be his ruin as a maker of atmospheric engines. And there were many others who disliked and resented what they regarded as the intrusion of Boulton and Watt. Even when the efficiency of the new engine was practically proved they were not reconciled to it, although compelled to admit the inefficiency of the old one. But in spite of detraction and opposition Watt's Chacewater engine was at length completed and put to work, doing its duty in fine style, to the satisfaction of its inventor

and the disappointment of his enemies. At starting, the engine made eleven eight-foot strokes per minute; and it worked with greater power, went more steadily, and "forked" more water than any of the ordinary engines, with only about one-third the consumption of coal, and thus silenced all cavil. At this juncture, however, the affairs of Boulton and Watt were somewhat embarrassed from the very heavy expenses incurred in the engine manufacture, which as yet had been wholly unremunerative. This greatly depressed Watt, whose peculiar temperament always led him to look on the dark side of the picture, and he was for reducing the staff and otherwise curtailing expenses. Boulton, on the other hand, although much harassed, saw through the gloom into the brilliant future of the engine, and actually increased the working staff and in other ways added to the expenses of the establishment. After a pecuniary struggle, through which Boulton's tact and management pulled them in safety, matters began to mend. Orders now came in from abroad, the result of Boulton's communications to foreign states, and the first engine was despatched to Nantes in May, 1779. It had been ordered by M. Perrier, of Paris, and was erected by M. Jary at a colliery near Nantes. An accident prevented the firm securing the French patent, and M. Perrier was soon at work manufacturing steam engines after the alleged invention of M. Betancourt, although this "invention" turned out to be a close copy of an engine M. Betancourt had himself imported from Soho. We must now, for the present, bring our notice of Mr. Smiles's graphic narrative to a close, not, however, without acknowledging that very much credit is due to that gentleman for the manner in which he has placed the histories of the two most illustrious men of their day before the public. To say that the volume is the production of Mr. Smiles is to say all that need be said, for in his previous productions Mr. Smiles has achieved a reputation to which no laudation we could bestow could add.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

THE WEIGHT OF SOME OF THE MINUTE PORTIONS INTO WHICH MATTER CAN BE ACTUALLY DIVIDED.

WE recorded last week the results of some recent speculations respecting the size and weight of the ultimate atoms of bodies; here are three instances illustrative of the marvellous minuteness of the particles into which we know that bodies can be actually divided. One-eighth of a grain of indigo dissolved in sulphuric acid is capable of giving to three hundred ounces of water a sufficiently deep blue colour to be distinctly visible in a single drop of the water. As in three hundred ounces of water there are about 125,000 drops, in one drop of the blue solution there would be just about one one-millionth of a grain of indigo, the visible blueness of the drop thus proving that indigo may be divided into portions weighing not more than one one-millionth of a grain each. It is not to be supposed, of course, that the portion of indigo in each drop of the solution is all in one piece, but if it were its bulk would not exceed one five-hundred billionth of a cubic inch. The case of the silver in sea-water is still more wonderful, except that the presence of silver in a solution so dilute as that of this metal in sea-water cannot be rendered appreciable to the eye, as is the presence of indigo in the solution just mentioned. It is well ascertained, however, that silver exists in the ocean in the proportion of one part of silver to one hundred million parts of sea-water, and as it is impossible to doubt that the elements contained in any aggregate of drops of sea-water exist in their due proportion in each individual drop, it follows that in each grain of sea-water there is one one-hundred millionth of a grain of silver.

Even this, however, is nothing to what we know of gold, for Muncke found, some few years ago, by calculation from, on the one hand, the size of the smallest piece of gilt silver wire the gold on which was distinguishable by means of a microscope magnifying a thousand times, and, on the other, the quantity of such wire that a given weight of gold is capable of covering, that a grain of that metal admits of being divided into *ninety-five thousand millions of visible parts*,—visible, that is, by the aid of a microscope of the power referred to. A sovereign is thus capable of division into ten millions of millions of visible particles, being ten thousand times as many such particles as there are men, women, and children in all the world; and who shall say how many "ultimate atoms,"—each, there would seem reason to believe, in a state of inconceivably rapid movement, and probably having, like the globe on which we live, two motions: one on its own axis, and the other round some point external to itself, and thus constituting a kind of miniature planet,—each of these astoundingly small portions is made up of? The human mind is staggered by the grandeur of the stellar creation; but the wonders of the systems of worlds are surely paralleled by the wonders of that system of atoms which each smallest appreciable speck of matter seems to constitute.

ELECTRICITY AS A MEANS OF TAKING CORRECT SOUNDINGS IN DEEP WATER.

In taking deep-sea soundings, the great difficulty is to determine the exact moment at which the lead touches the bottom. Several very ingenious contrivances for overcoming this difficulty have been devised of late years, but none of them have proved so successful as one which has just been suggested by M. Hédouin, of Lyons, seems to promise to be. M. Hédouin proposes that the sounding-line should be a kind of light telegraph-cable, enclosing two carefully insulated wires, both connected, at one end, with the lead, and at the other with the two poles respectively of a voltaic battery, and that the lead should be so constructed that on touching the bottom it should make metallic contact between the extremities of these two wires, and thereby cause the instant passage of an electric current. It is obvious that this current could be made either simply to give warning, by ringing a bell or otherwise, of the lead having touched the bottom, or to put in action an automatic brake, and so prevent any more line passing into the water.

DETECTION OF VERY SMALL QUANTITIES OF THE HALOGENS BY SPECTRUM-ANALYSIS.

The earliest experiments with that marvellous method of inquiry into the chemical constitution of bodies which is known as "spectrum-analysis," and the discovery of which is unquestionably the proudest triumph, so far, of the science of our century, showed it to be capable of detecting inconceivably minute quantities of the metals of the alkalies and the alkaline earths,—such, for example, as one 195,000,000th of a grain of sodium, one 70,000,000th of a grain of lithium, one 60,000,000th of a grain of potassium or barium, and one 100,000,000th of a grain of calcium. Equally small quantities of certain of the non-metallic elements, and especially of the four halogens, fluorine, chlorine, bromine, and iodine, have not hitherto been detectable by spectrum-analysis, although immensely smaller quantities of them have been detectable by this method than by any other at present known; but Mitscherlich has just succeeded in finding a process by which spectrum-analysis may be made to indicate the presence of almost as infinitesimal quantities of chlorine, bromine, and iodine as it will of sodium. He well dries the substance to be examined, and then mixes it intimately with half its weight of sulphate of ammonium and one-tenth of its weight of oxide of copper. This mixture he places in a globular enlargement of a combustion-tube,

one end of which is open, and the other connected with a gasometer containing hydrogen. A stream of this gas is then passed through the tube, heat being at the same time gradually applied to the mixture in the globular enlargement of it; the hydrogen issuing from the open end of the tube is then ignited, and the light from its flame examined by the spectroscope. Any chlorine, bromine, or iodine contained in the substance thus treated will enter into combination with the copper of the oxide of copper, forming therewith a volatile salt, the spectrum of which may be very readily recognised. If the substance contained both chlorine, bromine, and iodine, the spectrum of chloride of copper will appear first, then that of the bromide, and afterwards that of the iodide, this being the order in which the three compounds are respectively volatile. The recognition of exceedingly small quantities of chlorine, bromine, or iodine, when occurring in a mixture of haloid salts,—an achievement which has not been practicable at all hitherto,—may thus be effected very easily. Mitscherlich states that he has detected by this method the iodine in chloride of sodium in which iodine was contained in the proportion of only one part in ten millions.

RELATIVE ABUNDANCE OF IODINE AND BROMINE.

Iodine, at present, occurs in commerce much more abundantly than bromine, and hence does not command so high a price as the latter element, the present commercial value of bromine being, weight for weight, nearly double that of iodine. The greater portion of the bromine of commerce is obtained from the mineral springs of Theodorshall, near Kreuznach, in Prussia; that of the iodine of commerce, from the mother liquors of "varek," or kelp, being the liquors which are left after the complex solution obtained by lixiviating the ashes of seaweed has been freed as far as possible, by careful evaporation and cooling, from the chloride of potassium, chloride of sodium, carbonate of sodium, and sulphate of sodium, which are the salts most abundantly contained in them. These mother liquors also contain bromine, though in much smaller quantity than iodine, a ton of raw seaweed yielding about a quarter of a pound of iodine, but not more than half an ounce of bromine. Both the bromine and the iodine contained in seaweeds are of course derived from the ocean, and the curious thing is that whereas seaweeds contain about eight parts of iodine to one of bromine, sea-water seems to contain a much larger proportion of bromine than of iodine. The water of the Dead Sea has long been known to be exceedingly rich in bromine, without containing, so far as could be ascertained by the old methods of analysis, the least trace of iodine; and now Mitscherlich has not only failed to detect, by the delicate process of spectrum-analysis described above, the minutest portion of iodine in the water of the Dead Sea, which might well be conceived to be exceptional in this respect as in so many others, but he has also failed to detect iodine in European sea-water containing a very appreciable quantity of bromine. For example, he found that the residue from the evaporation of six and a half pounds of sea-water taken off Heligoland, treated by his process, showed the bromide of copper spectrum for seven minutes, but did not give the least sign of the iodide spectrum. There would thus seem reason to believe that bromine is more abundant in nature than iodine; if so, we may be sure that it will one day be more abundant in commerce too.

SOME ALLEGED NEW COMPOUNDS OF PHOSPHORUS.

Until comparatively recently, it was customary to refer to phosphorus as affording a typical example of that curious metamorphosis of elementary matter which is known

as "allotropy," and which causes certain elementary bodies, without either gain or loss of weight, and solely by means of some intimate transformation, the nature of which is entirely unknown, but which both heat and chemical action are known to be capable of effecting, to become so altered in their properties as to almost render them as it were new substances. In its normal condition, phosphorus is a soft wax-like body, has a pale yellow colour, melts at or below 111 deg. Fah., takes fire when heated in air to a temperature a very little beyond its melting point, is luminous in the dark, evolves an acid vapour when in contact with air, and is a virulent poison. Let ordinary phosphorus, however, be exposed, under certain conditions, to a temperature of 460 deg., and all its properties, except that of forming the same chemical compounds as ordinary phosphorus, become completely changed. It is now hard and brittle, instead of wax-like; and red, instead of yellow. It will not now take fire under a temperature of 500 deg., it is no longer luminous in the dark and no longer gives off acid vapours on mere exposure to air at ordinary temperatures, and it has ceased both to be soluble in bi-sulphide of carbon and to be prejudicial to animal life. In many other respects the altered phosphorus similarly differs from ordinary phosphorus, but until now no instance has been known in which, when the altered phosphorus has been made to enter into combination with other bodies, it has produced compounds in the least differing from those of ordinary phosphorus with the same bodies,—not the slightest perceptible difference existing, for example, between the phosphoric anhydride produced by the combustion of red phosphorus at a temperature of over 500 deg., and that produced by the combustion of ordinary phosphorus at a temperature not exceeding 120 deg.,—and hence when chemists came to find that iron, copper, cobalt, mercury, gold, platinum, and other metals, though unknown in more than one form in the free state, certainly existed in some of their compounds in a form differing from that in which they exist in others of their compounds, and more especially when there was discovered a compound of carbon in which that body, known in the free state in the three distinct forms of diamond, graphite, and amorphous carbon, evidently existed in its graphitic modification, phosphorus ceased to be regarded as capable of exhibiting all the known phenomena of allotropism. It is so capable, however, if it be true, as is asserted, that a Hungarian chemist has succeeded in producing oxygen-compounds of allotropic phosphorus altogether differing from those of ordinary phosphorus, both in their properties and in the proportions in which they contain their two constituents. We shall look for particulars respecting these remarkable alleged compounds with much interest.

NEW SOURCES OF RUBIDIUM AND CÆSIUM.

We recorded a fortnight ago the discovery of some new sources of the metal thallium, and we have now to announce that rubidium and cesium, two of the three other very rare metals the existence of which has been revealed to us by spectrum-analysis, have been found to occur in the lepidolite of Moravia and the mica of Zinnwald in larger proportion than in any of the few minerals, existing in any abundance,—for the one sole mineral into whose constitution either of these metals is known to enter at all largely is exceedingly rare,—which were previously known to contain them. The lepidolite of Moravia contains about 0.54 per cent., and the mica of Zinnwald about 0.72 per cent., of the oxides of rubidium and cesium, and also a considerable quantity of lithium, and some thallium. Schrötter has devised a simple process by which these four rare metals may be readily extracted from either of the minerals in question, and we believe that this process,—treated by which a ton of the mica of Zinnwald would yield 62lb. of carbonate of lithium and 13lb. of

the chlorides of rubidium and cesium, together with an appreciable quantity of thallium,—is about to be applied on a scale which will enable rubidium and cesium to be introduced into commerce.

EMISSION OF LIGHT.

At the last meeting of the Literary and Philosophical Society, a paper was read entitled "An Attempt to refer some Phenomena attending the Emission of Light to Mechanical Principles," by R. B. Clifton, M.A., Professor of Natural Philosophy in Owens College. The author attempted to show, by analogical arguments, that it is possible to give some account of certain phenomena attending the emission of light, by assuming principles closely resembling, if not identical with, those adopted by Professor Clausius in his well-known paper on "The Nature of the Motion which we call Heat." Matter is assumed in all cases to have its atoms grouped together into molecules, an assumption which seems necessary when the different allotropic states of certain substances are considered. These molecules are assumed to be in motion, and also the atoms to be vibrating in the molecules; for, whatever may be the laws of the forces which bind together the atoms in the molecules, it is impossible to imagine the molecules to be in motion, and to be subject to mutual actions, without causing motion of the component atoms. In solids and liquids the molecules are supposed to remain continually within the spheres of action of neighbouring molecules, so that the internal motion in a molecule is never due to the undisturbed action of the interatomic forces—the only difference between solids and liquids being that in the former the same molecules are constantly neighbours, while in the latter a molecule may completely change its place in the liquid, and also that in liquids a molecule may perform complete rotations round axes through its centre of gravity, while in solids this is not generally possible.

In a perfect gas a molecule is supposed to be under the action of other molecules, only for a portion of time indefinitely small with respect to the whole time of motion, and its centre of gravity describes a polygonal path, only changing its direction of motion upon the near approach of the molecule to another molecule, or to a containing vessel, which may be considered as equivalent to an impact. In an imperfect gas a molecule is supposed to be under the action of other molecules during a finite portion of the whole time of motion, this portion increasing as the gas approaches its state of saturation. Between the molecules of a body, and the atoms of a molecule, the luminiferous ether is supposed to exist. The vibrations in the ether, which constitute radiant heat and light, are considered due to the vibrations of the atoms in the molecule, and not to the motion of the molecule as a whole; the latter bearing some such relation to the ether as a bell or a stretched string does to the air, the internal vibrations only in the two cases causing the vibrations in the surrounding media, which give rise respectively to light and sound.

It appears obvious that as the motion of a molecule of a body as a whole increases, that is as the temperature rises, the internal motion in the molecule also increases, considering that the action of one molecule upon another must be due to the mutual action of atoms, or to the interatomic forces, it seems probable that the internal *vis viva* in a molecule, to which the light is due, is proportional to the *vis viva* of the molecule as a whole, to which heat is to be referred. Thus, as the temperature of a body rises, the internal *vis viva* in the molecules increases, and the *vis viva* communicated to the ether also increases; hence the intensity of the vibration in the ether increases, and at the same time the period of vibration diminishes, or waves of shorter length are continually produced with increasing intensity. Hence as the temperature of a body rises radiant heat is given off, the intensity corresponding to a given wave length constantly increasing; at last, then, vibrations in the ether, with wave lengths corresponding to the extreme red of the spectrum, will be caused with sufficient intensity to be visible, and thus the body will begin at first to glow with red light; as the temperature still rises, and vibrations of shorter and shorter wave lengths become of visible intensity, the light emitted will gradually change from red to white.

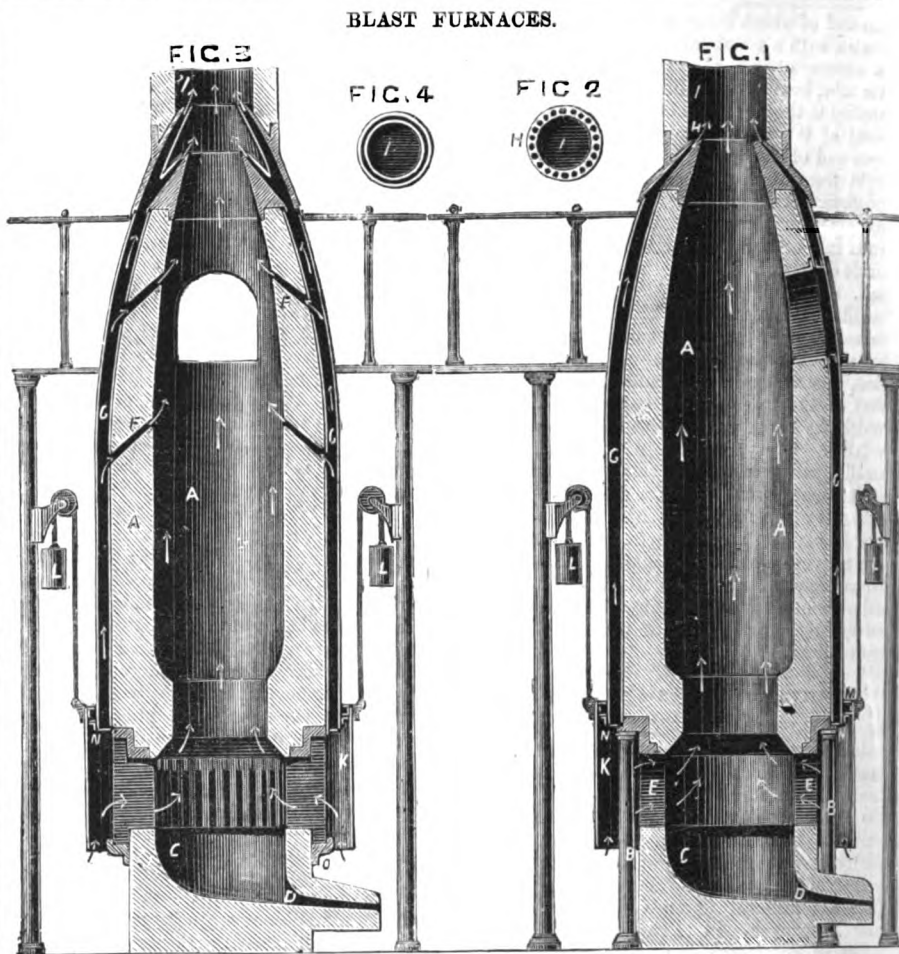
From Draper's Law, that all bodies become incandescent simultaneously, as well as from

other considerations, it seems probable that in all bodies the internal *vis viva* in the molecules bears the same ratio to the *vis viva* of the molecule as a whole. In solid and liquid bodies, the molecules being constantly under their mutual actions, and these actions being subject to constant change from the varying relative positions of the molecules, the atoms cannot assume any definite periods of vibration, but are constantly changing the time of vibration; hence the vibrations in the ether will be constantly, and with extreme rapidity, changing their periods. This change having apparently no limit, and the effect upon the eye continuing for a finite time, light of all wave lengths will appear to be given off simultaneously by such bodies when the temperature is sufficiently high; in other words, incandescent solids and liquids will appear to give off white light, which, when analysed by a prism, will yield a continuous spectrum. In the case of an incandescent gas or vapour sufficiently removed from a state of saturation to be considered perfect, the atoms will be left to vibrate under the action of the interatomic forces only, and will thus assume periods of vibration all included in a certain set; these vibrations will consequently cause vibrations in the ether corresponding only to certain definite wave lengths. Hence the spectra of such incandescent vapours will be broken, and consist only of a series of fine lines.

With imperfect gases, or vapours not far removed from their points of saturation, the intermediate phenomenon of spectra broken, but consisting of bands, is to be expected; when, however, the temperature of such vapours is sufficiently increased, a change from spectra consisting of bands to spectra consisting of fine lines is to be looked for. This change has been observed in many cases. When a solid body is incandescent, the light emitted so as nearly to graze the surface may be considered due mainly to the surface molecules, but these being free on the side of the surface, but affected by other molecules on all other sides, the internal vibrations in these surface molecules will have a bias in a direction perpendicular to the surface. Thus, the vibrations caused in the ether, which are propagated nearly grazing the surface, will preponderate in a direction perpendicular to the surface, or considering the vibrations in plane polarised light to be perpendicular to the plane of polarisation, the light emitted by such a body, so as to pass close to its surface, will be partially plane polarised, the plane of polarisation being parallel to the tangent plane to the surface of the body at the point of emission. In the case of an incandescent gas, the surface molecules are continually changed, and as a molecule may arrive at the surface in any position and is equally free on all sides, all trace of polarisation in this light will be destroyed. The fact that incandescent metallic plates do emit partially plane polarised light in directions nearly grazing the surface, the plane of polarisation being parallel to the surface, and that incandescent gases emit unpolarised light, has been observed by Arago.

As the molecules at or near the surface of solids or liquids can cause vibrations in the ether, giving rise to emitted light, it is to be expected that, in some cases at least, it will be possible for light, if of sufficient intensity, when incident upon a body, to cause vibrations in the atoms constituting the molecules near the surface, but considering the difference of mass of the atoms of the body and of those of the ether, that the atoms of the body will vibrate slower than those of the ether, the actual times of vibration depending, however, upon the molecular forces in the body. As these atomic vibrations will again affect the ether, such bodies will or may become luminous, the wave lengths of the emitted light being, however, longer than those of the incident light which causes the disturbance in the body.

This emitted light will necessarily last some time after the incident light is removed, for the vibrations in the body will not cease as soon as the cause of disturbance is removed, but in general it is to be expected that this emitted light will speedily disappear, though cases may occur in which it will continue for a considerable time. These probable deductions from the assumed principles coincide exactly with the phenomena of fluorescence and phosphorescence (not including in this term cases in which light is emitted by bodies undergoing slow combustion), all fluorescent bodies being phosphorescent for times of different, though in all cases at present observed, of very short duration.



BLAST FURNACES.

MR. RICHARD GANHAM, of Clerkenwell, foundry manager, has just patented some improvements in constructing cupola and other blast furnaces. His invention consists in supporting the furnace upon pillars and leaving an open space below the point at which melting takes place; he inserts in this space bars of firebrick, or other like suitable material, and surrounds the furnace with a jacket, open at bottom for the admission of air. The jacket is tapered off at top, contracted, and terminates in tubular apertures, or in a narrowed annular mouth inside the shaft, or chimney over the top of the furnace. Air, from the space first-mentioned, is free to enter into the furnace as well as into the jacket, or air may be admitted to the jacket through hollow columns; tuyeres are dispensed with, and on the furnace being charged and lighted, the air becomes heated and rarified in the jacket, and issuing from the narrowed mouth, causes air to be drawn into and up through the contents of the furnace. To regulate the admission of air into the jacket and furnace, or either, a cylindrical screen is employed outside the space first described, and counter weights are applied to enable the screen to be readily raised or lowered.

Fig. 1 of the accompanying engraving is a vertical section of a furnace constructed according to this invention. A A is the furnace, and B B are pillars on which it is supported; C is the basin or receptacle into which the molten metal falls, and from which it is run by the tap-hole D; E is an open space between the furnace A and the basin C—bars of firebrick, or other like suitable material, are inserted in this space. The manner in which it is preferred to place these bars in the space is to form a channel round the basin C, as represented at O, fig. 3, into which the bricks are dropped endwise. G G is a jacket surrounding the furnace, and open at the bottom for the admission of air; this jacket is tapered off and contracted at top, as shown, and terminates in tubular apertures H, as seen more clearly in fig. 2, which is a plan of the top of the jacket. Instead of a single series of apertures, the jacket may terminate in a double series, as represented in sectional elevation in fig. 3, or it may terminate in a narrowed annular mouth or mouths, as represented in plan in fig. 4. In some cases additional apertures are formed from the jacket into the furnace as represented at F. The mouth

or upper end of the jacket is inside the shaft or chimney I of the furnace. Air is free to enter the furnace between the bars in the space E as well as into the jacket G. K is a cylindrical screen, outside the space E, for regulating the admission of air into the jacket G, and for protecting the workmen from the fire. This screen is connected to counter-weights L L to enable it to be readily raised and lowered as required. It is prevented being lowered below the bottom of the jacket G by a ring M, on the screen coming against a corresponding ring N on the jacket. On the furnace being charged and lighted, the air becomes heated and rarified in the jacket G, and issuing from the narrowed mouth, causes air to be drawn into and up through the contents of the furnace.

MANUFACTURE OF AMERICAN LOCOMOTIVES.

THE great competition in locomotive building in America has made a resort to system, or fixed plan of procedure, a matter of necessity. There are no less than twenty noted establishments where quantities of engines are turned out, to say nothing of lesser ones, and repair shops, which do a great deal toward renovating and rebuilding engines. In the best of these large shops the same principle is pursued as in the manufacture of Colt's pistol, or a Springfield rifled musket; that is to say, every engine of its class is exactly like its predecessor, and a cylinder could be made and fitted to a locomotive anywhere with the certainty that it would be right as to its centre from the frame, right as to its position on the frame, and of the same dimensions in other respects to ensure its proper working. The Jersey City Locomotive Works is a representative shop, and we shall proceed to give some account of the manner in which the *Scientific American* states the principal details are there executed, such as the cylinders, the frames, the drivers and connections.

The frames are in two parts, for convenience of handling; that is to say, the section which carries the cylinders is bolted to the section on which the pedestals of the driving-wheel boxes are forged. The frames are laid on the planer and faced off, and two sets are thus going on at the same time; the crosshead of the planer being wide enough to carry two tool stocks. The frames are all planed to hardened steel

ganges, so that the distances and dimensions prescribed by the draftsman are arbitrarily preserved. The pedestal sections are laid one on top of the other on a slotting machine, where the jaws are slotted out together, so that the dimensions and lengths are correct beyond cavil. The two parts, the cylinder sections and that just named, are also bolted together at a fixed distance, so that when the frames are set up they are identical—the bolt holes for the cylinders, brackets, &c., having all been drilled on a press beforehand. On the frame there is a shoulder which the back end of the cylinder flange is fitted against; this shoulder is faced accurately on the planing machine a set distance from the centre of the pedestal, and when the cylinder is bolted in place a key is driven in behind it on the forward side, so that it is fast between two solid wrought-iron shoulders, on a solid forging, and can never be displaced or be out of truth.

The cylinders are not bored in pairs as in the English works, nothing being gained by that operation as locomotives are here made. They are bored singly, on a machine constructed purposely by Hewes and Phillips, of Newark, N.J. The machine consists of a cast-iron bed with a platen laid on top of it. On each end of the bed are two vertical columns which carry shafts, to which boring bars or heads are attached. The cylinder can thus be set on its own bottom, as it was planed, and moved anywhere by means of screws, to be bored accurately. The boring heads are also adjustable by moving a handle, so that in a very few minutes the cylinder can be put in the machine, secured and set; this also by any ordinary workman. The cylinders are faced on the flanges, and turned outside of the same before they are moved from the boring mill. The cylinders, when on the engine, are bolted to the saddle piece on which the fore end of the boiler rests; they have, therefore, a vertical flange which must be faced off true with the bore. To do this the planing machine is fitted with coned centres—the cones being the diameter of the bore—16in. or 18in., as the case may be. The cone centres having been once set, any number of cylinders can be put in and planed off without loss of time in adjusting them. Moreover, the vertical flange that rests against the saddle, and the valve face, are both planed at one operation, and the cuts are not mincing ones, but the tool takes a good solid chip at first, so that the work is well and speedily done. When the cylinders are bolted to the saddle they are correct, and there is no heavy handling to be done. Formerly, when the cylinders were bolted to the sides of a square smoke box, they were frequently out of centre; that is to say, the cylinder had to be made to suit the smoke box of the boiler, and as it was obviously impossible to rivet that on within a hair's-breadth, much delay ensued. The crank pins could not be turned until it was known where the cylinders were. They were sometimes a sixteenth of an inch in or out, and the shoulders of the pins had to be faced accordingly. All this delay is obviated by the simple means alluded to.

The lathe in which the driving wheels are turned is a remarkable machine, and is built by Messrs. Bement and Dougherty, of Philadelphia, with some additions by Mr. Davis, the superintendent of the Jersey City Locomotive Works. The wheels are of cast iron, and are mainly completed at one operation; that is to say, at one setting in the lathe, all except the crank pin holes, which are bored in a special machine. The outside or tread of the wheel, the hole for the axle and facing off the hub, are all going forward at the same time. Two wheels a day are turned out complete. Before the wheel is taken off the lathe, the key seat is cut in it by a special attachment. A seat one inch and an eighth wide, and half an inch deep and in length—the depth of the hub—is cut in ten minutes, on an average. In no instance do the cranks exceed one-sixteenth of an inch deviation from being at right angles. The axles are also cut as to their key seats, and when the two parts come together they stay there; there is no fitting and filing, no backing the wheel off, no key seats to be chipped and filed, as in some works. All this is an immense saving of time, while in point of workmanship the quality is unsurpassed.

In no department of the machine shop can skillful management be shown to better advantage than in the details—in the picking up of the loose ends, so to speak, and the small processes

which waste time and add in no respect to the value of the work. In days bygone it was a distinction, coveted by many workmen, to fit up the connecting rods, and all such details as had gibs and keys and brasses. There was much inspection of joints, much criticism as to the fit of gibs in the jaws, and a nicety of discrimination in regard to the flanges of the brasses where they embrace the strap, that was highly praiseworthy. The long, laborious filing of key ways is a thing of the past; filing and scraping of brasses is also done away with, and when the rods come from the machine the key ways are very nearly perfect, and require little alteration. The brasses fit like a kid glove to the hand, if the workmen follows his gauge, and the consequence is that where dollars were expended, cents are sufficient. Messrs. Bement and Dougherty are the makers of the machine for cutting out key ways in connecting rods, and a more useful tool of its class has not been produced in this century. It is an original conception, carried out in a workmanlike manner. A slotting machine is by no means reliable to make straight key ways. Sometimes the tool springs sideways, and cuts under the centre punch marks. In spite of squares and straight edges, the workman is in a measure working in the dark, for one side of his job is always hidden from him. Smoking lamps or stinking gas jets are of no avail to disclose the mysteries of that nether side, and, to his mortification, the skillful artisan sometimes find that the slotting machine is a delusion and a snare, that fails in time of need. Not so with the machine of Messrs. Bement and Dougherty. The rod, once planed, is put in centres like those of a lathe, and two cutters, in form like drills, but peculiar in shape, on the cutting ends, are set revolving at right angles with the centre on the place where the keyhole is to be cut. After these cutters are started, and the machine properly set, they go forward and backward, and work out the keyhole complete without any further attention, except that which all tools working on iron require—that is, to see that no accident occurs to the edges. The cutters are two in number, and work from each side; they start in solid metal, and no holes are to be drilled previously. They meet in the centre when the key way is finished, and they work down and then return, repeating this operation until the job is completed. We regard this machine as one of the most novel, ingenious and useful ever produced for the engineering profession. In various other details of American locomotive shops a great many changes and improvements have been made of late years. The work of erection—at one time a slow and costly part of the job—is much expedited and rendered cheaper, for no part waits on the other, and when the several details are to be put together they require but little adjustment. The number of engines turned out in the Jersey City Works is six in a month. This is accomplished with a force of 600 men. It is the calculation to make one engine per month with 100 men, and we are informed that the Company does this.

THE "ROYAL ALFRED."

THIS iron-cased wooden frigate, 4,056 tons, 800-horse power, first appeared on the Admiralty Navy List as one of the latest improved 90 gun screw line-of-battle ships, and was all but completed in that form when iron-clad ships became popular. She was then ordered to be razed to a frigate, divested of quarter and stern galleries, figure-head, &c., given a conical-shaped stern and a swan-breast stem, and clothed externally, from 5ft. below her load water-line upward, with 4½-inch rolled iron armour plates. In the meantime, however, 4½-inch iron-plating on the sides of a wooden ship possessing no inner iron skin had been demonstrated by experiments to be worse than useless. Accordingly the "Royal Alfred" has been again re-arranged, and in her new and latest form will, without doubt, be the most formidable iron-cased converted wooden ship afloat. She will at the same time possess serious points of weakness, which are unavoidable in a converted wooden vessel. Purely as a specimen of workmanship, or rather as a specimen of the skill of shipwrights in iron work, the "Royal Alfred" will surpass every other ship afloat. The edges of the armour-plating have been fitted with excessive nicety, and the plates subjected to a course of most elaborate and costly

chipping, filing, and burnishing which seems unnecessary. It is expected this vessel will be completed in her armour plating and floated out of dock early in the present month.

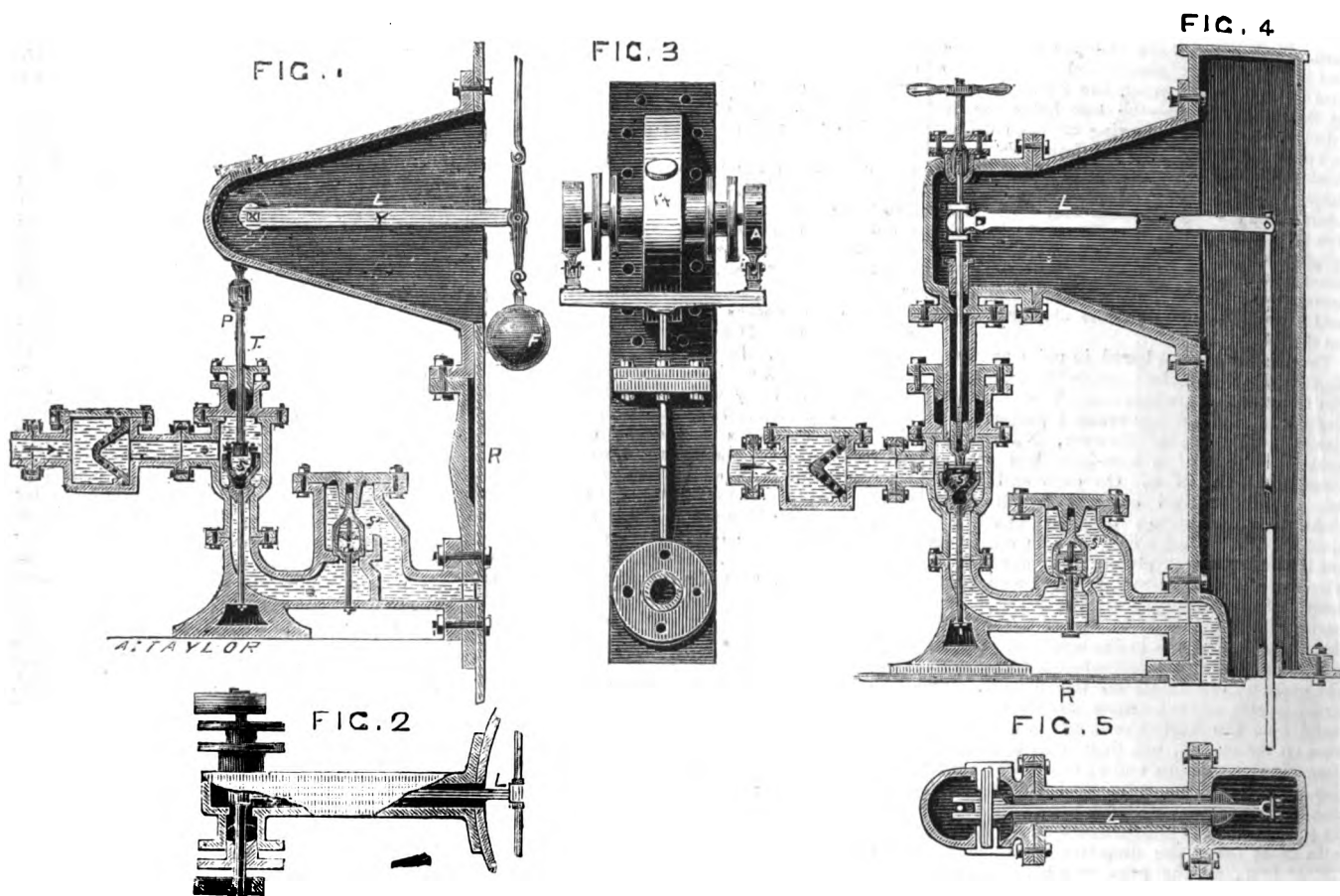
ATMOSPHERIC INSULATION.

