

NOTICES OF BOOKS.

SIR WILLIAM ARMSTRONG'S celebrated observations on the probable exhaustion of our coal fields have served as a peg whereon to hang cognate remarks ever since. The note once struck has never ceased to vibrate—the refrain has been re-echoed with every conceivable variation, until at last we have come to be very chary of anything that at all savours of the coal question.* But we feel impelled to return to it once more at the special invitation of Mr. Jevons, who has bestowed much thought, time, and labour upon the subject. There cannot be two opinions upon the value of coal as the mainspring of modern material civilisation. As fuel it is the source at once of mechanical motion and chemical change, and it is the important medium of almost every improvement and discovery. The power of coal is in fact universally felt and admitted, for it decidedly commands the present age. But the supply of coal is limited—that point is conceded; and we are working it and consuming it at such a rate that we shall presently find ourselves shivering in the dark—this we don't at all apprehend. Were the supplies of coal to cease in a year from the present time, we have no fear but that, before the old sources of heat, light, and motion had given out, new ones would have been found to take their places. But let us see what says Mr. Jevons. The data upon which he commences to work are, first, the Geological Survey, which gives some degree of certainty to our estimates of the coal existing within our reach; and, next, the returns of mineral statistics which inform us very exactly of the amount of coal consumed. Upon these he shapes out a first rough approximation to the probable progress of our industry, and consumption of coal in a system of free industry, drawing attention to principles governing the subject which have rather the certainty of natural laws than the thickness of statistical numbers. The first seven chapters are mainly devoted to the physical data of the question; the remaining chapters treat of the social and commercial aspects of the subject. The chapters, however, have rather the character of essays treating of the more important aspects of the question, as the extent and complexity of the subject render a notice of the bearings of fact upon fact more or less a matter of impossibility.

The author commences by citing the opinions of earlier writers whose views coincide with his own. One of the earliest writers to conceive the possibility of exhausting our coal mines was John Williams, a mineral surveyor, who, in 1789, published a work on minerals, in which he devoted a chapter to the consideration of the limited quantity of coal in Britain. Sir John Sinclair, in his "Statistical Account of Scotland," expressed considerable fear as to the future exhaustion of our mines. In 1812, Robert Bald, another Scotch writer, showed most clearly how evenly and rapidly a consumption growing in a quick increasing series must overcome a fixed store, however large. Later on Dr. Buckland never lost an opportunity of bringing this subject before the public. Our author adopts Mr. Hull's estimate of the coal existing in England as the geological datum of his arguments. Mr. Hull's estimate allows for all hidden coal likely to exist, and is, therefore, more liberal in its character than most others of its kind. For instance, in the Newcastle field he takes 460 square miles as the area of the open coal measures, and 225 square miles as the available area covered by newer geological formations. His estimate of the probable contents of our chief coal fields gives a total of 4,499 square miles as the area of open coal measures; and 932 square miles as the area covered by newer formations; whilst the total coal to the depth of 4,000ft. is stated to be

79,843 millions of tons. Mr. Jevons shows that in all probability there is no precise physical limit of deep mining, but that the growing difficulties of management and extraction of coal in a very deep mine must greatly enhance its price, and this rise of price will denote gradual exhaustion. There does not yet appear to have been any rise of sufficient importance to be construed into a sign of exhaustion, but at the same time the high price of deep drawn coal indicates the high price that ordinary coals will presently fetch. The author goes on to notice inventions in regard to the use of coal, and shows that we owe almost all arts to continental nations except those great arts which have been called into use here by the cheapness and excellence of our coal. It is argued that the constant tendency of discovery is to render coal a more and more efficient agent, while there is no probability that, when our coal is used up, any more powerful substitute will be forthcoming. But we do not hold with Mr. Jevons' conclusions. In one sense it may be that discovery renders coal efficient; but, in the main, discovery and scientific research render us less and less dependent upon coal in its various functions. There are around us growing evidences that substitutes for coal will be forthcoming at the proper time, that is, when they are needed, and, although it is by no means necessary that they should be *more powerful*, yet it is very probable that they will so prove themselves.

We now arrive at a point where the question is viewed in a totally different aspect. The author explains the natural principle that a nation tends to multiply itself at a constant rate, so as to receive not equal additions in equal times, but additions rapidly growing greater and greater. In this interesting division the author incidentally points out that the nation as a whole has rapidly grown more numerous from the time when the steam engine and other coal-consuming inventions came into use. The agricultural and manufacturing populations increased in the same ratio until about the year 1820, when the former became excessive. This, of course, led to much pauperism in agricultural districts, whilst in towns and in the coal and iron districts scope was afforded for a rapid and continuous increase. This rate of growth increases the more nearly we approach industry concerned directly with coal. We are then made familiar with the rapid and constant rate of multiplication displayed by the iron, cotton, shipping, and other great branches of our industry, the progress of which is in general quite unchecked up to the present time. There is every reason to suppose that the consumption of coal has similarly been multiplying itself at a growing rate. The present rate of increase of our coal consumption is then ascertained, and with this most people are, or ought to be, sufficiently well acquainted to render further reference here unnecessary. From this increase the author shows that if the consumption multiplies at the same rate for but little more than a century our coal mines would then average 4,000ft. in depth, and the average price of coal would be much higher than the highest price now paid for the finest kinds. The simple inference, then, is that we cannot long continue our present rate of progress. Emigration, by exciting trade, may tend to prop us up for a while, but ultimately, Mr. Jevons says, we must sink down into poverty. Our iron manufactures will be underbid by the unrivalled iron and coal resources of Pennsylvania; our crude iron manufactures probably being our first loss, whilst goodness only knows how much of our manufactures may not follow it. Really this is a very sad and dismal picture of coming generations, and we cannot help pausing to wonder whether posterity will recognise a prophet in Mr. Jevons. We have, however, serious doubts about the matter. We confess ourselves unable to realise the deplorable effects Mr. Jevons would have us weep over with him. Our miners are already

being relieved in their work, where they labour under the disadvantages of increasing depth and increasing temperature. Mechanical means step in; the "iron man" goes pecking away down below, whilst its very breath—the exhaust air—at once cools and purifies the surrounding atmosphere. Beyond this attention is being given in many quarters to the utilisation of substances which will doubtless result in the ultimate production of an efficient representative of coal; perhaps long before our coal beds are abandoned from the inability to continue their working. It is not improbable that water will be the element from which this substitute will be derived, but be the source what it may there is no need for mankind to begin to be unhappy upon the subject yet. If chemistry only makes the same proportionately rapid progress that the last fifty years have shown we shall never know a greater want of caloric and light. It is all very reasonable and well to send forth the note of warning, and it may be that Mr. Jevons will have done no mean service in stimulating research in the direction of fuel. While, however, we differ from our author's conclusions, we are ready to admit that he has brought a very large amount of most useful information together; and those at all interested in the "coal question" will do well to examine carefully for themselves Mr. Jevons's views, as above shadowed forth.

To turn from the disease to the remedy will be in the present instance to leave the coal mines and glance at petroleum springs. Of late years, this substance has become the subject of a most extensive trade, and several attempts have been made to utilise it for the purposes of steam fuel. Although we have not yet any instances of decided success in its adaptation, we have such proofs of its capability of replacing coal for this purpose, that we do not despair of seeing it thus applied in course of time, and there is reason to believe that that time is not very far distant. It is well, then, that we should know somewhat of the past, present, and future of a substance which is exciting an incredible amount of interest, and yielding an incredible amount of profit, in the regions whence it is obtained. Much information is afforded upon the subject in an interesting work having for its title "Derrick and Drill."* This is a compilation of facts and speculations in relation to petroleum presented in a very interesting and readable form. The materials were collected by a gentleman who observed the progress of every great public interest and who attentively watched the development of the prevailing excitement on the subject of petroleum. From the time the first flowing well was opened in Pennsylvania down to the publication of the volume in question all facts and statements bearing on the question were carefully preserved by him and committed to the editor, who honestly confesses there may be errors and exaggerations for which he will not be held responsible; he has suppressed and corrected many, but has not been able to do so in all cases. Ten years ago the country drained by Oil Creek, in Venango county, Pennsylvania, was a barren, uninviting region, in many places very sparsely settled and most of the settlers hardly able to gain a livelihood. Money was scarce, lumber being the chief circulating medium, and the man was deemed fortunate who handled 250 dol. in a year. Improved lands were a drug at 10 dol. per acre, wild lands could be had for a song and in fact were often sold for taxes. But times have changed now, and the poor farmer of yore has given place to—or perchance has become—the millionaire of to-day. Aladdin's lamp was not worth talking about as compared with a flowing well, and the wealth of California pales in the light of the fortunes accruing from petroleum. Fortune seekers, in

* "The Coal Question; an Inquiry concerning the Progress of the Nation and the Probable Exhaustion of our Coal Mines." By W. STANLEY JEVONS, M.A., Fellow of University College, London, and of the Statistical Society, London and Cambridge: Macmillan, 1865.

* "Derrick and Drill: or an Insight into the Discovery, Development, and Present Condition and Future Prospects of Petroleum." By the author of "Ten Acres Enough." New York: James Miller, 522, Broadway, London: Trübner and Co., Paternoster-row, 1865.

fact, are attracted from all parts of America and Europe to this hallowed spot of oildom.

The great oil producing region lies along both sides of Oil Creek, between Oil City and Titusville. The farms along the creek are all good ones, long yielding, long celebrated, and owned for the most part by companies of proved capital, energy, and integrity, and the proprietors are doing all in their power to increase the *bona fide* oil product of the region. From an inquiry made in the early part of the present year into the present and prospective condition of the most important farms along the creek, it appears that there are altogether in this district fifteen farms occupying an area of about 3,324 acres. The number of wells down is 480, of which number 189 were producing and yielding on an average 4,325 barrels per day. The number of wells to be put down was 542. There is a possibility that the above yield is somewhat in excess, the other information, however, being correct. Many interesting and useful particulars are given of wells in the various districts, and of the operations in getting, refining, and disposing of oil. A very correct notion of life in those parts can be obtained by a perusal of the book, and the grouping of the various narratives affords an accurate and most diversified view of the origin, development, and progress of the mighty social, industrial, and pecuniary revolution which has swept over the entire region within which the oil has been discovered. Those seeking information on the subject will here find a mass of facts and opinions which possess a certain value, and, although they are not altogether to be depended upon for accuracy, yet they afford an excellent approximate idea of the present condition of things, sufficiently correct for practical purposes. The vast oil interest of Pennsylvania is only in its infancy; in time it will become worthy of the same elaborate attention which cotton, coal, and iron have each in their turn received.

It is not often we have the opportunity of realising the extent to which operative surgery is indebted to mechanical science for its assistance. Except we are unfortunate enough to become practically acquainted with the appliances for restoring the interrupted functions of various parts of the body to their natural state, we are content to leave the matter to those whom it may concern. There are, however, a great number of machines and contrivances used in surgery involving a considerable amount of ingenuity and mechanical skill. In fact, there are numerous conditions where mechanical aid is the sole or principal resource of the surgeon. Mr. Heather Bigg* makes us acquainted with these machines and introduces to us their history, construction, and application. He also treats of the principles which govern the construction of these appliances, and their adaptation to the different kinds of deformity, debility, and deficiency which may be alleviated by mechanical assistance. His object is that of claiming for mechanical therapeutics recognition as an independent branch of the healing art. By reference to the gradual but perfected development of mechanical science in its relation to the treatment of deformities, deficiencies, and debilities of the human frame, he shows that a just ground exists for advancing such a claim and for bestowing on this branch a distinctive name. And truly the claim is justified when we consider the extent to which mechanics are needed, and the important part they play in therapeutics. And not by this alone, but also by the fact that mechanical therapeutics, being now susceptible of reduction to rule and method, may rightly be regarded as a science as well as an art.

Orthopraxy is the legitimate culmination of mechanics as applied to therapeutics, and its origin and growth constitute a curious chapter

of the history of medicine. Hippocrates, the father of medicine, is also the father of mechanical therapeutics, but from his time to the sixteenth century the history of the art is a blank. In the sixteenth century, however, the system was again promulgated, and has continued since steadily to gain ground and its importance to be increasingly acknowledged. Nearly a century ago Mr. Sheldrake in this country laid the foundation of a new and successful profession; Mr. Bigg's father succeeded him in supporting it, and now Mr. Bigg himself is the exponent of its importance and independent character. To instance but a few cases wherein the importance of mechanics is fully vindicated, we may observe that the successful treatment of spinal curvature is impossible without mechanical aid. Attempts to invigorate the system by medications, or change of climate, or by regulated gymnastics, will prove useless unless combined with some mechanical appliance for antagonising the tendency to distortion. But when a competent mechanist aids the physician success becomes well nigh a certainty. So with hernia; no question in surgery demands greater thought than the construction of trusses, and no instruments exact more from the skill and ingenuity of the mechanician, and this importance attaches throughout the whole range of surgical appliances. The time when the mechanical treatment of deformities was chiefly a question of brute force is not very remote. Now, however, the mechanist endeavours to secure his end by a just adaptation of the means at his command, founded upon a careful appreciation and accurate calculation of the kind, direction, and amount of force required. The treatment of deformities, however, has not yet passed into general medical practice; it is more or less a speciality. The reason, perhaps, lies in the want of a trustworthy guide to the mechanical aids necessary for its fulfilment. This want is amply supplied by the volume before us, which is a complete manual of mechanical therapeutics. It is profusely illustrated with engravings showing both the construction and application of the various mechanical arrangements employed in the healing art.

The pursuit of gas engineering is becoming very general, and any information upon the subject, especially in a compact and accessible form, will always prove acceptable. So the "Gas Engineer's Book of Reference"* will be found to serve a useful purpose in this respect. It contains a variety of information useful for gas engineers, managers of gas-works, and others interested in gas matters, and is illustrated with engravings of some of the most important improvements in gas apparatus. Being a gas engineer and manufacturer himself, Mr. Bower's first object appears to be to draw attention to the various kinds of gas apparatus made by himself. But beyond this his book supplies, in a very compact and convenient manner, a variety of information relating to the science of gas lighting, and which has hitherto been attainable only by consulting many and larger works upon the subject. Among other arrangements by Mr. Bower may be noticed a portable gas apparatus of extremely simple construction, subject to but little wear and tear, and which is very easily managed. There is also an ingenious double-acting retort apparatus, which is equally well adapted for the manufacture of gas from oil, peat, wood, or resin. It is, however, especially applicable for making oil-gas, which, it may be observed, possesses three times the illuminating power of coal-gas, without its impurities. The cost of gas, when made from petroleum by this apparatus to supply 100 burners for 6 hours, each light being equal to 8 candles, is stated to be about 17s. 6d. per 1000ft. This price includes interest on capital on outlay fund for renewal of plant, wear and tear, labour, fuel, &c., and

is considerably less than the cost of oil, tallow, wax, or sperm, as ordinarily burned, and is without their inconveniences. The advantage of this apparatus is apparent in localities where gas-coal is difficult to be obtained, as wood or peat may be distilled and the gases carburetted by the vapours from petroleum or other oils. Mr. Bower's book abounds in useful extracts from competent authorities on all the varied branches of gas making and lighting.

Although road locomotives have only recently acquired sufficient importance to necessitate the passing of acts of Parliament for their regulation, yet their history goes back for eighty years or more. Watt in 1784 patented a road locomotive with a wooden boiler; a little later Trevethick invented and constructed a steam coach, and subsequently Hancock, Gurney, and others worked at the question. For twenty years, however, it rested until the late Mr. Boydell again revived the principle by the introduction of the traction engine. In 1861 an act was passed for regulating the use of locomotives on turnpike roads. This act removed the prohibitory tolls and substituted an equitable scale, but by it the Secretary of State had power to restrict or prohibit the use of locomotives in certain districts. The undue exercise of this power led to an application to Parliament for, and the passing of, the Locomotive Act of 1865, by which the Home Secretary's power of restriction and prohibition is removed, and the power of making regulations for the use of road locomotives placed in the hands of the local authorities of towns where the population exceeds 5,000. This act came into operation on the 1st of the present month, and in our issue of that date will be found an outline of its various clauses. We have since received a handy book* upon the subject which contains an epitome of the locomotive acts of 1861 and 1865, which will be found more useful than the two acts in full, as many of the clauses of the 1865 act are inserted only for the purpose of annulling clauses contained in the act of 1861. No one need fear to act upon Mr. Aveling's little book, for the epitome contains the whole law of both acts, and has been carefully revised by an eminent lawyer, and will be found most useful by those to whom it is addressed, namely, the owners and drivers of road locomotives. There is no doubt that the use of the road locomotive, not only for agricultural purposes but also for the removal of heavy loads, will become more and more general now that the question of steam on common roads is placed on a fair footing.

THE BRITISH ASSOCIATION.

SECTION A—MATHEMATICS AND PHYSICS.

AERIAL NAVIGATION.

MR. F. W. BREAREY read some "Remarks upon Aerial Navigation, suggested by Mr. Glaisher's late Ascent." The interest taken by the Association of late years in the condition and phenomena of the atmosphere, said the report, had led to the interesting experiments of Mr. Glaisher. Mr. Brearey believed that in order to carry out such experiments on that scale which was absolutely requisite to make the balloon a means of aerial locomotion, it was necessary to form a society, which, preserving a connection with the British Association, should appeal to the wealthy for subscriptions. We had been too much accustomed to regard the balloon simply as a toy, and though our aeronauts were distinguished for courage, they were not eminent for mechanical or scientific attainments, whilst at the same time they had been deluged with mere suggestions. Among the desiderata in aeronautics were—the power of ascension and descension without loss of gas or ballast; economy of the gas used for inflation; the best motive power for screws, screw sails or paddles; the prevention of gyration; and the encouragement of mechanical invention in the direction. Mr. Brearey's own suggestion was

* "Orthopraxy: the Mechanical Treatment of Deformities, Debilities, and Deficiencies of the Human Frame." By HEATHER BIGG, Assoc. Inst. C.E., Anatomical Mechanist to the Queen, the Royal Hospitals, &c., &c. London: Churchill and Sons, New Burlington street, 1865.

* "The Gas Engineer's Book of Reference, and Price List of all Articles required for, and in connection with, the System of Gas Illumination." By GEORGE BOWER, St. Neots.