MR. EDWARD BEVAN, of Birkenhead, and Mr. Abel Fleming, of Liverpool, have invented an improved jacket or protector for metallic and other vessels and structures containing solid substances, liquids, or gases, to prevent radiation of heat from or communication of heat to such vessels and structures. This jacket is applicable to all kinds of vessels and structures, those which are or can be closed, as well as those which have openings to the air, and it may be used over or to protect the whole or a part only of vessels and structures, the objects being to prevent or retard loss or waste of heat by radiation, and to insulate vessels or structures containing substances or fluids at temperatures either above or below that of the atmosphere so as to preserve them for a length of time at or near the same temperatures, and in the same conditions as they were when placed in the said vessels or structures. As instances of application where the temperature is above, and it is desirable that it should be kept above, that of the atmosphere, the inventors refer to steam and hot water boilers or vessels, blast and other furnaces, and vessels for domestic purposes, and where the temperature is below, and it is advantageous that it should be kept below, that of the atmosphere, ice safes and wine coolers are named. To prevent or retard radiation and penetration of heat from or to vessels and structures it has been the practice hitherto to interpose between an inner and outer vessel, and between inner and outer walls, or between the walls and an outer casing of a structure, some palpable substance, such as charcoal, brick dust, or ivory, which is not a good conductor of heat. After lengthened experiments the inventors have found it inadvisable to use palpable substances, and their invention consists in jacketing or protecting vessels and structures either wholly or partially, as may be necessary, by atmospheric air or other gaseous fluids, preferably not in communication with the external air. To keep the inner and outer vessels and the structures and casings apart, small pieces of earthenware or other non-conductor of heat are used. Where the temperatures are high and fluctuating one or more small openings to the air might be left in the outer vessel or casing, and such openings could be provided with safety valves to open outwards and inwards so as to allow for increase or decrease of pressure of the said jacket or protector of atmospheric air or other gaseous fluids. In all applications of the invention, it is advantageous and desirable that the air or gas jacket or protector should be kept still or quiet.

LARGE IRON RAILWAY BRIDGE.

THE Newhaven, Hartford, and Springfield Railroad Company are now erecting a fine bridge across the Connecticut river, at Warehouse-point. When completed this will probably be the finest railroad bridge in the United States. It is built on the truss principle, and consists of seventeen spans, the longest being 177ft., extending over the river, the carriage road, canal, and towpath. The entire length of the structure is 1,525ft. The total weight of iron used in its construction is about 700 tons, and cost in England, where it was made, £11,231. The plans for its construction were designed by Mr. James Laurie, an American engineer, and were at first tendered to an iron firm in Philadelphia, but at that time nearly all the large iron workers in the country were engaged on Government work, and it was finally determined to procure the construction of the bridge in England. The contract was awarded to William Fairbairn and Co., of Manchester, but afterwards a portion of it was assigned to the London Engineering and Shipbuilding Company. The bridge being built in sections and fitted together, was then taken apart, and shipped to America. About 175,000 rivets are employed in fastening together the various pieces. The great difficulty encountered in putting the bridge in its place arose from the fact that the new bridge is to occupy the same position as the present wooden one, and it was desirable that the traffic of the road should not be interrupted while substituting the one for the other. A good deal of planning and study was

BOILER FEED-WATER APPARATUS.



required to effect this object, but the skill and ingenuity of Mr. Laurie have hitherto overcome all obstacles, and most of the spans are now in position, without, we believe, a single interruption to any train. The erection of the bridge was commenced about the 1st of July last, and it is expected that the entire structure will be in position and completed by the end of January next.

BOILER FEED-WATER APPARATUS.

This apparatus consists of an arrangement of valves and levers acted upon by a float inside the boiler or reservoir, and gives passage to liquid through it into the boiler or reservoir, so as to feed the same, and maintain the liquid therein at any desired level. It has been patented by M. Louis Valant, of Paris, civil engineer, and the accompanying engravings fully explain the invention. Fig. 1 shows in sectional elevation the apparatus fitted to a vertical boiler or reservoir; fig. 2 is a sectional plan, and fig. 3 an end view. S is a valve for allowing passage to water or other liquid into the boiler or reservoir R; S' is another valve preventing liquid returning from the boiler; L is a lever, one end of which is connected to a float F. This lever communicates the motion imparted to it by the float to a shaft A, upon which there are one or several eccentrics connected by their collars to the rod T, which imparts a rectilinear to-and-fro motion under the impulse given by the float to the valve S.

The principle of the apparatus is based upon the following equation:—F being the force which moves the float consequent upon the power exerted by the liquid in the reservoir; P being the power which acts upon the valve S; Y, the distance from the direction of the force to the axis of the shaft A; X, the distance from the axis of the rod of the valve S to the axis of the shaft A. $P \times X = F \times Y$. The force F, the value of which is, $F = P \times \frac{X}{Y}$ may be made as great as desired, the ratio $\frac{X}{Y}$ being variable at will, according to the conditions of pressure and volume of liquid to be introduced into the reservoir under which the

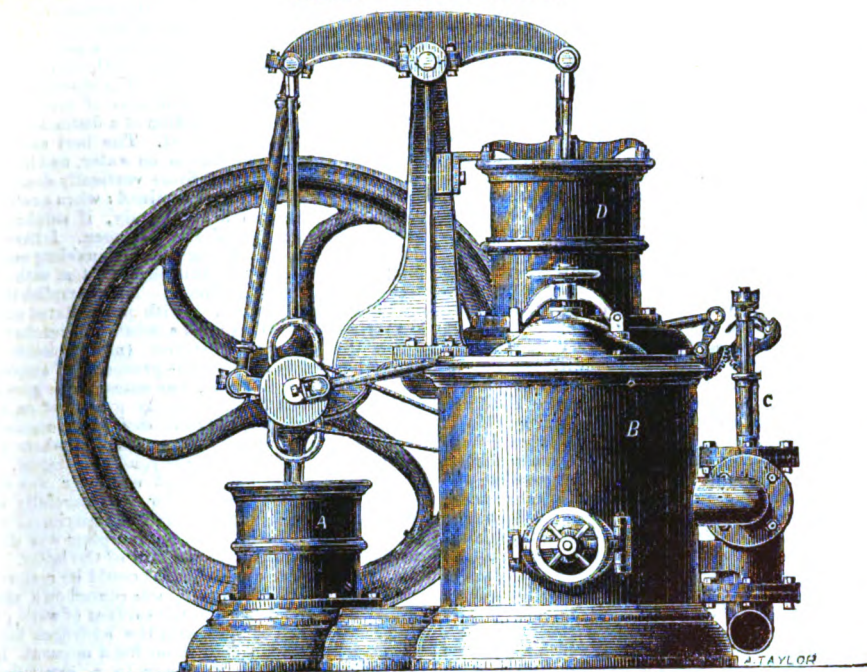
apparatus is to be worked. Figs. 4 and 5 are respectively a vertical section and a horizontal section showing the apparatus connected to a horizontal boiler or reservoir, and with a cam motion substituted for that from eccentrics, as shown and described with reference to figs. 1, 2, and 3. Parts corresponding to those in figs. 1, 2, and 3 are marked with similar letters.

LONDON NEW WATER SUPPLY.

THE recently expressed fears as to the continuous supply of water to London by the present means have excited some attention among the public. To supply the three million souls who reside within the metropolitan area, there are eight water companies, who obtain at least one-half of the supply from the Thames. The population having so largely increased, the gross daily quantity delivered has nearly doubled during the last six years. As is well known, the volume of the Thames has greatly diminished of late years, and several companies have sought for additional means of supply. It is feared, however, that it will be impossible to obtain increased supplies from the old sources, and some liberal method ought to be adopted to meet the difficulty. An eminent civil engineer, who has for many years had great experience in water supply, has just proposed a scheme that bears upon it the impress of practicability. Mr. John F. Bateman has published an account of an extensive scheme for obtaining the supply of water to London from the sources of the river Severn. In his opinion, no proposal is worthy of attention that would not bring in less than two hundred million gallons of water per day, at an elevation which would supply nearly the whole metropolitan district by gravitation without pumping. "The nearest district," he says, "from which this quantity of water can be obtained is that which, lying on the flanks of the mountain ranges of Cader Idris, and Plynlimmon, in North Wales, forms the basis of the main tributaries of the river Severn." This district is somewhat similar to the Cumberland and Westmoreland mountains, where there is an extraordinary rainfall; and from a number of observations, Mr. Bateman concludes that 45 in. may be said to represent the annual net produce of two or three

successive dry years upon the drainage ground from which he proposes to obtain the water supply of London. Reservoirs of sufficient capacity to last out about 140 days might be constructed; and two districts are selected, situated on the Upper and Lower Silurian formations, one of which, 66,000 acres in area, has summits of 2,914 ft. and 2,979 ft. in height, and the other of equal area, 2,500 ft. in height, the discharge pipes of the lowest reservoir in each of these districts being placed 450 ft. above the level of Trinity high water mark. Mr. Bateman proposes to conduct the water by separate aqueducts of 19 miles and 21½ miles in length respectively, near to Marten Mere, a spot situated north-east of Montgomery, from whence by a common aqueduct, crossing the Severn, near Bridgnorth, the water will be conducted along a line of route near to Stourbridge, Bromsgrove, Henley-in-Arden, Warwick, Banbury, Buckingham, Aylesbury, Tring, Berkhamstead, and Watford, to the high land near Stanmore. Here service-reservoirs must be constructed at an elevation of about 250 ft. above Trinity high water mark. The works would be of simple character, and the length of the common aqueduct is estimated at 153 miles; it will be capable of conveying 220 million gallons daily. "The total distance from the lowest reservoir on the river Vyrnwy will be 171 miles, and the total distance from the reservoirs on the Severn will be 173½ miles, to which must be added the length of piping from the service reservoirs to London, about 10 miles, making the total distance 183 miles." Partly by open and partly by covered aqueducts the water will flow through the valleys of the rivers Stour, Avon, and other streams, avoiding all coal-fields, &c. It is intended that no embankment of a reservoir should be more than 80 ft. in height, and "they will be placed in situations either where hard impervious clay, or the solid rock of the Silurian formation, afford the means of making perfectly safe and watertight reservoirs." One of these reservoirs might form a lake of five miles in length. The cost of the works is estimated at about £8,600,000, which is "not more in proportion either to the quantity of water to be obtained, or the ability of the inhabitants to pay for it, than has been expended in Glasgow, Manchester, Liverpool, and many

HEATED AIR ENGINE.



other towns, while it is far below the cost incurred by many towns which could be mentioned." But this would only bring a supply of 130,000,000 gallons: the subsequent outlay for completing the whole scheme for 220,000,000 gallons per day would bring the total sum to £10,850,000. Mr. Bateman seems to think that, in order to meet this outlay, the plan now carried out in Glasgow and Manchester should be adopted for London, viz., to charge upon all householders a domestic rate and a public rate. In Manchester, for instance, these rates are respectively 9d. and 3d. in the pound, the public rate being charged for the use of water in extinguishing fires, &c.; water for trading purposes is separately charged. The author of this colossal scheme considers that a saving of £75,000 a year might be effected by its adoption, and by the amalgamation of the various companies into one undertaking. We may add that the water would be of a soft and pure nature, and equal to that of Loch Katrine.—*Building News*.

HEATED AIR ENGINE.

This engine, which is of American origin, differs in its mechanical construction and operation from the other hot air engines which have been constructed; as it uses the products of combustion and expansion of the heated air in direct communication with the working piston; the regulating and controlling of it being performed by the agency of improved induction and education valves. The other engines have only used the products of combustion to heat the air introduced by pressure into an air chamber or generator, whereby an immense amount of power has been wasted or lost, which might have been rendered available by using it in connection with the expanded atmosphere. The engine is perfectly self-contained; the air pump, cylinder, and furnace being bolted down on a base or sole plate, and it can be moved into its position and at once started to work, whereby the loss of time incurred where foundations, &c., for boiler and engine have to be put up is entirely saved. On reference to the engraving, it will be seen that its parts consist of an air pump A; a furnace B, connected by proper passages with the air pump; a cylinder D, to and from which the heated air is admitted and withdrawn by the valves and their arrangements C; the beam, connecting rod, and governor are, as in an ordinary beam engine, for communicating the power to machinery requiring it; and the bed plate or sole piece, on which the whole is bolted and supported.

The air being drawn into the pump A, at the upstroke of its piston, is by its downward motion forced through the passages into the furnace, on its way to which it passes round the lower part of the cylinder to keep it cool, getting gradually heated on its way, and passes under the bottom of the furnace B, and enters a passage on one side of it, passing up and enter-

ing into the furnace over the burning fuel, where it mixes with the gases and other volatile products of combustion; then passes out of the furnace through a proper opening into the valve chest C, whence at the right moment, by means of the induction valve, it enters under the piston, forcing it to the end of the stroke, at which moment the induction valve closes, the eduction valve opens, the heated air escapes, and the piston is brought down to the bottom of the cylinder again, by the dead weight of it, assisted by the momentum of the fly wheel and other moving parts. We may add that this engine is to be seen at work at No. 16, Laurence Pountney-lane, City. Having inspected its working we can testify to the efficiency of the arrangement.

NATIONAL RIFLE ASSOCIATION.

THE annual competitive trial of small-bore rifles, to ascertain the best description of weapon by various makers for shooting for the Queen's Prize at the next Wimbledon meeting of the National Rifle Association, took place on yesterday week, at the Government practice range attached to the Royal Arsenal, Woolwich. The regulations were generally similar to those on former occasions, each competitor having to fire three out of six rifles previously approved by the Association; the successful competitor to supply sixty rifles for the annual prize shooting, of which thirty will be purchased by the Association. On this occasion the firing at the 500 yards range was entirely dispensed with, it being considered that the true test of merit and efficiency for small-bore rifles was the range of 1,000 yards, which therefore decided the contest. The only competitors were Mr. Henry, of Edinburgh, and the Birmingham (Whitworth) Small Arms Company. Mr. Rigby, of Dublin, had made every arrangement to compete, but, unfortunately, by an accident became disqualified. The contest was exceedingly keen. Each competitor was entitled to eight trial shots. The firing of the first rifle showed:—Henry, 1'91, Birmingham Company, 2'22. The diagrams of the second two rifles were respectively—Henry, 2'27; Birmingham Small Arms Company, 2'46. The completion of the contest was the shooting of 30 rounds by each competitor from the third rifle. At the termination, both targets presented appearances of much skill, but that of Mr. Henry had two shots so close together that only a white line could be seen between, and that scarcely with the naked eye. Some discussion took place as to whether this was the mark of two shots, or only one shot which had so splashed as to make two marks. Ultimately, however, it was agreed that the whole of the thirty shots were visible on the target. The total result, as given at the time, was—Birmingham Small Arms Company, 2'09; Mr. Henry, 2'11. The difference between the competitors is therefore in favour of the company by only two one-hundredths of a foot, or less than a quarter of an inch in the 90 shots. Practical men claim a decided victory for Mr.

Henry, inasmuch as he used common soft cylindrical bullets, whilst his competitor made use of mechanical-fitting hardened bullets, the latter being evidently a great advantage. The council of the Association have just issued the official verification of the diagrams, and the following is the result given:—Birmingham Small Arms Company, 2'08; Henry, 2'11; the difference in favour of the company being but three one-hundredths of a foot.

CONTACT OF HYDROGEN FLAME.

By W. F. BARRETT.*

THE following paper, on some physical effects produced by the contact of a hydrogen-flame with various bodies, has been communicated by the author to the *Philosophical Magazine*:—In the spring of this year, when conducting a series of experiments for Professor Tyndall, on the character of the radiation emitted by various solids heated by means of a hydrogen-flame, I noticed that on the surface of several of the substances examined a deep blue colour arose as soon as the flame was brought into contact with the body. Other engagements prevented a further investigation of the matter until some time afterwards, when, again observing the same phenomenon, I drew Professor Tyndall's attention to it, and he advised my pursuing the subject. For this purpose he kindly placed sufficient time at my disposal, for which, and other marks of kindness, I may here perhaps be allowed to express my sincerest thanks. A careful examination of this blue coloration showed that it occurred only when the flame came into actual contact with the substance, the colour being restricted with great precision to the place where the hydrogen was in combustion; accordingly it gave in section a faithful image of the construction of the flame. This singular appearance was invariably of a rich blue tint; its production was instantaneous, but its duration was generally short, for it disappeared after a few seconds' exposure when the flame continued to play upon one spot, although it was immediately restored by shifting the position of the jet to an untried portion. The hydrogen in some experiments burnt from a small orifice in a brass tube, and in others from a platinum jet; the gas was made in the usual way, and was washed before passing into the reservoir which held it. The blueness was not due to any foreign element in the gas; for when chemically pure hydrogen was used, the colour appeared as bright as with the impure gas. I now examined a number of bodies taken at random from various places in the laboratory, and found the blueness was to be seen on most of them; it appeared with extreme brightness on some pieces of granite and glass tubing; but was not at all confined to non-metallic bodies, as the majority of the metals presented the same appearance. Still there were several substances which showed no blueness whatever, even when subjected to the most careful and repeated examinations; and there were others on which the blueness was only faintly and momentarily seen. This latter occurred with many objects taken from the cases of the mineralogical collection in the museum of the Institution. A classification of the substances experimented upon, according to the effects they gave, yielded no information as to the cause to which the phenomenon might be ascribed. The results obtained were in many cases so utterly anomalous, and the blueness appeared so capriciously, that it at once became evident that only by varying the experiments in every way could I hope to discover the origin of the colour. Nevertheless, from the nature of the appearance, I imagined it might probably have to be attributed to a new kind of fluorescence, differing from that investigated by Professor Stokes in requiring contact of the source of rays, and in its disappearance after a short exposure to the flame—therefore in some respects resembling phosphorescence, yet quite distinct from it in the sharpness of its outline, the rapidity of its appearance, and its non-persistence when the source was removed even to the smallest distance.

The examination of the various bodies demonstrated one fact of some importance—namely, that in every case where the blueness appeared it was always of the same colour and shape, the area over which it extended being, as already mentioned, strictly determined by the size of the hydrogen-flame. Heating the solid to redness, by any means, sufficed to destroy its power of showing the colour: for example, a piece of granite was taken which gave the blueness in every part; one spot of it was then exposed to the oxyhydrogen flame: the granite when cold was again examined, when the blue appeared distinctly on every part except that portion which had been heated; here the blueness was suddenly extinguished. This spot, which by heating had been deprived of its power to give the blue colour, and which it is evident did not recover the property on cooling, had its power restored after a few

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days' exposure in the laboratory, the blueness then being seen with a brilliancy which seemed to vary according to the length of time it had been exposed. Moreover, if a piece of granite, brick, &c., which showed the blueness vividly, was broken in two, the colour was invariably absent on the newly-fractured surfaces. Upon trying a block of ice, I found the blue coloration was produced here also, as soon as the hydrogen-flame touched its surface; but it was not so certain in its appearance as on other bodies; it was best seen around the bottom of the block, or between two pieces of ice placed nearly in contact. Some liquids as well as solids showed the blue colour when the hydrogen-flame was brought down upon them. Occasionally it was to be seen on the surface of water; but invariably it appeared with great brilliancy on sulphuric acid. With regard to the latter, a mere trace of the liquid could be detected by the sudden appearance of the blue: what, however, was most remarkable, and seemed extremely suggestive, was that the blueness did not disappear even after a prolonged exposure of the acid to the flame, the colour remaining undimmed throughout. As soon as the flame was brought to bear upon the surface of the acid, contact with the liquid was immediately announced by a vivid blue light, of a splendour only comparable to the blue line observed by Professor Tyndall in the spectrum of highly-heated lithium vapour. The blueness here, as elsewhere, shone from the body itself, and did not in any way tinge the flame with its colour. It appeared like a sudden luminosity emitted from the surface of the liquid wherever the actual flame came in contact with it.

The next inquiry which suggests itself is, whether the blueness was peculiar to the contact of a hydrogen-flame, or could it be excited by other sources? To answer this, I tried a luminous jet of coal-gas, the non-luminous flame issuing from a Bunsen's burner, and flames of alcohol, bisulphide of carbon, carbonic oxide, olefiant and marsh-gas—each flame being reduced to about the size of the jet of hydrogen employed. No trace of the blue luminosity was seen with any of these flames. Bodies which showed the colour strongly with burning hydrogen, when transferred to any of the foregoing flames were perfectly inert. Was the blueness, then, to be attributed to the high temperature of the hydrogen-flame, to its richness in chemical rays, or to its possession of some other property? I endeavoured to solve the first part of this question by urging the different flames with the blowpipe, and also by holding a piece of granite, which showed the blueness vividly with hydrogen, in the still hotter oxyhydrogen-flame; but in no case was the blue colour produced. I obtained, however, a very slight coloration by using oxygen and coal-gas, allowing the latter to be rather in excess. Finally, on account of the extreme richness of this source in rays of high refrangibility, I made use of the secondary spark from a powerful Ruhmkorff's coil. But even here no blueness was evident along the line of the spark. Moreover the passage of the discharge over a piece of granite was unable to bestow or restore its power of showing the blue radiance when the solid was afterwards exposed to the hydrogen-flame. An accidental experiment revealed the source of this curious appearance. Amongst the various substances I examined, I found that vulcanised india-rubber, when exposed to the flame, exhibited the blue colour with great brilliancy. But here I had reason to believe the blue colour was occasioned by the combustion of the sulphur with which the india-rubber is associated. To see if such were the case, a plate of platinum had its surface rubbed with a stick of sulphur, and was then exposed to the flame. Although no blueness was visible before, yet after the rubbing the coloration shone out brightly for a short time, having in every respect the same appearance as the luminosity seen on granite, &c. Afterwards I found that the slightest contact of sulphur, or a body containing it in the free state, was sufficient to impart to any substance the power of showing the blue coloration beneath the hydrogen-flame. When a plate of platinum which showed the blue colour from being wiped over with a piece of vulcanised rubber, was examined with a high power under the microscope, some spots were seen which were unaffected by a drop of water, but which readily dissolved in bisulphide of carbon. These and other experiments convinced me that, at any rate, the chief part of the phenomenon must be attributed to the presence and combustion of minute quantities of sulphur. It may be urged that if the blueness be simply due to the combustion of sulphur, the different flames tried ought, equally well with the hydrogen, to show the luminosity. But such is not the case, and as yet I have no experimental grounds for explaining why this difference in action should exist. It cannot be wholly due to the high temperature of the hydrogen-flame, but may probably have some connection with the chemical nature of the gas.

But how came the sulphur on the surface of those bodies which had not been purposely placed in contact with that element? It was extremely unlikely that some sulphurous substance had accidentally touched all the different solids on which

the blueness was distinctly seen. Could the sulphur proceed from the atmospheric dust deposited on the surface of these solids? This explanation was established by the following experiment. An old block of granite was taken and examined by the hydrogen flame; it showed the blue coloration vividly on every part of its surface. The block was now split in halves and again searched by the flame: on the newly-fractured surfaces not the faintest trace of colour was seen even in a darkened room. The two fragments were now placed on an upper shelf in a store room adjoining the laboratory, in which no fire was ever made. Over one of the pieces a glass vessel was inverted, dust being thus excluded from it, whilst the other fragment was left uncovered; both had their fractured surfaces turned uppermost. After three days they were again tried with the hydrogen-flame. The upper side of the portion which had been under the glass showed, as before, no blueness; whereas the other exposed fragment was now found to give a well-marked blue colour on its upper and previously inert surface. A piece of white paper had been placed by the side of the granite, and from this it was seen that dust had settled on the exposed fragment. Two plates of chemically clean platinum similarly exposed gave corresponding results; the same was true of marble and other substances; and similar effects were obtained when the bodies were exposed in other places away from the laboratory, in private dwellings, or in the open air. An instructive result was given by the examination of a flask, which, having remained in the laboratory undisturbed for some time, had become thickly coated with dust on its upturned parts. After trying the under surface of the flask, which showed no blueness whatever, the hydrogen flame was caused to pass slowly up the surface of the flask. As the upper portions were approached, a slight coloration made its appearance; and when the flame came into contact with the dust on the upturned surface, an extremely bright but momentary blueness was seen on the spot examined. The duration of the colour could easily be prolonged by moving the flame to other dusty portions of the flask.

These experiments, as far as they go, show, I believe, that among the other foreign ingredients of our atmosphere, sulphur, either free or in a state of combination, must be regarded as occupying not a very unimportant place—derived, it may be, from our coal fires. From investigations that have been recently made in France, it has been stated that traces of sulphate of soda are often present in the air: it may be objected that under the intense heat of the hydrogen-flame, it is this body which has been decomposed and burnt, and thus the sulphur of the compound mistaken for the free element. This conclusion is incorrect, for sulphate of soda does not apparently decompose in this way, no blue coloration having ever been produced by contact of a hydrogen-flame with this salt. On the other hand, the various specimens of alum which were tried, both on old and new surfaces, showed a vivid blue figure of the flame. On the sulphides generally, and on some of the sulphates, the blue was well seen, owing to their decomposition by the burning hydrogen. The singular persistence of the blue appearance on sulphuric acid points to the probability that the liquid was instantaneously decomposed by the contact of the flame. The explanation of the capricious appearance of the blue coloration seen on the surface of many bodies is now easy. Those which showed the luminosity had either been long exposed to the air, or had in some way come into contact with sulphur. The latter will account for the blueness seen on the surface of a block of ice. In order to convey the gas from its reservoir to the jet from which it was burnt, a piece of vulcanised india-rubber tubing had been used, in handling which the fingers had become coated with a film of sulphur. This was readily proved to be the case by exposing the fingers to the burning hydrogen; on the fore-finger and thumb the blue section of the flame was seen to perfection, which was not the case after the hands had been thoroughly washed. Having grasped the ice with unwashed hands, the sulphur on the fingers had been partially transferred to its surface. By the liquefaction of the ice the particles of sulphur were carried down to the base of the block; hence, as already noticed, the blueness was always seen brightest around the lower part of the ice. But the fingers had not thus come into contact with the water on which the blueness occasionally flashed out. Here the coloration was found to be due to particles of sulphur carried over, by the current of hydrogen, from the interior of the tube, on to the surface of the water: there they were burnt; and, when observed through a lens, their presence could be verified by the discontinuity of the blue colour. If absent before, a slight shake of the tubing was generally sufficient to cause the appearance of the blueness on water or other liquids. In subsequent experiments care was taken to avoid the use of any vulcanised india-rubber tubing. This destroyed the blue seen on water and ice, but did not affect the other results which have been enumerated.

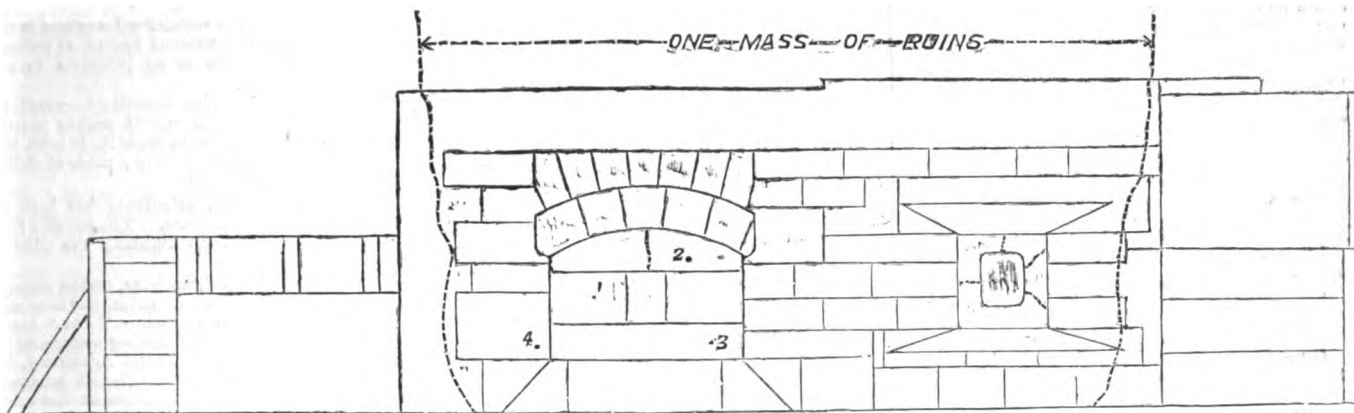
The sudden appearance of a blue colour when a

hydrogen-flame is brought into contact with a body, thus becomes a test for the presence of sulphur, and as such it is one of great delicacy. For example, after the fingers had touched a piece of vulcanised india-rubber, the passage of them through a small quantity of water caused the blueness to be seen on its surface. What weight of matter was here employed in the production of a distinct colour I will not venture to suggest. The best mode of observing the blue coloration on water, and indeed elsewhere, is to bring the flame vertically down on to the surface of the body examined: when a certain part of the flame reaches the body, if sulphur be present, a blue ring of light is seen. I have to thank my friend Mr. Broughton for enabling me to compare the delicacy of this physical test with the best chemical test for sulphur. To accomplish this, milk of sulphur was mixed with precipitated silica in varying proportions until a point was reached at which the chemical reagent (nitroprusside of sodium) failed to indicate the presence of sulphur. With the hydrogen-flame, the silica alone gave no blue colour, but it immediately appeared on the admixture of sulphur, and could easily be recognised, not only in part of the very mixture where the chemical test failed, but far beyond this degree. It is almost needless to state that whatever was employed to support the powder was carefully examined by the flame just before the experiment was made. A mixture of silica and sulphur was made containing the 1-500th of a grain of the latter. Of this, the minutest quantity that could be removed, less than 1-100th of a grain, was placed on a piece of platinum or thrown on the surface of water; in either case, when contact with the hydrogen flame was made, the blue colour shone for a moment. By the chemical test, the sulphur in a less minute quantity of the powder remained undetected. If it could be uniformly mingled, I have reason to believe that certainly the 100,000th part of a grain of sulphur could readily be detected by means of the hydrogen-flame. The presence of sulphur in the homoeopathic powders which are said to contain a trace of that substance was easily verified by moistening the powder (so as to prevent the combustion of the sugar of milk) before it was examined by the hydrogen-flame: as the water evaporated, the blue was seen for an instant. But, from the brightness of the colour in the two cases, it would appear that the homoeopathic doses of sulphur are exceeded by the quantity we daily inhale with the atmospheric dust.

I must now briefly allude to another phenomenon which was observed early in the foregoing investigation. In addition to the blue colour seen on so many bodies, I found that contact of a hydrogen-flame with some metallic surfaces gave rise to a second appearance succeeding or sometimes accompanying the blue coloration. This was a bright scarlet spot encircled by a green ring of light, forming together a section of the flame. The coloration now mentioned was not nearly so general in its appearance as the sulphur blue. On tin, or any of its alloys, it was seen brightly, and it also momentarily appeared on any surface which had been rubbed by these bodies. With a piece of thick and tarnished tin-foil a beautiful experiment may be made. Scraping the foil in places, and bringing it into contact with the hydrogen flame, the blue colour is seen on the dull parts, and the scarlet and green light appears on the bright surfaces, the latter remaining until the foil melts. The colours may sometimes be made to commingle, and a lovely purple is the result. On some clean pieces of lead the same appearance was noticed; but here it soon faded away, and was probably only caused by the impurity of the metal. On clean zinc it could not be seen; but after a piece of tin plate had been drawn over its surface it appeared for an instant. Like the blue coloration, this scarlet appearance could not be obtained by exposing tin to a coal gas or alcohol flame, nor to that of the oxyhydrogen blowpipe. An examination of this colour through a spectroscope will, I trust, in a future investigation, throw more light on its nature. I may mention in passing, that I found many of the solids examined phosphoresce brilliantly when held for a short time in contact with the hydrogen-flame. This was the case with marble, lime, selenite after it had been calcined by the flame or with plaster of Paris, granite, sandpaper, and with different kinds of writing paper. On sandpaper, if the hydrogen be suddenly extinguished, a phosphorescent image of the flame is observed. Chalk gives a brilliant greenish light, which changes into a still brighter yellow as time is formed, the mass glowing throughout on the continuance of the flame.

The combustion of the hydrogen itself offers some points worthy of further investigation. When burnt in an inverted vessel, it is generally accompanied by the blue colour, which is seen around the upper part of the flame where this is in contact with the sides of the vessel. If, however, the hydrogen be mixed with about a third its bulk of air, the blue colour becomes much fainter, and a dark space is observed above the burning hydrogen surrounded by a flame of a light green colour. The greenness is seen very well by employing a long test-tube, and

GRANITE AND IRON FORTIFICATIONS.



slowly bringing the mouth upwards as the hydrogen burns. Mr. Waldie, in a paper "On Combustion and Flame," published in the *Philosophical Magazine* for August, 1838, remarks that "one peculiarity in the flame of hydrogen must have been frequently observed, namely, a green jet inside of the usual dark central portion; and when the flame is full, a dark central part even in this." No explanation of this green colour is given by the writer; but it is, I believe, quite distinct from that which I remarked. The appearance seen by Mr. Waldie I have frequently noticed, and is probably caused by impurities in the gas. In connection with the hydrogen-flame, however, there is another curious appearance, which possibly has often been observed—namely, a kind of luminous stream to be seen stretching itself some distance above the tip of the flame when the gas burns in a darkened room. After the results detailed in the foregoing paper had been obtained, it occurred to me that it would be well to try the effect of bringing gases as well as solids and liquids into contact with the hydrogen-flame. I tried carbonic acid, and found that the presence of this gas instantly changed the colour of burning hydrogen from a yellowish brown to a pale lilac, the whole of the hydrogen-flame being here tinged. The same change in colour may be seen by allowing the products of combustion from a small and lightless gas or alcohol-flame to pass through a jet of burning hydrogen. A very small quantity of carbonic acid imparted this colour to the hydrogen; for it may be produced by merely breathing on the flame. Beyond the fact just noticed, I have as yet made no additional experiments: the explanation of the phenomenon is therefore merely conjecture; but it is possible this lilac-blue colour may be due to the hydrogen-flame rendering incandescent the molecules of carbonic acid—or, more probably, to a partial decomposition of the gas, and combustion of the carbonic oxide.

GRANITE AND IRON FORTIFICATIONS.

THE Ordnance Select Committee and a great concourse of engineers and artillery officers were in attendance on Thursday, the 15th ult., to test an experimental granite casement, with two embrasures protected by iron shields. The total frontage of the masonry is 50ft. in length by 20ft. 5in. in height. The greatest thickness of the granite piers is 14ft., including 2ft. of brickwork inside. The eastern or largest embrasure is 12ft. by 8ft., and the western is 6ft. by 6ft. The former is filled with a built-up shield, the latter with a solid plate of iron, 13in. thick, each shield having an embrasure or porthole 3ft. by 2ft. 4in. The shield for the large embrasure has a front plate of 4in. thick, and a backing of thin iron plates 8in. deep, their outer edges supporting the front plate, and their inner bearing on a second plate of 2in. in thickness. This, again, rests upon a cushion of teak timber, 6in. thick, the whole bearing on a skin of inch iron, and bound together by 22 bolts of 3in. diameter, and 16 bolts of 2in., all having shallow square threads. The skin is attached to two struts by double angle bars, 6in. by 4in. by ½in., and strengthened by six similar bars, running at right angles to the struts. A strong girder, 20in. deep, strengthens the shield across the top of the embrasure. The struts to which the shield is attached rest upon a bottom plate of inch iron, 3½ft. wide, and through this plate the entire mass is secured to the stonework by ten bolts of 2½in. diameter. This shield owes its origin to the successful trial of the Chalmers target in April, 1863, and the recommendation of Lord Palmerston, who introduced the inventor to the Secretary of State for War. As originally proposed, the principle was the same as the Chal-

mers target, but at the suggestion of the late Iron Plate Committee, and the engineers of the War Department, it was altered to its present form. For the compound backing, or alternate layers of timber and iron, of the original design, the present backing of layers—all of thin iron—was substituted, on the ground that it was not advisable to introduce such a perishable material as timber in a permanent work. Half of the shield, therefore, has a backing of plain bars 8in. by 1in., and the other half has bars which match or bind into each other. The latter were suggested by Mr. Chalmers, and their adoption for the entire shield would add about £10 to its cost. These alterations, while they still leave a cushion of timber in the very heart of the structure, add greatly to the weight and cost of the shield, without improving its powers of resistance.

This shield has cost over £1,000 (independent of the consideration paid to Mr. Chalmers for the invention, and for superintending its construction—£600); but a shield of the same size, on the plan originally submitted, which the inventor thinks would offer greater resistance to shot, would cost only about half this amount. Mr. Chalmers has also submitted to the War Department a plan of a shield suitable for the smaller class of embrasures, which, he thinks, would not cost over £300. The size of the large shield is 12ft. by 8ft.; its weight per foot 650lb.; the total weight, including struts and foundation plate, is about 29 tons. The armour-plates were manufactured by Messrs. John Brown and Co., and the shield was constructed by Mr. H. Grissell, at the Regent's Canal Ironworks. The plate for the small embrasure was also manufactured by John Brown and Co. The right flank of the casemate is protected by an iron cramped wall, generally termed "the puzzle," because the pieces of iron bind into each other in the manner of certain puzzles made of wood for the amusement of children. The left flank is protected by 4in. armour-plates, backed with timber and concrete. The entire cost of the structure is about £6,000. The battery to test this structure is placed at 200 yards' distance, and consists of the following guns:—

7-inch shunt, throwing a steel shot of 115lb. with 18lb. charge		
8	150	22
9½	220	30
10	280	36

The experiments on Thursday were confined to testing the shields, both of which proved a perfect defence against the 7-inch and 8-inch guns. The small or thick plate shield, however, was cracked on one side by the first blow from the 9-inch gun, and the 10-inch or 300-pounder broke it right across, virtually placing it *hors de combat*. Another shot would have driven it into the casemate, but that—perhaps to save the feelings of its projector (the superintendent of the works)—was withheld. No such merciful treatment, however, was afforded to the shield of the outsider, for when it did not succumb to the ordinary charges, the charges were increased to 41lb., and the firing continued till it was severely punished. At the conclusion the fastenings were nearly all destroyed, but no shot had penetrated the target, nor was it displaced by the heaviest firing ever seen at Shoeburyness. The thick plate shield, which was disposed of at the fourth round, was struck by a total of 765lb. of metal propelled by 106lb. of powder; whilst the built up, or Chalmers shield, resisted 2,442lb. of metal, and 311lb. of powder.

On the next day, Friday, the practice was commenced at the stoneworks. The guns were fired in salvos, and the effect was to bring down the granite and brickwork in huge masses; the steel shells completely penetrated the massive granite pieces, 14ft. thick. A few shots were, on the succeeding Wednesday, fired at the Chalmers embrasure from the 10-inch gun, four of which struck in about 2ft. square at the right upper corner of the embrasure. Weight of steel shot, 280lb.; powder charge, 41lb. As each shot struck, the massive granite keystones over the embrasure were forced out of their place and the vaulting inside the embrasure fell in. The embrasure itself was not penetrated, although the armour-plates were cracked, and the backing much bent, the bolts also giving way. To sum up, 80 shots in all have been fired at this granite work and embrasure, and the whole are in ruins; so much for a combination of granite and iron work. The practical result will be realised by an inspection of the accompanying sketch which shows the extent of devastation effected.

Correspondence.

LIGHT DRAUGHT ROLLER SHIP.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—Mr. Moy may possibly know much more about ordinary ships than I do; but he certainly does not understand the ship I attempted to describe, as is evident from the incorrect assumptions he makes in his letter of November 11th. The model he saw at the Adelaide Gallery was intended to be propelled by the wind; the forward motion of the vessel to cause the "hollow wheels" to revolve. In the ship I suggest, the globes would revolve by the power of compressed air, and would carry forward the boat exactly as the paddlewheels of a steamer urge forward the boat to which they are attached. The revolution of the globes would give a forward motion to the boat—not the motion of the boat give revolution to the globes. By means of falling weights from a high building and a long cord, I have long since dragged such a craft as Mr. Moy mentions over a sheet of water, but, as he states, the smooth drums would not revolve. Put floats on them and turn them by force, and the whole affair moves forward. "A vessel is immersed in two fluids—water and air;" of course it is; and in the case of the "Mosquito," and all sailing ships, a large exposure to the air is a necessity, in order to obtain impelling power; and as a natural consequence, there must be weight and draught in the water below to ensure stability, otherwise she would not keep upright. But in the case of the revolving globe ship, exposure to the air for propulsion is not a necessity, but rather an evil; therefore, as little surface as possible would be exposed, and consequently less power would be exerted by the wind. The sides might be made angular so as to present no flat surface to the wind. The result would be stability and safety with little immersion, and without ballast.

The assertion that such a vessel would go "dead to leeward" resolves itself into a question of relative forces. If the propelling power of the compressed air, or whatever else was used, was greater than the power of the wind, and the vessel answered her helm, she would certainly go where she was wanted to go in spite of the wind. That she could be furnished with the requisite power and steering quality, I have not the least doubt. Dr. Lardner demonstrated on paper that the "Great Western" would be a failure, but she succeeded, despite the demonstration. My idea of the most likely work for the revolving globe boat in its earliest forms is that of river navigation, ferrying, and short coast journeys, in which it would never go far from calling places, at which stationary engines

would be constantly at work compressing air. Stationary steam-power is much cheaper than moving steam-power, whether locomotive or marine. My egg-shell experiments followed many others, and were undertaken as the readiest means to ascertain the resisting power of a hollow spherical body, and to me they were eminently satisfactory, as affording presumptive proof that well-made globes would stand the buffeting of the sea. I see this week that others entertain similar views to mine. A Mr. Bedder has completed a patent for a boat very much like the Adelaide Gallery craft; and Mr. B. S. Jones is stated to have provisionally patented a method of storing compressed air in ships. I hope we shall soon see a good revolving buoy ship successfully afloat, and vying with the locomotive in speed.

Stockport, Nov. 25.

Yours, &c.,
WM. BARBER.

BRITISH RAINFALL.

SIR,—Permit me to ask your readers' attention to a request on the above subject, the importance of which in relation to engineering and drainage questions is well known. It is now some years since I began collecting returns of the fall of rain, but my main difficulty has been to find out the persons who keep such records. When the collection was first organised in 1860, scarcely two hundred persons were known to observe and record the rainfall; by steady perseverance, and the aid of a portion of the press, the number has been raised until there are now more than one thousand two hundred places whence returns are regularly received. Still I know there are many more, probably hundreds, who have either never heard of the establishment of a central depot to which copies of all rain records should be sent, or they have been too diffident to send them. It is of paramount importance to gather these, and make the tables yet more complete. I therefore beg leave through your columns to ask every reader to think for a moment if he or she knows of anyone who keeps, or has kept, a rain-gauge; or who has any tables of rainfall (or old weather journals), in their possession. And if they do know of such persons, I ask them on behalf of science, of my fellow-observers, and on my own behalf, to use every effort to secure their assistance, and to favour me with their names and addresses. We want old records, we want records for the present year, and from many parts of the country we want returns for the future, if a few persons will notify to me their willingness to assist, and to pay 10s. 6d. for the very cheap and simple gauge now supplied. A complete list of the places whence returns have been already collected shall be sent to anyone willing to make good use of it. I may add that an influential committee of the British Association has been appointed to superintend and assist in my investigations, and that they cordially support my present application.

I am, Sir, your obedient servant,

G. J. SYMONS.

136, Camden-road, London, N.W.

[The Committee consists of J. Glaisher, Esq., F.R.S., Lord Wrottesley, F.R.S., Professor Phillips, F.R.S., Professor Tyndall, F.R.S., Dr. Lee, F.R.S., J. F. Bateman, Esq., F.R.S., R. W. Mylne, Esq., F.R.S., and our correspondent Mr. J. G. Symons, whose labours in the cause of science are well known, and to whose suggestions in furtherance of the above object we hope our readers will respond.—ED. M. M.]

Meetings for the Week.

- MON.**—Society of Engineers.—Renewed discussion on Mr. V. Pender's paper on "Locomotive Adhesion and certain Expedients for Increasing and Supplementing that Function," and, if time permit, a paper on "Giffard's Injector," by Mr. L. Olrick, 7.
- TUES.**—Institution of Civil Engineers.—Continued discussion on Sir O. T. Bright's paper, "The Telegraph to India, and its Extension to Australia and China," 8.
- WED.**—Geological Society, 8.
- THURS.**—Chemical Society, 8.
- FRIDAY.**—Lancian Society, 8.
- SATURDAY.**—Geological Society.—The following paper will be read:—"On the Western Limit of the Rhetic Beds in South Wales, &c.," by E. B. Tawney. 2 "Notes on a Section of the Lower Lias and Rhetic Beds near Wells, Somerset," by the Rev. P. B. Brodie.
- SUNDAY.**—Architectural Association.—"Study, as a Preparation for Practice," by Mr. T. R. Smith, 7.30.

TO CORRESPONDENTS.

THE MECHANICS' MAGAZINE is sent post-free to subscribers of £1 ls. 8d. yearly, or 10s. 10d. half-yearly, payable in advance. Post-office orders made payable to Mr. E. A. Brooman, of 166, Fleet-street, E.C.

Advertisements are inserted in the MECHANICS' MAGAZINE at the rate of 6d. per line, or 5d. per line for 6 insertions, 5d. per line for 13 insertions, 4d. for 26 insertions, and 4d. a line for 52 insertions. Each line consists of about 10 words. Woodcuts are charged at the same rate as type. Special arrangements made for large advertisements.

All communications should be addressed to the Editor, 166, Fleet-street.

To insure insertion in the following number, advertisements should reach the office not later than 5 o'clock on Thursday evening.

We must absolutely decline attending to communications unaccompanied by the name and address of the writer, not necessarily for insertion, but as a proof of good faith.—ED. M. M.

RECEIVED.—H. F.—W. S.—W. V.—J. M. C.—P. F. G. Co.—J. P.—C. B.—O. L.—M. M.—P. H.—W. B.—T. O.—J. B. P.—W. H. P.—C. J. R.—H. M.—W. P.

Miscellaneous.

The Field boiler has been introduced by the Admiralty in the steam fire-engines fitted on the principle of the dockyards of Keyham and Portsmouth. As an auxiliary boiler on board Her Majesty's ships, such as are now fitted on board all our ironclads for fire-engine purposes, washing decks, heaving up the anchor, hoisting out ashes, &c., the Field boiler possesses valuable properties, which promise to bring it largely into use in the Royal Navy. But this is not all, for the principle, under certain modifications, is equally applicable to the main as to the auxiliary engines of ships.

The Telegraph Company's steamer, "Hawk," with Mr. Saunders and staff, has successfully repaired the cable from Corfu to Otranto, and placed it again in direct telegraphic communication with the rest of the world. The cable was laid in February, 1861, the depth of water in one part being over 800 fathoms, but off the Island of Fano, it now appears, there is a rocky bank, with only 20 fathoms water on it, and the cable unfortunately crossed it, and in March last the continued friction chafed it completely asunder, about 16 miles from Corfu. The old cable is similar in principle to the Atlantic, but much smaller, and it is interesting to know that nearly all the cable recovered, ten miles, was in excellent state of preservation. The first message passed through the repaired cable was advice of the interruption in the Malta and Alexandria Telegraph, which we announced in our last.

Iron improved with titanium has been tested for tensile strength, and has stood a strain equal to 47 tons per square inch; and, in puddling furnaces fettered with the ore, the fettering has in some instances lasted a month without renewal, the iron produced being of uniform good quality. These are extreme cases, but indicate the value of the use of the ore.

The number of locomotives at work on the twelve principal railways of Great Britain at the close of 1864, was as follows:—Caledonian, 262; Great Eastern, 376; Great Northern, 345; Great Western, 697; Lancashire and Yorkshire, 396; London and North-Western, 1,187; London and South-Western, 207; London, Brighton, and South Coast, 203; Manchester, Sheffield, and Lincolnshire, 179; Midland, 512; North-Eastern, 663; and South-Eastern, 214.

According to French official returns just published, the quantity of beetroot sugar manufactured in September last amounted to 10,749,515 kilogrammes, and in October to 56,509,101 kilogrammes, making altogether 67,258,616 kilogrammes. The quantity manufactured during the two corresponding months of the preceding year was only 41,603,310 kilogrammes, or 25,655,306 kilogrammes less.

While we are making our scientific ascents in England, the balloon in America is being appropriated to other and more genial uses. A bridal party recently made a wedding tour in the clouds from New York. This trip took place on the 8th of November, and only two persons accompanied the bride and bridegroom. The car ascended from the Sixth Avenue and Fifty-ninth-street entrance to the Park, and, after a very pleasant excursion through the upper air, landed at Mount Vernon, Westchester county, about sunset.

A scientific contemporary draws attention to an undescribed ore of iron. It has much of the characteristic appearance of plumbago, and leaves a black greasy stain when rubbed between the fingers. It is comparatively soft, and when scratched with a knife, falls off the mass in beautiful shining particles, having a metallic lustre, and not unlike powdered mica. This mineral is said to have been obtained in Ireland, near the surface, underlying about 15 ft. of peat. Its analysis gives the following percentage:—Insoluble (in HCl and HNO₃) 9.5, Ferric oxide 90.5, total 100.0. This mineral is quite unacted upon before the blowpipe, and contains no carbonaceous matter whatever.

A French engineer, M. Paulin Gay, has lately perfected a machine, on the disc principle, for sawing or cutting through the hardest rock in quarries and tunnels. Experiments have been made lately at the Conservatoire des Arts et Metiers of Paris, which prove the utility of the invention.

There are four shot towers in New York and vicinity, the capacity of each being from 10,000 lb. to 15,000 lb. of shot per day, or a total of from 40,000 lb. to 50,000 lb.

We understand that the reported destruction of Sir Isaac Newton's residence is incorrect. The house in Kensington, in which Sir Isaac died on the 20th March, 1727, is at present known as Bullingham House, and there is no intention to demolish it.

A large fire-proof safe has recently been made in America for a banking firm. It weighs 20 tons, and required eleven horses to draw it. It is 8 ft. 6 in. high, 7 ft. 6 in. wide, and 3 ft. deep; made of chilled and wrought iron and steel.

At Amiano, in Italy, petroleum has been extracted for two hundred years. The supplies from this source were used for lighting the cities of Parma and Genoa.

One of Captain Rodger's anchors, on the principle of the patent indented small palm, has been used on board H. M.'s steam storeship "Fox," during the past twelve months, and, having undergone the most severe test, as ordered by the Admiralty, was reported to have done the work of the old Admiralty anchor weighing 49 cwt., the Rodger anchor weighing only 30½ cwt.

Professor Snell, of Amherst, Mass., states that he has not, during twenty-seven years, recorded so small an amount of rain for a single month as during the month of September last. The water measured only thirty-eight hundredths of an inch.

The Prussian War Office has lately arrived at the conclusion that the immense improvements in modern artillery have rendered a large number of fortifications utterly inadequate for the purposes for which they are intended, and has determined to dismantle them accordingly. Fortifications on a very large scale are either commenced, or, at least determined on, at many other places, such as Alsen the Sundewitt, and Kiel. The scale of these may be imagined from the fact that the estimates for the works at Kiel alone, including artillery and barracks, exceed £360,000.

In some observations taken to determine longitude in England, a 32-pound rocket was sent up, perpendicularly, 6,000 ft.; a 24-pound rose 4,500 ft.; a 1-pound 2,400 ft., and a 1-pound 1,500 ft.

The correspondent of a San Francisco paper says that he has seen some specimens of cinnabar containing 90 per cent. of quicksilver, taken from the North Almaden Mine, opened in July last. The mine is situated on the opposite side of the valley from the famous New Almaden Mine, from which it is about eight miles distant.

From Victoria an important coal discovery is reported as having recently been made at or near the Queen Charlotte Coal Company's mine. A quantity of this coal has been tested at Victoria with the most satisfactory result. About half a ton of iron was smelted, and the coal was pronounced to be of a most superior character for the purpose, and equal to the celebrated Pennsylvania coal, the heat-giving properties being intense, with an absence of sulphuric gases which renders the ore softer and purer.

One of the heavy Woolwich guns, made on the Duke of Somerset's principle, weighing 1½ tons, and intended to fire a 300 lb. shot, is being mounted on an iron gun carriage made on Lieutenant-Colonel Shaw's method. The gun and carriage, after undergoing a severe test, will be shipped on board the four-gun iron-cased cupola ship "Prince Albert." The whole of the battery equipment, it appears, is ordered to be composed of wrought iron, yet, notwithstanding the orders to that effect, it is stated that a lingering regard for their favourite hobby has induced the Carriage Department authorities to supply the slides and platforms of wood, which of course will have to be altered.

Dr. Joule has observed the effect of the anorion on his sensitive magnetic needle. The needle was violently agitated, as many as thirty-six changes of deflection, varying from 10° to 1° 40' occurring per minute. The cause of the movements seemed to be instantaneous in its action. It was remarked that when the beams preponderated on the west of the magnetic north the needle took an easterly direction.

An armour-plate now being prepared at Portsmouth for trial has a new form. It has a ridge and furrow outer surface on a peculiar and patented design. Extraordinary results are expected from the trial of this plate, which will be watched with considerable interest.

At the ordinary meeting of the Literary and Philosophical Society, held November 14th, 1865, R. Angus Smith, Ph.D., F.R.S., &c., president, in the chair, Mr. Charles Bailey, and Mr. Thomas Barker, M.A., Professor of Mathematics, Owen's College, were elected ordinary members of the society.

The new bridge about to be suspended over the Ohio river at Cincinnati will be the longest structure of the kind in the world, being more than 200 ft. longer than that over the Niagara river, and 540 ft. longer than the Menai Bridge. Its total span will be 1,067 ft. The stone piers rise 110 ft. above the floor of the bridge, and 200 ft. above their foundations. One year is allowed for building it.

On recently testing one of Captain Rodger's patent indented small-palmed anchors, weighing 74 cwt. 2 grs. 18 lb., the Admiralty proof, 55 tons 9-33, with 56 9-33, deflected half an inch each arm; with 83 59-64 deflected 5-8ths; permanent set, nil. An Admiralty anchor, weighing 111 cwt. was put to a similar strain—viz., 71 3-8 with 71 3-8 tons deflected 13-16th; 73, 15-16ths; 75 tons, 13-8ths; 77 tons, 13-8ths; 80 tons, 41-64, 19-10ths; 83 tons 59-64 deflected 13-8ths; permanent set, quarter of an inch.

Mr. J. H. Greener has just returned from Bagdad, after a residence of five years in that city, in connection with the Indo-European Telegraph. In 1860, Mr. Greener was sent out by the Government to inspect and report upon the condition and capabilities of the line of telegraph already established by the Turks, from Constantinople to Bagdad, with a view to open out a direct telegraphic communication between England and India via the Persian Gulf. He subsequently accompanied the surveying expedition for taking soundings, and for fixing the positions of stations, &c., from Jask, to the head of the gulf at Fao. Afterwards he, in company with Colonel Kemball, traversed the country through Mesopotamia to Garne, making arrangements for constructing and establishing the line through the Arab district. Mr. Greener superintended the construction of the line through the whole district, and ultimately joined the wires coming from India on the one hand, and Europe on the other, thus completing, on the 19th January, 1865, the long-desired communication between London and India.

Patents for Inventions.

ABRIDGED SPECIFICATIONS OF PATENTS.

The Abridged Specifications of Patents given below are classified, according to the subjects to which the respective inventions refer, in the following Table. By the system of classification adopted, the numerical and chronological order of the specifications is preserved, and combined with all the advantages of a division into classes. It should be understood that these abridgements are prepared exclusively for this Magazine from official copies supplied by the Government, and are therefore the property of the Proprietors of this Magazine. Other papers are hereby warned not to produce them without an acknowledgment—

BOILERS AND FURNACES.—1259, 1270, 1282, 1291
BUILDINGS AND BUILDING MATERIALS.—1213
CHEMISTRY AND PHOTOGRAPHY.—None.
CULTIVATION OF THE SOIL. Including agricultural implements and machines.—1246
ELECTRICAL APPARATUS.—None.
FIBROUS FABRICS. Including machinery for treating fibres, pulp, paper, &c.—1233, 1235, 1236, 1239, 1248, 1261, 1263, 1275, 1281, 1283, 1298
FOOD AND BEVERAGES. Including apparatus for preparing food for men and animals.—1242, 1244, 1263, 1267, 1292, 1297
FURNITURE AND APPAREL. Including household utensils, time-keepers, jewellery, musical instruments, &c.—1278, 1281, 1286, 1243, 1284
GENERAL MACHINERY.—1230, 1241, 1245, 1247, 1252, 1254, 1271, 1277, 1279, 1280, 1237, 1294
LIGHTING, HEATING, AND VENTILATING.—1237, 1249, 1266, 1269, 1274, 1286, 1296, 1299
METALS. Including apparatus for their manufacture.—1229, 1255, 1295
MISCELLANEOUS.—1232, 1257, 1272
ROADS AND VEHICLES. Including railway plant and carriages, saddlery, and harness, &c.—1256, 1258, 1260, 1265, 1268, 1285, 1290
SHIPS AND BOATS. Including their fittings.—1234, 1250, 1251, 1278, 1288
STEAM ENGINES, &c.—1227, 1240, 1253, 1254
WARFARE.—1276, 1289, 1293, 1300

1227 F. WISE. A mode of obtaining decoctions and apparatus for carrying the same into effect. (A communication.) Dated May 2, 1865

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

1228 W. E. NEWTON. Improvements in folding beds and bedsteads. (A communication.) Dated May 2, 1865

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

1229 T. ALLCOCK. Improvements in finishing and polishing metal tubes and rods and in apparatus or machinery to be employed therein. Dated May 2, 1865

This invention consists in an improved mode of finishing metal tubes, by which the patentee lessens or avoids the employment of manual labour in the operation termed floating the tubes, and also in an improved mode of polishing metal tubes and rods. The apparatus he employs for these purposes consists of a revolving drum or barrel lined internally with buff, felt, or other suitable material, into which the tubes or rods are placed in considerable numbers at one time, together with some sharp cutting grit or grinding medium, such as emery, ground glass, or pounded brick; the barrel or drum is then caused to revolve by steam or other power, by which motion the tubes or rods are violently agitated, and the surfaces are ground and polished. *Patent completed.*

1230 C. W. SIKKENS. Improvements in the means and apparatus for regulating the power and velocity of machinery or apparatus in motion. Dated May 2, 1865

The present invention has for its object to accomplish the functions of the free conical pendulum by an equally chronometric, but less delicate, arrangement, which, on account of its simplicity, is capable of very general application as a regulator of motion and power, and which may be termed a liquid chronometer. It consists of a cupola shell, open at the top and bottom, rotating on its vertical axis, which, dipping into a bath of liquid, imparts centrifugal motion to the portion of the liquid inside the cup, causing the liquid so impelled to rise until it is on the point of overflowing. The liquid is maintained in this condition without further expenditure of power, so long as the speed or power of the machine or apparatus to be regulated remains at the nominal standard; so soon as this is exceeded, and a consequent increased impulse is imparted to the cup, the liquid overflows the upper edge of the rotating cup, causing expenditure of power, which will prevent the further acceleration of the cup; and this absorption of power may be further increased by causing the liquid thrown out to pass alternately against a series of fixed radial vanes, and vanes rotating with the cup. *Patent completed.*

1231 J. CATILLON. An improved self-supplying pen. Dated May 2, 1865

This invention has reference to an improvement in the mode of supplying ink to the ordinary description of steel pens or nibs, through the medium of the handle or holder in which they are fixed, whereby a more continuous and uniform supply of ink is obtained without requiring to be constantly supplied as at present, and consists in employing in connection with the handle or holder (which is of a hollow or tubular form suitable for containing the ink) a projecting tube attached longitudinally thereto, so as to pass within the hollow or cavity of the pen, forming therewith a capillary tongue from which the ink is discharged through the medium of a small valve opening outwards from the ends of the said tube or tongue, in connection with which a thumb stud and reacting spiral spring, contained within the handle or holder, is also employed for actuating the said valve, and discharging the ink on receiving pressure from the thumb or finger. *Patent completed.*

1232 J. B. LAVANCHY. A "chair ladder." Dated May 3, 1865

This invention is not described apart from the drawings. *Patent completed.*

1233 G. T. BOUSFIELD. Improvements in machines for drying and stretching woollen and other textile fabrics. (A communication.) Dated May 3, 1865

The patentee claims a machine for tentering textile fabrics, constructed substantially as described, combined with and travelling in a hollow vertical shaft through which a continuous current of heated air is passing. The invention cannot be fully described without reference to the drawings. *Patent completed.*

1234 E. T. READ and J. B. FYFE. Improvements in apparatus for receiving the thrust of screw propeller and other revolving shafts. Dated May 3, 1865

This invention is not described apart from the drawings. *Patent completed.*

1235 P. A. LE O. DE FONTAINEMOREAU. A new apparatus for ascertaining the degree of torsion and resistance in the threads of textile substances. (A communication.) Dated May 3, 1865

This apparatus is composed of a frame supplying a screw set in motion by a crank arm; the degree of torsion of a given thread is ascertained by untwisting it by means of a nipper fixed to the screw, and in counting the number of revolutions that it has been necessary to cause the screw to perform for the said operation. The resistance is ascertained in stretching the thread either by means of a weight, or of a spring balance. *Patent abandoned.*

1236 M. H. BROUIN. Certain improvements in the manufacture of penholders. Dated May 3, 1865

This penholder is closed by a reservoir or chamber filled up with ink. A communication is prepared between the pen placed in the renholder and the above reservoir by a piston provided with a spring. A stud set in motion by being pressed by a finger determines the movement of the piston, and consequently, the feeding of the pen with the required quantity of ink. *Patent abandoned.*

1237 P. A. LE O. DE FONTAINEMOREAU. A new illuminating apparatus for burning petroleum. (A communication.) Dated May 3, 1865

This invention consists in the construction of an apparatus for the burning of petroleum in the open air without the use of a chimney, and by which smoke and smell are avoided. We cannot here give space to the details of this invention. *Patent abandoned.*

1238 T. W. ROK. Improvements in machinery for folding and carrying lace or light fabrics. Dated May 3, 1865

We cannot here give space to the details of this invention. *Patent completed.*

1239 W. CLARK. Improvements in the means and apparatus used for stretching woven fabrics and other materials. (A communication.) Dated May 3, 1865

This invention consists in an improved means of stretching all kinds of fabrics or materials such as knitted fabrics, leather, skins, and others either wholly or partially by their application between surfaces of india-rubber. *Patent completed.*

1240 J. H. JOHNSON. Improvements in steam generators and engines, and in apparatus for feeding steam generators. (A communication.) Dated May 3, 1865

This invention relates, first, to improvements in steam generators whereby economy in fuel and in the cost of the

generator is obtained, and the danger of explosion is obviated; second, to an improved apparatus for feeding steam generators; third, to an improved valvular arrangement of reciprocating steam engines, whereby a simple and easy mode of effecting the cut-off is obtained without the necessity for interfering with or adjusting any of the actual moving parts, provision being at the same time made for the perfect balancing and rendering uniform of the action of reciprocating steam engines. The details of the invention are too voluminous to be given here. *Patent completed.*

1241 W. E. CADOG. An improved fan or exhaust for thrashing machines. (A communication.) Dated May 3, 1865

This invention cannot be described without reference to the drawings. *Patent abandoned.*

1242 C. G. LENK. An improved process for purifying water. Dated May 3, 1865

This invention consists of a mixture of hypermanganate of potash, carbonate of soda, alum, and neutralised aluminate, which on being added to the water precipitates all organic and inorganic impurities, and renders it clear and wholesome; the water can then be drawn off, and, if a tap is used, it should be fitted with a tube projecting towards the middle of the vessel, the end being slightly raised from the bottom of the vessel to prevent the precipitated impurities being drawn off with the purified water. *Patent abandoned.*

1243 G. JONES. Improvements in paper hangings. Dated May 4, 1865

This invention has reference to a mode of producing upon plain or figured surfaces of paper hangings designs or devices in coloured or uncoloured, chromo, or other lithography, and consists in placing the said designs, obtained as above, in suitable order or position, as required for being arranged upon the piece of paper to be ornamented or embellished, and causing the same to adhere to the surface thereof through the medium of gum, or other suitable composition or cement, whilst the rough unfinished edging of the said lithographs are subsequently surrounded with an ornamental framing or border printed or stamped in gold, silver, bronze, or colours as a finish to the same; as also to conceal the edge or line of union between the lithographic device and the paper. *Patent completed.*

1244 E. G. SMITH. Certain improved contrivances for preparing vegetables and fruit for culinary and other purposes. Dated May 4, 1865

This invention is more especially adapted to such uses as shelling peas or beans and stoning fruit. To shell peas according to this invention, the patentee provides for the unshelled peas a proper receptacle, from which they are carried by a feeding contrivance to a pair of rollers between which the peas' coats alone pass falling outside, while the peas being too large to pass the rollers are separated from the peas' coats and fall into a receptacle by themselves. *Patent completed.*

1245 W. F. STANLEY. Improvements in straight line dividing engines and tools for regulating distances. Dated May 4, 1865

This invention consists of three improvements, which are all applicable to the straight line dividing engine; they are applied to different portions of the engine, and may be used either combined or separately. The dividing engine is used for producing the divisions upon scales, rules, or other purposes which require consecutive lines at equal or proportional spaces. The first improvement relates to a new system of regulating these distances or spaces of division. The second improvement relates to the means employed to render the action of dividing engines continuous or self-acting. This the patentee accomplishes by the employment of a ratchet wheel for giving motion to the screw, the teeth of which being equally divided and cut take the place of a divided disc or its equivalent, in the ordinary engine. The third improvement consists in self-acting means of regulating the lengths of the lines, or readings, as they are called, of the divisions upon scales. *Patent completed.*

1246 J. STALKART. Improvements in ploughs. Dated May 4, 1865

An important feature of this invention consists in forming the angle of the share so that, where the nature of the soil will permit, it splits or breaks up the ground as it is turned over by the ploughshare. *Patent abandoned.*

1247 G. RENNUP. Improvements in machinery or apparatus for cutting cylindrical or conical articles. Dated May 4, 1865

This invention consists in the use of knives, cutters, or saws which, as they are brought up or forward, the act of cutting a bung or other cylindrical or conical article, are expanded so that there is no friction upon the article while being cut. *Patent completed.*

1248 F. CALDWELL. The employment of machinery or apparatus for tying or winding strings or threads upon a certain part or parts of hanks of cotton, silk, linen, thread, worsted, merino, or other yarn previous to dyeing the same. Dated May 4, 1865

We cannot here quote the details of this invention. *Patent completed.*

1249 J. HAMPTON. An improved refrigerator and condenser. Dated May 4, 1865

This invention consists of a refrigerator and condenser in which two shells or vessels of cylindrical or conical shape are placed one within the other, and between them is a pipe wound or coiled round the inner shell or vessel. This pipe is of such diameter that it wholly fills up the space between the outside of the inner shell or vessel, and the inside of the outer shell or vessel (in the direction of their diameter); the coils are placed at any required distance from each other. A disc or lid is placed at a short distance from one edge of the inner vessel, and another disc or lid, or a stay, is placed at the outer edge thereof. Through the centre of these discs, or of the disc or stay (which are pierced for the purpose), there passes a pipe which conducts away the water which has abstracted the heat from the wort or other liquid to be refrigerated, or vapour to be condensed; such water which has run away is supplied at one end of the vessel by an inlet pipe connected with a cold water cistern—such water passes in the space between the coils, and abstracts the heat, and as the water passes along the wort, or other liquid to be cooled, or vapours to be condensed, it is supplied to the coiled pipe at the opposite end thereof, and escapes cooled or condensed at the same end of the vessel as that at which the cold water is admitted. *Patent completed.*

1250 W. ROBERTS. *Improvements in shackles or links for connecting chain cables and other chains.* Dated May 4, 1865.

In constructing shackles or links for connecting chain cables and other chains according to this invention the patentee forms a shackle or link of two pieces, each similar to the half of one of the links of the chains to be connected, each piece having a bend formed in it similar to the bend at each end of a link; both legs or straight ends of one piece are screwed with a right-handed and both legs of the other piece with a left-handed screw thread; the two pieces are connected together by two sockets or tubes which screw on to the two ends of each piece, each socket having at one end an internal right-handed and at the other end an internal left-handed screw thread on therein, so that the socket may be simultaneously screwed on to the ends of the two pieces. Around the exterior of the socket holes are formed in order that each socket may be held by a wrench and screwed up. The screws are formed slightly taper, so that until the sockets are nearly screwed up hard the sockets may be turned easily by hand, and then both sockets may be simultaneously screwed up by a wrench suitably formed for the purpose. *Patent completed.*

1251 J. LILLEY. *Improvements in ship and other compasses.* Dated May 4, 1865.

The patentee claims the construction of ship and other compasses with the magnets suspended in spirit, or other suitable liquid, while the card or indicator is suspended in a separate chamber, substantially as described. *Patent completed.*

1252 A. MACKIE, H. GARRIDE, and J. SALMON. *Improvements in machinery for distributing printing type.* Dated May 4, 1865.

The type to be distributed according to this invention is prepared so that each type will have a notch in one edge or side, the notch for the same character of type being made at the same distance from one end of the type, and for every different letter or character of type the ratchet notch is made at a different distance from the end of the type. The patentees take type thus prepared in line, as it is arranged for printing, and then, by acting upon all the ratchet notches which come in the same straight line, they simultaneously separate all the type of the same letter or character by one movement, and by making in succession as many movements as there are type of different letters or characters in the line operated upon, all the type in such line will be completely distributed. *Patent completed.*

1253 T. WOOD. *Improvements in or applicable to marine condensing steam engines.* Dated May 4, 1865.

This invention consists in condensing the steam by injecting fresh water or water previously used, and in refrigerating or cooling the water used for this purpose over and over again, except such portion as is led to the boilers. *Patent abandoned.*

1254 G. PEEL, jun., and I. MASON. *Improvements in hydraulic presses for compressing cotton and other substances.* Dated May 5, 1865.

This invention is particularly applicable to pressing cotton or other substances requiring a light pressure at the commencement, and a great pressure, to complete the operation. In the application of the invention the patentees employ a compound hydraulic press with three cylinders, two of which are comparatively small in diameter, and furnished with long rams attached to or acting upon each end of the follower, to give the requisite pressure at the commencement, while the third cylinder is of a large diameter, and furnished with a short ram acting in the centre of the follower to give the final compression. The large cylinder with the short ram is mounted on slides or rollers, and it is moved to and fro by racks and pinions, or screw and nut, or other equivalents, worked by hand or other power, so as to bring the cylinder and ram under the follower, or to one side when required. In working with this improved press the large cylinder and ram are moved to one side, and the follower is brought up by the two smaller rams, until the under side thereof is above the level of the large cylinder and ram, the large cylinder and ram are then moved under the follower, and the final compression is given by the action of the large ram. *Patent completed.*

1255 W. HENDERSON. *Improvements in extracting copper and several other metals from certain ores of these metals.* Dated May 5, 1865.

These improvements relate to means of obtaining in solution copper when it exists in the states of oxide, carbonate, arseniate, or other salt of copper associated with large proportions of silica or other substances insoluble in dilute acids. When oxides, carbonates, arseniates, or other salts of copper insoluble in water are separated from their gangues by solution in muriatic acid, and the copper afterwards precipitates from this solution by metallic iron, a solution of protochloride of iron is obtained as a residual liquor which has heretofore been allowed to run to waste, or has been decomposed by evaporation to dryness with sand, and repeatedly moistened as described in the specification of a patent granted to the patentee 30th September, 1857 (No. 2,617). The patentee, however, found that by treating the protochloride of iron in this manner a considerable proportion is decomposed into chlorine and oxide of iron, and that the gaseous chlorine passes up through the water and escapes from the tower uncondensed. The patentee also found that the protochloride of iron has a strong solvent action on the oxides and the salts of copper insoluble in water, and that it readily dissolves copper from ores of this class depositing peroxide of iron, and that by long contact it decomposes and dissolves the red oxide and sulphurets of copper. To convert the protochloride of iron into peroxide of iron the patentee adopts various methods, the following being one of them:—The protochloride liquor is stirred up and agitated with a small proportion, say 1 lb. of finely powdered peroxide of manganese to 100 gallons of liquor and run out into shallow ponds or vessels and exposed to the air and sun; the liquor is afterwards pumped up and repeatedly passed through walls or surfaces of thorns or brushwood, as is well known and practised for the manufacture of salt from poor brine springs, and is called graduation. The object, however, in this case is as much oxidation as concentration, but both are secured by this means, and it is found that a considerable portion of iron drops out of solution, as peroxide and a red liquor remain after settling, which the patentee returns to the dissolving tanks on to fresh copper ore; the metal is again readily dissolved and is again precipitated by metallic iron, and the resulting protochloride solutions oxidised, as above described. *Patent completed.*

1256 E. RICHARDSON. *Improvements in means and apparatus for producing or effecting fog signals.* Dated May 5, 1865.

This invention consists in the application of compressed air to the sounding of an alarm whistle or fog signal in such places, and under such circumstances, as where high pressure cannot be obtained, and in means and apparatus for producing or effecting the same. *Patent completed.*

1257 T. J. MAYALL. *Improvements in the manufacture or treatment of india-rubber or gutta-percha or compounds thereof, applicable to the production of stereotype plates and other forms.* Dated May 5, 1865.

In carrying out this invention the patentee takes the india-rubber or gutta-percha, or compounds thereof. When combined with sulphur and in a semi or partially converted state, produced by the action thereon of the sulphur aided by heat, and then in this partially converted state he applies such matter under pressure and heat to the surface to be stereotyped or copied, and he continues the pressure and heat until perfect conversion is obtained. By the terms "conversion" and "converted" he means that state of the material which is otherwise called vulcanised or cured. *Patent completed.*

1258 A. H. BRANDON. *Improvements in machinery for transmitting and receiving signals.* (A communication.) Dated May 5, 1865.

In carrying out this invention the inventor connects the places, stations, or rooms, from which communications are to be sent, and where they are to be received, by a small airtight pipe, one extremity of which is terminated by an airtight box or other receptacle provided with an elastic cover, whilst the other extremity is attached to a bent metallic pipe, similar to those used for pressure gauges and barometers known as aneroid barometers, so that on a slight pressure being applied to the elastic cover of the airtight box, it will cause the extremities of the bent pipe to open, and a signal to be given. *Patent abandoned.*

1259 C. LAMPORT. *Improvements in the construction of and mode of supplying fuel to firegrates, stoves, and the furnaces of locomotives and other steam boilers.* Dated May 5, 1865.