* "Road Locomotives: an Epitome of the New Road Locomotive Acts, for the use of Owners and Drivers." By THOMAS AVELING. London: E. and F. N. Spon, 1 Bucklersbury, 1865.

that a small balloon should be constructed to give just so much buoyancy to a man, that with a small exertion on his part it would ascend, and on his becoming quiescent would descend. In this he is to stand or sit in a light framework hooked to the balloon coming close up to his arm-pits, with a pair of broad paddles of bamboo and silk attached working freely in a joint. It is calculated that by a downward movement of the paddles the man would rise into the air, and by continuing the movement and "feathering" the paddles would continue to rise above all obstructions. By ceasing the movement he would descend under ordinary circumstances; under extraordinary circumstances he would have to reverse the movement. A mechanical substitute for the man, and a larger balloon, would supply much towards what is required in aeronautics, viz., power of ascension and descension, economy in inflation, and power to preserve inflation for days or weeks. In the discussion which ensued on the reading of this paper, the opinion seemed to prevail that the form of an aeronautic machine should resemble that of a fish rather than that of a bird, as had been formerly supposed.

VARIATIONS IN THE MOTION OF THE AIR.

Mr. A. F. OSLER read a paper "On the Horary and Diurnal Variations in the Direction and Motion of the Air." He had tabulated and drawn up a series of diagrams showing the force and direction of the wind every day and hour for the last ten years. The results showed various coincidences and great changes in the curves produced, and singular breaks in the curves of mean annual temperature in November and May. Mr. Osler afterwards exhibited an anemometer constructed to record the force of the wind during hurricanes abroad. Those hitherto constructed had generally given way, but this instrument would support the requisite strain.

RAINFALL OF THE BRITISH ISLES.

Mr. G. J. SYMONS handed in his report on this subject, but its reading was curtailed at the request of the President, to save time. Mr. Symons stated that his previous report had almost exclusively dealt with the rainfall of the last few years. His great aim, however, was the collection and discussion of all rainfall records. He now proposed to supply the omission, and to consider what had been done before and since 1860, what remained to be done, and to give some particulars respecting the rainfall of the last fifty years, and that of 1864. Under the first head Mr. Symons briefly sketched the rise and progress of rainfall observation in this country, noting the more remarkable registers. Mr. Symons also presented a voluminous index to the observations already collected. This comprised 1,815 stations, and the current ten years promised to yield nearly 10,000 complete returns. As to what had been done since 1860, the collection of the observations and the formation of the index referred to stood in the forefront, and Mr. Symons had been travelling about to see that accurate gauges were employed and kept in suitable positions. Reference was also made to the elaborate experiments with rain gauges now in progress at Calne and near Manchester, to the recent establishment of gauges round Snowdon and the Cumberland Hills, and to different new instruments and forms of gauge now under trial. As to what remains to be done, Mr. Symons said the leading features were the collection of old registers and their discussion; the regular examination of the current returns of each year; further experiments on the size, form, &c., of rain gauges; and a variety of other matters. The fourth part of the report briefly discussed the rainfall during the last fifty years, and was illustrated by a diagram and a map. The results of this preliminary investigation showed a marked decrease in the last ten years, and was based on the results of ten widely separated stations. In a subsequent comparison of the last ten years with the previous ten, some singular results were deduced, and were detailed in the report. Mr. Symons exhibited a very simple form of rain gauge, composed of a japanned hollow cylinder, with a funnel and a glass measuring tube, and the cost of which is only 10s. 6d. He also referred to the loss entailed upon himself from the time necessarily occupied in his operations, and intimated that without some assistance he would not be able to continue his labours.

SECTION B—CHEMISTRY.

MINERALS FROM SOUTH AMERICA.

Dr. FORBES' paper on this subject contained a

good deal of useful information on the discovery of an important body of minerals in South America. These beds of minerals are very valuable. Dr. Forbes exhibited a number of specimens containing metals, copper, bismuth, &c., establishing the fact that a large area of South America was rich in these productions. The chemical combinations of the specimens were explained, and a good deal of interest in the essayist's remarks was manifested, the only disparaging observations the paper met with being on account of its brevity. Dr. Forbes next proceeded to favour the section with his observations on

THE COLOUR OF GOLD.

SOME years ago, when making experiments on the determination of the amount of gold in native alloys, it was found that when the gold was doubly precipitated from its nearly mutual solution, by the addition of oxalic acid, it occasionally happened that an extremely thin film of metallic gold would attach itself rather thinly to the glass vessel in which the precipitation had been conducted; and when the vessel was dry, this film, with light transmitted through it, showed a fine blue colour, instead of green, which is generally attributed to metallic gold in a very fine state of division. On making experiments, in conjunction with Dr. Lloyd, it was ascertained that when gold is subjected to the action of transmitted light, side lights being excluded, there was no doubt remaining but that blue was the true colour of gold as thus viewed, and not green, and that this colour proceeded from the metallic gold itself.

PHOTOGRAPHY, MAGNESIUM, AND THE PYRAMID.

Mr. W. WHITE exhibited photographs of the interior of the Great Pyramid, taken with magnesium light, by Professor Piazzi Smyth. Mr. White observed that one of the first persons to suggest the above undertaking was the Scottish Astronomer Royal. Probably all have heard something of the interesting controversy connected with the granite coffer—the *sanctum sanctorum* of the Great Pyramid. It was Professor Piazzi Smyth's great object to bring this mysterious coffer to light, and to dissipate for ever all uncertainty about it. This, with the aid of magnesium, he has accomplished. We shall shortly have a volume from his pen descriptive of his researches and conclusions, and illustrated with photographs. Meanwhile he has most kindly allowed copies of his photographs to be exhibited to the Association, and has favoured me with a few notes concerning them which I shall now read. 1st. The interior of the Great Pyramid did not prove a good space for developing the excellences of the magnesium light. The ventilating passages opened by Colonel Howard Vyse in 1837 have been completely stopped up with stones and sand by the Arabs. Hence the air in the interior of the Pyramid has no visible means of being changed or purified, and as the said interior is visited every day through six months in the year by numerous parties of visitors bearing candles, the oxygen is so deficient, and the carbonic acid so abundant, that my surprise is that the magnesium burnt at all. It did burn, but in a languid sort of way, and the smoke it threw off remained suspended in the motionless air for twenty hours or more, so that only one picture could be taken in twenty-four hours. If a second was attempted, the illuminated smoky air intervening between the camera and the object desired to be pictured, was the only result on the photographic plate. 2nd. My object was not pictorial or artistic photography (of which I have therefore nothing to show), but the application of photography to certain disputed and special parts of the interior of the Pyramid for the sake of scientific examination and measurement; and these objects were obtained, notwithstanding all the drawbacks of the place, which really seemed combined to frustrate the merit of the light. 3rd. One example of success is presented in the granite coffer in the King's Chamber of the Great Pyramid. According to the theory of the late Mr. Taylor, that coffer was a primeval measure of capacity, from whence is derived the hereditary Anglo-Saxon wheat-measure called the quarter, of which coffer it is the fourth part. Whilst, however, we know by Act of Parliament how many cubic inches are contained in four quarters English, there has been much doubt as to the cubical contents of the granite chest of the Pyramid. The measures of the French Academy in 1799 made it nearly 6,300 cubic inches greater

than several English travellers had declared it to be, though they again by no means agreed with each other in subsidiary details. Now, however, by means of the magnesium light, we have a series of photographs of this coffer, with a system of measuring rods fastened about it, showing the size inside and the size outside; and finally, the cubical contents being summed up, prove that the remarkable granite vessel is a measure of capacity equal with almost mathematical accuracy to three quarters English.

Considerable discussion was evoked by the above paper, and Mr. White, in answer to inquiries, observed that castings could now be made of magnesium, although only a short time ago it had been prophesied that they could not accomplish that object, as it would so soon take fire. Magnesium could not be soldered. A good deal had been done towards cheapening the metal, and if supplied in large quantities now it could be had at a great reduction in price. No general application had as yet taken place with magnesium for illuminating purposes. Mr. Mather was the first person who had converted magnesium into wire. Mr. White had been informed that a photographer in Rome had received a commission to photograph the interior of the catacombs.

SECTION C—GEOLOGY.

SOUTH STAFFORDSHIRE COAL-FIELD.

A PAPER was read by Mr. Samuel Bailey, Walsall, on "The Economic Value of the various Measures of Coal and Ironstone in the South Staffordshire Coal-field." The minerals produced in this district are doubtless amongst the most valuable in the United Kingdom. The ironstone measures, together with the seams of coal, form a mixture from which iron of a superior quality can be made, and have placed this foremost among the iron-making districts of the country. To give some idea of the vast productiveness of a particular locality of this coal-field, it may be mentioned that the coal and ironstone gotten there realised a commercial value of above £20,000 per acre. This was, however, in the days of South Staffordshire's greatest prosperity. In referring to the various measures of coal and ironstone, the coal-field may be divided into five parts, in order to show more clearly the distribution of the respective measures, as they do not uniformly exist over the whole area of the coal-fields, and in some instances where they are the same seams, they differ very much in position and in quality. The measures particularised are those which are generally worked for the following purposes:—1. For domestic purposes. 2. For making gas. 3. For manufacturing purposes. Division No. 1: The northern boundary of this southern division is formed by a line drawn from West Bromwich, through Tipton and Deepfields, to the western fault, near Sedgley. The following coal and ironstone measures exist under this division: Brooch coal, thick coal, gubbin ironstone, heathen coal, white ironstone, new mine coal. The total thickness of these beds is 43ft., representing a value of £28,000 per acre. The brooch coal is of very superior quality. It is used exclusively for domestic purposes, and has always realised a high price. It is a favourite coal in Birmingham, and the counties of Worcester, Gloucester, and Hereford; but the supply is now very limited, and the variety known as the Cannock Chase deep coal is supplying its place. The thick coal is composed of ten or more beds, to which different names are applied. The following are the sub-divisions: Runfs coal, top slipper, white coal, lambs and tow coal, brazils, foot coal, John coal, stone coal, slipper, and sawyer benches. The first four of the above, together with the slipper and sawyer, are the purest and of excellent quality, and are adapted to the most delicate manufactures of the district. This coal is used raw or uncocked for smelting in the blast furnaces. The brazils is in much request for use in reverberatory furnaces, for which it is well adapted. The heathen coal is of very fine quality, and is the best for making gas, and is used raw for smelting purposes. It is also the best coking coal of the coal-field. The new mine coal is much inferior in quality. Division No. 2: The southern boundary is formed by the line describing the northern boundary of No. 1 division, and the northern boundary by a line from West Bromwich through Wednesbury, Darlaston, to the north of Bilston, into the western boundary fault, a little to the south of Wolverhampton. The measures existing under the division are

thick coal, gubbin ironstone, heathen coal, new mine ironstone, new mine and fireclay coal, fireclay balls ironstone, poor robins and white ironstone, bottom coal, gubbin or balls ironstone, blue flats ironstone. The brooch coal does not exist in this portion of the district. The new mine and fireclay coal form here a thickness of from three to four yards. The bottom coal is not equal in quality to the new mine coal. The mines in this district have realised a value of from £23,000 to £20,000 per acre, but they are fast being exhausted. Division No. 3 is bounded towards the north-east by a line drawn from Rushall to Bloxwich and to Wednesfield Heath. The measures here are heathen coal, brown ironstone, new mine ironstone, yard coal, four-foot coal, poor robins ironstone, bottom coal, gubbin ironstone, blue flats ironstone, silver thread ironstone, diamond ironstone. The heathen coal is here much the same as in the central part of the district. The yard coal corresponds with the new mine coal of the former divisions. It is, however, superior in quality, and realises a high price for domestic purposes, making gas, and for smelting. The four-foot coal corresponds with the fireclay coal. The bottom coal corresponds with this seam in No. 2 division. It is specially adapted for mill and forge purposes, and being the cheapest coal gotten in the district, it is much used in many of the ironworks. Division No. 4: The boundary to the north is marked by a line from Goscote to the neighbourhood of Cannock. The measures are black gubbin ironstone, brown ironstone, cannel coal, beach coal, bottom coal, four-foot coal. This portion of the coal-field is of considerable extent and importance, containing many valuable measures of coal and ironstone which have not yet been extensively worked, and which are now being looked forward to for the supply of the ironworks in that part of the field nearly exhausted. The cannel coal is a very superior coal for domestic purposes. The other division consists of the remainder of the coal-field extending towards the north. The only important seams here are the yard coal, shallow coal, and deep coal. The area of the last two divisions is equal to about forty square miles, and at an average estimate contains three hundred millions of tons of coal, besides ironstone, and at the annual average produce of two million five hundred thousand tons, will last one hundred years. The ironstone measures yield about an average of fifteen hundred tons per acre from each seam.

SECTION E—GEOGRAPHY.

ON A POLAR EXPEDITION.

A PAPER, read by Mr. C. R. Markham, "On a Polar Expedition," recommended the land journey by Smith's Sound. The paper set out by alluding to the large amount of attention which the important subject of North Polar Exploration has occupied; the work to be done was referred to in detail. It was a mistake to suppose that men of science attach much importance to reaching a mere mathematical point called the North Pole, and that this problem is to find out the shortest route to such a point and the quickest way back. The desired achievement—one which is worthy of the men who have served Franklin—is to explore the greatest possible extent of the unknown Polar Sea, and to do so thoroughly and deliberately. The three approaches to the unknown region, namely, by Behring's Straits, by the ocean between Greenland and North Zembla, and by Smith's Sound at the head of Baffin's Bay, were referred to and described in detail. Various considerations were set forth against the Spitzbergen route, and the opinion of Sir L. M'Clintock was cited as adverse to it. Captain Sherard Osborn and those who concurred select the Smith's Sound route, because, considering the presence of land to be essential to Arctic exploration, it is here alone that the coast tends towards the Pole. It was proposed by Captain Osborn that two screw steamers should sail in the spring of 1866, and proceed up Baffin's Bay to Smith's Sound; that one should winter near Cape Isabella, while the other pushed on as far as possible northward, taking care not to exceed a distance of 300 miles from her consort. During the ensuing autumn depôts would be formed, and in the spring sledge-travelling operations would be carried out. Experience had shown that healthy men, with proper care, could well spend two winters in the Arctic regions, so that further discovery could be

proceeded with during the second season. In this way the great scientific objects of Polar exploration would be attained. Besides Captain Osborn the advocates of exploration by the Smith's Sound route were Admiral von Wrangle (the explorer of Arctic Siberia), Sir George Back, Admiral Collinson, Sir L. M'Clintock, Captain Vesey Hamilton, Mr. M'Dougall, and many more officers of Arctic experience. The various objections which had been raised to the Smith's Sound route were discussed. There was not the smallest reason for expecting to meet with open water early in the spring extending so close in shore as to stop a willing party. Much had been said of the open sea discovered by Dr. Kane's men in Kennedy Channel, but all the arguments which had been founded on it became baseless when Dr. Hayes found the same space frozen over in 1861. Of course, it was not to be expected that water would not be found there, as in all other parts of the Arctic regions, at the end of June; but the travelling season was from February to May, and in June the sledges would return to their ship. If they were to imagine anything so improbable as that when water would be met with breaking on the cliffs or against the beach early in an Arctic spring to the north of 80 deg., they might at the same time rest assured that such a man as M'Clintock would not allow a line of water to stop his progress while he could put india-rubber boats on his sledges. An expedition up Smith's Sound would incur no undue risk. There would be not the remotest possibility of such a catastrophe as befel the "Erebus" and "Terror."

SECTION F—ECONOMICAL SCIENCE.

THE GUN TRADE.

MR. J. D. GOODMAN, one of the principal gun-makers of Birmingham, gave an interesting account of the small arms manufacture of Birmingham. Having noticed the origin of the trade (for Government supply) in the reign of William III., the paper minutely described the various branches of the trade. The manufacturers now engaged in the trade, number, according to the Directory, 599, who are distributed in the various branches of the trade. Birmingham workmen are paid at a much higher rate than those employed on the continent, which gives continental manufacturers a great advantage over those in Birmingham. On the other hand, the better paid and better fed English workman can accomplish more than his Belgian work-fellow; and the English manufacturers possess a further advantage in the more extended application of machinery, the use of which in Liege is discouraged by the cheap rate at which hand labour can be obtained. The manufacture of small arms by machinery is due to the invention of an American of the name of Blanchard, and is now carried out on a large scale at Enfield and Small Heath, the advantage being that guns so produced interchange in their parts, that is to say any part of any gun will fit into any other gun. The establishment by law of the obligation to prove all guns before sending them out gave English guns a good name for security, and aided in obtaining for the Birmingham trade the high reputation which it enjoys. The paper went on to give the following statistics with regard to the production of guns at the commencement of the present century during the Peninsular war. From a return published shortly after that period of the number of barrels made for Government in the years 1804 to 1815, I find the total to be 3,037,644, or an average number of 253,137 annually. In 1804 the number produced was 80,000; it steadily increased up to 1813, when it reached 490,000 in that one year made for the Board of Ordnance alone. During this period Birmingham produced barrels and other materials for the India Company amounting to a million. This makes the total number of arms made in the twelve years somewhat over four millions, or 1,074 per working day. A large number of these materials, manufactured in Birmingham, were made up into guns by the London gunmakers. To verify the traditional "gun a minute," said to have been the production of Birmingham during the war, we require 1,440 guns per day, or 525,000 per year. For this we must confine ourselves to the two highest years, 1813 and 1813, which produced respectively, including the India Company's supply, 581,682 and 654,450. It will be instructive to compare with the results now given the production of the French Government during the same

period. The information is obtained from returns published in 1822 by M. Dupin, a field officer in the French service. During the years 1803 to 1814, a period of 12 years, the arms manufactured by France numbered 2,456,257, or about 200,000 annually. This number gives us for every working day 604 guns; the number made in England, it will be recollected, being 1,074 per working day. At this time it must be borne in mind that France had at her command the resources of Liege and Turin, in addition to her own. St. Etienne, the most important seat of the arms manufacture in France, supplied 754,000, while Liege produced 279,900, and Turin 107,000. Seven other towns supplied the remainder. The paper then made the following remarks with regard to the supply of America during the recent war:—From the returns I have in my possession, I have drawn out as accurately as I possibly can the number of arms manufactured in Birmingham and elsewhere for the Americans during the last four years. The first shot was fired at Fort Sumter on the 12th September, 1861. On the 9th May following five purchasers of arms, some commissioned by different Northern States, others private speculators, arrived in Birmingham. Each had so well kept secret the object of his mission, that when they found themselves all engaged in Birmingham on the same errand they suspected each other of purchasing for the enemy, and their anxiety was increased accordingly to secure the few thousand arms that were then in store in Birmingham. The few in hand were at once shipped off, and large orders were given, which continued to occupy the trade at their full power, with one interval, till March, 1863. The interval I allude to was on the occurrence of the Trent affair in November, 1861, which led to an embargo being laid on the export of arms on the 4th December, 1861. This embargo was removed early in 1863. On the removal of the embargo, one steamer took out from Southampton no less than about 40,000 rifles to New York. The trade worked at its full power, straining every nerve, till, I find by the return from the Birmingham Proof-house, that in one month, the month of October, 1863, 60,345 rifle barrels were proved, being very few short of 2,000 per day from Birmingham alone, a number altogether unprecedented in the history of the trade. At that time the supplies produced in America at the Springfield Armoury and elsewhere began to tell upon the demand. We still find, however, that the numbers were 40,000 to 50,000 per month, till March, 1863; they then fell to 14,000 per month, till in September, 1863, the Northern demand ceased altogether. Without notice the orders were suspended, and guns that had been sent over were even returned to this country. The United States Government found at that time their factories were equal to supply the whole demand. From the Proof-house returns I obtain the following numbers, showing the extent of the supply of arms from this country to America:—Birmingham supplied 683,534, London, 344,802; making a total number of Enfield rifles sent to America of 1,027,336.