The object of this invention is to supply fuel for consumption on the inner side of the fire. The fuel is forced up by a piston or partition working in the segment of a cylinder, and attached to a strong axle, or rather it is fitted into a slot therein, and is capable of being drawn through such axle, so as to pass it from one side to the other thereof. *Patent abandoned.*

1260 J. MITCHELL. *Improvements in constructing roads and streets.* Dated May 5, 1865.

In constructing roads and streets according to this invention the whole surface of the formation of the road or street, whether for concrete or pavement, is to be brought to the inclination and convexity fixed on, and then watered and rolled with a heavy iron roller. On this surface concrete metal is to be laid to a depth of eight inches for a street or road, or to a less or greater depth, according to the locality and peculiarity of the traffic, and beat hard with beaters. Any apparent irregularities on the surface are to be filled up with a grout of cement and sand before consolidation, and the whole rolled over, if necessary, with a heavy iron roller. *Patent completed.*

1261 J. WADSWORTH, H. DUBERT, and J. M'MURDO. *Improvements in jacquard and indexing machines.* Dated May 5, 1865.

This invention consists in an improved arrangement of hooks and needles for the purpose of dispensing with the spring box and springs of jacquard machines, and also with one set of needles in the double action machine. The hooks are guided at the bottom plate and at the top in strips of wood or metal, each strip serving for a row of hooks. Between the bottom plate and strips there are two griffs for raising the hooks, and one needle acts upon two hooks, so that, when the end of the needle is pressed by a blank in the card, one hook is pushed out of the way of its corresponding griff without interfering with the other hook, and a similar effect takes place when the other end of the needle is pressed by another blank, the hooks returning to their original positions by their own elasticity. In the single action machine there are as many needles as hooks, but the spring-box and springs are dispensed with by the elasticity of the hooks, and similar hooks and needles can be applied to indexing machines employed for working a number of shafts or heads. *Patent completed.*

1262 J. M'GLASHAN. *Improvements in the preparation of jute, hemp, flax, and other fibrous materials, and in the machinery or apparatus employed therein.* Dated May 5, 1865.

This invention relates to certain improvements in machinery or apparatus for the preparation of jute, hemp, flax, and other fibrous materials, and consists in arranging the "fans" or rings used in circular drawing and roving frames so as to revolve upon a stationary bar or shaft of iron or other material. These fans or rings are, by preference, made of cast iron, and also serve as wheels, by having teeth cast on their outer surfaces at one side; the draft pinion gears into these toothed rings, thereby conveying motion to a counter shaft below the machine, which communicates motion to the other end of the system, or to as many systems as may be desired on the frame or frames. This arrangement of fans or rings allows the internal guides for the fallers to be fixed to the stationary bar or shaft at the part where the pressure is greatest. This bar or shaft on which the "fans" or rings filled with fallers revolve, and for which the internal guides are fixed, is supported on brackets outside the gearing, and can be shifted backward or forward, upward or downward, to suit the length or strength of the material passing over the machine. *Patent completed.*

1263 S. BENNETT. *Improvements in brewing, distillation, the production of vinegar, and the extract of malt and other grain.* Dated May 5, 1865.

The patentee claims, first, the improved method of producing the extract of malt from the malt alone of malted grain, by separating and removing the husk or offal therefrom, as and for the purposes described. Secondly, the improved method or process of treatment of such extract, that is to say, the synthetical treatment of the malt, by a gradual process, after its separation, until its entire conversion into one wort, and the principle of exhausting the goods by gradual or progressive reduction of liquor for conversion in one gyle by never allowing the soluble diastase to be removed or killed until the complete solvency of the goods is effected by the immediate or intimate union or contact of diastase and the action of catalysis in mash-

ing. Thirdly, the keeping of the process as much as possible from the influence of oxidation, and maintaining each process at one uniform or initial temperature. For such processes the temperature of the mash tun, room, and respective floors is likewise regulated and maintained, as described. Fourthly, the improved construction of covered mash tuns with rose or perforated under cover, the arrangements for the supply of liquor, and the screw blade with projections or pins thereon for kneading or commingling the goods, and other improvements, as specified. Fifthly, the general improvements in the fermenting and rounds, substantially as specified. Sixthly, the method and process of reducing the lengths of the fermentation, as specified. Seventhly, the improvements in distillation by the employment of the meal alone, and the process applicable thereto. Eighthly, the improved method of producing vinegar by using the meal alone, as described. Ninthly, the application of the improved mash tun to mash malted grain as hitherto used by brewers, the husk or offal not being removed. And, lastly, the general arrangement of apparatus and system of operation in order to carry out the purposes of the invention. *Patent completed.*

1264 W. E. NEWTON. *Improvements in steam engines.* (A communication.) Dated May 6, 1865.

This invention has for its object to apply a motive power to the piston of an engine by means of the instantaneous generation of steam from water injected into a generator which communicates immediately by means of a valve opening into the cylinder in which the piston works. The invention cannot be described without reference to the drawings. *Patent completed.*

1265 S. TROTMAN. *Improvements in the means of communication between the passengers and guard, or the guard and driver of railway trains.* Dated May 6, 1865.

In carrying out this invention the inventor employs as a signal a ball that may be caused to become mobile at will by releasing it from a fixed position, and causing it to enter a pneumatic tube passing through the entire length of the train. *Patent abandoned.*

1266 I. SWINDELLS. *Improvements in the manufacture of coal gas.* Dated May 6, 1865.

During the distillation of coal or cannel in the manufacture of gas the inventor admits or passes steam at high temperatures, that is, the vapour of water superheated into the retorts amongst the "charge"; by so doing the bisulphide of carbon liberated during the distillatory process is decomposed and carried forward by the gas to the purifiers in a form or condition for which the ordinary purifying agents have great affinity. *Patent abandoned.*

1267 J. HUNT and H. TONGE. *Improvements in apparatus for grinding corn, seeds, minerals, or any other substance ground on the flat surface of a stone.* Dated May 6, 1865.

This invention relates to means of removing or taking away the ground corn or other substance from the stones. The improvements consist in providing or forming a universal or continuous opening around the whole circumference of the bed stone, so that the ground corn or other substance is continually passing from the stones at every part of their circumference, and is conducted from thence by suitable spouting placed underneath. *Patent abandoned.*

1268 W. O. CROPP. *Improvements in carriage lamps particularly, and all lamps of a reflecting nature generally.* Dated May 8, 1865.

In performing this invention an ordinary tin case, or case of other metal, is prepared, having, instead of plate or cut glass or plated silver as a reflector, an oval or globular shaped and hollow glass, which is filled with water or other liquid, from which it partly derives its reflecting and magnifying power; the glass receptacle is placed immediately in the front of the case or at the side, or at any angle, and projects or otherwise; behind it is placed a candle, lamp, or light derived from oil, or any other suitable material, and the reflector is not burnished or plated silver, but one or more pieces of bright prepared glass, specially adapted for reflecting and other purposes. *Patent abandoned.*

1269 P. A. LE C. DE FONTAINEMOREAU. *Certain improvements in apparatus for illuminating.* (A communication.) Dated May 8, 1865.

This invention consists in means of preventing the shadow produced by a light from being projected around the said light. To carry the invention into execution the inventor places above the flame a cap supported by very thin rods, and holding a reflector, the surface of which is so traced that the luminous rays after reflection are made to converge lower than the luminous burner, and to produce light underneath the said burner, which is in the shade in the apparatus now in use. *Patent abandoned.*

1270 J. BUCHANAN. *Improvements in furnace firegrates.* Dated May 8, 1865.

We cannot here give space to the details of this invention. *Patent completed.*

1271 W. CLARK. *Certain improvements in machinery for setting and distributing printing types.* (A communication.) Dated May 8, 1865.

This invention relates to a machine for setting and distributing types which is partly automatic in its operation and partly operated by the action of an attendant. The purely automatic part lies in the type distributing operation, while the setting of the types is governed by an attendant. Both setting and distributing may be going on at the same time or separately. The specification of the invention is too elaborate to be quoted here in detail. *Patent completed.*

1272 J. H. JOHNSON. *Improvements in apparatus for measuring spirits.* (A communication.) Dated May 8, 1865.

This invention is not described apart from the drawings. *Patent completed.*

1273 J. GASKY. *Certain improvements in window sashes and frames, whereby the sashes may be removed and applied at pleasure, part of which improvements are also applicable to sashes as ordinarily constructed.* Dated May 8, 1865.

In giving effect to this invention the patentee makes the sashes and frames in every respect as now generally constructed, with the exception that he applies at the inner parts of the sides of the sashes, where the cords are commonly attached, metal plates or clips that permit the cord by which the sashes are suspended to pass freely in, but which prevent the same being pulled through by means of a knot, or other equivalent, formed at the ends of the sash cords, and by which means such cords may be detached or attached at pleasure. *Patent completed.*

1274 J. H. JOHNSON. *Improvements in safety lamps.* (A communication.) Dated May 8, 1865.

This invention is not described apart from the drawings. *Patent completed.*

1275 R. B. COOLEY. *Improvements in the manufacture of elastic knitted or looped fabrics.* Dated May 9, 1865

The patentee claims, first, the introduction of an additional thread or threads of india-rubber into circular knitted fabrics, as described. Secondly, the introduction of two or more additional threads to or with each loop thread employed in the manufacture of circular knitted fabrics, as described. And, lastly, the introduction of two or more additional threads in the manner described to each course of looped work made in straight frames, or into looped fabrics made on warp machines. *Patent completed.*

1276 S. and J. LAW. *Improvements in breechloading firearms.* Dated May 9, 1865

This invention consists, firstly, in an arrangement or combination of parts for fastening down and releasing the barrels of such breechloading firearms as turn in a vertical plane upon a joint in the fore part of the body, the said firearms being commonly called drop down or snap guns. Secondly, in the following improvements in discharging the cartridges of breechloading firearms by a central fire action. Through the face of the break a pointed pin or striker works, the said pin or striker being pressed into a recess in the break-off by a coiled spring. A vertical bolt working through the break-off acts upon the striker by means of its bevelled end bearing against the inclined side of a recess cut in the upper side of the striker. When on the pulling of the trigger the hammer falls, it strikes on the top of the vertical bolt, and causes it to urge forward the pin or striker, and discharge the cartridge. *Patent abandoned.*

1277 P. WELCH. *Improvements in machines for dressing and finishing printers' types.* Dated May 9, 1865

This invention is not described apart from the drawings. *Patent completed.*

1278 J. C. O. HALKETT. *An improved composition for coating iron or other vessels and for other similar purposes.* Dated May 9, 1865

This invention relates to an improved composition, which is intended to be used as an anti-corrosive and anti-fouling mixture for coating iron or wooden vessels, buoys, piles, piers, or other such structures as are exposed to the deteriorating action of sea water, and consists, principally, of a mixture of a poisonous compound of mercury with mineral tar or pitch, or with vegetable tar or pitch, or other substances of a bituminous nature, in combination with oxide of lead or sulphate of baryta. *Patent completed.*

1279 J. G. HEY and V. SAVORY. *An improved selfacting apparatus for and means of extinguishing fires.* Dated May 9, 1865

In carrying out this invention the inventors form of brass or other metal or material a hollow perforated cylinder; in one end of the said cylinder a hole is bored, and fitted with a plug of brass or other metal, secured therein by solder or other readily fused metal, or the hole may be fitted with a plug of gutta-percha or india-rubber. Inside the cylinder is a spindle, one end resting on the above-mentioned plug, the other end being enlarged and convex for the purpose of forming a valve; in the other end of the said cylinder is screwed a short pipe, having its end fitting and pressing to the convex end of the said spindle, thus forming a valve; the other end of the above-mentioned pipe is screwed into a hole made in the water or steam pipes usually employed in mills or warehouses. The action of this apparatus is as follows:—On a fire occurring, the flames or heat reach this apparatus, when the solder, gutta-percha, or india-rubber immediately fuses; the plug falling out removes the support from the spindle and valve, which at once opens and allows the water, steam, sulphurous acid, or other fire extinguishing gases, to enter the cylinder through the perforations in which it is discharged in various directions, the holes or perforations in the cylinder being bored at various angles for the purpose of facilitating distribution. *Patent abandoned.*

1280 E. T. BELLHOUSE and W. J. DORNING. *Certain improvements in hydraulic presses for packing cotton and other materials or substances, and in the boxes for containing the same.* Dated May 9, 1865

This invention relates, first, to that portion of the hydraulic press known as the cylinder, and consists in the use of a tube or cylinder composed of wrought or drawn iron, or wrought or cast steel, and either made in one piece or in sections secured together to form the cylinder barrel, which is to be connected at its upper end to the cylinder head by being screwed into it, or riveted or bolted to it, such cylinder head being made of wrought or cast metal, and the junction being rendered watertight by a leather or metallic washing being inserted at the place where the joint is made, and may be strengthened by means of a metallic band or hoop shrunk on the outside of that part of the cylinder head. The lower extremity of the cylinder barrel is also to be secured on to or bolted on to the cylinder bottom, and the joint closed by a washer, and strengthened by another loop outside, which completes the construction of the cylinder when in pieces. When formed of one piece, the cylinder will be made of wrought or cast metal, not hitherto used for the purpose, and possessing great strength with comparative lightness. The second part of the invention relates to a novel method of fastening and unfastening the confining bars surrounding the boxes for holding cotton, and consists in the use of a vertical bolt with catchers thereon working into a series of notches, formed at the extremities of the metal cross-hind bars of the box. This vertical bolt is caused to rise and fall by means of a lever and handle attached to the front of the box. A slight movement of the said lever and handle causes the liberation of all the catches simultaneously, and consequently effects the instantaneous opening of the door. *Patent abandoned.*

1281 J. GORTON. *Improvements in the manufacture of a certain description of woven fabric called "Turkish towel."* Dated May 9, 1865

These improvements consist in weaving a fabric of somewhat open texture with a warp and weft of silk waste, which has been previously made into yarn, and which prevents an uneven or knotty appearance and texture. When the warp and weft of this material is combined in weaving, it forms a fabric, the surface of which is covered with tufts or knots, which fill up the interstices left between the open warp and weft, and which knotted surface absorbs moisture to a great degree, and is also peculiarly soft and agreeable to the skin. *Patent abandoned.*

1282 R. H. TWEDDELL. *Improvements in means or apparatus for fixing or tightening the ends of boiler and other tubes, and in cutting the ends or other parts of such tubes.* Dated May 9, 1865

The patentee claims, first, the fixing or tightening of the ends of boiler and other tubes, by means of dies formed in sections and acted upon by inclined sides or surfaces drawn outwards by hydraulic pressure, in manner substantially as explained; secondly, the use of cutting surfaces applied to dies acted upon by inclined surfaces in manner substantially as explained. *Patent completed.*

1283 T. J. MAYALL. *Improvements in door and other mats, part of which improvements is also applicable to brushes and brooms, and to producing card or tooth surfaces employed in operating on various fibrous substances.* Dated May 9, 1865

These improvements relate to forming door and other mats of india-rubber, gutta-percha, or compounds thereof, with points or projections of such material standing up from the surface thereof, to facilitate the more ready removal or cleansing of the dirt or other matters from boots or shoes or other surfaces operated upon by them, and the improvements consist:—First, in forming the backs or under sides of such points or projections hollow, by moulding the same in dies having projections to pass into the backs or under sides of the points or projections of the material forming the mat, by which the points or projections produced will be found more elastic in action, whilst a saving of the material will be effected; secondly, the invention relates to forming such points or projections of cocoa nut or other fibre, or the refuse or chippings of india-rubber or gutta-percha, or other suitable matters, with an outer coating thereto of the india-rubber or gutta-percha, or compounds thereof; thirdly, the invention relates to forming door and other mats of india-rubber, gutta-percha, or compounds thereof, with projections thereon obtained by the introduction of tufts or lengths of hair or other fibre or wire. *Patent completed.*

1284 G. HARTLEY. *Improvements in fasteners for stays or corsets or other articles of dress.* Dated May 9, 1865

According to one method of carrying out this invention the patentee attaches to one of the edges of the bands of stays, or to the stiffeners of dresses, three or more flat metallic tubular fastenings; the top and bottom one of each tubular piece has a nick formed on, or a piece cut out of, the under side; to the other edge of the steel or garment the patentee attaches flattened vertical hooks, their points being reversed or towards each other. Thus, when it is required to fasten the garment, the upper hook is merely dropped into the tube, the bend of the hook resting on the edge of the nick. So also with the lower one, which acts reversely by bending the hook or stiffener, and springing the hook into the tube. In the middle fastening, part of the under side of the tube is cut away, leaving a slot or space which forms a horizontal hook, and a flattened hook (the point of which is reversed to the former), being attached to the opposite edge, the two readily drag into each other, and thus a complete fastening is effected. *Patent completed.*

1285 S. HUDSON. *An improved safety stirrup for ladies' and gentlemen's riding saddles.* Dated May 9, 1865

This invention consists of a stirrup so constructed that when the pressure of the foot is removed from the sole or underplate, a slight pull outwards on one of the legs or sides of the stirrup will cause the leg or side of the stirrup to separate from the instep or top of the arch, and the leg when separated being hinged at the lower end where it joins the footplate is free to turn upside down so as completely to release the foot of the rider. *Patent abandoned.*

1286 J. H. JOHNSON. *Improvements in the manufacture of candles.* (A communication.) Dated May 9, 1865

We cannot here give space to the details of this invention. *Patent completed.*

1287 W. JACKSON. *An improved method of mixing gases and vapours and in the machinery or apparatus connected therewith.* Dated May 9, 1865

We cannot here give space to the details of this invention. *Patent completed.*

1288 C. S. BAKER. *Improvements in paddlewheels.* (A communication.) Dated May 9, 1865

The patentee claims arranging the floats or buckets of a paddlewheel upon its arms, or the equivalent thereof, whereby the buckets shall be continuously increasing and diminishing their depth in the water as the said wheel revolves, as and for the purposes set forth. *Patent completed.*

1289 J. O. CONTREARE. *Improvements in breechloading firearms and cartridges.* Dated May 9, 1865

We cannot here give space to the details of this invention. *Patent abandoned.*

1290 S. L. and A. FULLER and O. MARTIN. *An improved carriage step.* Dated May 10, 1865

The sides of this improved carriage step consist of angle iron, the treads being formed of iron plates secured to the sides by pivots, upon which they can freely turn, transverse bars being so placed as to support the treads when in a horizontal position and ready for use. At the upper part of the step is arranged a bar of iron, which, when the step is attached to a carriage, is placed immediately below the rocker and the door, such bar being provided with transverse pins at the ends thereof, by means of which the bar is retained in bearings of a suitable character, attached to the carriage in such manner that the said bar will work freely therein. A portion of the bar is cut away, so as to reduce the centre part thereof to a semi-cylindrical form, recesses being made in the bar for the reception and passage of the sides of the step. *Patent completed.*

1291 D. ADAMSON. *Improvements in machinery for drilling boiler and other plates of metal, and for riveting them together.* Dated May 10, 1865

This invention is not described apart from the drawings. *Patent completed.*

1292 W. E. BRODERICK. *Certain improvements in churns.* (A communication.) Dated May 10, 1865

The object of this invention is to produce in a cheap and efficient form a churn so constructed as to be capable of producing a prompt and thorough agitation of the cream, of breaking the maximum number of the sacks containing the butter, and of producing, therefore, the maximum quantity of butter, and this without injury to the globules of which it is composed, as it is well known that injury to these globules deteriorates the quality of the butter. For these purposes the inventor provides an upright vessel to receive the cream, and he agitates the cream by means of a perforated dasher, which is moved upwards and downwards by a hollow or air shaft, to which it is attached. This shaft is provided with a valve or valves to control the air-chamber within, and there is at its lowest extremity an en-

largement or inverted cup, which projects beneath the dasher, preventing the latter from striking the bottom of the churn to the injury of the globules of butter, and also providing space for a large quantity of air, which rushes out from radial holes in the sides of the inverted cup, and mixes with the cream, producing thereby a decided improvement in the quantity and quality of the butter, over all of those methods in which the air is not brought into practical requisition. He provides also, attached to the shaft or dasher, or both, one or more wings or arms, which can be made to gather the butter by a rotary or semi-rotary motion produced from the shaft. *Patent abandoned.*

1293 P. O'HAGAN. *Improvements in breechloading firearms.* Dated May 10, 1865

This invention consists of the improvements hereinafter explained in opening and closing the breech ends of such breechloading firearms as open and close by the turning aside of the barrels upon a joint, so as to bring their open breech ends against or remove them from the face of the break-off. A part of the said improvements may also be applied to breechloading guns of the kind called drop-down guns. On the under side of the barrels, and at a distance from their breech ends, nearly equal to the length of the body of the gun, is an axis perpendicular to the plane in which the axes of the barrels are situated. The said axis works in a cylindrical hole or bearing in the body of the gun. The said hole is situated in the centre line of the gun, that is, midway between the two barrels. The open breech ends of the barrels are convex, the curve of the said convex ends being struck from the centre on which the barrels turn. The face of the break-off is concave, and of the same curvature as the ends of the barrels. The barrels are by this arrangement made capable of turning aside in either direction, so as to expose the open breech ends for the introduction of the charge. After the introduction of the charge the barrels are restored to their normal position, and fixed by a spring catch or other fastening. Where the gun is required to turn aside for charging in one direction only, the inventor prefers to make the curvature of the ends of the barrels, and the face of the break-off, slightly eccentric to the centre on which the barrels turn. In this case the curved breech ends of the barrels fit against the curved face of the break-off with a slight wedging action. In all cases he places the axis on which the barrels turn in the centre line between the two barrels, and he makes it work in a cylindrical hole or bearing. *Patent abandoned.*

1294 H. W. HART. *An improvement in buttons, and means of attaching the same.* Dated May 10, 1865

This invention consists in constructing buttons with a shank formed of two metal plates or wires unconnected at the outer ends, and provided with a washer made with an aperture just large enough to allow of the two plates of the shank when in contact passing through it. The plates or wires must be of such metal as will allow of their being bent without breaking. *Patent completed.*

1295 D. HARTLEY. *Certain improvements in the manufacture of "moulds" for metallic castings having a cylindrical form.* Dated May 10, 1865

These improvements consist in the novel employment and use of a strike or template revolving in an axis supported on the moulding box, and parallel to the outer circumference of the cylinder to be cast; the profile or outer edge of such strike is formed to correspond with the shape or design of the casting required, so as during its revolution to remove the loam according to the varying shape of the mould required. When the revolving strike is employed to form moulds of large dimensions, such as supporting pillars and similar castings, the groundwork or foundation of the mould contained within the moulding box is to be permanently filled up with brickwork; the moulding loam is then to be plastered on to the inner surface of such brickwork, after which the strike is caused to revolve, as described, to form the surface into the design required, which produces a smooth and even surface upon the loam, and thereby forms an effectual mould for the cylindrical casting without the use of the solid pattern now employed. When a mould for a curved tube or elbow is to be formed, the above described method may be used to form the flange or ornamental cap, and the curve of the tube is formed by means of a groove or template, in which a profile moves to remove the loam, according to the shape of the template or guide. *Patent abandoned.*

1296 E. MYERS. *Improvements in wet gas meters.* Dated May 10, 1865

We cannot here give space to the details of this invention. *Patent abandoned.*

1297 J. FORBES. *Improvements in drying malt and grain and in the machinery or apparatus connected therewith.* Dated May 10, 1865

One mode of carrying out this invention consists in placing a fan, pump, or other exhausting apparatus on the outside, or other suitable portion of the kiln, ducts, passages, or pipes being led from the fan, pump, or other exhausting apparatus, to the interior of the drying chamber. Thus, when the exhausting apparatus is set in motion, the aqueous vapour evaporated from the malt or grain is drawn off, and a fresh supply of hot air is drawn in through openings in the bottom of the kiln, which, in passing through the layer of malt or grain, causes it to be dried much more speedily and effectively than under the old method, in which the evaporated moisture was permitted to hang over the grain being dried. *Patent completed.*

1298 J. MELVIN. *Improvements in jacquard machines.* Dated May 10, 1865

The patentee claims, first, the general arrangement and construction of parts forming the particular species of jacquard machines, as described. Secondly, the application of two barrels with two sets of carus to jacquard machines for the purpose of weaving a pattern or plain cloth or figured cross border in different parts of the same web, as described. Thirdly, the use of the sliding or spring board plates for acting on the alternate ends of the needles, and the use of springs for acting on the needles at both ends, as described. *Patent completed.*

1299 P. BRASH and R. IRVINE. *Improvements in ornamenting candles.* Dated May 10, 1865

This invention consists in the application of a well-known method of producing designs on glass and porcelain vessels, whereby the patentees are enabled to transfer coloured designs such as armorial bearings, bouquets of flowers, paintings, and other designs, to the surface of the candle. In carrying out the invention, the designs intended to be placed or transferred upon the candle are printed preferably

in varnish colours upon prepared or enamel paper (they prefer such paper coated with gypsum and size), and the coloured impressions produced are transferred to the candles by taking the paper having the lithographic or printed design upon it, and firmly holding it upon or against the candle, and pressing or rubbing it by means of a burnisher. The candle and design attached are now dipped in water till the paper has absorbed sufficient water for its easy removal, leaving the design fixed upon the portion of the candle to which it was applied. The patentees prefer to apply a quick drying varnish to the surface of the candle, so as to ensure the speedy fixture of the design thereon. *Patent completed.*

1300 J. J. Revy. *Improvements in the manufacture of gun cotton cartridges for cannon and small arms.* Dated May 10, 1865.

The patentee claims giving to the charge of gun cotton a greater density than heretofore by pressing the gun cotton charge around a cylinder by rollers, as described. Secondly, dividing the charges of gun cotton cartridges into two or more portions of differing densities, as described. Thirdly, separating the two or more portions into which the charge of a gun cotton cartridge may be divided by a strong resisting medium, as described. *Patent completed.*

PROVISIONAL PROTECTIONS.

Dated July 22, 1865.

1917 W. Wapshare, Salisbury. An improved apparatus for cooking, a portion of the same being applicable for washing and ironing.

Dated August 30, 1865.

2234 S. L. James, Groydon. Improvements in traction engines and other vehicles.

Dated September 16, 1865.

2370 H. A. Bonnevill, Forcheste-terrace, Bayswater. Improvements in safety lamps for use in mines and other localities. (A communication.)

Dated September 27, 1865.

2476 W. Tatham, Rochdale, Lancashire, machine maker. Improvements in machinery or apparatus for preparing and spinning cotton and other fibrous materials.

Dated October 3, 1865.

2529 H. A. Bonnevill, Forcheste-terrace, Bayswater. Improvements in the manufacture of sheet iron or steel cylinders for boilers, and similar articles, and in the apparatus relating thereto. (A communication.)

Dated October 6, 1865.

2574 W. Clark, Chancery-lane, engineer. Improvements in apparatus for steeping or treating paper pulp, and other matters subjected to the action of alkalies. (A communication.)

Dated October 16, 1865.

2687 J. L. Hancock, Tipton, Staffordshire. An improved method of, and apparatus for, separating ashes from cinders.

Dated October 24, 1865.

2743 F. H. Grey, Old Bond-street, gunmaker. Improvements in the construction of gun locks for the discharging of central fire cartridges, as used in breechloading fire-arms.

Dated October 27, 1865.

2770 R. B. Sanson, East-street, Manchester-square, London, engineer. Improvements in roller skates, and in the rollers to be used therewith, and for other purposes.

Dated October 28, 1865.

2774 J. Bernard, Lincoln's Inn-fields. Improvements in tools and apparatus employed in blasting, boring, and cutting rock, stone, and other hard substances, and in the means employed for making such tools.

Dated October 28, 1865.

2777 J. Murray, master mariner, and C. Wells, ship owner, Liverpool. Improvements in the means of attaching and detaching the sails of navigable vessels to and from the stays, yards, and other fittings connected therewith.

Dated November 3, 1865.

2842 E. J. Northwood, Felix-place, Islington, ballion refiner. Improvements in plating or combining gold, platinum, and other metals or their alloys.

Dated November 4, 1865.

2843 A. Heald, Manchester, engineer. Improvements in looms for weaving.

Dated November 4, 1865.

2846 A. Jemmett, Binfield, Berkshire. An improved apparatus for scattering lime, guano, or other artificial manures either in a dry or liquid state, or for scattering disinfectants.

Dated November 4, 1865.

2848 W. Brett, Gasworks, Hertford. An improved truck or barrow for wheeling and tipping coke, coal, or other substances.

Dated November 4, 1865.

2851 T. Page, Adelphi-terrace, Strand, civil engineer. Improvements in the means of preventing vessels from sinking, which means are also applicable for raising sunken vessels.

Dated November 6, 1865.

2857 W. T. Hamilton, Belgrave-square, Rathmines, Dublin. An improved bit for boring mortices in wood or other material.

Dated November 7, 1865.

2889 W. E. Newton, Chancery-lane, civil engineer. Improvements in apparatus for working, pointing, and checking the recoil of cannon or ordnance. (A communication.)

Dated November 8, 1865.

2875 W. Manwaring, Banbury, Oxfordshire, engineer. Improvements in the construction of reaping and mowing machines.

Dated November 8, 1865.

2882 G. A. Ermen, Eccles, Lancashire, manufacturer. Improvements in treating vegetable fibres used in the manufacture of paper and other similar substances made from pulp. (A communication.)

Dated November 9, 1865.

2889 B. Pitt, Hatton Garden, engineer. Improvements in the construction of door locks, latches, and such like fastenings, and in knob and handle spindles, and furniture used therewith.

Dated November 9, 1865.

2890 J. E. Ayr, Boulevard Sebastopol, Paris. An improved selfacting regula or dial applicable to all descriptions of public conveniences.

Dated November 9, 1865.

2891 W. E. Newton, Chancery-lane, civil engineer. Improvements in preparing the surfaces of paper, leather, woven and other fabrics and substances for receiving photographic pictures, engravings, lithographs, and prints, and for rendering such substances fire and waterproof. (A communication.)

Dated November 10, 1865.

2893 E. Myers, Millbank-row, Westminster, civil engineer. Improvements in the arrangement and construction of wet gas meters.

Dated November 10, 1865.

2894 E. T. Hughes, Chancery-lane. Improvements in the means of producing from roseaniline blue and violet colouring matters. (A communication.)

Dated November 10, 1865.

2895 A. V. Newton, Chancery-lane, mechanical draftsman. Improvements in the manufacture of embossed wood. (A communication.)

Dated November 10, 1865.

2897 T. Whitwell, Stockton-on-Tees, iron master. Improvements in furnaces for heating the blast for blast furnaces.

Dated November 10, 1865.

2899 H. O. Carden, Rue du Dunkerque, Paris. An improved metronome or apparatus for measuring intervals of time.

Dated November 10, 1865.

2900 C. W. Jones, Cheltenham, Gloucestershire. Improvements in firearms and projectiles.

Dated November 10, 1865.

2903 W. E. Newton, Chancery-lane, civil engineer. Improvements in making amalgams or alloys of metals. (A communication.)

Dated November 10, 1865.

2904 A. V. Newton, Chancery-lane, mechanical draftsman. Improved machinery for rolling shafts and axles. (A communication.)

Dated November 10, 1865.

2905 J. A. Nicholson, Adelaide-place, London Bridge. Improvements in regulating the flow of water and other fluids in pipes and valves, and determining the quantity passing through the same.

Dated November 10, 1865.

2906 J. Millar, Bethnal Green, physician. Improvements in cartridges.

Dated November 10, 1865.

2908 W. R. Lake, Southampton-buildings, Chancery-lane, consulting engineer. Improvements in the crank axles of locomotives for railroads. (A communication.)

Dated November 10, 1865.

2909 W. Reid, Granton, Midlothian. Improvements in supplying cattle with food and water on railways, and in the apparatus or means connected therewith.

Dated November 10, 1865.

2910 D. A. Jones, Birmingham, carpenter. Certain improvements in the manufacture of soles or inner soles for boots and shoes.

Dated November 13, 1865.

2913 G. H. Goodman, London-road, engineer, and E. Bow, Malstone, artificial stone manufacturer. Improvements in machinery for crushing or reducing stone, quartz, emery, and other mineral substances.

Dated November 13, 1865.

2917 W. Williams, King's Norton, Worcestershire, manufacturer. Improvements in door springs.

Dated November 13, 1865.

2918 J. Stephens, Great Rider-street, St. James's. Improvements in portfolios, writing desks, writing cases, and other similar apparatus.

Dated November 13, 1865.

2919 W. Fox, M.D., Henrietta street, Cavendish-street. Improvements in preserving meat and other articles of food.

Dated November 13, 1865.

2920 J. H. Whitehead, Royal George Mills, Saddleworth, West Riding, Yorkshire. Improvements in apparatus for heating the feed water for steam boilers.

Dated November 13, 1865.

2922 W. R. Lake, Southampton-buildings, Chancery-lane, consulting engineer. An improved method or process for producing papermakers' pulp from cane, bamboo, and other analogous substances. (A communication.)

Dated November 13, 1865.

2923 J. J. Long, Glasgow, timber merchant and match manufacturer. Certain improvements in cutting or dividing timber, and in machinery or apparatus connected therewith.

Dated November 13, 1865.

2924 H. E. Newton, Chancery-lane, mechanical draftsman. An improved mode of ventilating millstones. (A communication.)

Dated November 14, 1865.

2927 J. Williamson, Bagthorpe, machine builder, J. Lindley, wheelwright, and J. Coleman, coal miner, Selstone, Nottinghamshire. Improvements in brakes.

Dated November 14, 1865.

2929 J. Dixon, Abchurch-lane, City, ironmaster. Improvements in purifying or refining iron.

Dated November 14, 1865.

2931 T. A. Weston, J. Tangye, and R. Chapman, Birmingham, engineers. Improvements in apparatus for raising and lowering, moving, or transporting heavy bodies.

Dated November 14, 1865.

2932 T. Dobie, Barnsley, Yorkshire. Improvements in the permanent way of railways.

Dated November 14, 1865.

2933 W. Clark, Chancery-lane, engineer. Improvements in the means of connecting drums or pulleys with their shafts or drivers. (A communication.)

Dated November 14, 1865.

2935 S. L. Gill, Campbell-terrace, Bromley, Middlesex. Improvements in gas stoves.

Dated November 16, 1865.

2937 W. Bülger, Southampton-buildings, Chancery-lane, civil engineer. Improvements in photographic lenses. (A communication.)

Dated November 16, 1865.

2939 G. Chambers, Russia-row, manufacturer, and G. Gregory, James-street, St. Luke's, look manufacturer. Improvements in locks or catches for portmanteaus, portfolios, or other articles.

Dated November 16, 1865.

2941 A. Wells and W. Hall, Southwark, manufacturers. Improvements in submarine electric telegraph cables, and in machinery employed in the manufacture and submergence thereof.

Dated November 16, 1865.

2943 H. O'Connell, Ormesby Ironworks, Middlesbrough-on-Tees, engineer. Improvements in stoves for drying moulds.

Dated November 16, 1865.

2944 J. Goodier, Chester, miller, and J. F. Kishaw, New Brighton, Cheshire, cordwainer. Improvements in apparatus for feathering the paddles of propellers for navigable vessels.

Dated November 16, 1865.

2945 W. Clark, Chancery-lane, engineer. Improvements in the manufacture or purification of hydrocarbons and especially of petroleum oils used for lighting purposes. (A communication.)

PATENT APPLIED FOR WITH COMPLETE SPECIFICATION.

Dated November 16, 1865.

2942 L. A. Vain and F. E. Fosse, mechanicians, and L. E. A. Fosse, Rue des Tournelles, Paris. An improved arrangement for stopping or retarding railway carriages, waggons, trucks, or other rail or tramroad vehicles.

LIST OF SEALED PATENTS.

Sealed November 24, 1865.

1441 T. H. Hoblyn
1456 R. A. Brooman
1457 R. A. Brooman
1458 R. A. Brooman
1459 P. Young
1470 H. Son
1471 E. Myers and J. Stodart
1472 W. Johnson
1473 F. A. Paget
1475 W. T. Hamilton
1491 J. Jopling
1494 B. Lawrence
1497 J. Calvert
1490 T. A. Browne and J. Knight

1489 T. Spencer
1497 F. N. Gisborne
1503 W. J. Burgess
1505 H. Allman
1506 H. Allman
1512 H. Mallet
1515 H. Allman
1519 W. Gadd and J. Moore

1522 F. J. Bolton and R. Matheson
1531 O. de Bergua
1548 H. H. and J. V. G. Kronschoeder
1577 W. H. Harfield
1738 H. P. Tipper
1775 G. Low
2279 T. T. Ponsomby

Sealed November 27, 1865.

1482 W. Martin
1508 T. Brianhead
1510 F. Knight
1511 T. Hunt
1518 R. A. Brooman

1543 A. I. L. Gordon
1552 G. Haseltine
1578 G. E. Mapk and W. H. Howel

NOTICES OF INTENTION TO PROCEED WITH PATENTS.

From the London Gazette, November 28, 1865.

1852 W. P. Baylis. Locomotion of trains.
1856 J. O. Walker. Springs.
1871 W. A. Richards. Pouch.
1882 D. Oaddick. Working furnaces.
1891 H. A. Olum. Indicating atmospheric changes.
1896 A. V. Newton. Envelope machines. (A communication.)
1902 J. Walton. Looks.
1904 A. Smith. Sewing machines.
1905 J. H. Chandee. Salts.
1910 E. Ferré. Motive power.
1914 J. P. Gillard. Soda.
1922 J. Leetch. Orinolines.
1926 T. J. Mayall. Military outfits.
1934 M. Kenney. Rolling bridges.
1946 T. Pepper. Antiflammable starch.
1955 I. Gregory. Communication in railway trains.
1957 W. E. Newton. Airproof solutions for caustic. (A communication.)
2016 W. H. Preece. Electrical signal apparatus.
2021 W. Clark. Motive power. (A communication.)
2040 A. Millochau. Stills.
2048 W. Clark. Loading ships. (A communication.)
2081 P. C. Kjellberg. Fixing safes.
2128 N. O. Skerelmy. Paper boards.
2129 J. L. Naish. Illustrating astronomical phenomena.
2185 G. W. Howard. Tanks.
2348 S. Fox. Umbrellas.
2358 J. Whitehouse. Box irons.
2481 J. J. M'Comb. Paddlewheel. (A communication.)
2644 G. Marshall. Casks.
2654 W. J. Armitage, F. Wooler, and J. Hodgson. Tyres.
2671 T. M'Grah. Securing the handles of knives.
2727 J. W. Lea. Window apparatus.
2729 L. D. Girard. Sliding surfaces.
2788 J. Stanley. Knickerbockers.
2827 W. E. Dobson. Dressing lace.
2828 B. F. Brunet. Torsion in threads of textile substances.
2833 J. Webster. Generating gases.
2849 P. B. O'Neill. Selfacting boiler feeder.
2856 J. Whitworth. Charges for rifled ordnance.
2875 W. Manwaring. Mowing machines.
2881 N. Beard and J. Maiden. Lubricating cylinders of steam engines.
2903 W. E. Newton. Alloys of metals. (A communication.)
2942 L. A. Vain and F. E. and L. E. A. Fosse. Stopping railway carriages.
2943 H. O'Connell. Stoves.

The full titles of the patents in the above list can be ascertained by referring back to their numbers in the list of provisional protections previously published.

Opposition can be entered to the granting of a patent to any of the parties in the above list who have given notice of their intention to proceed, within twenty-one days from the date of the *Gazette* in which the notice appears, by leaving at the Commissioners' office particulars in writing of the objection to the application.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

3127 J. Townsend
3136 J. Taylor, jun.
3230 G. F. Blumberg
3155 W. Tatham
3168 T. Fletcher
3174 J. E. Danky and B. P. and E. P. Walker
3176 J. Halford
3193 W. Clark

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

2662 R. H. Hughes
2772 R. Legg
2672 F. C. Calvert and G. Lowe

LIST OF SPECIFICATIONS PUBLISHED

For the Week ending November 25, 1865.

No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.
102 1	s. d.	111 0	s. d.	120 5	s. d.	130 8	s. d.	139 1	s. d.
103 0	4	112 8	4	121 0	4	131 8	4	140 0	4
104 0	10	113 0	4	123 0	8	132 0	4	141 0	10
105 0	4	114 0	8	124 0	4	133 0	4	142 4	8
106 0	10	115 0	10	125 0	8	134 0	8	143 0	10
107 0	4	116 0	4	126 0	4	135 0	4	144 0	10
108 0	4	117 0	4	127 0	8	136 0	4	145 0	4
109 0	4	118 0	4	128 0	4	137 0	8	146 0	8
110 0	10	119 0	8	129 1	0	138 1	0	147 1	2

NOTE.—Specifications will be forwarded by post from the Great Seal Patent Office (publishing department) on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post Office Order, made payable at the Post Office, High Holborn, to Mr. Bennett Woodcock, Great Seal Patent Office, 25, Southampton-buildings, Chancery-lane.

MECHANICS' MAGAZINE.

LONDON: FRIDAY, DECEMBER 8, 1865.

SIEMENS' REGENERATIVE GAS FURNACES.

IN the adoption of any new method or scheme for producing effects which have previously been brought about by different means, the first question asked is, what will it cost? The real meaning attached to the question is, not so much what the actual first cost may be, although that of itself is a very important item, but what proportion the original expenditure will probably bear to the subsequent saving. Of the ultimate advantages of the regenerative gas furnaces over those ordinarily employed there can be now little doubt. They reduce the amount of fuel from 40 to 60 per cent., and at the same time allow of an inferior description being used, which is of more importance still. These furnaces are more durable than others, their heat is under perfect command, the flame is exceedingly pure, they take up very little space, are remarkably cleanly when in operation, and emit but a very small quantity of smoke from the chimney. With all these advantages in their favour, advantages which it is admitted they have been shown to possess, it might be reasonably demanded, what are the objections to them? In the first place they are very expensive, and secondly they are not suitable, as we shall point out hereafter, for any but large establishments. We do not find fault with their being expensive, for all really valuable improvements are so, but we maintain that their cost is far beyond what it ought to be. Under our title are included the "producers," which make the gas for supplying the furnaces, and are of course indispensably connected with them, although they may be built at any convenient distance from them. It may be remarked that the further they are apart the greater will be the length of the smoke and gas flues which form the connection between the producers and furnaces. These flues are, for this reason, universally built one over the other wherever circumstances will permit. The cost of a work depends chiefly on the value of the materials and labour employed in its construction. A very small quantity of a cheap material may, by the employment of a large amount of skilled labour upon it, be converted into an article the selling price of which would be enormously in excess of its intrinsic value. Let us consider now the materials forming the principal component parts of the regenerative gas furnaces. They are ordinary stockbricks, firebricks, cast iron, and a very small portion of wrought iron. None of these materials are, *prima facie*, of a very expensive nature. The stockbricks are comparatively few in number, and are used in the foundations and to form the carcass, so to speak, of the furnace. The cast iron is nearly all in the form of large plates, or other convenient shapes. The patterns for castings of this description can be made at a very low price, and most of the castings themselves may be run "open sand," thus obviating all necessity for using "boxes," and thereby saving considerable time, trouble, and expense. In bringing the castings from any distance, care must be taken that they be securely packed, or otherwise a serious loss may be incurred, as the plates are very liable to crack, their thickness not usually exceeding half an inch or at the most three-quarters. The wrought iron in the furnaces consists simply of tie rods, bolts and nuts, and a few bars of angle iron in the producers, involving no cranking, welding, or forging whatsoever. The cooling tubes, certainly, demand the aid of skilled labour, but not of any unusual kind. They are formed of thin plates of wrought iron

bent round until they overlap each other, and then riveted together with a lap joint.

Simplicity of construction is the chief desideratum in every design. If we investigate any patent for an improvement in a particular machine, we shall generally find that the improvement consists in doing away with some cumbrous or complicated part of the machine, and substituting a simplification in its stead. In fact, it may almost be said at the present day that to improve is to simplify. So far, we have no fault to find with the regenerative gas furnaces on this point; but directly we come to that portion which is built of firebricks any approach to simplicity is at an end. The firebricks, that is firebricks of the ordinary kind, form a lining all round the inside of the furnaces for the manifest purpose of keeping in the heat. In addition to these, there are burrs, soap bricks, split bricks, arch bricks, and silica bricks. If there were but one description of each of these there would still be quite sufficient a variety to cause a great deal of extra trouble and expense, but the following particulars will show that for the area occupied by any one furnace the number of different-sized materials employed is without a parallel. It may here be repeated that the furnaces are built up of brickwork and cast iron, and that wherever the iron plates, girders, valve boxes, &c., are inserted, it becomes necessary to bring up the brickwork to their level. For this purpose three or four different sizes of split bricks are used, varying in thickness by only a quarter of an inch, in order to compensate for the unevenness produced in the work by the building in of the cast-iron parts. In any ordinary description of work, these small unevennesses would be made good either by thickening the joints or inserting filling pieces. It speaks well for the care and attention bestowed upon the original design that these usual make-shifts—for at the best they are nothing more—should have been discarded altogether and a more efficient, although, it must be confessed, a much more expensive, substitute provided. Of all the materials employed the burrs present the greatest amount of diversity. Burrs are simply firebricks of an unusual shape and size. In a set of producers and in three or four furnaces supplied from them, there are no less than upwards of twenty different-shaped burrs. These are principally used for spanning small openings, the dimensions of which are so limited that it would be inconsistent with good workmanship to turn an arch over them. In other instances the depth of the arch would itself interfere with other portions of the work. It is not only the variety of sizes of burrs, ranging from about 10in. to 30in. in length, that creates considerable trouble and inconvenience during the construction of the furnaces, but much is also occasioned by the fact that only three or four of the larger sizes—say, of those from 24in. to 30in. in length—are required in one particular furnace. It is perhaps fortunate in a pecuniary point of view that so few of these larger-sized burrs are required, for they cost on an average about two and sixpence each, which in comparison, bulk for bulk, with ordinary firebricks is an enormous price. On the other hand, as even these three or four are absolutely indispensable to the progress of the work, it is a ways advisable to have a double supply, since they frequently get broken in their transit. This latter accident is one to which they are very liable, and which renders them perfectly useless for their intended purpose. Unless there are some in hand to replace them, the building of the furnaces cannot be completed, and a very awkward delay might be thus occasioned. It also frequently occurs that the burrs which are intended for a certain position in any particular furnace are put in some other place, and as those for which they are substituted will not answer for their place, there is another necessity for having a double quantity on the ground. This of course arises partly from the carelessness of the workmen, but when we consider what a large

quantity of different-sized materials they have to deal with, in many instances varying but very slightly in general appearance from each other, it is not to be wondered that such mistakes will continually occur. Such being the complicated nature of the construction of the internal portions of the furnaces, thereby entailing so much additional extra work and outlay, it may reasonably be expected that before long some remedy will be found which will effect a reduction in their first cost. The great and insuperable obstacle to the employment of a cheaper material is the intense heat generated by the combustion of the gas. Cast iron would melt away, wrought iron, we believe, has been tried, but was found to scale off and deteriorate so rapidly as to effectually prevent all attempts to make further use of it. A preparation of asbestos would certainly stand the heat, but in addition to it being in all probability quite as costly a material as the one in present use, it would be very difficult to apply it so as to afford the requisite degree of strength and durability.

Having now fully taken into account the points which conduce to render the erection of the furnaces a more troublesome and complicated job than it might be, we pass on to the consideration of their real economy, which, as it has been previously observed, will not be found in employing them in small establishments. The great secret is to keep them always going. Like the ancient vestal fire, when once lighted they should never be permitted to go out. What the boiler is to the steam engine the producers are to the furnaces, and the true economy of their introduction is precisely analogous to that of steam power. There is very little, if any, saving effected in substituting steam power for manual or other description of labour, if the demand be not constant. If the engine be idle while steam is generated in the boiler the power is going to loss, or, in other words, so much money is evaporating. It is well known that with an ordinary locomotive there is a certain speed which ought always, when possible, to be maintained, for not only is nothing saved, but, on the contrary, a loss sustained by driving it at a slower rate. The case is exactly the same with the regenerative furnaces. Within certain limits the supply of gas from the producers can be increased or decreased according to the consumption and the quantity required, but there is nevertheless a minimum quantity which ought always to be consumed in actual working, or, to follow out our simile, so much money is melting away. In all establishments whose workshops are not in operation both day and night, there is therefore a loss incurred during the night, for the producers cannot be allowed to go out, as it takes a very considerable time to get the furnaces up to welding heat. The quantity of the gas and purity of the flame in the furnaces are also much improved by a constant demand. The gas which is produced while the producers are in a state of incipient combustion, like the first products of chemical distillation, is inferior to what is generated after the producers have been some time at work and have got into full play. Another very important point, so far as economy of fuel is concerned, which requires to be attended to, is the working of the reversing valves. These valves are placed at the entrance of a small flue leading into the regenerator chambers, and, in fact, may be considered as the doors of those chambers, which work in pairs as follows. We will suppose all excess, waste, the products of combustion, &c., in the furnace to pass down two of these chambers into the smoke flue, while thence to the chimney the air and gas are passing into the furnace through the other two chambers. After a certain time the first pair become very much heated, and consequently the products of combustion would leave the furnace with a very high initial temperature, thereby causing a great loss of fuel. To prevent this, the valves are now reversed, causing the products of combustion to pass away through the cool

chambers and the air and gas to enter the furnace through the heated ones, which also give the cold air and gas the benefit of their high temperature. The simplest and best way of knowing whether the furnaces are in proper working order, and if this important point is attended to, is to watch the chimney. If it gives out much black smoke, there is something wrong. When everything is in first-rate order the chimney emits but a very small quantity of very light-coloured smoke, more like steam than anything else. This of course premises that the chimney is not used for any other purpose, otherwise the results will be ambiguous. The reversing valves are the only detail in the manipulation of the furnaces which give any trouble when they are once put in working order, and this only occurs from the fact that it is not an easy thing to get an ordinary workman to attend to them at the proper periods. They require to be reversed about every two hours, and, to show how important a thing it is that proper attention should be paid to this operation, sand glasses are provided for the purpose of indicating when the proper time arrives. We have every reason to believe that the regenerative furnaces are steadily gaining ground, and there is not the slightest doubt that where they can be worked, as we have shown, with real economy, the saving afterwards effected will more than warrant their present expensive mode of construction, a mode which we hope very soon to see altered both as regards its cost and the complicated nature of its details.

TREATMENT OF IRON FOR RAILS.

THE chemical composition of iron undoubtedly exercises a considerable influence upon the character of the ultimate produce, and too much consideration cannot be given to its constituents. But there is yet another point to which an equal amount of attention is necessary, and this is the mechanical treatment of the metal. This is an important point, and one quite irrespective of chemical components. The general practice in Wales is to use the ordinary squeezer, although in some works a patent squeezer, consisting of three grooved eccentric rollers, is used, and this is certainly a preferable machine to the other. The compression of iron is otherwise mechanically effected by the old tilt hammer and the steam hammer. At one time the tilt hammer was the only means of compression used, but since the furnaces have been driven, and forge and finery cinders and impure ores have been used, an inferior iron has been made, which will not stand the old tilt, and so the squeezer was introduced. By this instrument almost anything can be shingled into a bloom and passed through the rolls, whereas, with the old tilt, the iron, from first to last, has to bear the full weight of the blow. With the steam hammer, however, the case is different, as the blow can be regulated to any nicety. Specifications for rails frequently contain the stipulation that the iron shall be hammered, and not squeezed, and the plan has been adopted of doubling the puddle balls by slightly hammering them, placing them one on the other, and welding them into a slab for the head of the rail. By this arrangement the rail-head is made crystalline and not fibrous, as it is only submitted once to the drawing action of the rolls. After being squeezed or hammered, the iron is passed through the rolls, and leaves them as No. 1 iron or puddle bar, which is cut by shears into the lengths necessary for the subsequent pile. There are different methods of making the various piles for rails, &c., the great object in piling being to get the pile as solid as possible, and free from interstices. Piles are frequently made of puddle bar of different widths, piled alternately so as to break joint. In some instances the puddle bar is cut into short lengths, equal to the width of the pile, and each layer piled at right angles to the previous one. The

object of this arrangement is to make the iron less fibrous, and it certainly has that tendency.

There are various sections of rail in use, but the three most general are the double-headed rail, the bridge rail, and the American or contractors' rail. The double-headed rail is generally made with slabs at the top and bottom of the rail; which for the best quality of rails are about 2in. in thickness, and the rails are double-headed. In some instances these rails are made of three hammered slabs piled on each other. In rolling the American, or flange-rail, as it is also called, a particular description of cold short iron is made for the flanges to stand the strain that necessarily arises from the rails being rolled edgewise, and the flanges not travelling at the same speed (from the less periphery of the rails) the flange portion of the rail also should slip. Partially on this account, then, and partially on account of the flange becoming colder than the mass of the rail, it is difficult to obtain a perfect flange unless a peculiar description of iron is used. This iron is made generally with forge cinders and Welsh ironstone without any red ore. The bridge rail is rolled flat—head up and down,—and in this example the iron is only likely to rip by becoming cold, and is submitted to far less strain than in the flange rail. In the common sort of American rails the slabs for the heads are frequently made not more than $\frac{3}{4}$ in. thick, and the rails are only single-headed. Single-headed rails require on an average about 12 cwt. of coals to the ton, and double-headed about 16 cwt. The readiest method of ascertaining the way in which a rail has been piled and the thickness of the top slab for the head consists in filing a section of the rail smooth and applying dilute mineral acid to the surface. By this means the iron becomes dissolved and the cinder in the welds or joints is left intact. The strains to which rails are subject differ greatly from those imposed upon most other descriptions of manufactured iron. It therefore follows that fibrous iron, such as is used for making cable bolt, is not adapted for them, as, owing to the iron being too soft, the rails soon begin to laminate, and strips or ribbons pare off. Various means have been adopted to make iron crystalline and hard. As a rule, the more iron is rolled the more fibrous it becomes up to a certain point, and for this reason many engineers have the slabs for the heads of the rails hammered so that they may only be submitted to the drawing action of the rolls once. It has been found that by smelting the oolitic iron ores with a mixture of a cinder and clay ironstone, a peculiar description of cold short crystallised iron is produced, and this iron has been very largely used in the manufacture of the heads of rails. To the phosphorus accompanying the oolitic ores this iron owes its peculiar characteristics; phosphorus having the property of making the iron, with which it is alloyed, work soft and cold short. Rails made with this iron have been used on lines of railway with success. Although this iron is hard it is nevertheless somewhat weak, and as a hard strong iron can be made with equal advantage by the use of manganese it follows that this is a preferable ingredient to phosphorus, which reduces the strength of the iron.

BOULTON AND WATT.

PERHAPS no two men possessing such diverse temperaments as Boulton and Watt ever united their fortunes and brought their plans to so successful an issue as they did. Boulton, penetrating, self-reliant, energetic, and thoroughly commercial; Watt, timid, reticent, over-cautious, and dependent, and to whom each new triumph, although a theme of exultation in itself, was but the precursor of some new anxiety. But this very diversity of character was after all the secret of a success which, individually, neither might have achieved. Boulton, however, might have done without Watt, but Watt could not have

dispensed with Boulton. It was only a reliance upon his partner's superior business capacity and unflinching energy that enabled Watt to hold up his head at all during the financial crisis through which they had to pass. Boulton's was the head that steered them through the long and apparently interminable series of difficulties which paved their road to fortune and fame. Watt was often crushed, broken down, and despairing, and in this Boulton had to bear with and cheer him. Nor was Watt the only wet blanket on Boulton's operations. Fothergill, his other partner, was even more desponding than Watt. Matthews, too, the London agent of the firm, followed in the same strain, and ever and anon poured lamentable prophecies of impending ruin into poor Boulton's ear. However, Boulton's indomitable pluck carried him through all, and in spite of his three Job's comforters he succeeded—although not without a severe struggle—in placing them and himself far beyond the reach of a recurrence of similar circumstances. But though of such opposite characters there were undercurrents in the lives of Boulton and Watt which flowed on in unison; their genial, warm-hearted, honest, and honourable natures formed the true foundation upon which their success was built. Like most foundations, however, this has generally been kept out of sight, but Mr. Smiles, in his biography, to which we gladly return, gives us the key to their real greatness. The engine alone would not have produced the results which accrued to the partners had they possessed nothing in common beyond their talents, or their capacities for their respective work. But, however different the directions in which they appeared to work, their sympathies were one, and there was a mutual co-operation underlying all which led in the end to the attainment of results far beyond their most sanguine expectations.

Our previous notice of the work now before us left off at what appeared to be a turning point in the pecuniary struggles of Boulton and Watt. This was in the year 1779. Orders were coming in and matters looked hopeful, but to execute these orders much outlay of capital was needed. Skilled workmen were not only rare, but almost unheard of, and the mechanical appliances to aid labour were more or less rude and primitive. Thus things went on until 1785; everything had been outgo, the profits were all to come. Boulton was himself really in far greater straits than Watt; he had risked his whole fortune on the enterprise, and besides finding money for buildings, plant, wages, materials, and credits, he was maintaining Watt until the engine business became productive. Before that happy time arrived it is estimated that upwards of £40,000 were invested in the business, all this of course being found by Boulton. In 1785, however, it became clear that the enterprise would be a success, and that the demand for engines must shortly become national. But no sooner was this perceived than a danger of another kind threatened the firm, and caused nearly as much anxiety to Boulton as it did to Watt. A movement was set on foot in Cornwall and elsewhere, the object of which was to upset the patent. Had the engine been no improvement upon the old Newcomen machine, no one would have questioned the right of the patentees to their property. But directly its universal utility became apparent it began to be urged that the public ought to be free to use it without paying for it. The highest testimony to its efficiency was the allegation that it had become indispensable for the proper working of the mines. On these very grounds the Cornishmen sought the abolition of the patent right, observing truly that it would be an immense boon to the mining interest. Of course a patriotic spirit was imported into the movement and the agitators laboured to show how greatly the general industry of the country would be benefited by the repeal of the special act by which the patent had been extended, in that the ores would be worked at a greatly reduced cost. But it was the great reduction

in cost which had been effected upon the old system that led them to grasp at further gain and to grudge the inventors the well-merited reward of their labours. Boulton and Watt were charged with a monopoly, but against this stood out boldly the fact that the mining interest retained two-thirds of the advantages derivable from the use of the engine in saving fuel, whilst one-third only was reserved to the patentees, and even this was still further reduced to meet the pressure of the times. Of course, there was another side to the question; it was scarcely reasonable that Parliament would take away the right it had granted. The legislature would scarcely consign the inventors to certain ruin because it would be for the advantage of the Cornish miners to have the use of the invention without paying for it. This was the view taken by Boulton and Watt, and they felt strong in the conviction that their patent right would be maintained. After much agitation, the threatened petition quietly fell to the ground and was never presented to Parliament, so that the partners were again permitted to pursue their way unfettered, at least in this direction.

Among the many minor but not less useful inventions which emanated from the brain of Watt, was the copying machine, and this proved more speedily fortunate to the firm. Necessity has been well said to be the mother of invention, and in the present instance this was fully exemplified, for Watt's voluminous correspondence occupied so much time in copying that he set to work and succeeded in finding a method by which the labour of hand copying was saved. This consisted in the transfer by pressure of the writing made with mucilaginous ink to damped and unsized transparent copying paper, by means either of a rolling press or a screw press—in fact, just the principle employed in the present day. Opposition, however, met the partners here, for as soon as they commenced manufacturing the presses, there was an outcry raised that the invention would lead to increase of forgery, at that time a source of great terror to commercial men. However, undismayed by the opposition, Boulton and Watt took steps to establish the machine with the public, and in this they soon succeeded, and turned the invention to a profitable account. The celebrated sun-and-planet motion, usually ascribed to Watt, does not really appear to have been his invention, but that of William Murdock, who, entering the firm as a simple working mechanic, ultimately became identified with its highest interests. The necessity for the sun-and-planet or a similar motion arose from the fact of Pickard having patented the crank which Watt had invented, and considered patentable, but which one of his workmen incautiously described to his comrades in public, and in Pickard's hearing. Watt devised no fewer than five distinct methods of obtaining rotary motion without using the crank, by means of wheels of various sorts rotating round an axis. The motion eventually preferred was that invented by Murdock, and known as the sun-and-planet motion, which has the singular property of going twice round for each stroke of the engine. Watt has spoken of the sun-and-planet motion as an old plan of his own, revived and executed by William Murdock, but the late Mr. Josiah Parkes has stated that at an interview he had with Mr. Watt, at which Murdock was present, the latter spoke of the sun-and-planet motion as his invention, which Watt did not contradict. Boulton has also attributed the invention to Murdock, in an authenticated letter written about the time the motion was being patented. One of the original Boulton and Watt engines, fitted with the sun-and-planet motion, still exists at the brewery of Messrs. Combe and Delafield, where, through the courtesy of the manager, we recently inspected it. The engine is used occasionally when the more modern machine is stopped, and does good work.

And here we will take a glance at Murdock, of whom but little has hitherto been written

or known. He was not only a steady and most excellent workman, but a man of eminent mechanical genius. He was the first maker of a model locomotive in this country, he introduced lighting by gas, and was the inventor of many valuable parts of the working steam engine. His father, an Ayrshire millwright and miller, was the inventor of cast-iron bevelled gear for mills. The son inherited the father's taste for mechanics, which could have found no better field for development than the Soho Works, the fame of which had drawn him from his home in Ayrshire. On first calling at the Soho Works for a job, in 1777, Boulton's attention was attracted to a timber hat, which Murdock had turned for himself in a lathe of his own making. The lathe and wooden hat settled the matter for Murdock, so that he was soon put upon a trial job, which he executed so well that he was at once taken on as a regular hand. Beginning as a mechanic, Murdock applied himself diligently and conscientiously to his work, and became trusted. By degrees, duties of a more responsible character were entrusted to him, and he strove to perform them to the best of his power. His industry and skillfulness soon marked him for promotion, and he rose step by step until he became Boulton and Watt's most trusted co-worker and adviser in all their mechanical undertakings of importance. He proved himself invaluable in Cornwall, where he had charge of the engines for Boulton and Watt, for he gave himself no rest until he had conquered their defects, and put them in thorough working order. His devotion to his work is illustrated by the following anecdote, which Mr. Smiles tells of him:—On one occasion, when an engine was just ready for starting, the people of the house at Redruth, where Murdock lodged, were greatly disturbed one night by a strange noise in his room. A series of heavy blows on the floor started them from their beds under the impression that the house was coming down. Nothing so serious, however, resulted, but on rushing into Murdock's room there he was in his shirt heaving away at the bedpost in his sleep and calling out, "Now she goes, lads; now she goes!" With regard to the locomotive, Watt patented the idea in 1784, but took no steps to work it out, but Murdock's attention had been attracted to the subject, and in his spare hours he succeeded in constructing an actual working model. This gave rise to fears on the part of Boulton and Watt that they would lose Murdock, who would wish to profit by his invention, but he kept to his friends and neglected the locomotive for their business, thereby winning their highest esteem. He was a man after Boulton's own heart, unsparing of himself, and indefatigable in whatever he undertook. The part Murdock played in the invention of gaslighting is well known; first at his house in Redruth and then at the Soho Works did he demonstrate its practicability. He also used a portable gaslight when returning home from work across the moors; it consisted of a bladder of gas fixed beneath a lantern in which was a jet through which the gas was supplied. Like Watt, Murdock was constantly inventing and improving, and one of his most cherished schemes was the employment of compressed air as a motive power. He contrived to work a little engine of 12in. cylinder and 18in. stroke, which drove the lathe in the pattern shop by means of the compressed air of the blast engine employed in blowing the cupolas at the Soho Foundry, and this arrangement continued in use for about thirty-five years. He also constructed a lift worked by compressed air which raised and lowered the castings from the boring mill to the level of the foundry and the canal bank. He applied the same power to many other useful purposes, the bells of his own house being rung by its agency. In 1803 he contrived a steam engine for impelling shot, and thus anticipated Perkin's celebrated steam gun.

But of all Murdock's inventions, the one which has proved itself the most widely useful

has been the cast-iron cement. His quickness of observation is illustrated by the manner in which he availed himself of an accidental observation. Some iron borings and sal-ammoniac had by chance become mixed in his tool chest and had rusted his saw blade nearly through; so, taking note of the circumstance, he mixed the ingredients in various proportions, and at last arrived at the famous cement. This article eventually came to be extensively manufactured at the Soho Works, completely superseding the cement invented by Watt. In 1810 Murdock took out a patent for boring stone pipes for water and cutting columns out of solid blocks by one operation. Five years later his attention was directed to heating the water at the Leamington Baths. For this purpose he invented an apparatus, which acted by the circulation of water through pipes from a boiler; this method has since been extensively adopted for heating buildings. But Murdock's ingenuity was not confined within the sphere of his special calling, for it was constantly at work upon outside matters. He devised machinery for consolidating peat moss, finely ground and pulverised, under great pressure and moulding it into medals, necklaces, and other articles of that class, which took a brilliant polish and had the appearance of the finest jet. He, too, taught the London brewers to substitute fish skins for isinglass with economy in their operations. But perhaps the most interesting of his many ingenious schemes was a proposal which has but recently been brought to practical issue—that of transmitting letters and packages through a tube exhausted by an air pump. This idea doubtless led to the projection of the atmospheric railway, which owed what little success it did attain to the practical ability of Murdock's pupil, Samuel Clegg. But although the atmospheric railway came to nought Murdock's original idea has since been revived and worked out to a successful issue by Mr. W. T. Rammell in the Pneumatic Despatch, as recently described by us. Such, then, is the brief outline of the life and works of this estimable man and ingenious mechanic, who for many years was the mainstay of the Soho Works. He had a strong constitution, and although he sorely taxed it, he lived to pass his eighty-fourth birthday, surviving Boulton and Watt by many years.

About the middle of last century the manufacture of counterfeit money was very common in Birmingham, the button makers turning coiners and often making fortunes out of the trade, though sometimes dangling from gibbets for their malpractices. A branch of business largely pursued at the Soho Works was the button manufacture, and here Boulton had special facilities for coining. He received orders for counterfeit money from parties at home and abroad, but indignantly rejected all overtures. He went further than this, for he took an active part in the measures adopted for the prevention of illegal coining. This, again, led him to conceive the idea that a more perfect system of coinage than the clumsy appliances of the Mint authorities permitted would effectually suppress counterfeiting and its numerous evils. So we find his active mind turned in this direction, and in time he had compassed his favourite idea of applying steam power to the stamping of money—an idea of which he has the exclusive merit. In 1786 he successfully applied the engine for the first time in executing a contract with the East India Company for above a hundred tons of copper coin. It was not, however, until more than ten years after he commenced the coining business that Boulton received orders from the British Government, although in the meantime he executed commissions for many foreign powers. At length in 1797 he began to execute a copper coinage for Britain, and this led to the subsequent organisation by him of the new mint on Tower-hill. He introduced many improvements in the art of coining from time to time, and to his indefatigable energy and perseverance is, in a great measure, to be attributed the perfection to which that

art ultimately attained. Another subject which occupied much of Boulton's attention was the improvement of steam boilers, and at an early period he introduced the tubular system. He first suggested iron tubes, but Watt advised against them, and he then proposed copper tubes, of which Watt approved. Boulton accordingly introduced four copper tubes 20 in. in diameter into the Wheal Busy mine boiler, which was 26 ft. in length. The fire passed through two of the tubes and returned through the other two. In this, therefore, we have Boulton anticipating the invention of the tubular boiler and clearly adopting it in practice, prior to the existence of the locomotive, for which it was afterwards re-invented. We cannot afford space to follow this ingenious and noble-minded man further through his varied and untiring exertions. At the age of eighty-one years he ceased from his labours and went to rest, not, however, without previous suffering, and not without the sincere regrets of a wide circle of relatives and friends.

Although Watt was of a fragile and sickly nature he nevertheless outlived the most robust of his contemporaries. Boulton always found pleasure in the active pursuit of business, but Watt, on the contrary, ever regarded it as a worry, and was glad in the latter part of his life to cast it altogether behind him in well-earned retirement. But to the close of his life he took great pleasure in inventing, and one of the machines which occupied his leisure hours for many years, and nearly up to the time of his death, was that for copying statuary. The principle of the machine was to make a cutting tool or drill travel over the work to be executed in like ratio with the motion of a guide-point placed upon the original. A copy could be taken the full size of the original or reduced in any desired proportion. Watt executed copies of statuary in various materials, marble, jet, alabaster, ivory, &c., many of which evidence by their finish the perfection to which he brought his copying machine before he died. It is a curious fact that this ingenious invention of Watt has since been revived in America and applied with sundry modifications to the shaping of wood in various forms. Powerful copying machines are also in use at the Government works at Enfield, where they are employed in the production of gunstocks. The copying machine bears singular testimony to Watt's skill and perseverance, inasmuch as at his death it was almost his only unfinished work. At length the time of Watt's dissolution arrived. He worked nearly to the last, and passed from this life with but little suffering, having been peculiarly exempt from the infirmities of age. In his eighty-third year he died, and was buried near his deceased friend and partner, Boulton, in Handsworth Church. Let his works, and the epitaph by Lord Brougham on his monument in Westminster Abbey, speak the rest.

We have lingered thus long on Mr. Smiles's book because every page is filled with happy recollections of the men who "rose to an eminent place among the most illustrious followers of science and the real benefactors of the world." They are brought before us with all the distinctness of life, and we follow them through their disappointments and their successes as though they were men of the day and we their intimates. As the pioneers of applied mechanics, Boulton and Watt commend themselves to the special gratitude of those whose pursuits lie in the path wherein they first trod. So, too, in his degree does Mr. Smiles deserve to be remembered for the services he has rendered in thus embalming the records of those men to whom England owes so very much of her greatness.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

RETARDATION OF ELECTRIC WAVES IN SUBMARINE TELEGRAPH LINES.

IN a paper on electric conduction, from the pen of Mr. John James Waterson, which appears in the new number of the "Philosophi-

cal Magazine," that gentleman reiterates the opinion, which he expressed in a paper on the same subject some few months ago, that voltaic electricity is conveyed solely by the surface of the conductor, and not, as is ordinarily taught, by the entire thickness thereof, and proposes a "crucial experiment" for the purpose of ascertaining whether or not this opinion is in accordance with the fact. The proposed experiment would consist in measuring, by means of M. E. Becquerel's apparatus, the conducting power for voltaic electricity of an iron wire plated with copper, and that of a copper wire coated with tin. Mr. Waterson believes that the copper-coated iron wire would be found to conduct as well as a copper wire of the same thickness, and that the tinned copper wire would be found to conduct no better than a tin wire of the same dimensions, and that it would thus be established that voltaic electric conduction is a purely surface phenomenon. Should this prove to be the case, Mr. Waterson is of opinion that it would be found practicable to avoid the retarding effect of induction in submarine cables. "The mere covering of gutta-percha upon a wire," he remarks, "does not cause retardation. The presence of a conducting medium on the outside of covered wire is also necessary. Hitherto experiments seem to have been confined to iron and water as the outside conductors. So far as I know, the effect of copper as outside conductor has not yet been tried. Iron has one-sixth or one-seventh the conducting power of copper; water only about a thousand millionth. Electric conduction as a whole depends on the freedom of motion allowed to the force as a whole. The induced current should thus have the same freedom to move as the primary. Practical considerations would probably require that the outside copper conductor should be insulated; so that, to make the trial effectively, it would be necessary to connect the outside coating (of woven thin copper wire?) with one pole of the battery, while the other pole led to the central wire. At the signal end, of course, there must be a similar arrangement, and this would give to the induced current the same propelling force as the primary, and utilise the half of the power of the battery that is now lost by putting to earth." Further on he insists that it is essential that the outside and the inside conductor should be of the same metal, and adds that his proposed arrangement "would exclude earth-currents; and if the signal house, as well as the shore end of the cable, be iron-covered, it is difficult to see how atmospheric electricity could intrude upon the signals." It certainly seems desirable that this gentleman's theories should be practically tested.

EXTRACTION OF VEGETABLE OILS BY MEANS OF VOLATILE HYDROCARBONS.

It is found that all the more common vegetable oils, including palm oil, olive oil, colza oil, linseed oil, rape-seed oil, and cotton-seed oil, may be extracted with great economy by means of some of the volatile hydrocarbons obtainable from petroleum, or by the distillation of coal, schist, or bitumen. The hydrocarbons which answer best for this purpose are those which are volatile at a little above the boiling-point of water. The seeds or fruits from which the oil is to be extracted, having first been crushed or ground in the usual way, are digested with the hydrocarbon in tightly-closed vessels. The hydrocarbon gradually dissolves out all the oil contained in the crushed seeds or fruits, and from the resulting solution of vegetable oil in mineral spirit the volatile solvent is driven off by evaporation. The solvent is of course condensed for use over again, and, with careful management, the loss of hydrocarbon per operation is found to be exceedingly slight, while the yield of oil obtained in this way is from 40 to 50 per cent. greater than is obtainable by the ordinary method,—that of mechanical pressure. By this process of

digestion with a volatile mineral solvent there could be obtained from the olives which are pressed every year in the neighbourhood of Marseilles alone not less than six millions of pounds more oil than is at present obtained from them.

A NEW ARTIFICIAL LIGHT FOR USE IN PHOTOGRAPHY.

M. Sayers, of Paris, has found that a light possessing a very high degree of actinic power is produced by the combustion of a mixture of twenty-four parts of well-dried and pulverised nitrate of potash with seven parts of flowers of sulphur and six of the red sulphide of arsenic. This mixture does not cost more than threepence a pound, and its light is, therefore, for the present at least, much cheaper than that of magnesium, to which it is said to be only very slightly inferior in actinic energy. It is not, however, so suitable as the magnesium light for indoor use,—and one cannot conceive much occasion for the practice of photography out of doors by night.

THE DENSITY OF OZONE.

M. Regnault has just presented to the Academy of Sciences a memoir on the density of ozone, in which he pretty clearly proves that the density of that body is just one and a half times that of ordinary oxygen. This density would seem to support the theory that ozone is a combination of oxygen with oxygen, in which three volumes of the gas, as it exists in its ordinary state, are condensed to two.

UTILISATION OF ALKALI WASTE.