INTER-COMMUNICATION BETWEEN RAILWAY PASSENGERS.

THE following paper on this subject was read by Mr. G. B. Galloway:—Some time ago, my mind was impressed with the necessity for a simple practical plan to enable railway passengers to protect each other while travelling, and to communicate any cause of accident to the guard of the train while trains were in motion, for experience has proved that insults, robberies, and even murders, can be effected in railway carriages, as at present arranged, and the perpetrators of such deeds in some cases have escaped with impunity. To remedy this state of things I take leave to introduce to your notice the following plan:—My plan consists in cutting the seats of the existing railway carriages, and causing them to lift up like seats in the pews of churches, or the part of the seat which is to be cut the width of the doorway can be affixed to the door, and so be moved with it. The doors of both ends of the carriages are proposed to be in part glass, and the doors as between the compartments (which can be made to open either way, into each compartment) would be in part perforated zinc. The advantages of the perforated zinc, in addition to its ornamental appearance, are that it would not allow passengers while sitting to look obtrusively into the adjoining compartment of the carriage,

while, in the event of a lady being insulted, or other passenger being ill-treated, a cry or alarm, beyond ordinary conversation, could be heard, and by the door communication from one compartment to the other, assistance could be rendered; while the fact of this existing mode of communication in connection with the means of observation through the perforated zinc would have the direct tendency to preserve order, protect virtue, ensure safety, and generally inspire confidence to railway passengers. I also propose to affix a tubular arrangement throughout the entire length of railway trains. To effect this object I propose to affix in connection with the roof, inside railway carriages, a flexible or metallic tube of sufficient diameter; to this tube I affix branch tubes of smaller diameter, coming down the side of the carriage, having a mouthpiece, and immediately above this mouthpiece or orifice, I affix a valve within the pipe, in connection with a spring, and immediately behind this spring I affix a short signal. In the event of anything serious occurring requiring the attention of the guard, any passenger by pressing his hand on the valve at once opens it; the spring behind the valve simultaneously throws out the signal, which indicates the compartment requiring attention, and the passenger who has thus opened the valve and given the signal, by speaking loudly into the mouthpiece of the tube, can communicate with the guard; while the door communication would enable the guard to travel from his van without stoppage of the train to the carriage requiring his attention, and the tickets could also be collected while the train was in motion, just before arriving at the terminus, which would save time. I submit the above plan is observational, conversational, and communicational, and applicable to existing railway carriages. I offer this invention to railway companies at a trifling royalty for its use. The means of the tubular communication can be effected from one carriage to the other by flexible tubes, coupled by union connections.

SECTION G—MECHANICS.

A NEW COTTON GIN.

MR. E. A. COWPER read a paper descriptive of "A new Cotton Gin for Separating the Fibre from the Seed." The writer said that though undoubtedly the fibre could be taken off the seed by the finger and thumb in the best possible manner, and no doubt was so taken off in olden times, the process was so slow that a man could do no more than one pound weight of cotton per day. After describing the machines previously in use, the new machine was described. This gin is composed of a roller having strips of leather on its surface at intervals, and strips of pointed surface between them; the roller revolves continuously and there is a blunt steel blade which is caused to approach the roller, and recede from it, at intervals by means of eccentrics which also move it up and down both in the direction of the surface of the roller, and in the opposite direction; in addition to this roller and blade, there is a vibrating beater to push off the seeds, this last action being very similar to the motion of the beater in a M'Carthy gin. The eccentrics are on a small crank shaft that moves the beater, and which has a pinion on it driven by a wheel on the roller shaft. This gin differs from all others in its complete intermittent action, and it also acts on an entirely new principle, viz., that of nipping fast hold of the cotton fibre close up to the seed (just as it might be taken fast hold of by a person's finger and thumb) whilst the seed is separated.

The steel blade recedes from the roller when fibre is entering, and then nips upon it and holds it fast close up to the seed, whilst the beater pushes off the seed. In consequence of the fibre being thus locked fast in the jaws, it has been called the "Lock Jaw Gin," one side of its jaws being formed of the strips of common leather on the roller, whilst the jaw on the other side is formed of the blunt steel blade caused to approach the leather surfaces when nipping, by means of eccentrics. This machine (manufactured by Messrs. Parr, Curtis, and Madeley, of Phoenix Works, Chapel-street, Manchester) does its work so effectually and quickly that it gets through several times as much work as a common "M'Carthy Gin" can, and many times as much as an "Indian Churka," and at the same time gives a decidedly increased length of staple from a given sample of cotton. This new principle of action in separating cotton fibre from seed promises to cause as great a change and improvement in ginning cotton as Heilmann and Lister's invention did in the combing of wool. The new machine, it is anticipated, will tend to great improvement in the growing and packing of cotton, as the machines are adapted for use on the cotton fields.

GUN COTTON.

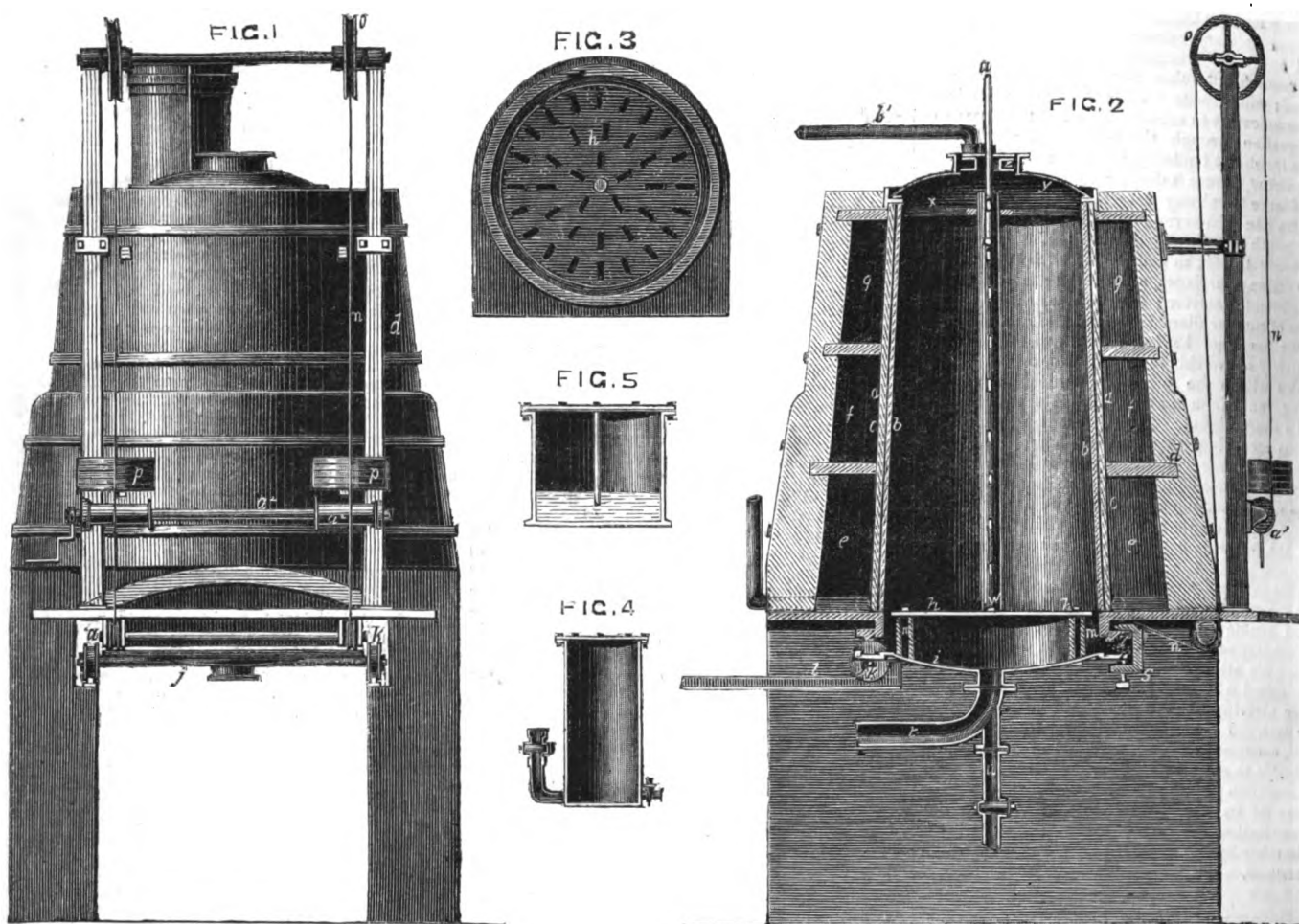
DR. FAIRBAIRN read the report of the Gun Cotton Committee, which stated that after the Newcastle meeting of the British Association the committee drew the attention of the Minister of War to the usefulness of gun cotton, and in January, 1864, the Government appointed a committee, of which General Sabine was appointed chairman. The Government committee were still prosecuting their inquiries, and after they shall have reported, the committee of the Association will be prepared to take action. Dr. Fairbairn said there might be some doubts as to the application of gun cotton for military purposes, and the Government had instituted strict inquiries into the subject. As soon as the Government Commission reported, the committee would deal with the matter. He might state that certain improvements had lately been made in the manufacture of gun cotton, which was now formed in cakes and afterwards cut into pieces.

RAILWAYS IN WAR.

SIR J. BURGOYNE was to have read a paper on this subject, but in consequence of the pressure of business it was postponed until next year. The following is the paper, which opened by stating that railways would have an important effect on war, and that it was a matter of interest to ascertain the means of obtaining the greatest advantage from them, and what would be their precise capabilities. A vague idea existed that armies could be transported from place to place, and to a seat of war, with the same facility and speed as ordinary travellers, whereas there were many circumstances connected with the conveyance of the former which would show any such comparison to be quite fallacious. With regard to a small body of infantry, there was no reason why this should not be the case; but with large forces and with cavalry and artillery, and all the accessories of an army, its baggage, camp equipage, spare ammunition, its waggons, &c., enormous means would be required, and difficulties would arise which called for study and consideration to reduce them to a minimum. How to adapt the ordinary railway passenger and horse carriages and trucks in the best manner to the transport of troops of all kinds, and how to get the troops most rapidly in and out of them, would be easily ascertained if it had not been so already; the great desideratum was to define how large forces could be moved in greatest strength, with the most rapidity, on single railways or by a limited number of lines, for it was on these calculations, having under consideration the several lines which could be brought to bear on the operations, that the generals in command must arrange their plans. The basis for consideration would be what could be done by any one line of railway with its ordinary means, or aided by additional means from other lines of the same gauge with which it was connected, on the same level, and which might not have the same pressure on them. To afford an idea of what might be required, it might be assumed that the officers and soldiers would occupy the space of ordinary travellers, and consequently it would become a question how many passenger carriages, in how many trains, each drawn by one locomotive, would be required to convey 1,000 men, with their officers; and how many horses of cavalry, artillery, and for staff of infantry regiments, one truck would carry. The guns and equipments of each battery of field-pieces, with number of trucks necessary to carry them, should be defined, as well as the number of horses per battery of horse or foot artillery. To give an idea of the amount of conveyance required for such forces on one occasion, to transport a battery of field-pieces, with its horses and carriages, and about 500 cavalry, merely to a review, no less than six trains were required, consisting each of thirty railway carriages. Viewing the very large means necessary for moving any but a very moderate force, and the embarrassments which would attend the undertaking in the rapid succession required to be effective, it became a matter of much interest for railway engineers to consider and define how arrangements could be made in providing, stationing, and working the trains that would tend to facilitate the service, and what, with the adoption of these measures, would be the capabilities of conveyance of troops of given strength to given distances in given times on emergent occasions on any one railway; whether, for instance, as the great traffic is in one direction, both lines of rails might not be used for it for certain distances, under the best arrangements which can be made for the return of carriages, &c. These researches are required not only to ascertain the best modes of accelerating the movements, but also to come to a clear understanding as to what, even when duly organised, can be obtained from railways in rapidity of transport for large bodies. It is manifest that, as they approach the scene of action, the railways would have less influence on the immediate theatre of warfare itself, and it would be somewhat dangerous to trust to them at all under the chance of the enemy interrupting the communication between the divisions and resources of the army. For short distances there would rarely be much advantage, as regards time,

in moving troops by them, on account of the time required for getting to and away from the railway, and into and out of the carriages. Their great advantage would be for concentrating troops and means, by converging lines, from the interior to some appropriate point forming a basis of operations; for gradually bringing up reinforcements and other resources to the rear of the army; and for the speedy and better removal of sick, wounded, prisoners, and all encumbrances. They will also be particularly favourable to retreating forces, by expediting their movements; while, by the destruction of the lines behind them, the enemy would be deprived of any use of them. The partial destruction and the repairs to railways will hereafter be an engineering duty for which the service should be prepared. Every railway, even in the vicinity of the operations in a campaign, will be of much value, so long as it can be used without danger of interruption, and therefore it becomes a subject of interest to possess a knowledge of the best means for their destruction, and how to apply them in cases where the lines are likely to fall into the hands of the enemy, or for re-establishing any that may have been more or less injured. It is clear that a portion of a railway might be for hours in temporary possession of a part of an army, who might, from ignorance, or want of some trifling means, be unable to take advantage of the occasion, and thus would leave it to be re-possessed by its enemy in perfect order, when, by due instruction and a little preparation, an influential amount of damage might have been done to it. The military engineers of an army have attached to them in the field a selected assortment of the most useful implements for the different services most frequently required of them, the proportions of which they vary according to the prospect of the nature of the approaching engineering operations, such as for sieges, entrenchments, destruction or repairs of roads and bridges, mining, &c.; and they are practised in the best modes of applying whatever means may be at hand for their purpose. To these must now be added what is applicable to the destruction and re-establishment of railways. In damaging a railway so as to impede the progress and available means of an enemy's army, the object will of course be to do as little injury to a great convenience of the country as is consistent with the primary consideration of crippling the military resources of the enemy for the time. Should the exigencies of the period justify extensive damage, it will be done by blowing in tunnels, bridges, viaducts, or embankments, by mines and processes as practised by military engineers, with regard to the old routes, to the extent that circumstances will allow, and may admit. The object for consideration, however, here is, how the peculiarities of a railway can be dealt with to most effect, in a summary manner, with little time and small means? Taking it, then, as a question rather of dismantling than of destroying, the first measure would be taking up and destroying of the rails. This would be easy enough to a party of railway navvies provided with their apparatus; but what we require is, some instructions and practice given to soldiers how to do as much as possible with the smallest means. Thus, instead of being, as at present, from ignorance perfectly helpless, they might be taught under previous instruction, that even a few stray articles for implements, such as might be found in an adjoining house, as might be described, could, on an emergency, be made available to some extent. Possibly, it could be shown that, after a first rail was removed, the very article itself, with the sleepers, &c., might be used to extend the damage. Another question would be, having in view the possibility of obtaining a temporary power over a railway which is of service to the enemy, what very small and most portable assortment of implements might be carried within a detachment being accompanied, if possible, by a few sappers that would aid such a proceeding, and what would be the most effective process; and if the implements could be such as to enter into the assortment forming part of the engineer field equipment, required for other purposes, all the better. The rails being raised, the best disposition of them would be clearly to carry them away altogether; but it is very improbable that there would be available means of conveyance to render that practicable. The next most easy resource would be to scatter, hide, or bury them; but if it could be shown how they could be broken, or rendered unserviceable, the effect would be still greater. The destruction of the sleepers would be much more easy, but the effect would be less, and the removal of the chairs from their portability would be easy, and also valuable for the object. With regard to the reinstatement of a damaged line, it would be instructing to know whether any temporary expedients can be adopted for the passage of locomotives and carriages, or even of the carriages only, across the places where the rails may have been removed, till new rails can be procured; and, if so, what those expedients may be, and how to be applied. One resource might be available in double lines, namely, to dismantle one of the double rows, from the nearest part un-

DISTILLING HYDROCARBONS.



touched, to make good a thorough communication for at least one single line. It will be very desirable to obtain from railway engineers a consideration of all these matters, and special instructions drawn up on all expedients that can be suggested, in which the troops, but more particularly the engineer soldiers, might be subsequently practised; nothing of the kind, it is believed, having yet been undertaken.

DISTILLING HYDROCARBONS.

THE object of this invention is to obtain liquid hydrocarbons and other matters in an improved condition by means of the apparatus, which facilitates the process of manufacture, and enables a considerably lower temperature to be used than has been hitherto employed. These improvements have been patented by Mr. William Cormack, of 15, Little Moorfields, chemist, and consist in placing the solid or semi-solid matters to be distilled into retorts, which are heated externally in the usual manner; but instead of employing one heat for the separation of the oil and another higher heat for its vaporisation and expulsion, the lower heat only is used for the separation of the oil, and the oil is then expelled from the retort by the introduction of a jet of atmospheric air, or gas, or steam, singly or combined, superheated or otherwise, near the surface of the matters to be distilled, which system prevents the oil from being charred or deteriorated, and thereby enables an increased quantity and superior quality to be obtained. A perforated pipe is placed in the interior of the retort, which is afterwards hermetically sealed at the top, and the gases formed during the distillation propel the liquid hydrocarbon or other products downwards into suitable receivers, and thus the products of distillation being confined within the retorts become mainly the propelling agents of the oils or other products by the downward distillation.