Should Mr. A. G. Hunter's proposed modification of the processes of the soda manufacture, described in these columns three weeks ago, prove successfully applicable on the great scale, the residue of that manufacture will by-and-bye be a much less troublesome product than the "alkali waste" which is at present produced at all alkali works in such large quantity,—at some works as much as five or six hundred tons of this refuse product are produced per week,—and upon endeavours to utilise which so much money and ingenuity has been spent in vain. This troublesome residue has to be allowed to accumulate close to the works in vast mountainous heaps, occupying large spaces,—and every week larger and larger spaces,—of frequently very valuable ground, and, besides being thus cumbersome, it is not less objectionable in another way, for it gives off into the surrounding air large quantities of that pernicious gas, sulphuretted hydrogen. It is usually regarded as being essentially an oxysulphide of calcium, and it certainly contains all the sulphur of the sulphuric acid used in the first of the series of processes from one of which it results. As this sulphur is the essential element of the most costly reagent the soda manufacturer has to employ, and as it is due to the noxious gas with which the alkali waste contaminates the atmosphere in its neighbourhood, the recovery of this constituent of the waste, if rendered practicable within certain limits of cost, would at once cheapen the most valuable product of the chemical arts, and render inoffensive the waste bye-products of its manufacture; and hence the problem of how to recover this sulphur cheaply, or, if not exactly to recover it, to utilise it in some other way, has occupied the attention of inventors from the first moment of the present method of manufacturing soda having come into use. Of the host of plans for turning the sulphur of the waste to account which have been proposed and patented, only two, however, can be regarded as having proved at all successful in practice. One of these consists, essentially, in exposing the waste,—spread out, on large hurdles or otherwise, so as to present the largest possible surface to the atmosphere,—to the oxidising action of the air for about three weeks, lixiviating, and then repeating the process with the wasted

residuum. The air oxidises a portion of the insoluble oxysulphide of calcium into soluble hyposulphite, a solution of which salt is obtained at each lixiviation, and by treating the waste twice in this way,—a third treatment seems not to answer,—as much hyposulphite may be procured as will contain from one-half to two-thirds of the whole quantity of sulphur originally contained in the waste. As other hyposulphites may be formed by means of the hyposulphite of calcium thus obtained, and as the hyposulphites are salts which are extensively used in the arts, and the use of which is likely to greatly increase, while they can be obtained in this way much more cheaply than by any other method as yet known, this process has considerable value, but it does not utilise all the sulphur in the waste, and the demand for hyposulphites, almost certain as it is to reach very important dimensions indeed before long, yet cannot be expected ever to become such as to absorb in supplying it more than a very small portion, comparatively, of the vast quantity of alkali waste which we shall always go on producing while the manufacture of soda is conducted as at present. The other method of utilising the waste which is referred to above consists in treating it with "chlorine residues,"—the residua of the process by which chlorine is obtained for the manufacture of bleaching powder,—and this method has just received great improvements at the hands of Kopp, who first suggested it, some seven years ago. Kopp has recently presented to the Academy of Sciences a memoir embodying a full description of his improved process, all the essential features of which shall be put before our readers immediately upon the publication of this memoir. Meanwhile, it will sufficiently attest the value of that process to state that from each 2,800 gallons of chlorine residue, treated with an equivalent quantity of alkali waste, it obtains two tons of highly sulphuretted sulphide of manganese, yielding, when burnt, from 14 cwt. to 16 cwt. of sulphur in the form of sulphurous acid.

A BRITISH MINERAL RICH IN CERIUM.

Among the "new and rare Cornish minerals" of which Professor Church has just presented an elaborate account to the Chemical Society, is one containing not less than 61 per cent. of oxide of cerium. It is essentially a hydrated phosphate of cerium, but seems always to contain a small portion of phosphate of calcium. It is found in the neighbourhood of Lostwithiel, in a copper lode on quartz and killas, and occurs as a thin crust, made up of very minute crystals, closely investing a quartzose matrix. Cerium had not previously been found in any British mineral, except in exceedingly minute quantities.

THE SOLVENT PROPERTIES OF ANHYDROUS LIQUIDS.

When it is desired to bring bodies into the liquid state, in order to facilitate their chemical action upon other bodies, liquid or solid, the solvent used, in the great majority of cases, is water. Water, however, is not the only liquid having a solvent action upon certain solids. Several non-aqueous liquids, such as bisulphide of carbon, chloride of sulphur, chloride of arsenic, and bichloride of tin, have long been known to possess the power of dissolving, not only some of the substances which are soluble also in water, but likewise many substances which are insoluble in water, and some substances which, though soluble in water, are decomposed thereby; but the results obtainable by the reaction upon each other of bodies dissolved in one or other of these anhydrous liquids have been as yet but very little inquired into. The first systematic investigation in this direction has just been made by Mr. George Gore, F.R.S., a paper by whom, which appears in the December number of the "Philosophical Magazine," gives an account of the results of many hundreds of experi-

ments upon the solvent action of one of the liquids above named,—bisulphide of carbon. The bodies which Mr. Gore found to be soluble in this liquid are phosphorus, sulphur, selenium, bromine, and iodine, the chlorides, bromides, and iodides of phosphorus, sulphur, selenium, arsenic, and antimony, the two sulphides of hydrogen, and the bichlorides of titanium and tin. Metallic oxides, sulphides, and fluorides, and all the metallic chlorides, bromides, and iodides, except those of antimony and arsenic, as also the whole series of oxygen salts, including the carbonates, borates, hypophosphites, phosphites, phosphates, sulphates, sulphites, hyposulphites, chlorates, bromates, iodates, and nitrates, he found to be insoluble in it. The details of his experiment are very interesting,—his researches upon this subject constituting the first important step into a new field of inquiry, in which results of great practical moment are certain to be reaped by-and-by.

ABSORBENT POWER OF COCOA-NUT SHELL CHARCOAL.

The property of absorbing large quantities of gases which is possessed by wood-charcoal and other porous forms of carbon,—a property which has received several valuable practical applications, and is probably susceptible of others,—has hitherto been supposed to be presented in largest measure by the charcoal made from box-wood. Mr. John Hunter, however, has found that the absorbent power, for gases and vapours, of charcoal made from the shell of the cocoa-nut is between two and three times greater than that of box-wood charcoal. Cocoa-nut shell charcoal, after having had all the air expelled from its pores by strong ignition in a nearly-closed vessel, will absorb, at about the temperature of boiling water, one hundred and fifty-five times its own bulk of the vapour of methylic alcohol.

GEOLOGIC ORIGIN OF THE SOUTH STAFFORDSHIRE IRON ORES.

Dr. T. L. Phipson has just published the results of an analysis he has recently made of a fossil which occurs among the iron ores of the South Staffordshire coal measures, and, after showing that this fossil has the same composition as the ores which constitute its matrix, he remarks: "We could not have greater proof that these vast deposits of iron ore, to which England owes so much of her commercial and industrial prosperity, must be looked upon by the geologist as fresh-water formations: deposited, doubtless, in the first instance, as hydrated peroxide of iron, like the bog-ore now forming in the Swedish lakes, which swarms with minute organisms, and afterwards reduced to the state of carbonate of protoxide by the constant presence of organic matter in a state of decomposition." A much "greater proof" of the soundness of the theory that the South Staffordshire iron ores were deposited from fresh-water is afforded by the fact, which Dr. Phipson seems to state only incidentally, and not at all as the basis of his argument, that the fossil in question is a mollusca of the genus *Unio*, "all the mollusca of which genus are fresh-water mollusca." He represents the fossil as containing, per cent., 74.55 carbonate of iron, 6.20 carbonate of lime, 3.20 carbonate of magnesia, 1.0 carbonate of manganese, 0.20 phosphoric acid, 13.50 silicate of alumina, and 1.20 water.

PASSAGE OF THE EARTH THROUGH THE TAIL OF A COMET.

Early in the month of June, 1861, M. Liais, the celebrated astronomer, wrote from Rio Janeiro to the Academy of Sciences of Paris, to the effect that the observations which he had made of the great comet of that year, which had not as yet become visible in Europe, had convinced him that there was a great likelihood that the earth would come in contact with one of the tails of that body. M. Liais, who is now in Paris, attended the sitting of the Academy on Monday week,

and submitted elaborate calculations proving beyond question that on the 19th of June, 1861, the earth really did pass through one of the comet's tails. The moment of contact was twelve minutes past six a.m., Rio Janeiro time, and, according to the calculation of its dimensions made by M. Liais, the earth must have been wholly immersed in the tail for about four hours! This immersion in the tail of a comet had no perceptible influence upon the weather,—a very remarkable fact, adding one more to the many reasons there were already for supposing that cometary matter is some millions of times rarer than our atmosphere. Not the least curious consideration suggested by the phenomenon is that it was one which perhaps had never occurred before,—for, according to Arago, the chances against the contact of the earth with a comet are more than two hundred and fifty millions to one.

INTERNATIONAL COMMUNICATION.

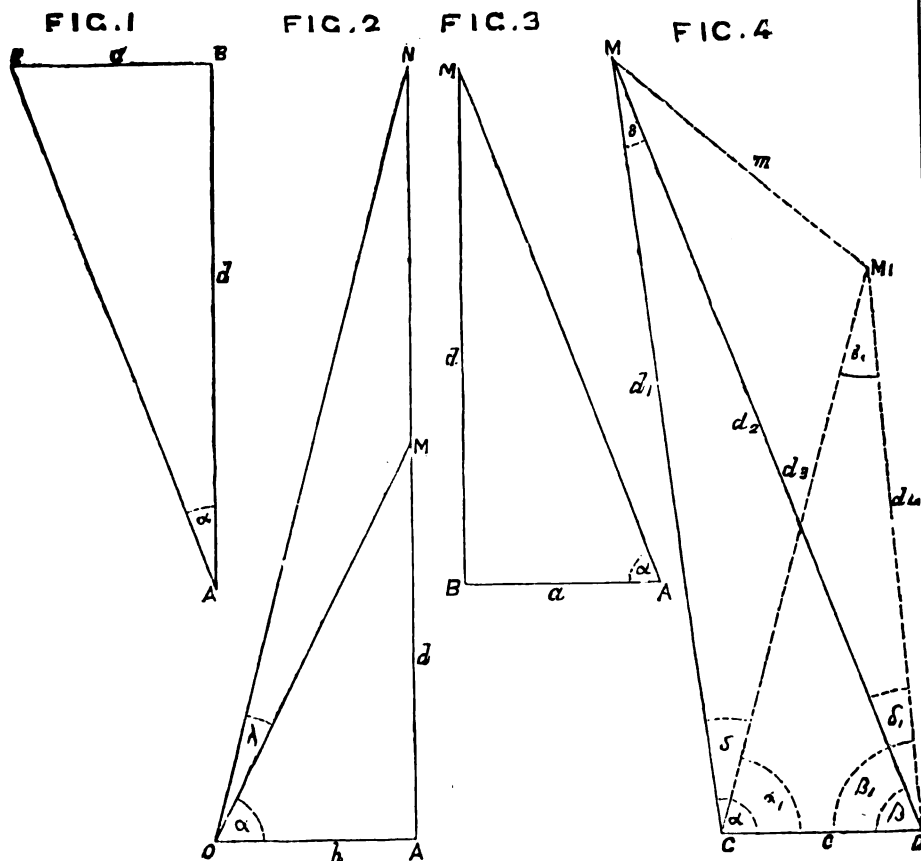
WITHIN the last few years Dover has reasserted her former boasted position as the highway to the continent. Two railways daily pour throngs of passengers on to the sea borders of this flourishing town, thence they proceed by boat to Calais, the return journey of each packet bringing a batch of candidates for transport by rail inland. The railway companies vie with each other in taking passengers through in the least possible space of time. They have reduced the time of transit to the veriest minimum to suit the requirements of this active age. But the age is not satisfied; its activity demands further concessions. If speed cannot be increased, find some other way of saving time, is the cry. So engineers have been knocking their heads together lately, and the result is an application to Parliament for permission to still further expedite passenger communication between our shores and those of la belle France. And this is how it is proposed to effect this object, whereby the important space of forty minutes is to be saved to the traveller on each journey. A new pier is to be constructed close by, and eastward of the Admiralty pier; it is to reach some 960ft. out to sea. Connections are to be made by tramways between the lines of the London, Chatham, and Dover, and the South-Eastern Railways, and the head of the pier. Similar arrangements are to be effected at Calais, and between the two harbours steam vessels of great power, speed, and burthen are to ply. As to the *modus operandi*, we believe the intention is to convey the railway trains along the tramways to the pier head, and when they reach that point powerful lifts will effect their deposit—minus the locomotive—in the special vessels. Arrived at the other side the trains will there be hoisted bodily to land and sent on their way. This saving of twenty minutes at each port, and the comfort of not having to quit the railway carriage once on the journey, are two points that must meet with public appreciation, although the conferring of such a boon will cost somebody something. We presume the enterprising London, Chatham, and Dover Railway Company is at the bottom of this scheme; at any rate, we know there are engineers of eminence behind it, and believe it has the support of the Emperor of the French. —*Building News*.

NAVAL AND HYDROGRAPHICAL TELEMETRY.

By DR. A. GURLT.

THE following observations on the telemetric methods employed at sea, and a description of the new naval and hydrographical telemeter invented by M. Hermann Gurlt, Engineer Royal Prussian Navy, are intended as a supplement to a paper on telemeters by the late Mr. Archibald H. Bell, Royal Artillery, which appeared in the MECHANICS' MAGAZINE of November 3rd and 10th. In that paper the various methods and instruments which have hitherto been in use on land for estimating distances are ably discussed; amongst the latter the telemeters of Cavallo, Roohan, Professor Piazzi Smyth, Lieutenant-Colonel Clerk, Otto Struve, and the instruments invented for the use of coast batteries only by Colonel Shuttlesworth, Captain Jerningham, and the deceased author himself. As the methods and instruments therein described are,

NAVAL AND HYDROGRAPHICAL TELEMETRY.



however, not applicable for naval purposes, the following remarks on methods of naval telemetry may prove acceptable. Mr. Bell says with regard to these: "We require to estimate distances on board ship, where not only the object, but also the observer, may be in motion." This is certainly the most complicated case of all, and as to instruments which will meet it, the author remarks justly: "This requirement is one of the navy rather than of our own profession, but it is of equal public importance, and though there are many difficulties in this form of the problem, there is every reason to believe its solution to be quite practicable and that it will be some day effected." This difficult problem has found a satisfactory solution already, through the invention of the instruments of M. Hermann Gurlt, and of which it is now proposed to give a description. Mr. Bell is not quite correct in remarking that all telemetric methods and instruments depend upon one fundamental principle, and upon which all our efforts to estimate distances must be built, viz., that, knowing the base of an isosceles or of a right-angled triangle, we can ascertain its height by measuring the vertical angle, as we shall see that scalene triangles may be used for this purpose as well, supposing that there are other elements known by which their values may be ascertained.

One of the commonest methods of estimating at sea the distance between two ships is to measure with the sextant the angle α of the supposed right-angled triangle (fig. 1) ABE , in which $BE = a$ represents the height of the other ship's mast, which is supposed to be known. The distance AB or d is then found after the formula $d = a \cot. \alpha$ by a very simple and easy calculation, for which purpose even tables may be prepared representing the value of d for the limited number of values α and a . This method appears to be very easy, but it is little commendable, as it admits of very considerable errors, and for the following reasons. The correctness depends in the first instance on the knowledge of the real height of the other ship's mast, which can only be guessed, and is consequently a source of great error. Besides, even if the real height were known, in case the ship rolls or is inclined leeward, the observer never knows how much of the real height he can see; and supposing the mast to be inclined leeward 39 deg. out of the vertical line, the difference between the real and apparent height would produce an error as great as one-

fourth of the distance. Besides the uncertainty of α , even the value of angle α is difficult to ascertain on board ship, as two points—say, the mast-head and the part where it appears over the bulwark—must be simultaneously observed. Lastly, this method is not at all adapted for operations against coasts.

A second method is based upon the *exactly* known height of the observer in the rigging above the level of the sea. In fig. 2, the distance AM or d of the other ship M is ascertained by measuring from the elevated standpoint O the angle λ which the two lines OM and ON form; the former being a line drawn from the observer's eye to the ship's waterline, the latter one to the horizon. As the angle AON is known for the different values of $AO = h$, i.e. length of base line of the triangle AMO , the angle AOM or α is ascertained by deducting λ or NO from NOA , and the triangle supposed to be right-angled, the distance d is found from the formula $d = h \tan. \alpha$ for which tables might easily be calculated. Although this method is founded on a known instead of on a guessed base line, it is subject to several sources of errors which affect its correctness considerably. It is evident that this correctness is much influenced by the correct observation of angle λ , which, however, is hardly possible, as the observer has to lay his instrument simultaneously upon two objects, and as this angle is necessarily small from the limited height of the base line h . To this we must add that even the base line is influenced by the oscillations of the vessel, and its value consequently much varied, and that it is impossible to lay an instrument exactly upon the waterline of a ship at sea, and much less so upon the horizon. From all this it follows that this method must needs be very incorrect, and as it is not applicable whenever the horizon is not visible, that is, when covered by coasts, thick weather, powder smoke, &c., it is evident that it is very little use at all.

A third method is based upon the same formula as the one just described, but it has the advantage of a constant base line $AB = a$ (fig. 3), fixed along the deck of the vessel. At B is a sighting instrument so arranged that its axis forms a right angle with the base line; and at exactly the same moment when the object M , either by turning the ship or by any movement of the object M itself, passes before the sight, another observer stationed at A measures the angle α , and the distance $d = a \tan. \alpha$ is then

easily ascertained. This theoretically very simple and—owing to its long permanent base line—much favoured method is, however, in practice hardly applicable, as for every observation the vessel requires to be brought exactly in such a position that her base line forms the desired and supposed right-angled triangle with the lines AM and BM , which, however, is not very easy to accomplish. Besides, it labours under the disadvantage that the observation can only be made at a certain moment, and does not allow any repetition. From this it will be seen that the telemetric methods hitherto in use at sea are extremely imperfect, and that any method or instruments which will permit of accuracy in measuring distances at sea, both for purposes of naval gunnery and of hydrographical survey, are a real desideratum. This difficult problem appears at last to have found its solution by the method and instruments of M. Gurlt, so that little remains to be desired. M. Gurlt's new method rests—like all other military and naval telemetric methods—upon trigonometric principles; but as it is based on the measurement of any scalene triangles by means of a very ingenious instrument, its application is far more manifold and accurate than that of any other at present known, and as it can be used when either the observer or the object, or both, are in motion without any loss of accuracy, it must be admitted to fulfil even the most sanguine expectations. In the triangle CDM (fig. 4), the two distances d_1 and d_2 are ascertained from the known base line $CD = c$ and the two adjoining angles α and β after the

formulas $d_1 = \frac{c \sin. \beta}{\sin. \gamma}$ and $d_2 = \frac{c \sin. \alpha}{\sin. \gamma}$. The

great superiority of this over all other methods consists in the exactly simultaneous observations of the two angles α and β , it being entirely indifferent whether they are right, obtuse, or acute, and in the use of a permanent unchanging base line. The method is simply carried into practice by measuring along the deck the constant base line CD , and in placing at each end of it one of Gurlt's telemeters. The same object or part of an object, the distance of which from the base line it is intended to ascertain, is then sighted with the telescope of each instrument, so that following the motions of the object or those of the observer's vessel, it is always kept covered by the cross-hair centres of the instruments, when at any given moment both telescopes can be simultaneously fixed in their position through the action of two powerful electro-magnets, which are attached to each instrument and brought into play by a galvanic battery. The two observed angles α and β are then read, and they furnish the necessary elements for the calculation of the triangle sought. As this method must increase in accuracy with the length of the base line, it is clear that CD should be made on board ship as long as possible, and as this length is practically unlimited on shore, it is evident that this method is of great value for the purposes of coast defence. Its very great accuracy, however, renders it most valuable for the hydrographical survey, which almost constantly has to solve the problem of the inaccessible distance, i.e., to find the distance from each other of two points M and M_1 (fig. 4) which cannot be approached. It is only necessary to measure the triangles CDM and CDM_1 to find the angle $\delta = \alpha - \alpha_1$ and $\delta_1 = \beta - \beta_1$; and, from two sides and the enclosed angle M or m , is ascertained in the triangle CDM , $m = \sqrt{d_1^2 + d_2^2 - 2d_1d_2 \cos. \delta}$ and in triangle CDM_1 , $m = \sqrt{d_1^2 + d_2^2 - 2d_1d_2 \cos. \delta_1}$. In order, how-

ever, to save the trouble of calculation, which would require some little time, and to comply with one principal requirement of a good telemeter, which Mr. Bell justly says is its capability of being used with rapidity, and showing the result at a glance, M. Gurlt has invented another auxiliary instrument, the "constructor," by which the measured triangle can be reconstructed *en miniature* in a few seconds and its values d_1 and d_2 read direct from a graduation.

The *telemeter* is of course an angle-measuring instrument, and its essential parts consist of an astronomical telescope, movable round a horizontal and vertical axis, and of a graduated semi-circular limb, upon which any angle between 0 deg. and 180 deg. may be read by means of a vernier and microscope, which are fixed to the telescope. The telescope rests with its cylindrical pivots upon a support, which is fastened

to a circular base-plate, and can revolve with the same horizontally round a conical pivot. This pivot rests again in an universal joint fastened to a tripod. The base-plate bears two electro-magnets, which may swing slightly round a horizontal axis, and which are armed with two pole pieces. Below this is another horizontal circular base-plate of a little larger diameter, which rests on the same conical pivot and bears two standards in which the graduated semicircular limb rests with its horizontal axis in such a manner that both the axis of this limb and that of the telescope coincide in one line, which is at right angles with the axis of the conical pivot. In order to arrest the telescope it bears upon its pivots two vertical and semicircular arcs of iron, and the lower bottom plate on its circumference a ring of iron; both act as armatures to the electro-magnets, one pole of which is attracted upwards by the vertical arc, and the other downwards by the horizontal ring, whenever an electric current is allowed to pass through the instruments. It is thus possible to fix both instruments simultaneously by magnetic attraction of four poles in each. The telescope bears a catcher by which it communicates to the graduated limb its vertical oscillations, whilst it slides along the same when turned sideways. The angles read upon it are formed by the base line between the centres of both telescopes and their respective optical axes. The constructor is composed of two graduated arcs, round the centres of which two long arms can turn, each being provided with a vernier, micrometer, and microscope near the circumference of the arcs. The distance between the centres of these arcs represents *en miniature* the base line on deck of the vessel, and by fixing the movable arms with screws upon the angles which were observed with the telemeters, they construct the measured triangle and the values for d , and d , may be read from their graduation, where they intersect each other. The foregoing observations will doubtless contribute to the general knowledge and just appreciation of M. Gurlt's ingenious telemetric instruments, which will be found highly useful and accurate for all requirements of hydrographical survey, naval gunnery, and coast defence.

SIR DAVID BREWSTER ON PATENT RIGHTS.

THE first sessional meeting of the Royal Society of Edinburgh was held on Monday evening last. Sir David Brewster, as President, delivered an inaugural address, in the course of which he showed himself to be a warm defender of patent rights. We extract the following from his well-timed and truly pertinent remarks:—The present raid against the patent laws is the direct and acknowledged result of the ungenerous influence of trade. The shortness of the tenure of patent rights, and the heavy tax levied from inventors, are expressly maintained in order to diminish the number of patents; and the avowed reason for thus diminishing them is, that from their number and frivolity they interfere with the operations of tradesmen and manufacturers, by exposing them to actions for infringement. That there are many patents not remunerating, and not immediately beneficial, is painfully true, when we consider how much they have cost the sanguine inventor. That there are any patents really frivolous or useless, in the true sense of these terms, can be maintained only by ignorant or interested parties. There is no patent that does not contain a proposal to do something that is new, or to make some improvement upon what is old; and there are many examples of apparently useless patents containing the germs of future and valuable inventions. There are cases even in which the invention stigmatised as useless has proved to be an essential element in a future patent, where the new patentee has piratically used it, and dared to complain that he has been prosecuted for infringement. But there is a still more intelligible reason why no patent can be called useless. In bringing it into the market workmen are employed and materials purchased; and even if the process, instrument, or machine thus offered to the public has no sale and no useful application, the hapless patentee has given liberal fees to several functionaries of the State, and contributed nobly to the patent fund. That any patent is frivolous and injurious, in the sense of interfering with the functions of honest traders, is simply untrue. If an invention which has been patented at the cost of £175, and produced nothing in return, is a necessary part of an impor-

tant invention subsequently patented, it is a positive proof that patents apparently frivolous may be truly valuable. The first invention is, therefore, neither an obstacle to improvements nor a ground for litigation. It has, on the contrary, led to a greater invention; and, whether the second patentee has used it ignorantly or advisedly, he ought to pay for the use of it, instead of pleading in a court of law, as he generally and dishonestly does, that the original specification is defective. But even if the cases of interfering patents were more numerous than they are, and more fertile in litigation, it is the lawgiver, and not the inventor, that is to blame. If Parliament, in its wisdom, cannot reconcile the interests of patentees and honest tradesmen but by robbing the former, they overlook the fundamental law in social economy that no great improvement can be made in the arts of life, and no true reform in our institutions, without interfering with a variety of interests. In proposing to abolish patent rights, its promoters seem to have wholly overlooked the international interests that are at stake. If we have no patent law, we deprive every foreigner of his existing right to a British patent. Foreign Governments may therefore adopt a policy of retaliation, and refuse to our countrymen the patent rights which they now so freely enjoy; or, what is more probable, they may hold out additional privileges to our ingenious artisans, and thus obtain the firstfruits of their skill. Inventors will follow their inventions, and in the exodus to foreign countries—to the United States, especially, with its cheap and judicious patent laws—we shall lose, more rapidly than we have yet done, the most ingenious of our inventors, and the most useful of our citizens. A policy like this, so Boetian in its character, and so injurious in its results, is as politically unsafe as it is socially unwise and personally unjust. Rights that have been firmly established and long enjoyed are not readily abandoned. Illiberal and oppressive as the patent laws are, they are still the Magna Charta of the commonwealth of inventors, and in an age tending to democracy they will not be surrendered without a struggle. Rights hitherto unquestioned, and not more sacred, may be exposed to the same scrutiny, and social interests endangered which all classes have been accustomed to respect and defend. If these views of patent rights be just, and if, as movable property, they are as sacred as copyrights, there can be no just reason why they should not be granted equally cheap, given to every applicant, and enjoyed during at least the life of the patentee.

INSTITUTION OF CIVIL ENGINEERS.

At the meeting on Tuesday evening, Dec. 5th, Mr. John Fowler, Vice-President, in the chair, the first ballot for the session 1865-6 was taken, when fifteen members and twenty-five associates were duly elected, including as members, Mr. James Danford Baldry, Westminster; Mr. William Cole Bayly, Bombay, Baroda, and Central India Railway; Mr. James Augustus Caley, assistant civil engineer in the western province of Ceylon; Mr. James Cross, St. Helen's; Mr. Frederick East, Madras Irrigation and Canal Company; Mr. Thomas Hardinge Going, Madras Railway; Mr. Hugh Leonard, superintending engineer in the Department of Public Works of Bengal; Mr. Edward Orpen Moriarty, engineer-in-chief for harbours and rivers, Sydney, N.S.W.; Mr. Parke Neville, engineer to the corporation of Dublin; Mr. Wm. Henry Price, superintending engineer of Kurrachee harbour works; Mr. Cubitt Sparkhall Bundle, Calcutta; Mr. Bernhard Schmidt, resident engineer of the Berlin-Görlitzer Railway; Mr. Charles Tarrant, county surveyor of Waterford; Mr. Cromwell Fleetwood Varley, chief engineer to the Electric and International Telegraph Company; and Mr. Edward Wilson, Worcester; and as associates Mr. Joseph Brierley, Blackburn; Mr. Thomas Buckham, Wandsworth; Mr. Seymour Clarke, general manager of the Great Northern Railway; Mr. William Clarke, late of New Zealand; Mr. John Dickson Derry, assistant engineer in the Department of Public Works of Bengal; Mr. John Dunning, Middlesbrough-on-Tees; Mr. Cornelius Willes Eborall, general manager of the South Eastern Railway; Mr. James Grierson, general manager of the Great Western Railway; Mr. Richard Harris Hill, London; Mr. George William Horn, of the London and South-Western Railway; Major Julian St. John Hovenden, R.E., deputy consulting-engineer to the Government of

India in the railway department; Mr. Francis King, Bombay; Mr. Conyers Kirby, Newport (Mon.); Mr. William Lang, London; Colonel William Montagu Scott M'Murdo, C.B.; Mr. Robert Messer, late of Oporto; Mr. Robert Moseley, manager of the Great Eastern Railway; Mr. William Newmarch, F.R.S., London; Mr. Jeremiah Ryan, Bombay; Mr. Archibald Scott, traffic manager of the London and South-Western Railway; Mr. Edward Rush Turner, Ipswich; Mr. Howard Unwin, Carmarthen; Mr. Leveson Francis Vernon-Harcourt, M.A., Westminster; Mr. George Ambrose Wallis, Eastbourne; and Mr. George Woolcott, F.R.G.S., secretary to the Central Argentine Railway Company.

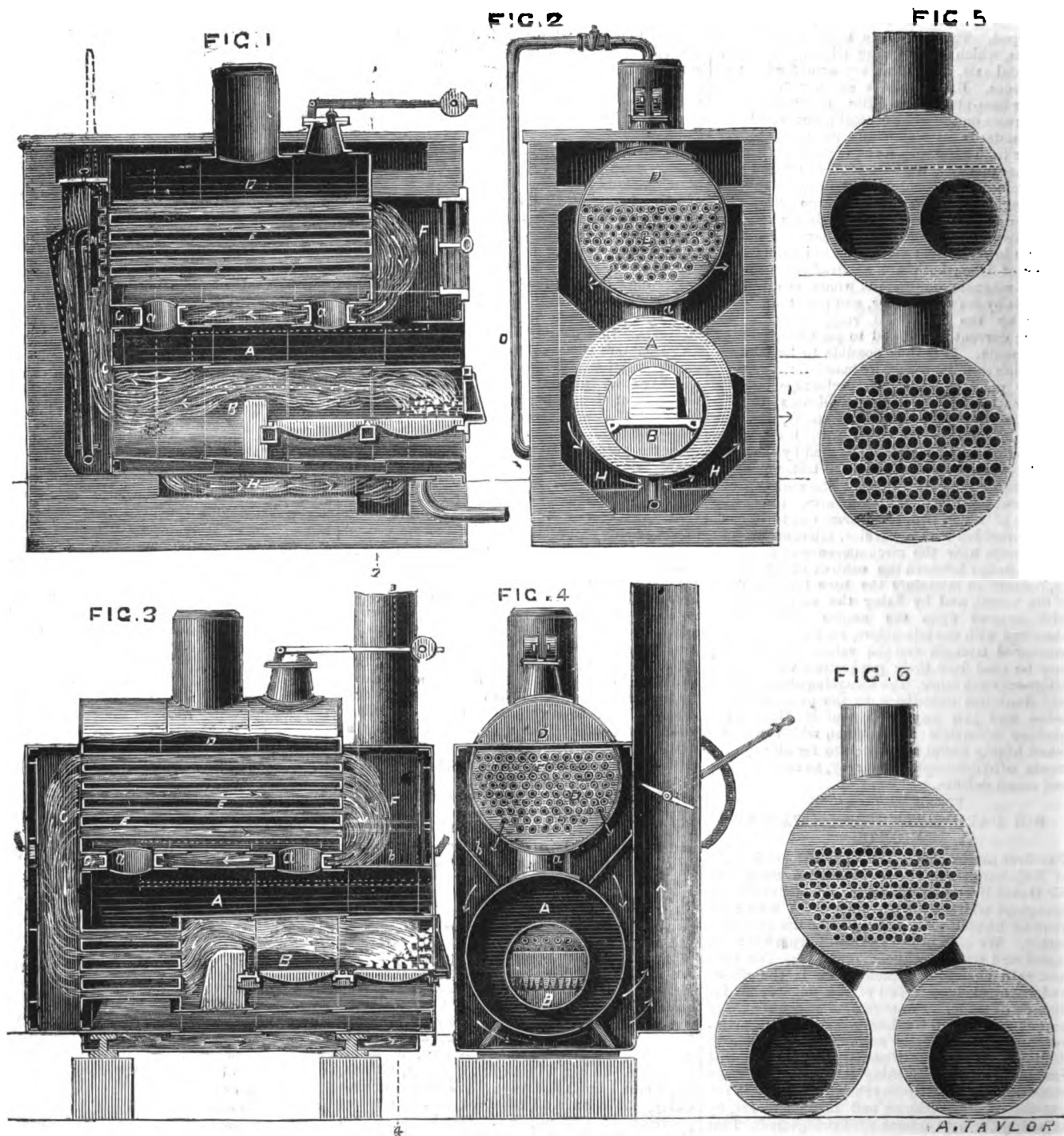
TUBULAR BOILERS.

MR. JAMES C. AMOS, of the Grove, Southwark, and Mr. William Anderson, of Erith, have patented some improvements in tubular boilers, the chief object of their invention being the construction of a compact, economical, and efficient steam boiler for general purposes. The main feature of novelty is the combination of a horizontal cylindrical case containing within it a cylinder forming a fire chamber, ashpit, and flue, with a second cylindrical case fitted with tubular flues like the boiler of an ordinary portable engine, the water spaces in the two divisions of the boiler being connected by necks or tubes, which unite the two cases, and form passages through which the water can circulate freely. In some instances the internal or fire chamber cylinder is made of the same length, and in others shorter than the enclosing or outer case. When the length is contracted the space thus gained beyond the fire chamber cylinder is employed as boiler space, and therein short lengths of fire tubes are inserted which conduct the flame and heated gases through this extended portion of the boiler. The flame and gases then pass upwards and return through the tubes in the second case, and after circulating around the annular water space in the lower cylindrical case, pass thence through an uptake to the chimney. The improved boiler may be set in brickwork, or it may be constructed as a self-contained boiler.

In the accompanying engraving, fig. 1 is a longitudinal vertical section of a boiler constructed according to this invention, and set in brickwork; and fig. 2 is a partial sectional elevation of the same, the section being taken in the direction of the line 1, 2 of fig. 1. A A is a cylindrical case constituting the lower division of the boiler. This case is made of boiler-plate iron, and contains within it a cylinder B, similarly constructed, and set eccentrically therein. In this cylinder B a fireplace is made, and access is gained thereto by a fire-door in the front end of the cylinder. The other end is open and leads into a flue C formed in the brickwork. Above the cylinder A, and connected thereto by short tubes or necks $\alpha \alpha$, is a cylinder D, which forms the upper division of the boiler. Both this cylinder and the cylinder A are set in brickwork, as shown at fig. 2, by means of which the divisions of the boiler are properly supported and the external flues are formed. The cylinder D is provided with tubular flues E, the ends of the cylinder forming the tube plates. It is also fitted with a steam dome and safety valve. The course of the flame and heated gases is indicated by arrows. When the heated gases pass the bridge and leave the fire chamber cylinder they enter a flue C, and passing upwards proceed to the front through the tubes E. The gases then enter the smoke box F and pass between the two cylinders A and D. Here they meet a wall of brickwork G, and the current is deflected downwards and caused to traverse along one side of the cylinder A until it reaches the end of a divisional wall H, when it takes a reverse course, and passes along the other side of the cylinder A, and thence to the chimney by the flue I.

Fig. 3 shows in longitudinal section, and fig. 4 in vertical section, taken in the line 3, 4, of fig. 3, a self-contained boiler constructed on the principle of arrangement above described. In this instance, the coupling flue C and smoke-box F form a portion of the metallic structure; fire-brick lining being provided at those portions of the case where the heat is greatest. Within the lower division of the boiler are short fire tubes K, which divide up the water space formed by the contraction in length of the cylinder B. The course of the flame and heated gases is some-

TUBULAR BOILERS.



what different in this boiler from that of the first described arrangement, for the gases, when they have arrived at the smoke-box F, pass under and around the cylinder D, and through openings in the rear end of the parting plates *b b*, which split the gases into two currents. These currents then circulate around the cylinder A, returning to the front of the boiler, and they then pass off by the chimney L. One advantage consequent on this novel combination of parts in whatever way the main divisions of the boiler may be relatively disposed is that as the boiler is not fired at the lowest point, or where the sediment is deposited, the risk of burning out the boiler by reason of the non-conducting power of the sediment will be removed.

In general the inventors propose to place the tubular division of the boiler above the cylinder or case containing the fire chamber, as shown in the figures above referred to, and to connect the cases together by means of the short vertical tubes or necks *a a*, which will admit of the water circulating freely around the annular water space of the lower division, and rising up between the fire tubes, and giving off its steam to the steam space in the upper division of the boiler, whence it will be taken off by a steam dome, as usual. But in some instances it may

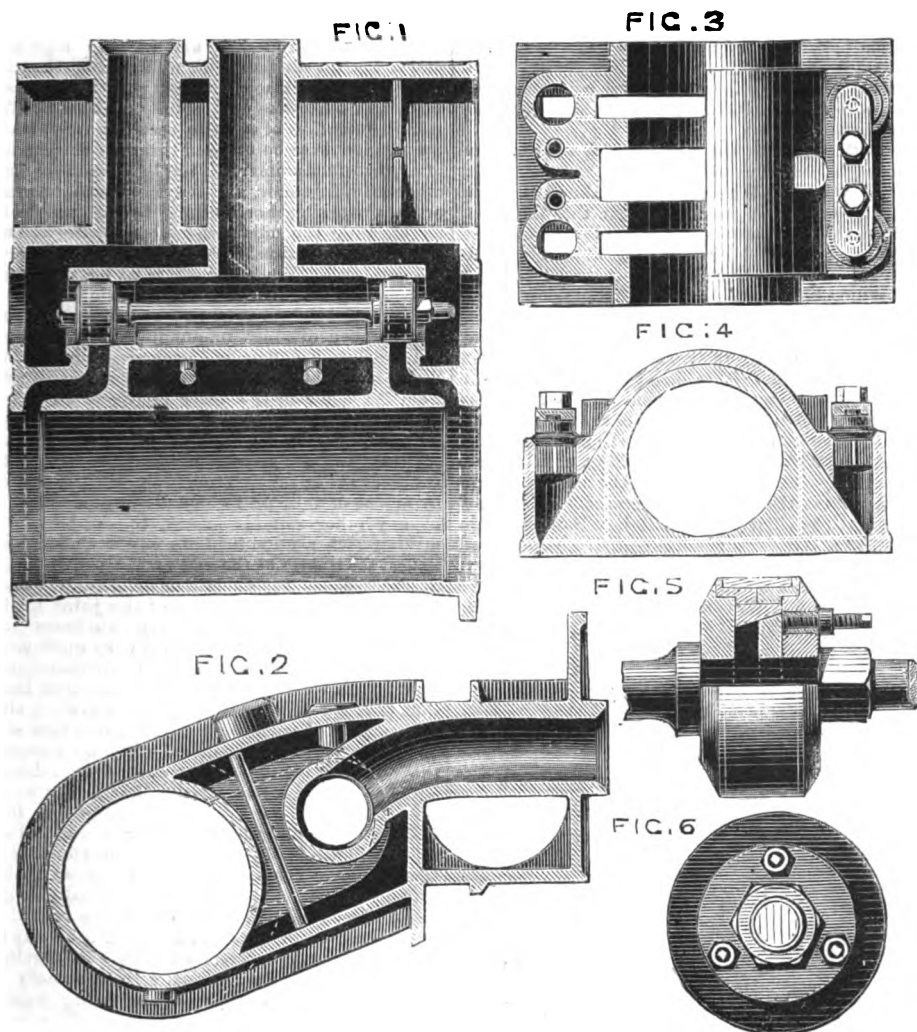
be advantageous to invert the position of the divisions of the boiler, thus having the cylinder containing the fire chamber on the top of the tubular division. This arrangement is shown at fig. 5. The products of combustion will in this arrangement descend and pass through the fire tubes, and reach by any ordinary arrangement of flues the chimney. When this plan is adopted the feed water will be led into the tubular division of the boiler. The upper case is enlarged for steam space, and the steam chest and mountings are placed upon the top of it. In some instances it is found advantageous to lay the cylindrical cases side by side. This arrangement will serve where head room is limited and extended lateral space is available. Another arrangement of the improved boiler is shown at fig. 6, where two outer cases with internal cylinders or fire chambers are connected by necks or tubes to one fire-tube case. This arrangement may be found convenient for marine purposes.

In order to cleanse the tubular flues of these and other tubular boilers of soot, the following contrivance is provided for injecting jets of steam into the tubes. In front of one of the tube plates (see fig. 1) and within the flue C, is mounted a hollow disc M, which is capable of being moved

to and from the ends of the fire tubes E. That face of the disc which is nearest the tube is fitted with a series of nozzles *m*, corresponding in number and relative position with the fire tubes E. The disc M is carried by a pair of pipes N, which are jointed at their lower ends to a fixed horizontal pipe connected by a pipe O with the steam chamber of the boiler. These pipes N form a rocking frame, and serve to bring the nozzles *m* up to the ends of the tubes when it is required to clean them. The disc with its nozzles is moved up to the drawn position of fig. 1 by means of a forked lever, shown by dots in the figure. To clean the tubes it is only necessary to advance the hollow disc from its dotted to its drawn position, and then to turn on the steam; a jet will then be discharged into all the tubes simultaneously. This operation may be effected while the boiler is in action, the soot being discharged into the smoke-box, or an equivalent receptacle, from which it may be removed at the first opportunity.

There were 23,000 persons weighed on the scales at the Boston U.S. Mechanics' Fair. The average weight of men was 141lb.; average weight of women was 124lb. The largest man weighed 293lb. The largest woman weighed 274lb.

NEW PISTON VALVE.



NEW PISTON VALVE.

In an article last week upon the manufacture of American locomotives, Mr. Thomas S. Davis, the superintendent of the Jersey City Works, was alluded to as having improved the lathe in which the driving wheels were turned. We have now to call attention to a new piston valve of that gentleman's design, which he has applied to locomotives and many other engines on land and sea. Persons at all conversant with marine or steamboat engines know what an enormous amount of power is consumed in reversing some of them, particularly those in which the ordinary slide valve is used. Some of the engines of American vessels of war have valves, which, besides being balanced by a number of extra traps, have an extra engine to each cylinder, large enough to drive a good-sized vessel, solely for the purpose of reversing the engines, and it is a long job, and requires a number of men to do it, at that. These engines are necessarily very expensive, and the cost of maintaining them in a serviceable condition is very great; where a pair of such engines are used in one vessel, the liability to accident is so imminent as to make the movements necessary to be gone through with, in an action at sea or on entering a port, anything but agreeable. By using the valves and case, shown in the accompanying engraving, the inventor will guarantee to so improve any engine of this kind that one man can work the vessel into any position necessary without the help of tugs, and with no more risk than is usual to easily-managed boats; the engines shall be entirely under the control of the engineer, and can be handled easily, and reversed instantly, without the loss of time necessary to shut off or throttle the steam. The great desideratum of a reduction in the quantity of coal consumed is also accomplished. There is said to be no instance on record, where these valves have been applied to old engines, that the consumption of coal has not been greatly reduced. The inventor has never been able to get an engine to alter for the saving in coal for one year, the owners for some reason preferring in all cases to

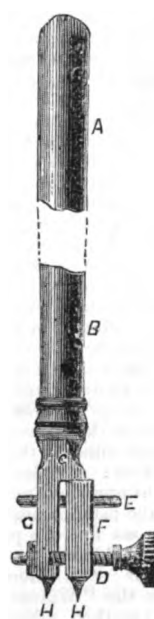
pay a certain specified sum of money for the work done.

Fig. 1 in the engraving is a section of a 12-inch locomotive cylinder, showing the steam-chest ports, exhaust pipes, and method of applying the valves. In this case the cylinder and valve chest are one and the same casting. The cylinders of marine engines are made in a similar manner, much simplifying and lessening the first cost of the engine. The cost of fitting up these cylinders is very slight, the boring bar does the whole of it—simply boring out the short bearings for the valves and squaring up the sides of the ports, all easily and quickly done. The steam enters the outer chest, from the boiler, and almost entirely surrounds the case in which the valve moves, thus ensuring an equal expansion of all parts and preventing the sticking of the valves; the full pressure of the steam is exerted upon the outside ends of both valves, and it is exhausted between them—consequently balancing them. This arrangement makes the only truly balanced valve now made; a child can move them without difficulty when they are properly adjusted and cared for. As they are incompressible by the steam, relief valves are inserted to relieve the excessive back pressure when reversing suddenly. This is absolutely necessary on a locomotive cylinder, but is not so necessary on any other kind of engine. Fig. 2 is a section of the same cylinder through the centre of the exhaust pipe, and shows the arrangement of the ports, valve case, and relief valves. The pressure of the steam in the exterior of the case keeps the latter closed. They are placed over each port, and have a small spring over them to ensure their closing. When the back pressure in the cylinder becomes greater than the pressure in the chest, the valves open, and the steam or water, or both, are discharged into the steam chest. The water falls to the bottom and is discharged by cocks inserted for that purpose. Fig. 3 represents a partial section and top view of the valve case, as made and applied to the valve face of the ordinary slide-valve cylinders. This one was made for a locomotive, but those for marine engines

are made in the same manner, except that they have no relief valves. In some cases, where the valves removed have approximated in size to barn doors, two or more valves have been used, placed side by side and worked by one valve stem. The inventor has found this manner of using them better than to make the valves very large in diameter; they take less room and give all the area requisite. Fig. 4 is a section through the centre of the port of the same valve case. Figs. 5 and 6 represent the valves, showing the manner of placing the rings together, one inside of the other; they are all cut in one place, and so put together as to break joints, with dowel pins to prevent their getting out of place. The cheeks or followers are held together by the shoulder upon the valve spindle and the nut; they are fitted to the spindle, and also to the shoulder or recess in the rings, and are made to fit the bore of the valve chest as nearly as possible, leaving the extreme periphery as thin as it will stand. Through one of the followers are screwed set screws of any number desired—three are generally used. In very small valves the set screws are left out entirely, and the cone is forced into the rings by placing a thin piece of metal or other material between the cone and the follower, and screwing the nut up until the follower comes to a bearing upon the recess and edge of the rings; this answers all practical purposes, and is also cheaper. The conical plug is solid, and is fitted to the valve spindle and also into a ring which is made conical upon its inside periphery; outside of this ring are placed two rings, alike but reversed; they are recessed on their outside edges to give a bearing for the followers; the outside ring is made a little wider than the port, otherwise it might spring out and catch when passing it; its edges are slightly bevelled, being a little wider upon its interior periphery to allow the two-joint breaking rings to grasp and retain it. The action of the arrangement is this:—By screwing up the set screws or nut, the solid conical plug is driven into its surrounding conical ring, which, being cut, is expanded, and through it the surrounding rings are also expanded; at the same time the distances from the centre of the valve to any point or points of its exterior periphery are all equal, or the outside of the valve is true to the centre, and the valve has all the advantages of a solid block, without the disadvantage of being obliged to insert new valves when they begin to leak. These valves have been in successful use for the last four years, and they are stated to have accomplished their object thoroughly.

TURNSCREW FOR BARREL CENTRES OF GENEVA WATCHES.*

By JOHN M'KAY, EDINBURGH.



It has often occurred to me while engaged at work, that the tools requisite for watch jobbing are not so numerous as to meet all wants; occasionally some little thing has to be done, and there is no tool to answer the purpose; very possibly the requisite tool is in existence, but to us unknown. I could point to several matters connected with watch jobbing, where this want is much felt; as, for instance, in the case of unscrewing a Geneva barrel centre—the usual method of doing which as far as I have seen or heard is by using a stout pair of tweezers having their points filed down, or if the centre be very tight (as is often the case), by taking hold of it with a pair of pliers or cutting nippers. The latter method even the most unreflecting workman will allow is very dangerous, inasmuch as it has a tendency to raise a barb on the edge of the centre which, if not removed, will very likely be the means of causing the watch to stop, in consequence of the barb biting into the barrel cover. To obviate these difficulties, I have constructed a little tool which I find very useful, of

* Communicated to the "Horological Journal."

which the accompanying engraving is full size. A is the handle, of ivory or wood; B the ferrule, half the length of which is upon the handle; C is the stock, the tong being fixed with shellac in the remaining space of the ferrule; D is the adjusting screw, on which and the steady pin E traverses the movable piece F; the adjusting screw revolves in the stock, and is kept in place with a shoulder on the inside, and with a collet and pin G on the outside; on the other end of the screw is a brass milled head; the points H H can by means of the screw be set to enter the holes of any size of centre. I have had this tool in constant use for three years, and the points, although very small, have not broken, although it has unscrewed centres so very tight that it required all the pressure that could be applied to the handle to move them.

THE "ALGONQUIN" AND "WINOOSKI."

HAVING followed this extraordinary steam engine trial through its various phases, we now append the report of the naval engineers entrusted with the experiment. It will be seen that the full-power trial has not yet been made, but the results of the trial for economy of fuel afford some data of American marine engineering. The object of the trial was to determine the economy of fuel with which the power was respectively developed in the two cases. The trial was conducted in exact conformity with the instructions of the board of civilian experts. The paddlewheels were exactly alike, and the paddles had the same dimensions and immersion. The vessels were placed on opposite sides of the same pier, with a view to equalise the influence of the tide; but it was discovered in the course of the preceding trials that, owing to an opening through the pier at its head, the tide acted more unfavourably for the machinery of the "Winooski" than for that of the "Algonquin." The opening was not suspected when the pier was originally chosen. The coal was weighed on the pier for both vessels, taken from the same pile, and weighed on the same scales. An agent of the contractor for the "Algonquin's" machinery was present, and noted the weighing. An indicator diagram was taken every half hour, from each end of the cylinder of each vessel; and the mean result from them will be found in the accompanying table, which also contains all the other data necessary to be known.

The "Winooski's" machinery made the ninety-six-hours' run, working in the most perfect manner, and steadily improving, giving a better result for the last twelve hours than for the first. The performance of the machinery, in every particular, leaves nothing to be desired for efficiency in a marine paddlewheel steamer. Its durability and reliability could be depended upon for any length of cruising. The machinery of the "Algonquin" was evidently wanting in these particulars; and in proper adaptation for marine purposes, in style, finish, and convenience for manipulation, it was also far behind its competitor. Instead of performing through the stipulated ninety-six hours of the trial, it was stopped by Mr. Dickerson, its designer, and the agent of the contractor, after sixty-nine hours and eight minutes, and it will require about six weeks from date of stopping to repair and readjust it sufficiently to commence the full-power trial, which is still to be made. At the time the "Algonquin's" engine was stopped, it was falling rapidly behind the "Winooski's," the difference in the performance being nearly one revolution of the wheels per minute. The stoppage, in our opinion, was caused by this fact, and was wholly unauthorised, unwarranted, and unjustifiable, and was done in open defiance of our prohibition. With regard to the economical results, they are as follows, according to the two methods of determining them: By the first method, taking the cubes of the number of revolutions made per minute by the paddlewheels for the measure of the power, we find the power with the "Algonquin's" machinery to cost about two and one-tenth per cent. more in fuel than the power with the "Winooski's" machinery. By the second method, taking the indicator results for the measure of the power, we find the power with the "Algonquin's" machinery to cost about ten and six-tenths per cent. more in fuel than the power with the "Winooski's" machinery. By both methods, the economy of fuel is in favour of the "Winooski's" machinery, and the difference in the results given by the two methods is probably

due to the difference in the effects of the tide on the paddlewheels of the two vessels. As the anthracite used in this trial did not give the same per centum of refuse for both vessels, on account of the difference of time of the experiment, we have taken the coal consumed per hour, less the refuse, as the true weight of fuel consumed.

With regard to the rapidity with which steam could be raised in the boilers of the two vessels, from water of the same temperature, and with equal weights of wood and coal, the difference upon this trial was six minutes in favour of the "Algonquin's" boilers. The point at which the steam was out off in the cylinder of the "Winooski" was ascertained by hooking on the eccentric rod and turning the engine by hand, noting exactly on the main guides the point at which the toe of the rockshaft left the lifter on the lifting rod. This measurement gave 4ft 10in. for the upper stroke, and 8ft. for the lower stroke; which, as the stroke of the piston is 8ft. 9in., gave a mean of 0.619. The out-off of the "Algonquin's" engine, not being a positive one, could not be so measured, but has been computed from the indicator diagrams. The report is signed by chief engineers Robert Danby, Edwin Fithyan, and Mortimer Kellogg, and is addressed to the Hon. Gideon Welles, Secretary of the Navy.

The following are the data of the competitive trial of the "Winooski" and "Algonquin" for economy of fuel, at the Wharf, New York, 1865:—

	"Winooski."	"Algonquin."
Date of commencement, Oct. 22rd, p.m.	4'23	4'23
Duration of experiment in hours and minutes	96	69'8
Total number of revolutions	88,884	67,407
Total number of pounds of coal consumed	162,018	111,344
Total number pounds refuse from the coal	30,400	19,500
Total number pounds of coal consumed, less refuse	121,618	91,844
Per centum of refuse	20	17'51
Average steam pressure in steam pipe in pounds per square inch	19'61	71'83
Average point of cutting off steam	0'619	0'132
Average vacuum in condenser, in inches of mercury	27'80	20'54
Average barometer	29'94	29'94
Average revolutions per minute	14'9104	18'0480
Average indicated pressure on piston	28'276	31'6
Average indicated horse power	845'488	817'817
Pounds of coal consumed per hour	1583'49	1610'57
Pounds of coal consumed per hour, less the refuse	1266'82	1328'50
Pounds of coal consumed per hour, per indicated horse power	2'905	3'113
Pounds of coal, less the refuse, consumed per hour, per indicated horse power	2'322	2'588
Temperature on deck	53'6	53'6
" in fire room	98	108'9
" in engine room	66'8	70'1
" of injection water	55'	55'
" of discharge water	85'9	69'2
" of feed water	104'3	161'4

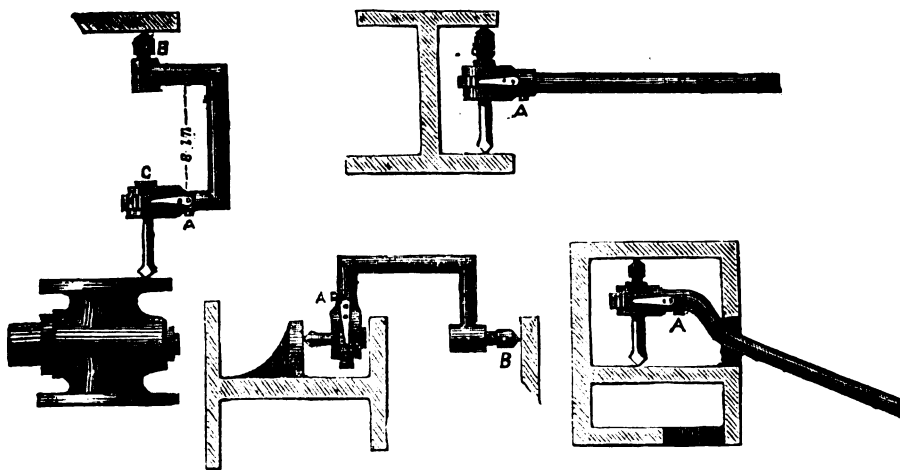
WROUGHT-IRON ORDNANCE.

OUR readers will doubtless remember the stir created in America a few months since by the performance of the Ames gun, the results of the experiments having appeared in our columns. During the present year the inventor, Mr. Horatio Ames, of Connecticut, has patented his improved method of gun construction in England. The making of a gun or piece of ordnance by means of a series of iron rings or tubes welded together is not new, and therefore the nature of this invention consists in an improved method of constructing a gun or piece of ordnance of wrought iron, the same consisting in arranging the rings thereof, and combining them together, and with one or more breechpieces or plates. The invention further consists in the employment, in combination with such method or process, of a centralising pin, and in the construction of each gun section (composed of rings arranged concentrically) where it is to be welded to another section or portion, crowning or convex, or projecting. The invention also consists in combining with the arrangement of the rings concentrically in sections, and the welding of such sections together, the turning of the rings of each section to a close fit with that next adjacent to and concentric with it preparatory to their being welded together. For the purpose of conveniently supporting and manufacturing the piece of ordnance during the process of constructing it a "porter bar" may be employed to advantage. This "porter bar" is a long shaft or bar of wrought iron, having a head or mass of iron at one end sufficiently large to compose the main portion of the breech of the gun, the balance of the breech being welded to

the head, and being a short cylinder of wrought iron, or composed of a cylinder of less diameter, and one or more wrought-iron rings arranged concentrically around it, and welded together, and to it. The surfaces to be welded together are first to be made smooth by being either turned, planed, or otherwise equivalently reduced. The welding together of any two sections or parts of the cannon is to be effected through the agency of a powerful hammer, driven by steam or some other suitable motor, a Nasmyth steam hammer or ram working horizontally being preferable for effecting the union where the joints are upright, or approximately so. The remainder of the gun, except the trunnions, is to be composed of a series of wrought-iron sections, each of which is to be formed of two or any other suitable number of rings or annuli, arranged concentrically. The first or lesser ring should be a little longer than the others, or each of the rings from the outer to the inner of them may be a little less in length than that next to and encompassed by it. Instead of so making each of the sections, the end thereof to be welded to that of another section may be rendered slightly convex by means of a die or former pressed thereon, or by any other suitable means, the object of so making each section being to cause the welding to first take place at the end of the inner ring of it, and to cause any cinders or extraneous matters to be forced laterally out of the joint during the process of hammering the surfaces into welding contact. In this way a very close union of the sections can be effected, their connection at or in the vicinity of the bore of the gun being thus obtained to great advantage. Further, after the welding of each section the front face of it may be brought to a convex shape by means of the concave die or former before mentioned. From the above it will be seen that in the welding of any two of the sections together they will first unite at or close to their bore, and the union will gradually take place from the bore to the circumference of each of the surfaces welded into connection. It should be observed that the rings of each section should or may be planed or made plane on their edges, and should or may be turned so as to correctly or well fit together when arranged concentrically preparatory to being heated for the purpose of being welded together, and into place in the gun. The bores of the various sections should be circular, and of like diameter, in order that the centralising pin may fit each of them when inserted therein. By turning and planing the surfaces to be united by welding, any defects in them may be discovered, and the fitting and union of the parts can be effected with precision, a matter of very great importance in making cannon of wrought iron.

Each section after having been made should be heated to a welding heat in a furnace, care being taken if possible that that end only next to be welded is raised to such a temperature, such being in order that each surface to be welded should be subjected but once to a welding temperature. To accomplish this to the best advantage the gun section may be placed with its axis horizontal or nearly so in the furnace, in order that the heating powers of the latter may so operate as to raise the end to be welded to a welding temperature, leaving the other end at a lower degree of heat. The portion of the gun welded to the "porter bar" and to be welded to the section should also be heated, or have its surface to be welded raised to a welding temperature. Next the section and the breech part projecting from the "porter bar" having been properly heated, should be brought together and hammered into close junction, cranes and tongs or other proper means being employed in bringing together and holding the parts in their due relations during the hammering process. Preparatory to connecting each two of the sections, the centralising pin should be inserted in their bores or central cavities, and suffered to remain there while the process of forcing and hammering the inner rings of the sections together is being carried on. The ram used in welding or hammering the sections together will strike on the head of the pin. This use of the pin not only serves to properly adjust one section to the other, but to bring the several bores or holes thereof into one straight line. After the two innermost rings of the two sections may have been hammered into welding contact, the pin should be removed from the sections, and the completion of the welding of them be effected by the hammer made to strike against the end of the outer section.

COMBINATION RATCHET BRACE.



Besides the welding of the sections together as above described, a grooved bed or grooved dies, and an upright moving ram or hammer are to be used in hammering and compressing the gun in radial or transverse directions. Thus, by hammering the piece on its external surface, and while the rings of a section are in a welding state, the union of the rings may be further effected, and the piece be made to approximate to the final form to be imparted to it by the lathe. The number of sections of which a gun may be composed will depend on the length of the piece and the width of each section. After the cannon may have been so far constructed, the surplus of the "porter bar" may be cut off and used in making another gun. Next, the turning, boring, rifling, and finishing the gun are to be done, the trunnions being screwed into or otherwise suitably affixed to it. In making each section or series of rings, the innermost ring should be so constructed that the laminæ or fibres of the iron may run transversely with the bore, rather than in parallelism or lengthwise thereof, the same being to prevent fissures or seams from being arranged longitudinally of and near to the bore of the gun.

COMBINATION RATCHET BRACE.

The apparatus represented in the annexed engraving is simple in construction and useful in character, as it comprises in itself an ordinary drill brace or a ratchet brace. Its usefulness will be proved by workmen going out to do repairs, when, instead of having to carry one of each sort with them, they will, by means of this apparatus, carry the two in one. It is the patented invention of Mr. R. H. Taunton and Mr. E. Davies, of Heneage-street, Birmingham, engineers, and is fully explained by the engraving, which shows the useful methods of its application. It will there be seen that the combination ratchet brace has many advantages over the ordinary ratchet and swing brace; it can be used as either at the same time; and as the shank is removable from the box by means of the set screw A, and the top centre B can be moved and fixed in the top of the box at C, it only requires a straight handle to make a complete ratchet brace, and by having this handle bent it will drill a hole in any position where a patent ball ratchet would be required. When lightness, combined with strength and cheapness, is required, the shanks are made tubular as well as the loose handles. It is allowed to be a great relief to a man, when using the brace as a swing, to be able to vary the motion to that of a ratchet, and by that means he can continue his work much longer with less fatigue.

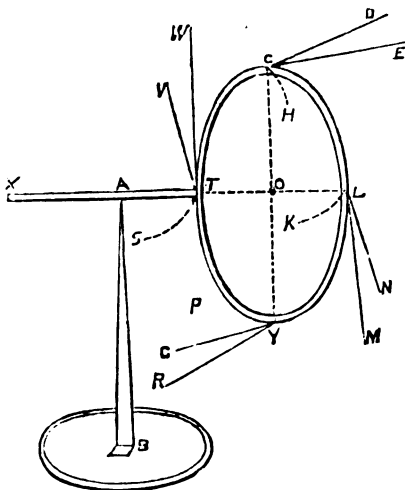
THE PROBLEM OF THE GYROSCOPE.*

By JAMES CLARKE.

The gyroscope, in its simplest form, consists of a wheel or disc revolving on an axle, which rests on an upright pivot, as represented in the annexed figure. When the wheel is set in rapid revolution, and the end of the axle or spindle opposite that on which the wheel revolves is placed on the pivot, the wheel and the end of the axle on which it revolves will remain supported as indicated in the diagram, and the axle or spindle will rotate about the pivot

in a direction opposite to that in which the top of the wheel revolves on the axle.

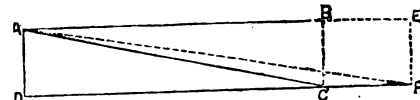
An analysis of the forces producing these phenomena is what is required by the problem of the gyroscope. First. What forces produce the revolu-



tion of the spindle A O about the pivot A? If we begin with the particle of matter situated at the point C in the circumference of the wheel, we will find it acted upon by two forces—the centrifugal, which tends to impel it in the direction of the tangent C D, and that of gravity, modified by the suspension of the axle on the pivot A B, the tendency of which is to cause the particle to describe the arc C H. The resultant of these forces, by a well-known mechanical law, gives to the particle at C an impulsion in the direction of the line C E, diagonal to the tangent C D and the arc C H*; and the like may be predicated of every particle of the wheel above the horizontal diameter T L. The resulting tendency of the forces acting on all these particles, then, is to change the plane of revolution of the wheel to one diagonal to the two planes perpendicular to the horizon, which respectively contain the tangent C D and the arc C H. Now, the wheel can only assume this new plane of revolution, or one parallel to it, by moving backward in a direction opposite to that in which the top of the wheel revolves, which it is free to do by the rotation of the spindle about the pivot A. If we consider the particle at Y (and the like is true of every particle situated below the diameter T L), we find it likewise acted upon by the centrifugal force in the direction of the tangent Y R, and by gravity (modified as explained above), in the direction of the arc Y P. The result is a tendency to produce motion in the direction of Y Q, the diagonal between the direction of these forces, and consequently (Y Q being parallel to C E) to change the wheel's plane of revolution into the same plane into which it is impelled by the forces acting on the particles situated above the horizontal diameter.

We have now accounted for the rotation of the spindle about the pivot A B. Secondly, it remains to account for the paradox of the wheel's continuing supported in the air. If we take the particle situated at T (and the like is true of every particle situated on the same side of the perpendicular diameter

C Y), we discover it is acted upon by the centrifugal force, in the direction of the tangent T W, and by the force communicated by the rotation of the spindle about the pivot A B, in the direction of the arc T S. The result is a tendency to impel the particle at T in a line T V, diagonal to the tangent and the arc, and the wheel into a plane of revolution diagonal to the horizontal plane which contains the arc T S, and the plane perpendicular to the horizon and to the axle A O, which contains the tangent T W.* But the wheel can only assume this new plane of revolution, or one parallel to it, by the elevation of the extremity O of the spindle on which it revolves. In like manner, the particle situated at L (and the like is true of all particles on the same side of C Y) is acted upon by forces tending severally to impel it in the direction of the tangent L N, and of the arc L K. The evident result is a tendency to impel it in the direction L M, and to produce the same change in the plane of revolution of the wheel that we have already shown to be the effect of the forces acting on the particles on the other side of C Y; and it is this constant effort to change the plane of revolution into one which, or a plane parallel to which, the wheel can only assume by elevating the extremity of the axle, which prevents it from falling.† The whole may be thus summed up. The rotation of the spindle on the pivot is the resultant of the action of gravity and the centrifugal force generated by the revolution of the wheel on the axle; while the wheel is prevented from falling by the combined action of the same centrifugal force and the rotation of the axle on the pivot. Corollary 1. If the extremity of the spindle opposite the wheel be prolonged beyond the pivot in the direction A X, and a weight be placed at X somewhat more than sufficient to balance the wheel, the spindle, instead of rotating about the pivot in a direction opposite to that in which the top of the wheel revolves, will rotate in the same direction. Corollary 2. If the weight exactly balance the wheel, the spindle will cease to rotate about the pivot. Corollary 3. If the weight be removed, and the rotation of the spindle be stopped by the interposition of any obstacle or opposing force, the wheel will fall. Corollary 4. If the weight be suffered to remain, and be more than sufficient to balance the wheel, and the rotation of the spindle be stopped, the wheel will tilt upward. Another fact remains to be considered, viz., the resistance offered by a body in motion to any force tending to divert or deflect it from the direction in which it is moving. Suppose a body placed at A to be impelled in the direction A B by a force



sufficient to carry it to B in a given time. Now, if the same body be simultaneously acted upon by another force in the direction A D, sufficient to carry it to D in the same time, by a familiar law already alluded to, the body will move in the diagonal A C, and will reach C in the same time in which the forces acting singly would carry it to B or D. The point to which attention is invited is this, that while the second force, if acting alone, would impel the body in the direction A D, when the same force acts in the same direction on the body simultaneously impelled toward B, with a force proportioned to that acting in the direction of D, as A B to A D, the path A C described by the body more nearly coincides with the direction of the stronger force; and if we increase that force, so that it shall bear to the other the ratio of A E to A D, A F the path of the body will be still more nearly coincident with A E. Whence it follows that a moving body resists diversion from the direction in which it is moving, and this resistance is in the compound ratio of its quantity of matter and velocity.

If we apply this principle to a wheel or other body revolving on an axis, and, leaving out of view the thickness of the revolving body, consider that the centrifugal force tends to impel every particle in the direction of the tangent to the periphery of the circle in which it revolves, and that all these tangents lie in the same plane (perpendicular to the axis of revolution), we can readily perceive that the revolving body will resist any change of its plane of revolution, or (which is the same thing) of the direction of its axis, with a power proportioned to the momentum generated by its revolution. If we take the thickness of the wheel into account, we find the particles revolving in a series of parallel

* The spindle is here assumed to be placed on the pivot at right angles with it, which is not necessarily the case; and the angle at which it is placed may subsequently vary, accordingly as the elevating tendency is greater or less than the force of gravity.

† If the spindle be placed on the pivot so as to form either an acute or obtuse angle with it, it is evident that the centrifugal force generated by the rotation of the spindle about the pivot, will tend to bring the spindle at right angles with the pivot; in the former case, acting in aid of the elevating force, in the latter, in opposition to it.

* From the Journal of the Franklin Institute.

planes, with a like tendency to resist change. It is this principle which gives to rifled fire-arms their chief advantage in point of accuracy. If we regard the projectile discharged from a piece of this description as moving in a right line (which is virtually true of short distances), its plane of revolution is at right angles to its line of progression; in other words, the axis of revolution coincides with the line of projection. It is evident that the tendency of revolving bodies to preserve the identity or parallelism of their planes of revolution, and consequently to maintain the direction of their axes, strongly operates to continue the ball in the line of the original impulsion. If we apply this law to the gyroscope, it will readily be observed in what manner it co-operates in preventing the wheel from falling. For, one end of the spindle being sustained by the upright pivot, the wheel can only fall by describing the arc of a circle, the centre of which is the point of the pivot and the radius, the spindle. But to fall in this manner, requires a constant change of the wheel's plane of revolution, the tendency to resist which has already been explained.

Correspondence.

LIGHT DRAUGHT ROLLER SHIP.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—Mr. Barber is possibly not very far from the truth when he says that I may know more about ordinary ships than he does, and I may add that if he knew more about ordinary ships he would not have proposed a light-draught roller ship at all. I contend that my assumptions in my letter of November 11th are not incorrect, and that I do understand the ship that he attempted to describe. In instantiating the "Mosquito," I did so for the purpose of showing that a small exposure to the air is a necessity for a ship that is required to go in any direction, and I referred only to the hull, which is constructed for that very purpose. The means of propulsion, whether sail or steam, are not so widely at variance as Mr. Barber supposes, for a weatherly boat must have only sufficient freeboard to make her seaworthy. Mr. Barber treats very lightly the fact that a vessel is immersed in two fluids—water and air. It is the inevitable large exposure to the air which prevents his project from having the slightest chance of success. If Mr. Barber is fond of making calculations, the following will enlighten him. We lately had a gale which gave a pressure of 27lb. to the square foot. Taking the resistance on a globular surface at two-thirds—say 18lb. to the square foot of exposed surface—what horses power would be required to enable his vessel merely to hold its own, that is, to remain stationary in the teeth of the gale? Again, what horses power would drive his vessel at twenty miles an hour head to wind in the same gale, as the pressure per foot would then be increased to about 33lb. ? Supposing his vessel to have been on a coasting voyage in that gale, all the mysterious compressed air power and revolving globes that could be brought to bear would not have prevented it from going dead to leeward. My acquaintance with the contents of the Patent Office is rather extensive, and I think your readers will agree with me that 90 per cent. of the supposed "improvements" there registered were conceived in ignorance of the several subjects attempted to be improved, and that the very first step to improvement is an intimate knowledge of what has already been done.

I am, Sir, yours, &c.,
1, Clifford's Inn, December 2. T. MOY.

Meetings for the Week.

MON.—Royal Geographical Society.—Papers to be read—1 "On Ankara, the Central Province of Madagascar, and on the Royal and Sacred Cities," by Rev. W. Ellis. 2 "A Boat Journey along the Coast Lakes of East Madagascar," by Capt. W. Rooke, 8.30.

Architectural Association.—"Plumber, Painter, and Glazier," by Mr. J. S. Edmeston.

TUES.—Institution of Civil Engineers.—"Experiments on the Strength of Cement, chiefly in reference to the Portland Cement used in the Southern Main Drainage Works," by Mr. J. Grant, 8.

TO CORRESPONDENTS.

The *MECHANICS' MAGAZINE* is sent post-free to subscribers of £1 ls. 8d. yearly, or 10s. 10d. half-yearly, payable in advance. Post-office orders made payable to Mr. R. A. Brooman, of 168, Fleet-street, E.C.

Advertisements are inserted in the *MECHANICS' MAGAZINE* at the rate of 6d. per line, or 6d. per line for 6 insertions, and 4d. a line for 52 insertions. Each line consists of about 10 words. Woodcuts are charged at the same rate as type. Special arrangements made for large advertisements.

All communications should be addressed to the Editor, 168, Fleet-street.

To insure insertion in the following number, advertisements should reach the office not later than 5 o'clock on Thursday evening.

We must absolutely decline attending to communications unaccompanied by the name and address of the

writer, not necessarily for insertion, but as a proof of good faith.—Ed. M. M.

RECEIVED.—Dr. A. G.—R. C.—N. S. H.—H. M.—J. C.—J. B.—W. B.—J. N.—W. W.—G. D.—J. C.—K. and L.—T. M.—W. M.—C. J. R.—J. F.—Messrs. J. N. and Co.

Miscellaneous.

We have to announce the sudden death, on Monday afternoon last, of Captain Fowke, R.E., at his official residence, South Kensington. Death was occasioned by the bursting of a blood-vessel, but Captain Fowke had been in declining health for some months. The deceased officer will be best remembered as the architect of the building for the Exhibition of 1862. He was also the architect of the South Kensington Museum, the Industrial Museum of Scotland, and the National Gallery of Dublin.

A great deal has been said lately about a telegraphic cable to connect all the islands in the Mediterranean with Greece, and it is thought, considering the large trade at Patras and other places, it would be a paying project, but no one seems to have money to spare at present for it.

At an industrial exhibition recently held at Vienne (Isere) a variety of artificial legs, constructed on an entirely new principle, were exposed to view. The jurymen whose duty it was to decide on the comparative merits of the instruments were much perplexed. At last they bethought them of assembling half-a-dozen Crimean and Mexican amputees and starting them over a half-mile course, equipped with the rival legs. The prize is stated to have been won by an *invalid*, both of whose legs had been taken off at the knee, but who nevertheless, went over the distance in nine minutes.