In the engraving, fig. 1 is an elevation, and fig. 2 a section of a vertical retort to be employed for downward distillation. The retort is formed of a metal shell *a*, surrounded internally and externally by casings *b c*, composed of firebricks, fireclay, or other suitable composition, and between the casing *c* and the outer brickwork *d* there are three flues *e f g*, which gradually diminish towards the top. At the bottom of the retort there is a perforated metal plate *h*, a plan

of which is shown in fig. 3, and to this plate is connected an outside door *i*, which is hinged on one side to the axle *j*, having wheels *k* adapted to a tramway *l*. Between the plate and door there are uprights or tubes *m* for determining the space between the two, and the combined plate and door are connected by chains *n* passing over pulleys *o*, and counterbalanced by weights *p*, and when the retort is to be closed at the bottom a lute of clay is placed on the parts *q r*, and the weights *p* pressed down until the two parts are in contact, which are then firmly held together by a number of clamps, one of which is shown at *s*; or, instead of the pulleys and weights, a windlass may be employed, as shown at *a'*. At the centre of the bottom door there is a pipe *t* leading to the receptacle of the products of distillation, to which pipe is connected another pipe *v*, the bottom of which is submerged in a suitable depth of water or other fluid, which acts as a safety apparatus; for if there should be any obstruction between the retort and the receiver the distilled matters would escape through the fluid and prevent any damage to the retort. In the interior of the retort there is a perforated pipe *v* held in its place by a stud *w* on the perforated plate and by a cross bar *x*. The retort is hermetically sealed at the top by the cover *y* and manhole lid *z*, provided with the necessary lutes, there being in the centre of the lid a hole for the reception of a thermometer *a'*. When the bottom of the retort is closed by the combined plate and door, and the retort charged with the coal or other substance to be treated, heat is then circulated through the flues *e f g*, and the gas which is evolved forces the oil or liquid hydrocarbons or other matters through the body of the coal or other substance, and through the tube and perforated plate and pipe into the receiver. After the volatile and liquid products are withdrawn, the clamps are loosened and the combined plate and door lowered, which are then wheeled on the tramway on one side for enabling the coke, charcoal, or other matters to be withdrawn.

When either atmospheric air, gases, or steam is employed to assist in the expulsion of the oil or liquid hydrocarbons or other matters, a pipe *b'* is connected to the manhole lid, and the air, gases, or steam is forced through the body of the matter operated upon, and after the oil or liquid hydrocarbons or other matters are discharged, if it be desired to produce a superior quality of

coke, the central tube is removed, and either atmospheric air, steam, or gas is admitted for a sufficient length of time to carbonise and purify the contents, by which process the hydrosulphurous acid gas and other impurities are driven off, and pass away through the manhole, the lid of which has been removed, or they may be conducted to chambers to be condensed. Fig. 4 is a section of the receiver, which is connected to the bottom of the retort for receiving the heavier liquid products, and the lighter products are carried onwards into a second vessel or condenser shown in fig. 5; this vessel contains two compartments or chambers, divided by a partition which extends from the top to within a short distance from the bottom; the partition at the bottom is submerged in water, so as to seal it. By the gaseous hydrocarbons having to pass through this column of water in the second vessel, nearly the whole of the liquid hydrocarbons are arrested and detained, the more volatile hydrocarbons being carried forward by the elastic force of the gases or vapours. Such vapours are further conducted into upright condensers, such as are in ordinary use for obtaining still more liquid hydrocarbons or other matters, the surplus gaseous hydrocarbons being allowed to escape, or they may be used for heating, lighting, or other purposes, or returned from the gasometer to the retort. When required an exhaust pipe is added which is connected to an exhaust pump for drawing off the oil or liquid hydrocarbons through the condensers, the receivers, and the retorts.

The long promised supply of water has at length arrived in Paris; the Custom-house officers have allowed thither Dhuis to pass their gates. When the washing and purification of the aqueduct and syphons have been accomplished, the inhabitants of the higher quarter of the city will drink water from the celebrated Champagne country of the Aime. The length of the aqueduct is eighty-four miles, of which seventy-four miles are of solid masonry work, with an inclination of the tenth of a metre for every five-eighths of an English mile, and nine odd miles are in cast-iron conduits across valleys, the inclination being 0.55 centimetres (a fraction more than half an English yard) for every five-eighths of a mile (1 kilometre). At Montmenard, Montretout, and Montceaux, the tubes go underground. The works were commenced on the 1st of June, 1863, and have cost 16 million francs (£2640,000).

CENTRIFUGAL APPARATUS.

FIG. 1.

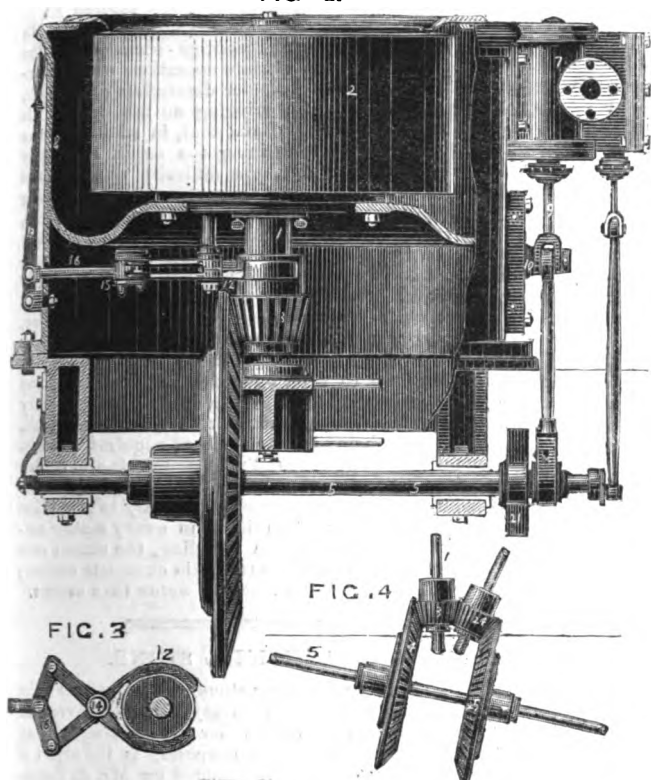
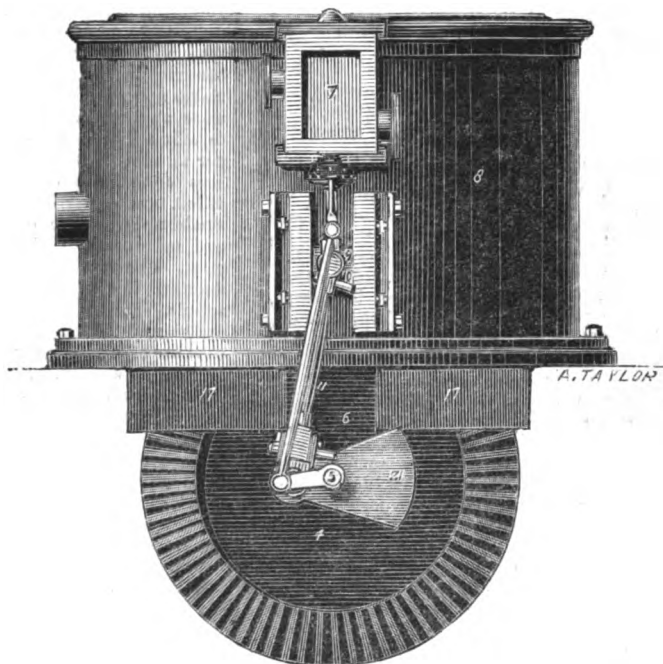


FIG. 2.



CENTRIFUGAL APPARATUS.

MESSES. ALEXANDER AND WILLIAM SMITH, of Glasgow, engineers, have patented an invention which relates to improvements designed to render centrifugal apparatus, such as is used in the manufacture of sugar, simpler in construction, more convenient for being erected, and, when in use, more efficient in action and less liable to get out of order than machines of the kind as hitherto constructed. In the accompanying engraving fig. 1 is a vertical section, and fig. 2 an elevation of the machine, whilst fig. 3 is a sectional plan of the duplex brake for stopping the motion of the basket. In this machine the vertical spindle 1 of the turbine or rotating centrifugal basket 2 is fitted with a small cone or conical pulley 3, to be driven by a conical pulley 4 fast on a horizontal shaft 5 carried in bearings 6 on the under side of the machine. This shaft 5, instead of being fitted with fast and loose pulleys to be driven by a strap from a line of main shafting according to one plan hitherto in use, or instead of being itself part of a long main shaft working two or more machines, and requiring engaging and disengaging appliances in connection with the turbine spindle, according to another plan hitherto in use, is here driven directly from a steam cylinder 7 bolted to the side of the casing or framing 8 of the machine. The cylinder 7 is inverted, its piston rod 9 issuing below and being jointed to a slide block 10, working in guides on the side of the casing 8, and connected by a rod 11 to a crank on the horizontal shaft 5. The machine is thus rendered completely self-contained and independent of other machinery or shafting, whilst engaging and disengaging gear is dispensed with, the parts remaining always in driving contact, and the machine being started in a gradual manner, and so as to avoid unequal action on the cones 3, 4, by gradually admitting the steam to the steam cylinder 7.

In stopping the machine the steam is shut off, and the momentum of the moving parts, which would continue the motion longer than is desirable, is overcome by means of a duplex frictional brake 12, actuated by a lever 13. This brake comprises two frictional blocks, which are applied to opposite sides of the boss of the cone 3 by means of crossed levers centred on a fixed stud 14, and connected to the lever 13 by links 15 and a rod 16. In using a single steam cylinder, as shown, smooth working is ensured by fixing a weight 21 on the horizontal shaft 5, to counterbalance the weight of the moving parts in connection with the steam cylinder; but if preferred two steam cylinders may be used, and the

cylinder or cylinders may be either fixed or oscillating, and with common rods or with trunks. The cylinder or cylinders may also be either vertical, inclined, or horizontal, but in all cases attached to the casing or framing of the machine, so that the machine with its driving power will be completely self-contained, and can be erected or set down in any position that may be most convenient, without reference to shafting or other machinery, the only connection required being that of a pipe to supply steam.

Another improvement applicable to the foregoing arrangements, and also to other arrangements, is shown in fig. 4, and consists in fitting on the driving shaft 5, placed with a slight inclination to the horizontal, two conical driving pulleys 4, 23, facing each other. One 4 of these driving pulleys is in contact with the cone 3 on the turbine spindle 1, whilst the other 23 is in contact with a similar cone 24, on a short intermediate spindle; this intermediate cone 24 being in contact with the cone 3 on the turbine spindle 1 on its other side. By this means the turbine spindle 1 will be driven from both sides, and the friction in its bearings will be greatly reduced, whilst it will run more smoothly, and continue longer in good order than when driven on one side only.

SELF-ACTING SYPHONS.

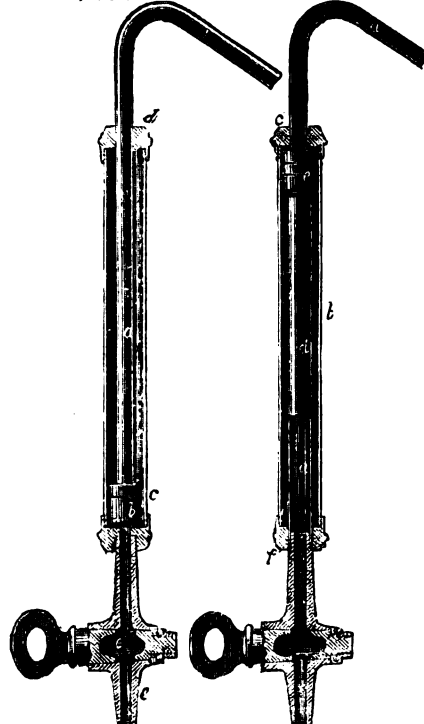
MR. G. H. DEVEREUX, of Lamb-terrace, London Fields, Hackney, has patented improvements in syphons. In order to render them self-acting, he makes the descending leg telescopic, and combines therewith a cylinder and piston in such a manner that by drawing out the leg to its greatest length a partial vacuum will be produced in the cylinder, and to supply this vacuum the liquid passes up the ascending leg, and is so drawn over and the syphon set in action. This arrangement is shown at fig. 1 of the accompanying engraving, which is a section of such a syphon. *a a* is a tube forming the ascending leg of the syphon and a portion of the descending leg thereof; at its end is fixed a piston *b*, which is made tight by a hempen packing wound around it; *c* is a cylinder into which the piston *b* fits, and in which it is able to slide; *d* is a cap screwed on to the top of the cylinder *c*, and the pipe *a* passes freely through a hole in the centre of this cap, which thus acts as a guide to make the cylinder *c* work truly with its piston; *e* is a cock at the lower end of the cylinder *c*. When the ascending leg of the syphon is immersed in liquid and the stopcock *e* is closed, if the cylinder *c* be drawn down so as to lengthen the descending leg, a partial vacuum is formed in the part of

the cylinder under the piston, and liquid will come up the ascending leg to supply it; then on opening the stopcock *e* the liquid will flow from the syphon. To stop the flow the stopcock is closed, and if it is desired to discharge the syphon the cylinder *c* is pushed up, and then the stopcock is reopened, when the whole of the liquid in the syphon will return to the vessel from which it was being drawn.

If it be wished that the liquid should be kept out of contact with the cylinder, which is some-

FIG. 1

FIG. 2



times desirable, as when the apparatus has to work with acid or a liquid which would corrode a metal cylinder, another construction is adopted as shown at fig. 2, which is a section of a syphon thus constructed. *a a* is the tube forming the ascending leg and the upper part of the descending leg of the syphon; *b* is a cylinder fixed to it, it screws airtight into a cap *c*, which is soldered to the tube *a*; *d* is the tube forming the lower part of the descending leg of the syphon, it

slides loosely over the tube *a*, and has a piston *c* at its upper end which fits the cylinder *b* airtight, and is able to slide up and down therein; *f* is a cap screwing on to the lower end of the cylinder *b*, and having a hole at the centre, through which the tube *d* is able to pass freely; *g* is a stopcock at the lower end of the tube *d*. The syphon is worked in the same way as that first described.

Obituary.

We regret to announce the death of Mr. Westley Richards, which took place yesterday week, after a long illness, at his residence at Edgbaston, in his 76th year. Of late years his increasing age and infirmities had obliged him to withdraw from active public life. Now that industrial exhibitions are so much in vogue, it should be remembered to Mr. Richards's credit that he was chairman of the committee of the exhibition held in Birmingham in 1849, at the last visit to the British Association, and which was the precursor of the larger displays in Hyde Park, and still more lately at Kensington. In connection with his branch of manufacture—the gun trade—Mr. Richards was a man of special note, as being amongst the oldest and most skillful members of the trade. His experience of gun-making, extending over more than half a century, embraced an infinite number of changes and improvements both in military and sporting guns. To these Mr. Richards greatly contributed, not only by adopting the inventions of others but by adding improvements of his own. It may be noted that he was the first person in Birmingham to take out a licence to use Forsyth's copper cap, which superseded the old flint gun, and he lived to see even this notable invention displaced by the self-igniting ammunition of breech-loading guns. With the last-named class of weapon the name of Mr. Richards is closely associated; and, indeed, throughout England no name is better known in connection with the gun trade generally than that of Westley Richards—the mark of his firm being a guarantee for high quality, trustworthiness, and excellence of workmanship.

We also have to record the death of Mr. Robert Charlton, engineer of the Killingworth Colliery. The deceased had only returned a few months ago from Servia, where he had been engaged in some mining operations, and since then he had been employed as one of the principal engineers at Killingworth Colliery, where he had gained, through his kind and amiable disposition, the affections and goodwill of all the workmen with whom he came in contact. His remains were interred at Dinnington Church on Friday; and to evince the respect in which he was held in the neighbourhood, nearly the whole of the old resident workmen connected with the colliery, together with many of those also from Seaton Burn, where the deceased had previously lived for many years, accompanied his remains to their last resting-place.

THE "BELLEROPHON."

THIS iron-clad frigate of 16 guns, upon the trials of which the future construction of the British navy so much depends, had steam up for the first time late on Tuesday, and on Wednesday steamed out to the Nore and back for the purpose of affording the engineers who have built her engines (Messrs. Penn and Sons) an opportunity of turning them round for an hour or two preparatory to taking the ship upon the measured mile on Thursday, and likewise for the purpose of affording Mr. Reed, the Chief Constructor of the Navy, who was on board, an opportunity of making a preliminary trial of the balanced rudder with which this ship is fitted. The run was attended by most satisfactory results. Although this was the first time of steam being admitted to the powerful engines of this ship, which are fitted with surface condensers and all recent fuel-saving appliances, the ship, as soon as she was clear of the sandbanks off Sheerness, started off at a speed of nearly fourteen knots, and after running for two or three hours returned to the harbour to await the full-speed trials. The action of the new rudder was most remarkable, the ship turning completely round at high speed from one direction to the opposite one in 1 min. 48 sec.

NEW RAILWAY SHACKLE.

MESSRS. FREEMAN and GRUNDY, of 78, Cross-street, Manchester, engineers and machinists, have invented and patented a new shackle or coupling apparatus for railway carriages, wagons, and other vehicles, with the view of superseding the coupling chains now in use. The system of attaching engines and carriages now in use requires a man to go in between two carriages approaching each other in opposite directions, at considerable risk to his personal safety, to affix a link on one of the carriages at the proper moment to hook on the other. Great numbers of men are crushed and maimed, if not killed, every year by the present system, and it would no doubt be desirable to adopt an easier and safer mode of accomplishing the same purpose. The apparatus by which Messrs. Freeman and Grundy seek to effect this object is very simple. Each carriage has a reversible screw wedge and bell-mouthed cone, so that, by the working of a lever over it, either may be put in position as wanted. Supposing two carriages approaching each other, one with the bell-mouthed cone in a horizontal position and the other with the screw wedge in a similar position, they are self-acting. The wedge goes within the bell-mouth, where there are four spring catches which at once seize the screw and hold it, so that the coupling is effected in an instant, without the intervention of a railway servant to guide it in any way. To uncouple the carriages, a porter at either side of the line is within reach of short levers which liberate the screw from the spring catches, and the uncoupling is effected as rapidly as the coupling. It is to be hoped that the invention may prove sufficiently successful to meet with the approval of railway engineers and directors, and be universally adopted.

ATLANTIC DEEP SEA SOUNDINGS.

ACCOUNTS of deep sea soundings have appeared from time to time; those obtained by the "Bulldog," Captain Sir L. M'Clintock, being the last, may be considered unexceptionable for accuracy. The following remarks on this subject by one of her officers appear in the *Nautical Magazine* for the present month:—In the deep sea soundings, a small line and heavy weight were found to be best adapted for determining the depths accurately, as with these the surest indications of the weight having reached the bottom were obtained. With a large line—deep sea line, for instance—it was found exceedingly difficult to ascertain when the lead was at the bottom. Cod line was, therefore, invariably used for the purpose, with weights as follow:—In depths under 150 or 200 fathoms, with a 28lb. lead; beyond 200 or 300 and up to 800 or 1,000 fathoms, with a 56lb. lead; and in all greater depths with an iron sinker of 118lb. weight. The cod line was supplied from the manufacturers on small wooden reels, containing 1,000 fathoms each; and to prevent the inconvenience of bending one line to another whilst sounding, was usually transferred to a larger, but very light, reel in one length of 2,500 fathoms.

The method of ascertaining the depths was as follows:—The line was eased down for the first hundred fathoms, and then allowed to run off the reel unchecked. The times occupied by the running out of each successive hundred fathoms were noted, and the rate, as might be expected, was observed to decrease gradually as the weight descended. When a marked decrease in the rate occurred the weight was known to have reached the bottom; and, under favourable circumstances, the line almost ceased to run out after this happened. Usually, it was also quite possible, by allowing the line to run loosely through the hand, and exercising great care, to feel when the bottom was reached. It was, however, the invariable custom, after the weight was known to be down, to allow the line to run out to the next mark, so that the time noted should prove the fact. The slack line was then hauled in, and the depth taken when the line was quite taut, and up and down. The line was then hove in slowly by the deck engine; but it very seldom happened that more than a few hundred fathoms were recovered, so that the weight and most of the line were sacrificed upon each occasion. Once, however, the iron sinker, of 118lb. weight, was brought up from a depth of 1,913 fathoms.

For bringing up a specimen of the bottom a special apparatus had, of course, to be employed; and it required a strong line to bear the

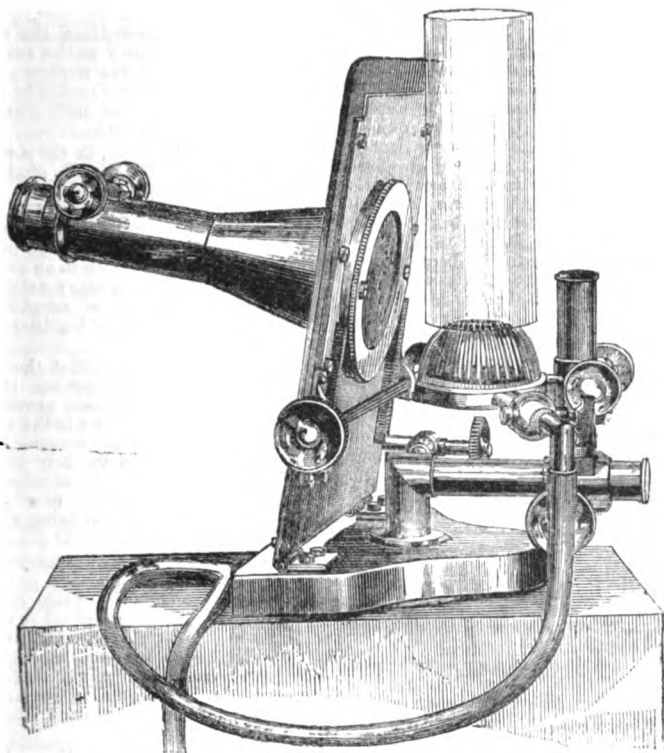
heavy strain put upon it whilst being hove in with the engine. Deep sea line was ordinarily used for this purpose; but when the ship had much pitching motion, the tapered whale line alone possessed the requisite strength. In all the deep sea soundings obtained by the "Bulldog," two distinct operations were, therefore, performed: one for determining the depth, and the other for bringing up the bottom. It may be well also to add that, in addition to the uncertainty of obtaining the depth accurately with a large line, the difficulty was rendered greater by the circumstance of the sounding machines being furnished with detaching weights, which released themselves the moment they touched the bottom. The time occupied by procuring a specimen of the bottom was usually about three hours; during which long period it was necessary to keep the ship over the line, and this was frequently attended with great difficulty. It was ordinarily effected by keeping her head to wind by means of the driver, and occasionally turning the paddle-wheels very slowly. When blowing fresh, the main topsail, set aback and braced about as required to assist the driver, was found very useful. It also tended to keep the ship astern, so that the paddle-wheels could be moved sufficiently to give effect to the rudder. In this, as in every matter connected with deep sea sounding, the utmost care is necessary in order to obtain complete success; and without it the labour is worse than useless.

ARTIFICIAL STONE.

To obtain a factitious stone which may take the place of the ordinary Turkey, Water of Ayr, and Arkansas stones used for sharpening cutting tools, and for kindred purposes, is the object of an invention recently patented by Mr. E. Parnacott, of Leeds. To this end he prepares a compound which will admit of being moulded to any required form, and which when moulded may be hardened and brought to the consistency of stone. In carrying out the improved manufacture, the chips and dust obtained in preparing lithographic stones are reduced to fine granules, emery powder, borax, and saltpetre are added and the whole thoroughly mixed in a mill. The mixture thus obtained is moulded to any required shape—for example, cutting and polishing tools; the same is first submitted to hydraulic pressure, and then to furnace heat, whereby the hardness and consistency of stone is imparted to the moulded articles. The following proportions will produce a good result, viz.:—pounded lithographic stone twelve ounces, borax two ounces, saltpetre half an ounce, and very fine emery two ounces. Place these substances together in an ordinary incorporating mill with edge runners (such as is used for preparing and mixing mastic and sand), the pan of the mill being heated by means of steam or gas, and subject the substances to the action of the mill until they are well mixed and incorporated. Then remove the compound thus formed and place it in strong iron moulds for the purpose of being submitted to pressure. These moulds are made of various shapes to suit the purposes for which the artificial stone is to be used.

The pressure necessary to effect a proper consolidation of the compound may be conveniently given by means of a strong hydraulic press. The amount of pressure which has proved satisfactory is about twenty tons per square inch of surface of the moulded article. When the requisite mechanical consolidation of the moulded articles has been thus obtained, the moulded article is subjected to a white heat in any suitable construction of furnace, or to such a heat as will serve to fuse the borax and saltpetre, and effect the binding together of the granules of stone and emery. The time required for attaining this object will in general be from half an hour to one hour. To prevent the warping and running of the moulded compound under heat, it is clamped in moulds made of plumbago, fireclay, or other like heat-resisting material, before being placed in the furnace. When it is required to produce cutting or polishing wheels, hoses, or other like articles with a less cutting power than those made from the before-named mixture, ordinary chalk is substituted for a portion of the lithographic stone granules. The proportions of the chalk and the granules should be half of each to produce a good result, the proportions of the other materials being retained.

THE DENTISCOPE.



THE DENTISCOPE.

The accompanying engraving illustrates Mr. Rahn's patent dentiscope, larynxscope, light-intensifying, and concentrating apparatus, for surgical and other operations. This most useful apparatus is a great boon to the professional world of surgery, and not only to them, but to mankind in general, inasmuch as that, while the former are aided and assisted with the most essential element, light, in a most convenient and beautiful arrangement, the latter may at all times and in all places have the remedial means resorted to at once to relieve or cure them, either at their own homes or in the operating-room of the surgeon and dentist. The invention is due to one of our ablest dentists, Mr. Rahn, who for years has been struggling with the difficulties of contending with the want of light. In the end, however, he was successful in producing an apparatus which answered all purposes most effectually, Mr. West, of Cook-street, having carried Mr. Rahn's ideas into practice in the manufacture of the instrument.

The dentiscope consists of an optical arrangement of lenses in a cone and tube, with a rack-and-pinion adjustment for focussing. This is mounted upon a plate, which moves in dovetails upon a larger plate, that forms a screen, with racks and pinions to raise and lower the optical arrangement at pleasure. The screen is jointed to a massive foot or stand, provided with a double-threaded tangent screw, with a bold milled-head nut for adjusting the screen to angles of elevation or depression. At the back of the screen, and upon the foot or stand, is fitted a branch with pillar, carrying a Leslie's patent up-and gas-burner, with stop-cock and connecting piece, to which may be attached any length of india-rubber flexible gas tubing to communicate with any gas supply on the premises, or provided in a portable india-rubber gas bag, to be placed in a suitable and convenient place for the performance of the operation. The branch and pillar carrying the gas burner is fitted also with racks, pinions, and milled-head nuts, to adjust the flame to the necessary distance and height required by the variable position at which the optical arrangement may be required. The whole of this structure is fitted upon a circular plate, with centre cone or turntable—thus the instrument may be brought instantly into any position required.

At the recent meeting of the British Association, Mr. Archer suggested that experiments should be made upon vegetable silk fibre, which was almost valueless for commercial purposes, but would, he thought, be applicable to the purposes of manufacturing a material in lieu of gun cotton.

Correspondence.

THE TIMES ON THE PATENT LAWS.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—Some of the views expressed at the late meeting of the British Association of course found an echo in the *Times*; and its eccentric arguments on this subject would scarcely deserve notice but for the "Finality Jack" style in which that journal indulges. In an article in the *Times* published on the 13th instant, two points are defiantly put forward as unanswerable, both of which may be very easily answered and refuted:—"First (the *Times* says) the right of exclusive property differs from all other property (with the exception of copyright) in being purely and entirely the creation of the law." "Secondly, no author can say that his literary career was hampered and development checked by the privileges conferred on those who had written before him." To the first assertion:—"The law was made to protect, as far as practicable, that which is already property before the law can be brought to bear upon it. The production of a man's brain is as much his property as the labour of a man's hand. The law attempts to protect that property which has been created by a man's study, industry, assiduity, ideality, and ingenuity. It is therefore highly absurd to say that the law creates the property. To the second assertion:—"An author is just as much hampered and checked by that which has been published before he writes, as an inventor is by that which has been invented previously to his invention; and the author who ignores other men's writings is very likely indeed to become a plagiarist. He also runs the same risk as the inventor of a modern antique; for if his book is not new, as well as good, it will not sell. Generally the arguments of the *Times* against the patent laws amount to this:—"The patent laws are not perfect, they do not meet every case; therefore abolish them. But I would remind the *Times* that many other laws are quite as imperfect as the patent laws, and that the proposition to abolish such laws on that account would be scouted by society."

I am, Sir, yours &c.
1, Clifford's Inn, September 19. T. MOY.

REVIVIFYING ANIMAL CHARCOAL.

SIR,—Animal charcoal for sugar refining has now become indispensable. It is true that it is a great expense to the refiners, but their whole success depends upon its use. Good charcoal enables them to obtain 5 or 10 per cent. more crystallised sugar, which bad coal destroys, converting it into syrup. It is therefore necessary for the refiner to pay the greatest attention to his charcoal, because therein lies his greatest profit. If coal is bad the greatest skillfulness in manufacture cannot justify itself. To my regret I must confess that the revivifying of charcoal in many sugar refineries is as yet in its infancy.

The sugar refiner, if he will succeed, has to make himself sure of the good quality of his charcoal before it is put into the filters. The charcoal should

be tested by a chemical proof; for this matter a small portion of the coal is boiled in distilled water, and in this water only a few drops of chemical preparations are put. When charcoal subsides the water should be as clear as before boiling. Now I would ask, is it possible to bring charcoal to its primitive strength by a simple reburning? I think not. As we know that the charcoal is not only able to remove the colour from out of the sugar, but also the lime, salts, and other impurities which tend to destroy crystallised sugar, it is clear that, to restore to charcoal its primitive strength, requires something more than a simple reburning. In filtering sugar through charcoal three different processes of removal are carried on; the first refers to substances offensive to taste and smell, the second refers to lime, gyps, salts, and the third to organic colouring substances. Now, if the charcoal which absorbs and retains all the above named substances be put into the reburners without any thing having been done to it, what must be the result? The colouring substances burn and leave ashes behind, and those ashes stop up the pores of the coal for the next filtration. The lime also by reburning remains unchangeable, as the heat has not the least influence upon it, only so far as it makes the coal from time to time harder and more glass-like, so that it soon gets quite unfit for taking up colour. The liquor then runs out from the bottom of the filters in the same condition as it is put on at the top. The refiner is surprised at the result, and wonders where can be the cause. It lies in the coal, which is badly prepared, and so instead of gain it brings loss.

In the revivifying of charcoal, therefore, three different processes are necessary, viz., first, the fermentation of the charcoal, which tends to destroy the organic colouring matters; second, the addition of a certain quantity of muriatic acid to dissolve the lime, which afterwards is washed away by water; and third, the reburning of the coal in open cylinders, which effects the removal of all the substances offensive to taste and smell. Charcoal prepared after this method enables the refiner to obtain from 20 to 30 per cent. better liquor, and this is the method adopted by

Your obedient servant,
C. GREEK.

9, William-street, Cannon-street-road,
St. George's East.

PEAT FUEL.

SIR,—I do not know whether you have observed a report of a paper read before the British Association, and headed "A New Preparation of Peat." I have read it, and beg to state that this so-called "New Preparation" has been in use in one of the central counties of Ireland for more than two years. Having during last summer visited Ireland, I took the opportunity of seeing these works, and when I read this paper was so struck with the resemblance of this so-called "new process" to the one in use there, that I think it only fair to inform the inventor, through your paper, that his supposed new invention of drying peat by means of a heated current of air has been used in Ireland before, and has been shown there also as a new invention.

Yours, &c.,
A. C.
London, September 19.

[We read the report of the paper above alluded to, and considered it to contain no new information, for which reason we did not give it insertion. The whole matter was investigated in detail in a paper on fuel read by Mr. Perry F. Nursey before the Society of Engineers in January, 1864. The only new point advanced appears to be the christening of the condensed peat produced under Buckland's patent by the name of Torbite.—ED. M. M.]

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. R. 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 advertisement.

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. C.—C.—W. W.—J. B. B.—C. G.—A. C.—E. A. C.—T. M.

ANSWERED BY POST.—N. P. B.—J. N., jun.—C. G.—W. W.—E. A. C.—F. R.—H. C.—O. L.

Miscellaneous.

In our last number we referred to phenic acid as an antipestilential agent, and alluded to the difficulty in obtaining it. We learn that phenic acid and its various preparations are well known in France, and a knowledge of its remarkable therapeutic and antiseptic qualities is principally due to the researches of Dr. Jules Lemaire. Steps are being taken for introducing the article into England.

One of the largest ploughing matches in England came off at Thame yesterday week in the presence of an immense number of spectators. The interest excited by the contest between Parsor and Barker, the rival ploughmen of the Howards of Bedford and Ransomes of Ipswich, for the prize open to all England, was perhaps never equalled. The effect of these competitions, which are becoming very popular, cannot fail to stimulate both ploughmen and plough-makers. The work done was of the highest order, the Bedford man being declared the winner, his veteran companion Hulett, who has ploughed in the presence of most of the crowned heads of Europe, having also won the first All-England match this year. At the annual ploughing match of the Bicester Agricultural Association the All-England prize was won for the fourth time this autumn by Messrs. Ransome's man ("Parker"), in competition with Messrs. Howard's man, George Brown.

"An old copper smelter" writes to the *Times* to say that in the neighbourhood of Swansea there is a gentleman who has invented a process, whereby the copper can be returned from the ore without any smoke, at the same time rendering the refuse fit for the iron furnaces, and worth about 12s. per ton for iron. He thinks that if an iron furnace were erected in connection with the copper works, it would answer the most sanguine expectations. In addition to the sulphuric acid which would be obtained in the process, small works where detecting chambers are provided could return ten or twelve tons per week of arsenic, which otherwise would be carried with the wind and dropped on adjoining land. The adoption of this invention would confer a great boon on the inhabitants of Swansea, who live almost their whole life in a cloud of smoke, mud, or dust.

The Paris correspondent of the *Chemical News* states that an important experiment has been made by M. Duchemin during a holiday at the seaside. He made a small cork buoy, and fixed to it a disc of charcoal containing a small plate of zinc. He then threw the buoy into the sea, and connected it with copper wires to an electric alarm on the shore. The alarm instantly began to ring, and has gone on ringing ever since, and it is added that sparks may be drawn between the two ends of the wires. Thus the ocean seems to be a powerful and inexhaustible source of electricity, and the small experiment of M. Duchemin may lead to most important results.

A mine of solid petroleum has been discovered in Western Virginia. The vein varies in depth from 50in. to 250ft. A ton of the ore yields about one hundred and seventy gallons of pure oil. This is the biggest grease spot we ever heard of.

Two more of the iron mortar-boats which have long been laid up in Chatham dockyard are to be turned to useful account. The mortar-boats 104 and 110, two of those built during the Russian war, are to be removed to Deptford, to be employed as lighters for conveying stores and provisions.

Advices by the West India mail state that the first portion of the pontoons and other materials for the floating dock arrived at St. Thomas on the 19th of August, all in excellent order. The remainder of the mains required for the completion of the gas works arrived on the 18th ult. The laying down of the pipes was progressing very rapidly, and it was confidently expected that the town would be lighted up with gas by the end of September.

A letter to the *New York Herald* says:—General Payne, late of Paducah notoriety, has created a sensation among river men by the invention of a new propelling power, which does away with the use of boilers, and causes an immense reduction in the expense of fuel. 100,000 dol. has been offered for one-tenth interest in the patent, with a view to bringing it into use on the Illinois Central Railroad.

The French Minister of Commerce and Public Works has issued a circular to the directors of all the railways in France on the subject of establishing signals for the security of travellers on railways, and it is said that, from the commencement of the coming year, all the carriages of every passenger train will be placed in communication with each other, and consequently with the conductors of the train.

We last week referred very briefly to a discovery of coal at the foot of Mount Olympus thirty miles from Salonica. It appears that the Viceroy of Egypt having been informed that coal was to be found in the neighbourhood of the classic mount at

once gave instructions for the striking of the stratum. The works were carried on successfully, and the result is that, after reserving for the Steam Company Azizie, of Alexandria, its full requirements of coal, the Viceroy proposes throwing open to all nations the delivery of this fuel, which can be furnished at the rate of 10s. per British ton, at a figure immediately below the present cost of coal in any depot along or around the Mediterranean seaboard. The importance of this discovery cannot be too highly estimated, for not only will it effect an immense saving in working the steamers of the various companies trading to Alexandria, and the eastern parts of the Mediterranean, but it is not impossible that depôts may be formed to meet the requirements of the Red Sea traffic, because coal can be shipped from Olympus and stored at Suez at a cheaper rate than coal drawn from other sources of supply.

Several inventions have lately been patented for the prevention of accidents in coal and other mines, but perhaps the most simple and most complete apparatus is that of Messrs. Denton and Whittaker, which consists in the application to the cages of strong iron springs, which catch the woodwork on every stoppage of the cages, and effectually prevent them from slipping. In case of an accident such as that which occurred at Wigan last week by the breakage of the rope, this apparatus would at once have stopped the cage, and prevented the great loss of life which took place. The invention also provides against accidents from overwinding, a slip-catch giving way when the cage has reached the required height. The patent has been successfully tried on the Ardsley colliery of Messrs. Firth, Donisthorpe, and Company.

A brief description of an ice-making machine now in operation in Paris is given in *Les Mondes*. The inventor, M. Menard, employs amylie ether, which is compressed to the extent of from five to seven atmospheres. From the reservoir the liquid is allowed to escape into a worm circulating round square vessels of water, which becomes frozen by vapourisation of the ether in the worm. The account, however, is somewhat ambiguous; it states that the machine will produce 50 kilos. of ice per hour.