At the general monthly meeting of the Royal Institution of Great Britain, held on Monday, December 4, Sir Henry Holland, Bart., M.D., D.C.L., F.R.S., President, in the chair, the Hon. Robert Bourke, the Viscount Cranbourne, M.P., the Rev. John Henry Ellis, M.A., John Heugh, Esq., Sir Edward Hilditch, M.D., and Staveland King, M.D., were elected members of the Royal Institution.

During 1864 gold was obtained from five mines in Merionethshire; 2,336 tons of auriferous quartz were crushed and treated by the amalgamating processes. From this the adventurers obtained 2,887oz. of gold, the value of which was £9,991. By an improvement in the process of amalgamation, the discovery of Mr. William Crookes, F.R.S., the well-known discoverer of the new metal thallium, it is expected that the production of British gold will be considerably increased during the current year.

We understand that by order of the Emperor the use of the gun cotton by the Austrian artillery and corps of engineers is prohibited. A few years ago forty batteries of eight guns were made, all of which were to be charged with gun cotton instead of powder, and now they must be recast. There is a large stock of gun cotton on hand which if not soon sold is to be destroyed.

From Prussia we learn that a military and naval commission has decided on Kiel as the future Cherbourg of that country. Some artillery experiments were recently made at which the gun used was a nominal 72-pounder rifled gun, carrying an elongated shot, weighing about 220lb. English. With a charge of 18lb. (equal to about 20lb. English) the shot penetrated a plate 4in. thick, as also the timber backing, at 500 yards.

In reporting a paper on a new mining theodolite recently read before the South Wales Institute of Engineers, two of our contemporaries—whose intimate acquaintance with mining matters ought to render them authorities on such points—state the weight of the instrument to be "not more than 13 tons"! Not more, for the sake of convenience, we should hope.

It was stated that the number of railway bills to be introduced next session would exceed even the enormous number which Parliament had to deal with last year. This has not proved to be the case, as there are ten less than last session. There are, however, no less than fifty-seven plans of railway and other schemes affecting the metropolis which have been deposited with the Metropolitan Board of Works, most of which are for progress of an extensive character, and will require much careful investigation.

The subject of the piracy of trade marks is fast becoming one of great importance to the manufacturers of this country, and the Council of the Society of Arts proposes to appoint a committee to inquire into the practical operation of the existing law, and to consider what improvements can be introduced to increase its efficiency; the committee will communicate with committees already formed with a similar object in the manufacturing districts.

There is a rumour afloat that the board of directors of the Great Western Railway Company have it in contemplation to reduce the broad gauge system to the narrow, throughout their entire line of country. The estimated expense is stated to be about three millions sterling.

The inhabitants of the town and county of Nottingham have appointed an executive committee to make arrangements for receiving the British Association in 1866.

In a paper recently read before the Edinburgh Photographic Society, Mr. John Peat strongly advocated the use of dry collodion plates for amateur photography in the field, and drew attention to the various troubles which attended the practice of wet plates, from the operator having so many articles to carry about from place to place—such as baths, bottles, tent, &c.—as compared with the light equipment necessary for dry-plate work, and the consequent great saving of time and trouble to those who, like himself, went occasionally to the country for a day's pleasure, and to pick up a few pictures when they were to be met with. For occasional use dry plates are certainly a convenience, but without doubt the best pictures are produced by wet plates.

A simple but very useful means has been devised at Kew for mapping the spectrum lines so as to show correctly their relative distances and positions. The paper to which the lines are to be transferred is wrapped upon a cylinder, the circle of which is graduated and fitted with a vernier and micrometer screw, by means of which it may be turned through any required angle from the starting place, where a ruler edge enables the operator to trace the line upon the paper without any difficulty. The angular distances between the lines of the spectrum are furnished by the graduated circle of the instrument and a micrometer attached to the eye-piece.

The consumption of steel for pen-making is enormous; twenty-four years ago it amounted to 120 tons annually, and was equivalent to about 200,000,000 of pens. This quantity is now greatly increased in consequence of the penny postage and the improvements in steel-pen manufacture. Some idea of it may be gathered from the fact that pens may now be bought by the trade at 4d. per gross, the box included, and that there are houses which produce 20,000, 30,000, and even 50,000 pens daily throughout the year. The best material is said to be Swedish iron, which is converted for the purpose both on the old plan in a furnace or by the Bessemer process, and subsequently hardened by tilting, casting into ingots, and rolling it into thin sheets.

Official accounts from Russia state that the steam navy of that country was composed at the beginning of the present year of six ships of the line, eight frigates, two iron-coated frigates, twenty-two corvettes, one clipper, three iron-coated batteries, eleven iron-coated gunboats, eighty barques mounted with cannon, four yachts, twenty-four galiots, seventy transports, and four lighters for landing troops, being two vessels less than the previous year. The Russian steam navy represents a force of 37,244 horses. It is armed with 2,095 cannon. The Russian navy is further composed of the following sailing ships:—One corvette, six schooners, three tenders, eleven transports, nine yachts, two gun brigs, and eleven barques, carrying seventy-five guns. To these must be added fourteen iron-plated floating batteries, carrying twenty-eight guns. The ships in the floating docks and those attached to the various seaports are not comprised in these returns. The Russian navy has been increased during the present year by forty vessels and batteries of various sizes, all iron-plated.

On the 28th of October, 1865, there was submitted to the Emperor Napoleon by General Clarke, Minister of War, the quixotic plan of a person named L'Homond, designated as "ex-chief of the battalion of aéronauts," for making a descent on England by means of 100 balloons of 100 metres diameter each, the car of which could contain 1,000 men with provisions for ten days, two pieces of cannon with their ammunition chests, 25 horses, and fuel for the balloons. The Emperor wrote a few words in the margin, ordering the plan to be sent to M. Monge, the celebrated mathematician, "to see if it were worth while to make so great an experiment."

Chili furnishes our chief supply of copper; thus, out of 66,916 tons of ore imported last year, 20,664 were imported from Chili, while of copper regulus, the quantity from Chili was 22,659 tons, the supply from all other sources being only 3,729 tons. Of pure copper, wrought and unwrought, Chili also sent us 304,350 cwt., out of an aggregate of 498,780.

If it were possible to separate the globe at its centre, in the same way as an orange or cheese is frequently divided, and to stand at the base of the division, the chasm would represent a height 1,456 times higher than the Himalayas, or if Great Britain were reared on end from the Solent to Cape Wroth, it would reach but about one-twelfth of the distance.

The great peculiarity of the season has been the very heavy dews we have had—great luxuriance of pasture nourished by dews and not by rain. Mr. T. Ainsworth, of Cleator, draws attention to this as being a predisposing cause of the present cattle disease. Not that it really engenders the malady, but predisposes the animal to take this peculiar type of disease. It is very probable that cattle would be injuriously affected by feeding on herbage which has not been well washed by occasional showers of rain. Dew has little or no washing effect, and cannot remove the impurities which are deposited upon the leaves of plants during long periods of dry weather.

The business of iron smelting may be said to be fairly inaugurated in Colorado, as the Belmont furnace is in operation near Denver, and is turning out two tons of pig iron per day. The ores used are pronounced to be the best in the world, and are excelled in richness only by the Pilot Knob and Lake Superior ores; but possess an advantage over these in the fact that they can be easier and more economically worked. The supply of ore is deemed inexhaustible and is easily obtained.

Dr. Angus Smith, when travelling in a railway carriage, collected some of the particles of dust which floated in the air and which seemed to shine with a metallic lustre. On examination Dr. Smith found that the larger class were in reality rolled plates of iron which seemed to have been heavily pressed and torn up from the surface. Another and smaller class were less brilliant, and when looked at with considerable power showed many inequalities of surface. Probably these were the particles which were not torn up but rubbed off.

At the last sitting of the Academy of Sciences M. Campisi sent in a paper on a combination of mercury and benzyle, a hydro-carburet composed of seven equivalents of carbon and seven of hydrogen. This new mercurial combination crystallises in white needles; it melts at a temperature exceeding 200 deg. Centigrade; it is but slightly soluble in alcohol at the common temperature, but is somewhat more so in boiling alcohol, and still more in ether. With this compound other metallic ones with benzyle may be obtained.

A Dr. Baconio, of Milan, who has been experimenting on electricity produced from vegetable substances, finds that a few alternations of slices of beetroot and walnut wood will set free electricity enough to excite convulsions in a frog when conveyed to its muscles by means of a conductor formed of scurvy grass.

The frequent recurrence of railway accidents, and the difficulty of obtaining medical and surgical appliances although doctors may be at hand, point out a strong necessity for the establishment by every railway company, at all small and outlying stations especially, of a medicine chest, properly fitted with such means and appliances (medical and surgical) as are requisite to meet the exigencies of these too frequent accidents.

Our readers may remember that during the last session of Parliament a bill for a direct railway between Greenwich and Woolwich was thrown out in committee, chiefly on the objection of Professor Airey, the Astronomer Royal, that the passage of trains through Greenwich Park would produce a vibration unfavourable to the operations at the Royal Observatory. It was at the same time intimated that by a deviation in the proposed line, this objection might be obviated, and plans have now been prepared, which will not be opposed on the part of the Admiralty. The new line will pass through the grounds of the Royal Naval Asylum, at such a distance from the Observatory as to obviate all inconvenience from vibration, and will connect the present London and Greenwich Railway with the North Kent line near Charlton.

Patents for Inventions.

ABRIDGED SPECIFICATIONS OF PATENTS.

THE Abridged Specifications of Patents given below are classified, according to the subjects to which the respective inventions refer, in the following Table. By the system of classification adopted, the numerical and chronological order of the specifications is preserved, and combined with all the advantages of a division into classes. It should be understood that these abridgements are prepared solely for this Magazine from official copies supplied by the Government, and are therefore the property of the Proprietors of this Magazine. Other papers are hereby warned not to produce them without an acknowledgment.

SOILS AND FURNACES.—1324
BUILDINGS AND BUILDING MATERIALS.—1315, 1330, 1335, 1287, 1340, 1348
CHEMISTRY AND PHOTOGRAPHY.—1313, 1325
CULTIVATION OF THE SOIL.—including agricultural implements and machines.—1321, 1328, 1345
ELECTRICAL APPARATUS.—None.
FIBROUS FABRICS.—including machinery for treating fibres, pulp, paper, &c.—1207, 1312, 1314, 1316, 1317, 1360
FOOD AND BEVERAGES.—including apparatus for preparing food for men and animals.—1319, 1346, 1349
FURNITURE AND APPAREL.—including household utensils, time-keepers, jewellery, musical instruments, &c.—1202, 1318, 1320, 1331, 1333, 1339, 1359, 1361
GENERAL MACHINERY.—1304, 1344, 1350, 1357, 1361, 1363

LIGHTING, HEATING, AND VENTILATING.—1334, 1336
METALS.—including apparatus for their manufacture.—1310, 1311, 1352
MISCELLANEOUS.—1309, 1327, 1329, 1354, 1359
ROADS AND VEHICLES.—including railway plant and carriages, saddlery, and harness, &c.—1308, 1322, 1323, 1343, 1353, 1358, 1362
SHIPS AND BOATS.—including their fittings.—1347
STEAM ENGINES.—&c.—1301, 1303, 1305, 1342
WARFARE.—1308, 1328, 1332, 1341, 1355, 1356

1301 W. J. RICE. *Improvements in machinery for obtaining motive power.* Dated May 10, 1865

This invention relates to a novel arrangement of mechanism whereby motive power can be obtained from the expansive force of compressed air. In carrying out the invention the patentee has a reservoir of suitable capacity and strength to contain air under considerable pressure. This reservoir communicates by means of valves opening outwards with the motive power engine, which forms the subject of the invention. The invention is not described apart from the drawings. *Patent completed.*

1302 R. HADFIELD and J. SHEPMAN. *Improvements in metal ribs for umbrellas and parasols.* Dated May 10, 1865

This invention consists in constructing ribs for umbrellas and parasols of a double tubular formation. *Patent abandoned.*

1303 S. POKUTYNSKI and M. MYCIELSKI. *Improvements in the mode of and apparatus for obtaining and applying motive power.* Dated May 10, 1865

The object of this invention is to obtain increased power from the pistons of steam engines, whether horizontal or vertical, fixed or movable, marine or otherwise, and at the same time reduce the dimensions of the cylinders in which they work, and by this means economising both steam and fuel. The piston rod the patentees make use of is so constructed as to be capable of extension and contraction. This is effected by connecting it with several pieces hinge-jointed together—in short, having the exact form and construction of the well-known instrument called lazytongs, the effect being to obtain a stroke twice or three times the length of the piston, by which means a longer lever can be employed. The lever is attached in the usual manner to the driving wheel, and the other free end is connected with the jointed piston rod above mentioned, so that, when the pistons rods are fully extended at the full stroke, on making the return they gradually contract. *Patent completed.*

1304 J. GOODWIN. *Improvements in casting iron girders and in apparatus therefor.* Dated May 11, 1865

This invention consists in casting iron girders with their broad flanges downwards, in order to obtain increased strength and solidity. *Patent completed.*

1305 J. H. JOHNSON. *A combined safety valve regulator, pressure gauge, water indicator, alarm, and "blow off" for steam generators.* (A communication.) Dated May 11, 1865

This invention cannot be described apart from the drawings. *Patent completed.*

1306 W. TIGOU. *Improvements in securing the rails of the permanent way of railways.* Dated May 11, 1865

This invention consists essentially in the application and use for that purpose of a "gib and cotter," or of reversed wedges set up or tightened one against the other and against the side of the rail by a nut and screw bolt, or by a bolt tapped into a lug on the gib, or into one of the reversed wedges. The gib and cotter, or the reversed wedges, are situated between the jaw of the chair and the side of the rail, and serve the purpose of the present wooden wedges. These gibs and cotters, or reversed wedges, are, by preference, made of cast or wrought iron, or other suitable metal, but, if desired, they may be made of wood, in some cases; the screw bolts, of course, in all cases being composed of metal. *Patent abandoned.*

1307 W. JAMISON. *Improvements in power looms for weaving.* Dated May 11, 1865

This invention relates to a former patent, dated 10th September, 1857 (No. 2,357). The first improvement consists in the application of a cylinder, the cylindrical surface of which is formed of sheet metal. This cylindrical surface is simply perforated with such a number and arrangement of holes as is required to represent or form the pattern to be woven. The second improvement consists in the application of three, four, or more cylinders, arranged in a frame turning on an axis supported in bearings on the vibrating frame. The third improvement consists in a new and simplified arrangement for actuating those double levers which carry the knife-box and rest-plate, or the single levers and appliances used as substitutes for the same. The fourth improvement consists in an improved apparatus for perforating the holes in the cylinders before mentioned. The second part of the invention consists in the application of apparatus for assisting the stopping of the motion of the loom on the breaking of the weft, and is applicable to looms of the ordinary construction. *Patent completed.*

1308 J. R. COOPER. *Improvements in breechloading firearms, and in cartridges for breechloading firearms.* Dated May 11, 1865

The essence of this invention consists in so forming the end of the plug, or closer, and the cartridge respectively that, on the explosion of the cartridge, its case is made to connect itself comparatively with the plug or closer, so that, on the withdrawal of the said plug or closer, the case of exploded cartridge is withdrawn from the breech end of the barrel. *Patent completed.*

1309 T. J. MAYALL. *Improvements in the manufacture of hose and other flexible tubing, which improvements are also applicable in uniting the surfaces of india-rubber, gutta-percha, or of compounds thereof, to each other, or to woven or other fabric or material for other purposes.* Dated May 11, 1865

In the manufacture of hose or other flexible tubing, the patentee takes sheet india-rubber or gutta-percha, or a compound thereof, with which sulphur has been combined for the purpose of its conversion or vulcanization; he applies to one surface thereof a layer of cement, and when a layer of such cement has been applied to the sheet india-rubber, gutta-percha, or a compound thereof, he subjects the sheet to the action of heat in the usual way to

effect its conversion or vulcanisation. When conversion or vulcanisation is complete, he cuts such sheets into breadths adapted to the size of hose or other tubing desired to be obtained, and he applies to the surface of such breadth to which the cement was previously applied a corresponding width of strong woven or other fabric or material, the surface of which (so applied to the surface of india-rubber, gutta-percha, or compound thereof) has previously received a coating of the cement referred to. He then presses together the two surfaces by means of rollers or otherwise, by which the complete union thereof will be effected. Hose or other tubing is then formed by sewing or riveting, or otherwise cementing together, the edges of such straps or breadths. The cement above referred to is obtained by mixing shellac with india-rubber, gutta-percha, or a compound thereof, dissolved by camphine or other suitable solvent. *Patent completed.*

1310 J. BENNETT. *Improvements in the manufacture of iron and steel.* Dated May 11, 1865

This invention relates more especially to the refining of iron and steel, and consists simply in projecting, propelling, driving, blowing, or otherwise dispersing highly fluid iron, splashing it into globules, drops, grains, film or spray, exposing as much surface as possible into and through the atmospheric air at as great a speed as possible, such air being heated or cold, in motion or not in motion, as may be found most desirable, such globules, drops, grains, film, or spray to be collected together whilst they are yet in a fluid state, attainable by the use of suitable apparatus, or by letting such globules, drops, grains, film, or spray, fall into a suitable space to be collected when they have become solid, and then reated upon or used for that purpose for which they are suitable. *Patent abandoned.*

1311 G. MOUNTFORD and E. WORROLL. *Improved apparatus for cutting, turning, and smoothing metal pipes and the surfaces of bolts, rods, or spindles.* Dated May 11, 1865

This invention consists in adapting to an ordinary screw stock, or to an apparatus of analogous construction, a cutter or cutters, or other suitable tools, which are capable of being advanced by screws (as is well known) for the purpose of cutting into, smoothing, or turning cylindrical surfaces of metal, such as pipes, bolts, shafts, or spindles. When the cutters are fixed in the stock, or in any other equivalent instrument which will embrace the pipe, bolt, or spindle to be operated upon, the stock is moved round by the handles, and will cause the cutters to cut into the metal. Cutters can also be applied for chasing screw threads at once on the cylindrical surfaces. The dies may be traversed in connection with the cutters, which can be applied or secured to the stock in various ways, such as by means of screws, wedges, or eccentrics. *Patent completed.*

1312 D. ELLIS and M. HILLAS. *Improvements in apparatus employed in weaving broadened and ornamental fabrics.* Dated May 11, 1865

This invention consists in certain constructions and arrangements of the apparatus used for introducing the weft in the fabrics above mentioned. For these purposes a swivel shuttle used in the swivel shuttle broadening is arranged to receive in one part a bobbin, barrel, cylinder, or other, or similar instrument, on to which, as heretofore, the weft to be introduced into the woven fabric is wound, and in another part of the shuttle another bobbin barrel, cylinder, or similar instrument is introduced, on to which the weft passes, and the drag on the weft is thereby regulated. *Patent completed.*

1313 A. PARKES. *Improvements in the manufacture of parkesine or compounds of pyroxilline, and also solutions of pyroxilline known as collodion.* Dated May 11, 1865

The patentee claims the use of nitrobenzole, aniline, and glacial acetic acid, or either of them, for dissolving pyroxilline in the manufacture of parkesine and similar compounds of pyroxilline. He also claims the use of nitrobenzole, aniline, and glacial acetic acid, or either of them in the manufacture of collodion. *Patent completed.*

1314 E. L. GIBARD. *Improved machinery for pulling fur hats or felt hats.* (A communication.) Dated May 11, 1865

This invention is not described apart from the drawings. *Patent completed.*

1315 E. CORDONNET. *Improvements in tents and stalls.* Dated May 12, 1865

This invention consists in causing the supports and cross beams to be bolted or hinged together and so arranged that, on removing the angle irons with which they are strengthened, they can be folded to admit of their introduction in an iron box, which may be sunk in the ground, and be capable of containing one or more tents or stalls, the box being so arranged as to be level with the ground when closed. The iron of which it is made can be protected from humidity in any of the ordinary ways, and such box being furnished with a lock, their contents are secure from theft or damage. *Patent completed.*

1316 T. SMITH and H. JAMES. *An improved woven fabric.* Dated May 12, 1865

In performing this invention the patentees take waste silk or silk noils, and make them into silvers by any of the ordinary machines used for preparing cotton or other fibrous material, and spin or twist the said silvers into threads suitable for warp and weft. They then weave it into a fabric, which in this state is very rough, but after discharging the colouring matter and dirt by any of the known processes, they produce a cloth suitable for towel-making and similar purposes. They make the said towelling with Turkey red dyed cotton borders and headings, and discharge the dirt and kill the smell by boiling them in soap and water and afterwards storing them in sulphur. *Patent completed.*

1317 J. HESFORD. *Improvements in machinery for stretching cotton and other fabrics or materials.* Dated May 12, 1865

This invention is not described apart from the drawings. *Patent completed.*

1318 G. HARTLINE. *Improvements in the manufacture of boots and shoes.* (A communication.) Dated May 12, 1865

We cannot here give space to the details of this invention. *Patent completed.*

1319 H. RAMSPOND. *Improvements in treating rice and other grain for the manufacture of starch, also to prepare them for use as food, and for other purposes.* Dated May 12, 1865

The patentee claims treating rice and other grain to obtain starch, or a starchlike matter, by the combined pro-

cesses of steeping in alkali, pressing, drying, and then grinding. Also, when the grain is not required to be ground, he claims the steeping in alkali, pressing, and drying the rice or grain in the underground state, as described. Also, he claims submitting the whole or unground rice or grain to repeated steepings in alkali, then drying, and lastly grinding it, as described. Also, he claims the repeated steeping in alkali, and afterwards drying whole or unground rice or grain, as described. *Patent completed.*

1320 S. T. GARRETT. *An improvement in stoppers and flasks, bottles, and other similar vessels.* Dated May 12, 1865.

The object of this invention is to enable persons to readily draw the contents from flasks, bottles, and other similar vessels. This invention consists in fitting in the cork or other stopper or in the upper part of the flask or other vessel a tube which extends inside the flask to near the bottom thereof, and in making an aperture through the stopper or through the neck of the flask below the stopper to admit air. When suction is applied to the tube the liquid in the flask rises in the tube and is replaced by air entering through the air aperture. *Patent abandoned.*

1321 R. WINDER. *An improved method of and apparatus for laying single line articulated railways, and a method of propelling thereon, particularly applicable for agricultural purposes.* Dated May 12, 1865.

This invention was described and illustrated at page 314, No. 2146, of this journal. *Patent completed.*

1322 W. CURVEY and S. FRY. *Improvements in the means or method of effecting communication between passengers, guard, and engine driver of railway trains whilst in motion.* Dated May 12, 1865.

These improvements consist in making a passage through the centre or other part of each carriage, and communicating from the outer end of each carriage by a platform or footboard to the guard to have free access through the whole line of carriages. The footboards have hinges to admit of their being thrown up during the operation of coupling the carriages, and are made to slide in sockets inwards upon the action of the buffers, and there is a spring at the back to throw them outwards when the train is in actual motion. The sliding socket is to be made of iron or other metal. *Patent completed.*

1323 R. E. DOROVAN and D. O'BRIEN. *Improvements in the means and apparatus for effecting traction on railways and roads where traction is used.* Dated May 12, 1865.

This invention has for its object to render the power of traction wholly or partially independent of the weight of the engine, and consists in causing the driving or traction wheels to be pressed by means of springs, compressed air, steam, or other suitable power, in such a manner against rails, bars, chains, projections, or surfaces fixed to or formed on the road or permanent way, that such pressure is wholly or partially independent of the force of gravity. *Patent abandoned.*

1324 W. HEWITT. *An improved composition for preventing corrosion in steam boilers.* Dated May 12, 1865.

In preparing this composition the inventor takes tanned leather or other materials prepared, dressed, or impregnated with bark, such as is used by tanners for tanning leather, and having cut the same into small pieces he proceeds to boil the same in water until the whole attains a yasty consistence. He then proceeds to mix therewith the washing soda of commerce, tallow, or other fatty matters, in the proportions of about one part of soda and tallow to twenty parts of the leather. He then reboils the whole and moulds it into blocks of suitable size and shape. *Patent abandoned.*

1325 G. and G. W. SIMMONS. *Improvements in the means and method of producing lithographic impressions, and in the apparatus connected therewith.* Dated May 12, 1865.

In carrying out this invention the patentees dispense entirely with the scraper, which, in passing beneath the work, is apt to, and frequently does, stretch the work, and, especially in colour printing, prevents the proper registering of the colours correctly. Again, it is well known by those in the trade that many stones are broken by being almost imperceptibly uneven by the rigid or unyielding pressure of the scraper. Now the patentees employ two, three, or more rollers of equal dimensions, either of hard wood, leather, brass, iron, or even steel; these rollers are set in suitable bearings, their lower surfaces being on the same plane. These rollers they cover with gutta-percha, india-rubber, felt, cotton, flannel, or other such material as will give a slight flexibility to the surface of each roller. It is thus evident that, as the work passes these rollers, it receives the equal pressure of the whole number, and brings off a more clear and even impression than by the old method of the scraper. *Patent completed.*

1326 J. EDDY. *Improvements in ploughs.* Dated May 12, 1865.

This invention relates to what are known as "turn-wrest" or one way ploughs, and also to the single ploughs, and has for its object the effectual burial of the surface soil by throwing up the subsoil over it, and breaking up the furrow so as to leave the surface comparatively smooth and level, and ready for seeds, without the necessity for the subsequent operating of harrowing. As the flys hitherto used in turn-wrest ploughs are entirely dispensed with in the improved plough, it is not liable to choke or clog up, and is well adapted for fallow land, and more easy of draught than the ordinary turn-wrest ploughs. The invention cannot be described without reference to the drawings. *Patent completed.*

1327 T. DAVIS. *Improvements in vessels for containing blacking, polishing oils, and other similar materials, and in apparatus connected therewith.* Dated May 12, 1865.

This invention has reference to vessels for containing blacking, polishing oils, and other similar materials, and to apparatus to be used with such vessels for the purpose of stirring their contents, and for preventing the accidental dipping of the brush too deeply therein, whereby greater cleanliness than heretofore is obtained, and waste of the blacking or other material avoided. According to this invention it is proposed to employ a cylindrical vessel, by preference of earthenware, fitted with a lid or cover capable of being easily rotated thereon by a knob or handle for that purpose. A notch is made in the periphery of the lid or cover, through which passes the upright stem of a stirrer, which may be also made of earthenware, and shaped thus (L), the horizontal part resting upon and turning over or scraping the bottom of the vessel when the lid is rotated, the stirring or mixing being thus accomplished without removing the lid. A float of wood or other buoyant material fits easily inside the vessel, and floats on the sur-

face of the liquid contents. This float is dished slightly on its upper face, and is perforated with a number of holes at that part, through which perforations a portion of the liquid rises and partly fills the shallow recessed or dished part of the float. By dipping the blacking or other brush into the liquid contained in the float, no more will be taken up by the brush than is required at one time, and hence all waste is avoided. *Patent completed.*

1328 T. CRAIG. *Improvements in breechloading firearms and ordnance, and in apparatus connected therewith.* Dated May 12, 1865.

The primary object to be obtained in breechloading guns is facility for firing shots in rapid succession, which is incompatible with other than few and simple movements of the parts of the gun whereby the loading is effected. With this view the patentee has arranged the parts of this improved gun so that by the simple movement of a lever by the right hand while the gun is being lowered from the shoulder (after firing and being still held by the left hand) the breech piece is withdrawn from the recess in the breech and raised to a position permitting the insertion of the cartridge. *Patent completed.*

1329 T. PARKINSON and W. SKODGRASS. *Improvements in stillages, stands, or supports for barrels, casks, or other similar vessels.* Dated May 12, 1865.

In carrying out this invention the patentees prefer to make the stand of cast iron formed by one vertical frame and horizontal projection therefrom, this vertical frame carrying the pivots of a beam lever frame constructed to receive the barrel, cask, or other vessel which is partly balanced thereon, the heavy end of the lever frame being supported by a spring or springs, or by a weight or weights, acting directly or through levers and inclines upon the lever frame, so that when the liquid in the cask or other vessel placed on the said lever frame has been drawn off sufficiently, the spring or springs, weight or weights, will, as the weight diminishes, act upon and gradually elevate one end, and consequently depress the other end of the frame. A latch is jointed to the vertical or horizontal frame which is arranged to hold down the lever frame, while the vessel is being placed upon it, and it is also used to prevent the lever frame from being forced down by accident, so as to agitate the liquid contained in the vessel. A screw may be substituted in place of the weights or springs, retaining the other parts of the improved combination, which screw may be made of brass, the screw being connected to a lever or levers attached to the lever frame and to the framing, so that, by turning the screw by hand, the lever frame may be gradually elevated at one end as required. For convenience of placing the cask upon the stillage, and to give facility for moving it about, they mount the frame (and this is a peculiar feature of the invention) upon two or more wheels, one or more of which may be made to swivel round a centre, so that the frame may be easily turned. *Patent completed.*

1330 A. WEIR. *Improvements in water gauges and cocks.* Dated May 12, 1865.

This invention relates, firstly, to a certain new method of arranging the plugs of water gauges and cocks; secondly, to an improved method of fixing the glass tubes employed in water gauges for the purpose of indicating the water level. According to the first part of the invention the plug is inserted from the front end of the gauge or cock, in contradistinction to being inserted at the side, as is ordinarily the case, and the handle is formed so as to protrude in the front of the gauge, the plug being maintained in its place by a packing nut pressing on it. A brass washer is also formed for the purpose of preventing the packing nut from turning while the plug is turned for the purpose of opening or shutting the cock. The inner end of the plug is made hollow, and a hole is formed in its side which communicates to the opening through which the fluid or liquid has to pass. The chief advantages resulting from this arrangement are, that by the position of the plug it is capable of being made much larger than formerly, thus giving a larger wearing surface and room for larger water passages. The improvements comprised under the second part of this invention consist in fixing the glass tube by a simple hollow nut, inside of which packing is placed, by the pressure of the nut upon which the tube is made tight, thus producing a simpler method of fixing, and the use of a much less quantity of metal. *Patent abandoned.*

1331 J. K. CAIRD. *Improvements in sewing machines.* Dated May 12, 1865.

The chief part of this invention consists, first, in the application and use of a spiral tubular needle for "over sewing," of such diameter and number of turns as will contain the required length of thread; secondly, in making a slot round the outside or circumference of same, so that the thread to be used may be readily introduced. *Patent abandoned.*

1332 W. SPENCE. *Improvements in the mode of rifling muzzleloading cannon, and in projectiles for the same.* (A communication.) Dated May 12, 1865.

This invention consists in dividing the interior of the cannon into alternate portions, composed respectively of larger grooves, along which the projectile is caused to enter the bore and pass to its chamber, and sets of smaller rifle grooves, for the purpose of giving a spiral motion to the projectile. The pitch or twist of the rifling may be varied as required. The rifles are all removed from the inner end of the bore, leaving the loading chamber free, and the projectile chamber is also left free, except that ridges are formed to act as stops for regulating the position of the projectile, as required. There is also a short space between the projectile chamber and the rifled part of the bore in which the rifle grooves are tapered, in order to facilitate the entrance of the projectile into them. The projectile is as usual of the size required to fit the bore, having its coating of lead or composition divided so as to correspond with the divisions of the bore, parts of the coating being cut away so as to leave projecting ribs corresponding with the larger grooves of the bore. There are also two ears on the front end of the projectile by means of which it is turned by the rammer into the position required for firing after it has been forced along the larger grooves of the bore. *Patent abandoned.*

1333 H. J. BURT. *An improved chaplet or headress.* Dated May 12, 1865.

In carrying out this invention, the patentee forms a chaplet or head-dress consisting of an ornament for the back of the head, and a diadem or coronet for the front part of the head, combined in one, but separable, if necessary, to form two ornaments. The back part may be in the form of a comb back, with ornamental balls and drops,

affording a bonnet rest when a bonnet is worn, and it may be furnished with a long pin and catch to secure it to the back hair, or comb teeth may be employed as a fastening in lieu thereof, if preferred. The front part may be made of beads, medallions, or other forms strung or arranged in a loop, the ends of which are attached to the back part in such manner that, if it is desired to wear only the back ornament, the front part may be detached, and may be used as a necklace or a bracelet. This chaplet may be formed of any solid material, such as papier mache, wood, glass, metal, ivory, or tortoise-shell. *Patent completed.*

1334 W. OLARK. *Improvements in gas burners and chimneys.* (A communication.) Dated May 12, 1865.

This invention consists of a chimney constructed either of a tube contracted at its upper end, or it may be provided with a cap or covering disc, having one or more perforations for the passage of the products of combustion, serving to regulate the draught or ascending current, with a view to the perfect combustion of the gas; it also consists in contracting in any suitable manner the inlet of the air at the lower part or by applying a disc with perforations at that point. *Patent abandoned.*

1335 W. CLARK. *Improvements in machinery for the manufacture of kinges.* (A communication.) Dated May 12, 1865.

This invention is not described apart from the drawings. *Patent completed.*

1336 G. H. OYSTON. *Improvements in the manufacture and reburning or revivification of animal charcoal.* Dated May 12, 1865.

Animal charcoal is at the present time manufactured and revivified in retorts, and it is discharged from these into coolers or vessels which are covered or closed to exclude the atmosphere, and according to this invention steam is introduced into the coolers and into the passages leading thereto from the retorts, so that the heated animal charcoal after leaving the retorts is caused to pass into and through an atmosphere of steam, by which the animal charcoal is improved. *Patent abandoned.*

1337 F. RANSOME. *Improvements in the manufacture of slabs, bearers, and other articles of artificial stone where great strength is required.* Dated May 12, 1865.

Artificial stone is now commonly manufactured by the inventor by mixing sand or grit with silicate of soda, or other soluble silica or silicate, and it may be with other substances. He moulds the compound and afterwards hardens the stone by immersing it in or otherwise saturating it with a solution of chloride of calcium or other salt acting in a manner similar on the soluble silicate or soluble silica. Artificial stone may be made in this manner equal to or greater in strength than Portland stone, but for many purposes a greater resisting power is required. Now the inventor finds that this artificial stone has the property of adhering very firmly to iron and other metallic substances, and, availing himself of this property he, according to this invention, strengthens slabs, bearers, and other articles of artificial stone by moulding the mixture around strengthening pieces of iron or other suitable metal. Thus to produce a slab suitable, say, for a landing, or for a staircase, he introduces in the mould pieces of hoop iron running from end to end of the slab, and set up on edge so that the width of the hoop iron is in the direction of the strain; the mixture of grit and soluble silicate is then filled in around the hoop iron, and when it is thus moulded the slab is hardened by immersion in a solution of chloride of calcium or other salt as heretofore. *Patent abandoned.*

1338 R. LANGRIDGE. *Improvements in the means or method of securing or fastening the stiffeners or supports of stays, corsets, and other such like articles of dress.* Dated May 12, 1865.

The inventor proposes to pierce a hole through the upper part of the stiffeners, and when the same are inserted in the bone or other spaces of the stay, corset, or other garment, to fasten or secure them in position by metallic clips, consisting of a thin ornamental or plain face plate, the upper and lower extremities of which are provided with tabs; the lower tab is to be passed through the pocket and stiffener, and is secured by bending pressure to the inside of the stay or corset, the upper tab passing through the pocket but over the top of the stiffener, and being bent downwards behind the same. By these means the stiffeners are prevented from rising and wearing through the pockets as is usually the case. *Patent abandoned.*

1339 J. F. COOKE. *Improvements in the manufacture of pocket pencils.* Dated May 12, 1865.

This invention is not described apart from the drawings. *Patent abandoned.*

1340 G. ENNIS. *Improvements in the construction of sawmills.* Dated May 12, 1865.

This invention relates to machinery used in combination with vertical saws. The face or guide plate, endless chain, and raked bar, commonly employed in sawing machinery are by this invention altogether dispensed with, and instead of the face or guide plate hitherto used in such machinery the patentee employs a series of vertical grooved rollers, such rollers being of equal diameter. The said rollers are connected with each other by means of a train of toothed wheels, and are actuated by a pair of mitre wheels, one of which is attached to the head or upper end of a shaft on which one of the connecting wheels is fixed, the other of such mitre wheels being mounted on a horizontal shaft carrying the ratchet wheel hereinafter mentioned, and by which the mitre wheels are actuated, thus giving the requisite forward motion to the timber to be sawn, which is pressed against the said vertical grooved rollers. The said ratchet wheel is furnished with the ordinary gear, well understood by persons acquainted with mechanical appliances. On the side of the apparatus further from the ratchet wheel are arranged one or more grooved rollers, the same being attached to a slide plate and provided with levers and weights, or other analogous contrivances, for the purpose of giving pressure. The last-mentioned rollers with the slide plate to which they are attached are actuated by a leading or gauge screw fitted under the same, and by means of which the last-mentioned rollers can be either forced against the timber, thus pressing it against the first-mentioned vertical grooved rollers, so as to feed the saws at any required speed and pressure; or they can be withdrawn in such manner as to admit any breadth of timber for which the machine may be adapted. *Patent completed.*

1341 W. DEAKIN and J. B. JOHNSON. *Certain improvements in the manufacture of gun barrels and ordnance.* Dated May 12, 1865.

These improvements (which relate to former patents No.