The adulteration of Dutch yeast is extensively practised; recent importations have been found to contain a large admixture of China clay ground as fine as flour. The average import of Dutch yeast in Hull is about 7,000 baskets per fortnight, and during the past fortnight 123 baskets of yeast have been destroyed as unfit for human consumption.

At the last meeting of the Academy of Sciences M. Carret presented a note On the new epidemic in Savoy, in which he reasserted the cause of this disease to be the carbonic oxide produced by the cast-iron stoves. His nephew, M. Jules Carrot, has proved the presence of the gas in a room heated by a cast-iron stove. M. Maurand submitted an instrument which may prove of great value. He calls it a "Ready Reckoner (*prompt calculateur*)," and it is intended to reduce with ease and accuracy the weights and measures of all nations to the French metric equivalents and vice versa.

A correspondent of an American exchange observes that invention has been exhausted upon machines to wash with, and that we are on the wrong track: it is to chemistry we should refer instead of mechanics. Benzine, for example, takes up grease. The French *eau Javelle* takes up dirt with little rubbing, but it eats wool. Could the odour of benzine be got rid of cheaply, and the fluid be again used, it might lead to successful investigation in chemistry that would much further relieve our domestics of their hardest work.

We understand that Mr. Fry, of Quay-street, Bristol, has designed a railway carriage in which the risks and annoyances to which railway travellers are at present subjected are entirely obviated. He connects all the carriages by bridges which are fastened on like the buffers, so as to recede in case of pressure, and there is a passage through the centre of all the carriages, so that the guard can pass with perfect safety from the last carriage to the engine-driver. The carriages now in use can be modelled on this plan with very little cost. The only objection is that the passage would occupy about a sixth of each carriage; seven carriages instead of six would be required. The additional cost would be very little compared with the perfect order and safety secured by the new design.

About twelve months since it was stated that in boring near the base of the Hambleton Hills, a seam of coal had been met with, of fair quality. Since then, the formation of the Gothland Deviation Railway showed the existence of a thin seam of coal in that district. These indications have led to further examinations, and it is asserted that indications of coal underlying Cleveland have been met with, especially near Staiths.

Several gentlemen interested in the elevation of the working classes have commenced a company, called "The Clayton Forge Company," for the manufacture of boiler plates and of bar iron, on the principle of dividing profits with the workmen and the customers. All profits up to 10 per cent, will

belong to the shareholders, all above 10 per cent., after providing for repairs and renewals of plant, is to be divided into three equal portions, the first of which will belong to the shareholders, the second to the workmen, and the third to the customers. The subdivisions amongst the workmen are to be in accordance with the wages earned by each, and the subdivisions amongst the customers according to the purchases made by each.

A trial was made lately, in the courtyard of the Archinto Palace, at Milan, with what the inventor, Paolo Porta, calls an "air ladder." It consists of several pieces, which, with a sort of carriage as a basis, can be fixed one on top of another. A height of 90ft. was thus reached in a very few minutes. The apparatus may be bent down to an angle of 45 deg., and is capable of carrying heavy weights. The principle, it is stated, can be adapted to portable bridges, which can be put together in an equally short time.

From America we learn that the Sixth-avenue Railroad Company, in building their immense stables a few years ago, made provisions for keeping their hundreds of horses in the basement; but experience has proved that keeping horses in this way is terribly injurious to their health, and the Company have come to the conclusion that they cannot afford it. They are now altering their stables, at great expense, to bring all the stalls for the horses above the level of the ground.

In Paris horseshoes may not be roughed, because that wears out the macadamised paving so general on the great thoroughfares of that city; but it tells fearfully on horses. Paris would reward the inventor who would contrive a shoe which, without having picking projections, would yet have bite enough to keep from slipping. Intervening strips of steel might, by the quicker wearing down of the softer iron, keep up the required edge, and not be too costly.

The Grand Duke Constantine of Russia, Lord High Admiral of the Imperial Navy, has presented Capt. Cowper P. Coles, R.N., with a massive gold snuff-box, set with diamonds, and bearing the initials of the Grand Duke in diamonds on the centre of the lid. Such an acknowledgment of the worth of the turret principle must be highly gratifying to Capt. Coles now that the turret is already fitted to about a dozen vessels of the Imperial Russian Navy in the Baltic, and has been tested under all possible conditions of wind and weather.

In section A of the British Association, Mr. Glaisher read a paper by M. A. Claudet, describing an ingenious contrivance by that gentleman for showing pictures of figures in apparent motion, the explanation depending on the known fact that the retina of the eye retains for a short time the image of any figure formed upon it. M. Claudet has contrived slides on which photographs of figures in different positions were placed, and being visible through two lenses to only one eye at a time, by rapidly moving the slide, the appearance of motion is given to the figures.

The torpedo question is receiving the attention of the Admiralty authorities, who we understand have sent orders to Chatham dockyard directing the sailing frigate "Terpsichore," 18, one of the numerous vessels rotting out their existence in the harbour, and encumbering the navigation of the river, to be dismantled of all her stores, and prepared for removal to the entrance of the harbour, near Gillingham creek, where preparations are in progress by the Royal Engineers for destroying her by means of sunken torpedoes. We further learn that Mr. Donald M'Kay, the well-known American shipbuilder, is at present in this country, and is in communication with the Admiralty on the subject of torpedoes. It is said the authorities purpose to entertain seriously the question of having on hand a stock of these destructive missiles, with a view of laying them down in the event of a war, in the different channels leading into our harbours, thus leaving our fleet to a great extent free to proceed to sea.

A visit to James Watt's workshop is thus graphically described by an Edinburgh gentleman attending the British Association:—We were admitted into his workroom—a garret at the top of the house. It appears he had a scolding wife, who didn't like the maces and noises he made, so he was sent to the attic. This room is exactly as Watt left it. The very ashes are still in the grate; his little lathe has a bit of unfinished work in it; tools lie about; books and drawings are in old drawers, and strewn here and there. It is a miserable little place. Only four of us could get in at one time. In fact, the daughter of the house who went with us had to tuck herself up into all manner of shapes to prevent her crinoline sweeping all the letters into the corners. The house is a very good one, and Watt was rich when he died there; but it's clear his wife kept him and his little workroom in the background. This room has only been recently opened. By the will of Watt's son it was ordered to be left for ever as the old man left it when he last went out at its door. It was not looked into for more than thirty years.

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.—None

BUILDINGS AND BUILDING MATERIALS.—542, 543, 559, 570, 578

CHEMISTRY AND PHOTOGRAPHY.—538, 564, 596

CULTIVATION OF THE SOIL, including agricultural implements and machines.—576

ELECTRICAL APPARATUS.—None

FIBROUS FABRICS, including machinery for treating fibres, pulp, paper, &c.—536, 548, 563, 566, 577, 583, 593

FOOD AND BEVERAGES, including apparatus for preparing food for men and animals.—546, 555, 561, 595, 599

FURNITURE AND APPAREL, including household utensils, time-keepers, jewellery, musical instruments, &c.—535, 541, 551, 552, 554, 556, 569, 579, 585, 588, 594

GENERAL MACHINERY.—557, 558, 560, 565, 575, 581, 584, 597, 600

LIGHTING, HEATING, AND VENTILATING.—549, 562, 568, 591

METALS, including apparatus for their manufacture.—580, 587

MISCELLANEOUS.—567, 571, 574, 592

ROADS AND VEHICLES, including railway plant and carriages, saddlery, and harness, &c.—537, 539, 544, 546, 579, 586, 589

SHIPS AND BOATS, including their fittings.—553

STEAM ENGINES, &c.—547, 582, 598

WARFARE.—540, 560

535 J. STARLEY. *Improvements in sewing machines.* Dated February 25, 1865.

This invention refers particularly to machines in which the work is supported on a cylindrical arm in which the shuttle or lower thread bobbin is contained. In the machines the work is caused to travel forward as the sewing progresses by means of a feed ring roughened on the periphery, the roughened surface of the ring coming flush or nearly flush with the surface of the cylindrical arm, and the work being pressed down on to the feed ring by a presser wheel or flat foot above. In such machine, however, the feed ring has been made as a piece by itself, and separate from the parts of the cylindrical arm on each side of it, which is an inconvenient arrangement, and involves more or less complication in driving the feed ring. According to this invention the patentee forms the feed ring on the casing of the outer end of the cylindrical arm, and drives both it and the casing by means of an axis passing through the arm centrally from end to end; at the extremity of this axis is a feather or stop, and this engages with the disc which closes the end of the casing, so that the feed ring and the casing rotate together, and the shuttle or lower bobbin traverses to and fro within it. The casing and feed ring are readily slid on off the arm to allow free access to the shuttle. *Patent completed.*

536 T. DRONSFIELD, T. E. JONES, and J. ASHTON. *Certain improvements in mechanism or apparatus for "blocking," rolling, and measuring calico, linen, flannel, or other woven fabrics.* Dated February 25, 1865.

This invention consists in the employment and use of a frame in which a series of fixed bars or rods are arranged, under and over which the cloth first passes, and is caused to pass between pressure rollers, whence it is delivered and formed into a roll upon a spindle or shaft which is supported in bearings fixed to the framing and turned by a handle. If a "block" of cloth is required, a blocking board supported on centres is employed in place of the aforesaid spindle for "rolling." The cloth in its passage from the pressure rollers to the roller or block is kept even and straight by a balance lever which is caused to press on the under surface of the cloth as required. *Patent abandoned.*

537 J. ASKEW. *Improvements in the construction of a portable vehicle for teaching children to walk and giving assistance to invalids.* Dated February 25, 1865.

This invention consists in the construction of portable carriages manufactured in various kinds of metals, such as iron, brass, steel, &c. The portable carriage is formed with a suitably shaped rim, by preference circular; to the under side of this rim three or more tubes are attached by pin joints, and within these tubes other smaller tubes or rods slide, the lower ends of which are connected to a large rim by pin joints; the lower rim is also preferred to be of a circular form. The inner tubes or rods have springs coiled around them by which they are retarded (according to the degree of the strength of the springs) from sliding within the upper tubes, by which is obtained an elastic motion between the upper and lower rims. These tubes have at their lower ends collars capable of being affixed in any desired position by set screws, and thus to regulate the height of the upper rim which receives the child or invalid. This upper rim is provided with a door or opening as heretofore, and is secured by a lock or key or thumb screw to prevent the child or invalid falling out of the carriage. The carriage is made movable and noiseless by castors of brass, &c., lined with india-rubber or other substance, and the slightest movement of the child's feet or feet gives the facility of going in any direction. *Patent completed.*

538 P. A. LE C. DE FONTAINEMOREAU. *Certain improvements in the treatment of madder and the products obtained therefrom.* (A communication.) Dated February 25, 1865.

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

539 W. CALVERT. *Improvements in signalling on railways.* Dated February 25, 1865.

This invention consists of a series of brackets of cast

iron or other suitable material placed at any desired interval upon a line of railway between the up and down rails. Each bracket is furnished with a shaft resting on a boss on the upper part of the same. On this shaft the inventor keys, at any desired angle, a short arm or lever having a "flat table" on its outer end, and at an angle to this arm or lever he keys on this same shaft a double lever. When in a state of quiescence, the "flat table" lever forms an acute angle with a vertical line drawn through the centre of the shaft, whilst the double lever at the other end of the shaft rests upon a pin in the side of the bracket, and has holes bored in its extremities to receive connecting wires. He affixes a stud on one side of the bracket beneath the upper arm of the double lever, and upon it places a right-angled lever, one end of which is so shaped as to form a catch, whilst the other end is plain and parallel to the rail. A lug is also formed on the catch end of the lever. Wires conveyed by means of carrying rollers from bracket to bracket are secured to these lugs, and the levers at the extreme end of the shaft. Upon an engine passing one of these brackets, the flange of one of the tyres of the wheel strikes a lever connected with the table lever, throwing it up, and in so doing throws a stud affixed to the upper end of the double lever into the catch lever before named, a spring or weight on the axis of which permits it to yield the requisite distance. The table lever is by this motion placed in a nearly vertical position. The engine passing on to the next bracket performs the same operation; that, however, relieves the first bracket; tension being brought on the connecting wires the catch lever releases the table lever. A second engine following the first one, and passing the first bracket before the first engine has reached the second bracket, is signalled of the danger by the table lever, which is nearly vertical, striking a projection in communication with a bell which may be placed on the weather board, or valve letting off steam, or on a whistle, and thus the alarm is given. *Patent abandoned.*

540 E. H. ELDRIDGE. *A magazine repeating and breech-loading rifle.* (A communication.) Dated February 25, 1865.

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

541 R. SMYTH. *Improvements in organs and harmoniums.* Dated February 25, 1865.

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

542 C. WHITING. *Improved portable frames and joints for tables and other articles, applicable also to frames for building purposes and the like.* Dated February 27, 1865.

In constructing these frames the patentee forms the joints with mortices or sockets, and tenons, dovetails, or tongues of brass, iron, or other metal, cast, rolled, or pressed to the required section, the latter being made to simply slide or drop in and lift out of the former. For table of the better class, he prefers to make the male and female parts of brass, or cast malleable iron, but for ordinary purposes common castings may be used. The metal sockets are let into the pillars, legs, or supports, and the tongues fixed to the ends of the side and end frames, and, except when the supports and frames are made entirely of metal, the joints and bearers of that material are concealed by the mahogany or other woodwork of the table. When it is required to make the frames so that they can be lengthened, as in the case of dining tables, the sockets are made in triple form, or the frames are made with changing sides of extra length. *Patent completed.*

543 W. H. TUCKER. *Improvements in fire and thief-proof safes, chests, and strong room doors.* Dated February 25, 1865.

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

544 H. H. HENSON. *Improvements in railway chairs, fastenings, and sleepers.* Dated February 27, 1865.

One of these improvements consists in forming the surface of the sleepers upon which the chair rests, as also the under surface of the chair itself, as an inclined plane, in such a manner that, for the chair to be moved outwards by the side thrust of the train, it would have to be raised up the inclined plane; as, in order to be so raised, the chair would at the same time have to lift the train, it will be evident that no such motion can take place under these circumstances. Another of the improvements consists in forming projections, lugs, or bosses upon the under surface of the chair, which fit into corresponding recesses or grooves formed in the surface of the sleeper, or in forming projections upon the sleeper which fit into recesses formed in the under surface of the chair, in such a manner that any shifting of the chair in an outward direction is impossible. Another improvement consists in forming the chair, or a portion thereof, of the same width as the sleeper, and in forming lugs or flanges upon the same to fit against the side surfaces of the sleeper; these lugs or flanges are provided with bolt holes through which bolts are driven or screwed into the side surfaces of the sleepers, in addition to the ordinary bolts, spikes, or trenails driven in the top surface. *Patent abandoned.*

545 F. DANCART. *Improvements in apparatus or bell alarms to facilitate the communication between passengers and guards of railway trains, which said apparatus is equally applicable to apartments and other similar purposes.* Dated February 27, 1865.

This improved apparatus is intended to be placed at the top of every carriage, so as to be visible to the driver of the train; it is worked from the interior by means of cords arranged in any convenient position for the accommodation of the passengers, the alarm being sufficiently loud to attract the attention of the driver, no matter at what speed the train is going. The following is a description of the improved apparatus and the mode of operating the same. In the interior of a metal box, which may be of any suitable shape and dimensions, is an ordinary clockwork movement communicating motion to an eccentric, at one end of which a metal peg or pin is securely fixed working in an opening made in a balance arm to which the hammers of the bell are attached, and acting on the peg as a lever. An escapement lever keeps the hammers in a stationary position; they are set in motion by pulling a cord attached to one end of the said escapement lever. Thus, in order to start the alarm, it is simply necessary to pull the cord, which raises the opposite end of the escapement lever; this causes a detent attached to the centre of the lever to liberate the peg of the eccentric, which being thus freed is set in motion by the action of the spring of the clockwork acting as usual in toothed wheels and pinions. The alarm may be stopped by pulling another cord attached to the other end of the escapement lever which causes the detent to catch the peg of the eccentric, and thus arrest its motion. *Patent abandoned.*

546 G. K. GYELIN. *An improvement in airtight jars for preserving eggs and fruit, and such like articles of food.* Dated February 27, 1865.

These jars and their covers are so constructed that they will show at any time whether they are really airtight, and how long they remain so. To obtain this result the inventor employs for the outside covering of the jar a cap made of some elastic material, such as india-rubber, with a strong ring of the same material which fits in a groove after the air of the jar is rarified, either by placing it in hot water or by packing the material. When hot the cap is fixed on the jar, which will be found depressed on the jar cooling, and remain so as long as the jar keeps perfectly airtight. *Patent abandoned.*

547 C. OHING. *An improved fluid valve.* Dated February 27, 1865.

The patentee claims, first, the peculiar arrangement of the corresponding portions of the cylindrical vessel, and the plunger, as described, for adapting gulksilver or any other suitable fluid to the purpose of controlling the passage of other liquids or fluids of less specific gravity. Secondly, the double receptacles for gulksilver or other sealing fluid, and the arrangement of parts described, whereby the same movement of the plunger produces a reverse action in the respective fluid receptacles, and so accomplishes in each case the particular effect required. *Patent completed.*

548 M. B. NAIRN. *Improvements in the manufacture or treatment of floorcloths.* Dated February 27, 1865.

This invention has for its object, by improving the manufacture or treatment of floor cloths, to render them, when dried by artificial heat, generally superior in quality and durability, and less liable to discoloration or stretching than heretofore. The invention consists in introducing moisture into the drying chambers or stoves, to compensate to some extent for the volatile oils driven off from the paint, and to prevent the goods from shrinking or stretching. *Patent completed.*

549 W. SIM. *A method of extracting gases from mineral oils, and in employing the same for illuminating and heat producing purposes, and in the machinery or apparatus connected therewith.* Dated February 27, 1865.

This invention has for its essential object the employment of the gases produced by the heating of mineral oils for the production of heat and the generation of steam, and when employed for the latter purpose it is preferred to convert the oil into gas for burning in a retort placed in the ordinary fire or fuel chamber of steam boilers; the gas may, however, be conveyed from a gasholder or other apparatus suitable for containing it previous to being burnt. It is, however, considered advantageous to employ it direct from a retort placed in the furnace of the boiler, as by means of this it is supplied and maintained at a high temperature, which is very desirable for the efficient working of the process, and for effecting an economical use of the oil. *Patent completed.*

550 T. W. ROYS and G. A. LILLIEWHART. *Improvements in rocket guns and rocket harpoons, and apparatus to be used therewith, for the capture of whales and other purposes.* Dated February 27, 1865.

The patentee claims, firstly, the construction of rocket harpoon guns with a longitudinal slot or cut on the under side of the barrel, substantially in the manner and for the purposes described and set forth. Secondly, the forming of the longitudinal grooves, slots, or openings in the upper side of the gun barrel for allowing the escape of a portion of the back fire to counteract or balance the escape of the lock fire through the cut in the bottom of the barrel, and for elevating the protecting curtain or flap as described and set forth. Thirdly, the application of the small pistol on the under side or side of the barrel, substantially in the manner and for the purposes described and set forth. Fourthly, the peculiar form of plug used to close the rear end of the rocket, and for carrying the barbed arms and looped rod. Fifthly, the looped rod or rod for carrying the double eye and transverse stop or rod for attaching the harpoon, line thereto, as set forth. Sixthly, surrounding the metallic rocket case or tube with paper or other similar substitute. *Patent completed.*

551 E. BARCLAY. *Improvements in sewing machines.* Dated February 27, 1865.

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

552 R. A. BACMAN. *A combined key and weapon of defence.* (A communication.) Dated February 27, 1865.

This invention consists in forming a key and weapon of defence in one. The inventor hinges the shaft of the key to the ring or handle within or upon which it folds when the key is not required for use. The ring or handle may be then firmly held by the fingers or hand and forms a good weapon of defence. When the key is required to be used it is opened out from the ring or handle which may be of various shapes. *Patent abandoned.*

553 J. BLACKIE, JUN. *Improvements in signalling apparatus, especially applicable to signalling on board ship.* (A communication.) Dated February 27, 1865.

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

554 G. HASLETTINE. *Improvements in the manufacture of mirrors.* (A communication.) Dated February 27, 1865.

The object of this invention is to coat the surfaces of glass or other substances with a preparation of platina, obtained by dissolving it in nitro-muriatic acid, and evaporating it to dryness to obtain the salts of platina. When thus obtained it is ground into an impalpable powder. It is then divided into two equal parts, one part of which is dissolved with the oil of the flowers of lavender, and the other part (separately from the first part), with the spirits of ether, and evaporated to dryness, and then re-dissolved with the oil of the flowers of lavender. When each of the parts are thus prepared, the first preparation is evenly spread over the surface of the glass or other substance to be treated with a suitable brush, and then allowed to dry; the article is then placed in an oven and heat applied until the metallised surface has a dark red colour. The heat is then withdrawn, and the plate of glass or other substance allowed to cool, when it is removed from the oven. The second part of the solution of platina is now applied with a brush as before, and the plate of glass or other substance again placed in the oven and reheated until it assumes a dark red colour. The fire is now withdrawn and the article operated upon allowed to cool before coming in contact with the cold atmosphere. *Patent abandoned.*

555 G. T. ELLIOTT. *Improvements in machinery or apparatus for baking biscuits.* Dated February 27, 1865.

This invention has reference to machinery or apparatus of that class in which endless platforms, belts, or webs of metal plates suitably jointed together, or other suitably constructed metallic webs, are employed for the purpose of conveying the biscuits to be baked into and through the heated chamber, whereby the baking is effected, and consists in separating the upper and lower or forward and return moving portions of the web (either by the employment of drums of increased size, or by making use of additional drums) to a greater distance apart than heretofore, and in making use of an additional furnace (or furnaces), or in so arranging the flues of a single furnace as that both the upper or forward and the lower or return moving portions of the platform or web shall be available and that biscuits may be baked upon the upper surfaces of each. *Patent abandoned.*

556 S. S. GRAY. *Improvements in paper and cloth lined paper collars for ladies and gentlemen.* Dated February 28, 1865.

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

557 M. MASON. *Certain improvements in apparatus for cutting paper, pasteboard, and similar substances.* Dated February 28, 1865.

This invention relates to a novel arrangement and construction of apparatus for cutting paper, pasteboard, or other suitable material wherein the knife or cutter is stationary, and the paper or material is brought into contact therewith by being raised upwards in a diagonal direction. The invention consists in the employment and use of a table and pressing bar to hold the paper or material thereon, which are mounted on a carriage and capable of being turned on a centre or circular plate on such carriage, so as to bring any side of the material under the cutting blade. This carriage is caused to travel up an inclined slide towards the stationary blade by means of a double wire rope or chain attached thereto, and which passes round two pulleys actuated by a long lever or handle, the whole being supported in a suitable framing. Thus, when any material is to be cut, it is secured and pressed upon the table by the pressing bar or clamp; the carriage is then drawn forcibly up the incline by the rope and pulleys, and the material comes in contact with the knife in a diagonal line, and a clean diagonal cut is effected; the carriage may then be lowered, and the table turned partly round to bring another portion of the material under the knife for another cut. *Patent abandoned.*

558 G. LAUDER. *Improvements in machinery for mining coal and other substances.* (A communication.) Dated February 28, 1865.

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

559 J. M. BART. *Improvements in the construction of doors or other covers of safes or depositories, and in parts connected therewith, for the purpose of obtaining increased security.* Dated February 28, 1865.

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

560 A. DAVY. *Improvements in making solid iron scales with bolsters for all kinds of spring knives.* Dated February 28, 1865.

In performing this invention the patentee takes a rod of iron of the required size, breadth, or strength, and after it has been made sufficiently hot in a furnace, or such other means as are usually employed, he places the hot iron between a pair of revolving rolls, one of them having one or more transverse grooves, plain or ornamental, of any size that may be required cut or cast in it, either partially across or the whole length of the rolls, and at such distances apart as the length of the rolls may be required; the plain part or surface of the rolls press out and flatten down the iron sufficiently thin and broad to form the web or scale, the substance required to form the bolster being forced into the grooves. He then separates the scales by cutting or other means, and stamps or presses the substance left by the grooves in dies, or prints into any desired shape or ornamental form. *Patent completed.*

561 W. CLARK. *Improvements in the means of decorticating grain and other seeds, and in apparatus for the same.* (A communication.) Dated February 28, 1865.

This invention consists in first soaking the grain for the purpose of softening the husk for from three to four minutes, according to the nature of the wheat or other grain to be decorticated. The grain thus prepared is ready to be subjected to the decorticating operation. The improved apparatus used for this purpose consists, first, of a pair of wood-grinding surfaces covered with an elastic material, such as buff leather, for example, and also with wire gauze, one of the said grinding surfaces (the lower one by preference) being rotated in order to effect the decortication of the grain; secondly, of a fan or blower for producing a current of air at the exit of the grain, for the purpose of the separation of the latter from the bran or husks; thirdly, of a second pair of grinding or finishing surfaces, also of wood, but furnished with an elastic covering only, and having a blower the same as the upper pair of grinding surfaces, by passing through which the wheat or other grain will be decorticated and separated from the bran or husks, and may then be ground in any ordinary mill. *Patent completed.*

562 W. B. DALSTON. *An improved atmospheric pressure lamp for the burning of benzole, paraffin, naphtha, or other volatile oils, which lamp may be used for all the purposes for which lamps are usually required, either for lighting, cooking, heating, or other purposes.* (Partly a communication.) Dated February 28, 1865.

The patentee claims the general construction of lamps for the object and purpose stated by elevating the fluid used to the point of combustion by means of compressed atmospheric air, and converting the same into gas at that point by the means described. *Patent completed.*

563 D. CHALMERS. *Improvements in the manufacture of textile fabrics, and in the machinery or apparatus employed therefor.* Dated February 28, 1865.

An extension of time for sealing this patent having been petitioned for, the documents relating to the invention cannot at present be seen.

564 J. FORDRED. *Improvements in treating hydrocarbon oils, and in vessels for containing the same.* Dated February 28, 1865.

The patentee claims, first, the employment of a solution of caustic soda or potash as a preliminary treatment or process of purification of the crude or of the distilled oils or hydrocarbons resulting from the distillation of coal, shale, or peat at a low temperature. Second, the treatment of the deposit or foots resulting from the action of the

caustic soda or potash on the crude or unrefined oils, and also in the treatment of the deposit or foots resulting from the action of sulphuric acid on the partially refined or impure oils in the manner described. Third, the lining or coating the interior of the wooden casks or similar vessels employed for the storing or transport of the refined or finished oils with an admixture of glue and treacle as described. *Patent completed.*

565 G. WRIGMANN. *Improvements in dies for cutting screws.* (A communication.) Dated February 28, 1865.

This invention relates to a peculiar construction of die intended to be employed in the cutting of metal screw threads whereby economy of time and labour is obtained with greater exactitude in the screw threads so cut. According to this invention it is proposed to make the passage through the die conical, and to form three or more projecting sharp-edged ribs therein, the edge of each rib having a number of sharp-pointed cutting teeth or serrations made thereon of a pitch corresponding to the pitch of the screw thread to be cut. The teeth at the entering or wider side of the die are shorter and stronger than those at the opposite or smaller side, and serve to remove the outer skin of the metal and make the first or preparatory cut; but as the rod or blank is secured inwards the teeth gradually cut deeper and deeper until by the time the blank has passed through the die the full depth of thread is cut, thus dispensing with the tedious operation of passing the blank through three or more separate dies. As the teeth act solely as absolute cutters a better thread is obtained than by the present die, wherein the thread is partly formed by compression of the metal. If desired this die may be made in two or more parts. *Patent abandoned.*

566 J. HARTSHORN and W. REDGATE. *Improvements in manufacturing lace in twist lace machines.* Dated February 28, 1865.

For the purposes of this invention in the manufacture of weavings in conjunction with willars and meshings when making what are known as Maltese laces, the patentees form the weavings in the following manner:—The longitudinal threads of the weavings are warp threads, and the wefting of the weavings is produced by two bobbin threads which are used alternately to weft the longitudinal warp threads; each time they are used they are drawn through the warp double, and are caused to form a double weft in the opening or shed in the longitudinal warp thread of the fabric. The warp threads round which the wefting threads catch are weighted so as to draw off sufficient of the wefting bobbin threads to produce the double weft each time of wefting. When thus working the wefting threads they may also be caused to produce purls either on one or both edges of the wefting; the purls may be made intermediate of the wefting shoots, and the motions may be such as to produce either twisted or other purls. *Patent completed.*

567 S. WHITING. *Improvements in shop and other counters and surfaces on which money is placed in passing it from one person to another.* Dated February 28, 1865.

This invention consists in forming those parts of a shop, or other counter, or pay place of a railway station, or other surface on which money is commonly laid, with grooves or undulations, in order that the pieces of money laid thereon, may be more or less unsupported at parts, and that the point or end of a finger may more readily raise a piece of money, when it is prevented by the thumb from sliding on the surface on which it is laid. *Patent completed.*

568 T. S. HALL. *Improvements in gas burners.* Dated February 28, 1865.

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

569 J. B. TOUSSAINT. *Improvements in gaiters, spatter-dashes, and other similar articles.* Dated March 1, 1865.

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

570 S. WHITFIELD. *Improvements in locks and bolts for fastening doors and door bars and drawers.* Dated March 1, 1865.

This invention consists in employing screw bolts for the bolts of locks and bolts for fastening doors, and door bars and drawers, instead of employing plain cylinders or rectilinear bolts, and in propelling the said screw bolts into and withdrawing them from screwed staples, or screw boxes, or plain staples, the propulsion and withdrawal of the bolts being effected by a screwing motion instead of a rectilinear sliding motion, as is usual. *Patent completed.*

571 J. YOUNG. *Improvements in distilling bituminous substances.* Dated March 1, 1865.

These improvements in distilling bituminous substances consist in the employment for the distillation of such substances of a chamber or vessel, with an opening at the top by which the coal or other bituminous substance is introduced, and an opening at the bottom by which the residue is withdrawn; the heat required to distil the bituminous substance being the hot products from the combustion of coke or other fuel forced or drawn through the interior of the chamber or vessel among the substances to be distilled. *Patent abandoned.*

572 G. H. BARTH. *Improvements in condensation and refrigeration of vapours and fluids.* Dated March 1, 1865.

The patentee claims, first, a method of causing vapour or fluid to traverse a successive or continuous series of spaces formed in a narrow chamber by inclined platforms or partitions (which in effect is similar to making vapour or fluid traverse a worm, as in the ordinary process of distillation), and cooling the vapour or fluid by contact or proximity with short tubes, which are kept cooled by the method described with air, gases, or vapours; second, employing moisture with air or gas or vapour, as described, to increase the power of cooling or conducting away heat, or any other suitable method of employing moisture for this purpose employed in this apparatus; third, the apparatus described for condensing vapours and fluids and refrigerating vapours and fluids. *Patent completed.*

573 W. HOLIDAY. *Improvements in presses for blocking the tyres of railway and other wheels.* Dated March 1, 1865.

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

574 C. J. FALKMAN. *Improvements in apparatus for distilling, purifying, and storing spirituous liquors.* Dated March 1, 1865.

This invention—so far as relates to the storing of spirituous liquors—consists in the employment of casks made of zinc, or of casks of iron or wood coated or lined with zinc. *Patent completed.*

575 M. BAYLIS. *An improved machine for pointing or drawing down railway spikes, and which said improved ma-*

chine is also applicable for forming or drawing down the shanks of ordinary spikes and other articles of irregular shape. Dated March 1, 1865.

This machine is composed of two eccentric rolls geared together so that their expanding and contracting surfaces shall simultaneously operate on the iron intended to be drawn out. By this process the inventor also uses lateral or side rolls that work by contact with the vertical rolls and the iron which is being reduced. The principal feature of novelty in the invention consists in advancing and retiring the two side rolls to and from their work, so as to relieve or remove their pressure, thereby permitting a momentum power to be acquired by the revolution of a fly wheel with such machine. *Patent abandoned.*

576 N. HEXWOOD. *Improvements in reaping machinery.* Dated March 1, 1865.

This invention relates to a novel arrangement of parts adapted for effecting a self-acting sheaf delivery from reaping machines. The invention consists in the use of a series of vertical turnstiles which rotate in pairs, and gather the stacks of corn as they are cut, and deliver the same in sheaves or bundles either at the back or at the side of the machine. These vertical turnstiles are mounted on upright shafts, which are driven in either direction by suitable toothed gearing, or by means of belts and pulleys actuated by the main driving wheel, or from the gear which drives the gatherers in front of the machine. The turnstiles are provided with one or more arms, according to the crops they are intended to reap, and of course they must be driven at different speeds to suit the crops, for which purpose sets of different sized pulleys or gear wheels must be mounted on the driving shafts, so that they may be thrown in or out of gear when required. A spring catch is adapted to the lower end of the turnstiles, and is worked by the hand or foot of the driver when it is required to stop or put in motion the turnstiles. The turnstiles may be made capable of expanding to suit different crops, and the driving gear must be arranged to admit of the machine being moved either forwards or backwards as may be required. *Patent abandoned.*

577 J. DONN. *Improvements in mules for spinning and doubling.* Dated March 1, 1865.

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

578 W. E. KOORS. *Improvements in the construction of beams or supports applicable to the building of bridges, viaducts, roofs, arches, and ships, and in instruments to be used therein.* Dated March 1, 1865.

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

579 A. T. GODFREY. *Improvements in musical instruments in the nature of organs in which reeds are employed.* Dated March 1, 1865.

In constructing these instruments the patentee places the reeds beyond the pallets, so that the wind when it is allowed to pass, on opening a pallet strikes the reed suddenly, and causes it immediately to speak. This, however, although it differs from the usual arrangement, is not entirely new. The reeds, as is usual in harmoniums, are free to vibrate in the current of air, that is to say, they are without any stop or surface against which to beat. According to this invention, he places over each reed a pipe or chamber. These pipes or chambers vary in form according to the quality of the sound which it is desired to produce, and in length they vary to some extent according to the pitch: in all cases, however, he closes the pipe or chamber at the top, and makes an opening or mouth on one side, usually the front, and at the upper end of the pipe or chamber. This opening or mouth is always less in area than the section of the pipe or chamber, and it is made more or less according to the quality of sound desired. The position of the parts is by preference such that the reed may be at right angles to the length of the pipe or chamber, so that the tongue vibrates to and fro in the direction of the length of the pipe. As before mentioned, the length of the pipes or chambers varies to some extent with the pitch of the notes, that is to say, he increases the length of the pipes or chambers from the treble towards the bass, until a length of (say) ten inches or a foot (or more for pedal notes) is arrived at; from this point, however, he makes all the pipes or chambers in the bass of one length, or thereabout, and he arranges all their mouths to open into a passage which is open only at one end, viz., that nearest to the treble, so that the wind and sound from any of these bass pipes or chambers has to pass along this passage for a greater or less distance, according as the particular pipe or chamber is further from or nearer to the treble. In front of the other pipes or chambers, or those towards the treble end, a board is placed, so as to compel the wind and sound to pass downwards before it can escape, which it does at the lower edge of the board. Usually he hinges this board at its lower edge, or that nearest to the foot of the pipes or passages, so that it can be turned back out of the way when the softness of sound which it produces is not for the moment required. *Patent completed.*

580 T. HORTON and D. S. PRICE. *Improvements in the treatment of certain products obtained in the smelting of iron.* Dated March 2, 1865.

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

581 J. PARK. *Improvements in machinery employed in the manufacture of paper, part of which is applicable to drying cylinders for other purposes.* Dated March 2, 1865.

This invention consists, firstly, in the application of the steam required for boiling the rags or other materials employed in the manufacture of paper for giving motion to a small steam engine by which the boiler for the rags or other materials is caused to revolve slowly during the process of boiling, the standard or other supports of the boiler serving as foundations for the steam engine; secondly, in an improved combination of machinery for keeping the endless web cloth or felt of paper machines nearly at right angles to the rollers over which it revolves; thirdly, in an improved combination of machinery for cutting paper, and lastly, in constructing the drying cylinders of paper drying machines with cast metal shells and wrought-iron ends, the ends being riveted to the shells to avoid the necessity of making a joint with cement or otherwise, and to economise labour and material. This mode of constructing cylinders is also applicable for calico and other drying cylinders. *Patent completed.*

582 J. M. HETTINGTON. *Improvements in making the joints of steam generators, and parts connected therewith.* Dated March 2, 1865.

This invention is particularly applicable in making the

joints of the cast-iron steam generators known as Harrison's, and for which letters patent were granted to J. H. Johnson, on the 30th August, 1859 (No. 1,970), and on the 6th of May, 1862 (No. 1,340), and on the 8th of June, 1864 (No. 1,424). The various chambers forming the steam generators have heretofore been united either by a jump joint of metal to metal, or by a socket joint with a metal ring between the outer and inner surfaces. Now this invention consists in making the joints with an angle-shaped ring made of lead, copper, or other suitable metal or alloy of metal, one portion of which ring fits between the flat surfaces of the joint, and the other within a recess or shoulder at right angles thereto, so that, when the surfaces are tightened together, a perfect steam and water-tight joint is formed against both angles of the packing. *Patent abandoned.*

583 S. BROOKS. *Certain improvements in and applicable to looms for weaving.* Dated March 2, 1865.

This invention relates to the fixings of the apparatus employed for distending the fabric in the loom commonly called the "temples," and it consists in an improved mode of connecting the rod to which the temples are secured to the breast beam, or other convenient part of the framing of the loom, so as to enable the temples to be set at any required distance apart to suit the width of the fabric that is being woven. The rod to which the temples are secured is a plain bar of round or other shaped iron, instead of being forged with eyes as heretofore customary, and this rod is supported in two sliding blocks to which the bar is secured by bolts with V-heads; the blocks are placed at any convenient distance apart to suit the width of the fabric, and they are held by studs bolted to the breast beam; or they may be connected to springs attached to a cross rail. *Patent completed.*

584 S. and E. HOPKINSON. *Improvements in smoke-consuming apparatus.* Dated March 2, 1865.

This invention has for its object the prevention of smoke arising from the imperfect combustion of coal in steam boilers, and consists in the application of heated air applied to the flame in a manner and by an apparatus hereafter described. Taking a flued boiler, for example, at the end extreme from the fire, the inventors place two rectangular iron chambers in a horizontal position parallel to each other, and at some distance apart. These chambers communicate with each other by means of rows of pipes, the numbers of which vary according to circumstances. To the upper chamber a stack or funnel is attached communicating with the outer air. From the bottom chamber a pipe extends into the flue nearly to the bridge. The flange of this pipe at the bridge end is made large to fill the bottom part of the flue, and extends somewhat higher than the bridge, the top of the flange being flat. A hole or holes of requisite size is or are made in the flange for the emission of air. Directly over the bridge the inventors place a casting, the upper part of which fits the top and side of the flue, the lower part resting upon the bridge. This casting is hollowed out and presents a semicircular aperture. The action of the apparatus is as follows:—Air descending the stack or funnel in passing through the chambers and pipes becomes heated; on emission through the hole or holes in the flange end of the pipe near the bridge it meets with the flame coming through the contracted aperture before-named, and might not in it consumes the smoke entirely or nearly so. *Patent abandoned.*

585 S. CHATWOOD. *Improvements in the manufacture of soap and in apparatus connected therewith.* Dated March 2, 1865.

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

586 J. KIRKLAND. *An improved arrangement of, and addition to, certain parts of omnibuses and other vehicles, to indicate the number of passengers carried.* Dated March 2, 1865.

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

587 D. HARTLEY. *An improved "core" to be employed in the casting of metallic pipes or tubes.* Dated March 2, 1865.

This invention relates to the novel construction, arrangement, and formation of cores employed in casting metallic pipes or tubes, and which are capable of being successively used for such purpose, instead of such core as now employed being made for its own particular pipe, and destroyed when the casting is complete. The apparatus consists of a central spindle or shaft upon which is secured any required number of rings or circular boxes, their peripheries being turned parallel to the axis of the spindle or shaft, and the under side of such rings being formed inclined or wedge-shaped. Three or more longitudinal segments or plates are secured outside and around these boxes by means of internally projecting wedges corresponding in form to the inclined under surface of the aforesaid rings or boxes, such segments or plates being slightly apart at their edges, so as partially to form the core when retained in position around the rings by means of gib and cotter and washer. Upon the outside circumference or surface of these plates ordinary moulding loam is placed, the whole forming the core for the interior of the pipe; and when the casting is complete the cotter, gib, and washer are displaced, and the end of the spindle driven back, which thus causes the boxes to be withdrawn from the retaining wedges secured to the outer segmental ribs or plates, such ribs closing together and forming thereby a small circumference, which thus permits the withdrawal of the core from the pipe or tube. *Patent abandoned.*

588 W. S. THOMSON. *Improvements in covered steel for crucible skirts and in machinery for covering and uniting the same.* (A communication.) Dated March 2, 1865.

This invention consists in making crinoline by covering and uniting two strip or bands of steel in a braiding machine, so that the two strips or bands of steel when covered and finished may be flat, that is, side by side, or edge to edge, being united by the covering, such strip or band of steel being in a separate and distinct cell, case, or covering. *Patent completed.*

589 P. BOWELL. *Improvements in arrangements or apparatus to be applied to vehicles drawn by horses to restrain and prevent them from running away.* Dated March 2, 1865.

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

590 W. E. NEWTON. *An improved process and apparatus for impregnating wood with chemical solutions.* (A communication.) Dated March 2, 1865.

This invention consists in the application of electricity for the purpose of facilitating the impregnation of wood with chemical solutions, in order to preserve the same

from decay, by which means great economy of time and also in the cost of the operation are effected. *Patent completed.*

591 C. RANX. *An improved instrument for concentrating light, applicable to dental, surgical, and other operations.* Dated March 2, 1865.

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

592 R. JOHNSON. *Improvements in constructing strained wire fences.* Dated March 2, 1865.

For the purposes of this invention the posts or uprights through which the wires pass, in place of being formed as heretofore, are made of a trough-like section, by which not only is greater stiffness obtained for a given weight of iron, but the holding of the wires is greatly improved. The sections of posts may be varied so long as they are trough-like in section. Each wire passes through two holes formed towards the two edges of the post, and the wire is held to the post by driving a wedge downwards in a vertical direction between the wire and the hollow surface of the post. The cross-section of the post may be of a V or other form, so long as the sides of the post will admit of two holes being made for the passage of a wire, and admit of a wedge being driven downwards in a vertical direction. *Patent completed.*

593 J. M. DUNLAP. *Improvements in carding engines.* Dated March 2, 1865.

In constructing carding engines according to this invention, the doffing or stripping apparatus used to strip the doffing or other cylinder of a carding engine which is to be stripped or doffed, is of a cylindrical form, and is caused to rotate or move on an axis. The cylindrical doffer or stripper is placed parallel with the surface of the cylinder of the carding engine which is to be doffed, and it is caused to revolve with considerable speed as compared with the card cylinder. The cylindrical doffer or stripper is formed with projecting discs or blades which are fixed inclined to or spirally around the axis from end to end of the cylinder, or such blades are, in some cases, wound and fixed spirally from the centre of the roller outwards. In some cases projecting blades are fixed or formed parallel with the axis. The axis of the cylinder is carried by and is caused to revolve in suitable bearings, which are adjustable in order that the blades may be set to or from the doffing or other cylinder of a carding engine, which is to be stripped thereby, and the doffing or stripping cylinder is caused to revolve nearly in contact with the cylinder which is to be stripped by it. The edges of the blades may be plain or serrated. *Patent abandoned.*

594 W. CLARK. *Improvements in the manufacture of buttons.* (A communication.) Dated March 2, 1865.

This invention relates to improvements in the manufacture of buttons of glass or other silicious or bituminous matter fusible or capable of being softened by heat, or of matters hardened by baking, as ceramic substances, or by exposure to the air, such as cement, mastic, or paste. According to this invention the inventor makes the shanks flexible, and of any suitable form or material. He manufactures similar buttons, but with flexible tufts or shanks, as follows:—He recesses a metal eyelet or thimble of brass, for example, into the glass or other material forming the button, leaving the edges projecting; he then stamps the button with any suitable ornament, and bakes the whole anew; when cold he cleans the brass eyelet by means of acids, and polishes the face of the button. He then places the tuft formed of thread or other fabric in any suitable form in the eyelet above mentioned, and turns down the edges of the said eyelet on the flexible tuft or shank, so as to enclose it and fix it to the button, which is then complete. *Patent completed.*

595 O. L. ROBERTS. *An improvement in cigars.* Dated March 2, 1865.

This invention has reference to an improvement in forming the tops or ends of cigars into smooth, agreeable mouth-pieces, impervious to damp or moisture, whereby the unrolling of the said ends of the cigars, as also the passing of the essential oil to the mouth of the smoker, is prevented, and consists in coating or covering the top ends of cigars with meerschaum enamel or composition reduced to the consistency necessary for enabling the same to be readily applied thereto by dipping or otherwise, whilst in like manner the drilled holes or cavities formed in the said ends for the passage of the smoke are also provided with a coating of the same communicating with the external film as above referred to. *Patent abandoned.*

596 W. R. BOWDITCH. *An improvement in carburetting gas, an improvement in the preparation of hydrocarbons for carburetting gas, and improvements in the treatment of alkali which has been used to purify coal oils, shale oils, petroleum and other mineral oils.* Dated March 3, 1865.

The patentee claims, firstly, a carburetting gas for illuminating purposes by passing it, or other heated hydrocarbons, substantially as described. Secondly, the preparation and use of hydrocarbons of an appropriate volatility for carburetting gas, substantially as described. Thirdly, the treatment of the alkaline residuum arising from the purification of mineral oils, so as to obtain useful substances therefrom, substantially as described. *Patent completed.*

597 D. and J. MANWELL. *Improvements in driving piles and in apparatus therefor.* Dated March 3, 1865.

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

598 SIR J. S. LILLIE. *Improvements in apparatus for propulsion by atmospheric pressure.* Dated March 3, 1865.

This invention consists in causing tunnels to be constructed underneath or alongside of railways, the trains to be propelled by pistons inside these tunnels, connected by chains or iron bars passed through valves at the side or other convenient part of such tunnels; also in the conversion of canals into railways by the removal of the water and substitution of tunnels or covered ways in which the carriages are propelled by atmospheric pressure on lines of rails laid on the bottom or sides of such canals. If trains travelling in covered ways are preferred, two such covered ways or tunnels can be constructed by a wall erected longitudinally along the centre of the canal and roofed in, by one of which trains could be moved in one direction, and by the other in an opposite direction, whereby liabilities to collision and other accidents now so much complained of would be provided against. For the removing of the air from the front of the propelling pistons to which trains or carriages are to be attached, the patentee proposes using the attractive force of currents of elastic fluids, such as steam jets or meal powder, as used in rockets passed through cylinders of about six times the diameter of the steam jet or rocket case, and about six diameters in length. He also proposes to

propel carriages by the removal of the air from their front by means of such currents passed through horizontal cylinders placed underneath the centre of such carriage, as thus described. *Patent completed.*

599 R. A. BROOMAN. *Improvements in refining sugar and in apparatus to be employed therein.* (A communication.) Dated March 3, 1865.

This invention consists in the agglomeration in the form of loaves of the crystals of sugar without the aid of a vacuum pan, by means of a sweet liquid or syrup of a density below 40 deg. Beaumé, and of a temperature varying with the nature of the material used. The invention consists also in constructing apparatuses hereafter described. The inventor mixes the sugar to be made into loaves in a cold state and without the employment of heat in a mill or mixer, with a limpid syrup of a density of 36 deg. Beaumé, in the proportion of about 45 quarts of syrup to 200lb. of sugar. On leaving the mixer the mass in a perfectly homogeneous state is received in a double-bottomed pan heated by steam, where it is heated to a point not exceeding 131 deg. Fahr., and run into moulds. Eight hours (more or less) after filling the loaves are set to drain without receiving any decolouring or being in any way worked; after draining about 48 hours the loaves are removed (*luche et suce*), and stored. A few days' stoving suffices for the perfection of the loaves. The apparatus cannot be described without reference to the drawings. *Patent completed.*

600 J. SPENCE. *Improvements in apparatus for operating engineers' and carpenters' tools by hand or other power.* (A communication.) Dated March 3, 1865.

This apparatus is especially applicable to the operations of drilling, boring, slotting, punching, planing, and other like mechanical operations, to obtain in these operations the adjustment necessary to manipulate on work of irregular forms. The invention consists in attaching a circular casting or frame within four circular slides of the same diameter attached to suitable framing erected on the foundation stone or bed-plate. On the edge of this circular casting, for half its diameter, there are formed cogs or teeth, gearing into a worm wheel for the purpose of attaining the angle that a particular casting may be required to be set to, according to a graduated scale placed on the framing, which gives the required angle on either side of the central vertical line of the machine. On the face of this circular casting are fitted slides in which works a slide rest actuated by a crank, eccentric, steam, air, or hydraulic cylinder placed below the frame, and arranged so as to give any length of stroke required. On the face of the said slide rest is fixed a circular cast metal box, in which is fitted the tool box, which is also made movable for any angle in the opposite direction to the before-mentioned one; within this tool box are bolted the various tools for the work required, such as drilling, boring, slotting, punching, and planing. *Patent abandoned.*

601 H. E. CLIFTON and A. HOSKINGS. *Improvements in binding attachments for sewing machines.* Dated March 4, 1865.

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

PROVISIONAL PROTECTIONS.

Dated June 17, 1865.

1634 W. Deltour, New York. An improvement in the preparation of vegetable fibre for the manufacture of paper.

Dated August 14, 1865.

2101 J. G. Dale, Warrington, Lancashire, and R. S. Dale, Manchester, chemists. An improved preparation for the prevention of forgery of bank cheques, bills, and other documents.

Dated August 17, 1865.

2124 F. J. Jones, Aldermanbury, manufacturer. An improved fastening for leggings or other articles.

Dated August 22, 1865.

2159 F. C. B. Robinson, Carlisle, Com. R.N. Improved safety couplings for railway carriages.

Dated August 24, 1865.

2173 J. Moody, Goole, Yorkshire, managing director. Improvements in floating lights, beacons, floating batteries, and other vessels.

2174 D. Davies, Crumlin, Monmouthshire. Improvements in steam hammers.

2175 W. C. Cambridge, Bristol. Improvements in the manufacture of steel, iron, and metal suitable for bearings, and in apparatus for the same.

2176 F. Thomas, Bishopsgate-street Within, cooking apparatus manufacturer. Improvements in the method of heating the ovens and boilers of kitchen ranges or cooking stoves.

2177 F. Ayckbourn, Southampton-street, Westminster. Improvements in stockings.

2178 W. E. Newton, Chancery-lane, civil engineer. Improvements in well sinking tubes. (A communication.)

2179 G. Bagnagatti, Leicester-square. An improvement in gasburners.

Dated August 25, 1865.

2181 L. Clayton, Stamford-street, Southwark, commercial traveller. Improvements in the manufacture and ornamenting of carpets, rugs, and other fabrics.

2182 H. H. Henson, Parliament-street, Westminster. Improvements in railway chairs, fastenings, and sleepers.

2183 W. Rogers, Newport, Monmouthshire, merchant. Improvements in the construction of the permanent way of railways.

2185 G. W. Howard, West Bloomfield, U.S. Improvements in tanks and other receptacles for containing and transporting petroleum, naphtha, and other oils and liquids to prevent wastage by fire or filtration or evaporation, or hazard of life.

2187 C. A. Watkins, Greek-street, Westminster, chemist. Improvements in apparatus for supplying carbonic acid gas to casks and other vessels from which beer, wine, and other fermented liquors are drawn.

2189 W. E. Newton, Chancery-lane, civil engineer. Improvements in steam boilers or generators. (A communication.)

2190 A. V. Newton, Chancery-lane, mechanical draftsman. Improvements in the construction of skates. (A communication.)

2191 J. Moule, manufacturing chemist, Hackney-road. An improvement in the treatment of tar and other substances suitable to be used in the manufacture of paint, and for other purposes.

Dated August 26, 1865.

2192 F. Hazeldine, Lant-street, Borough. Improvements in the construction of vans, waggons, or carts employed for transporting furniture and other goods on common roads and railways.

2193 J. F. Hearsey, Park-place, Church-street, Brompton. An improved construction of spirit meter. (A communication.)

2194 J. A. Wanklyn, London, professor of chemistry. Improvements in the manufacture of violet dye stuffs.

2195 J. Forded, Blackheath. Improvements in the treatment of certain products obtained in the refining of petroleum and other hydrocarbon oils.

2197 J. Symmons, Wolverhampton, manager. Improvements in the manufacture of horseshoes, and in machinery used in the said manufacture.

2198 E. D. Hodgson, Paper-buildings, Temple. Improvements in the manufacture of locks.

2199 R. G. Rattray, M.D., Aberdeen. Improvements in apparatus for supplying regulated or measured quantities of water.

Dated August 28, 1865.

2202 W. Graham, Bolton, Lancashire, J. Broughton, Manchester, and T. Corkhill, Birkenhead, Cheshire, stone-masons. Certain improvements in rotary engines.

2206 H. A. Bonnevill, Porchester-terrace, Bayswater. Improvements in dyeing and fixing colours in fibres, yarns, and fabrics. (A communication.)

2207 H. A. Bonnevill, Porchester-terrace, Bayswater. Improvements in apparatus for raising and holding the skirts of ladies' dresses. (A communication.)

2209 S. T. Jones, Oxford-terrace, Peckham. Improvements in submarine electric telegraph cables.

2211 A. V. Newton, Chancery-lane, mechanical draftsman. Improved apparatus for supplying boilers with water. (A communication.)

2212 E. Davies, engineer, and E. H. Taunton, tube manufacturer, Birmingham. An improved combination drill brace.

2213 W. P. Piggott, Argyll-street, Regent-street. Improvements in electric telegraph cables and in transmitting signals therethrough.

Dated August 29, 1865.

2215 G. Robinson, Dial Iron Works, Kingwinford, Staffordshire, manufacturer. Improvements in moulds for casting metallic pipes, rotors, and other articles.

2216 A. Gurit, Birmingham, metallurgical engineer. Improvements in condensing and utilising sulphurous smokes and vapours, and in apparatus to be used for that purpose.

2220 W. H. Gummer, Rotherham, Yorkshire. An improved stretch trap and sink pipe protector.

2221 I. and W. H. Bailey, Kighley, Yorkshire. Improvements in machinery for combing wool and other fibrous materials.

2223 W. Clark, Chancery-lane, engineer. Improvements in apparatus for propelling vessels. (A communication.)

2224 G. F. White, Hornsey, and H. Chamberlain, Falcon-square, City, agent. Improvements in apparatus for elongating and contracting waist and other belts, which apparatus is also applicable for other purposes.

Dated August 30, 1865.

2225 T. Cope, William-street, Hampstead-road, and W. Guest, Rossmore-street, Clerkenwell. Improvements in the manufacture of rope, cordage, yarn, wire rope, and other suchlike twisted and plaited fabrics, and in the machinery employed therein.

2229 W. Crookes, F.R.S., Wine Office-court, Fleet-street. Improvements in extracting and separating gold and silver from their ores or matrices, and in the treatment of mercury employed for such purposes.

2230 C. F. Anderson, Finchley, builder's foreman, and D. Durant, Colney Hatch, builder. Improvements in apparatus applied to pockets to ensure the safety of their contents.

2231 J. H. Johnson, Lincoln's Inn-fields. Improvements in tanning and in the preparation of extracts to be used therein. (A communication.)

2232 T. Wrigley, consulting engineer, and M. B. Westhead, merchant, Manchester. An improved method of retaining and preventing the vibration of sliding windows used in dwellings and in railway and other vehicles, and for an improved apparatus for effecting the said purposes.

2233 W. H. P. Gore, Langham-street, Portland-place. Improved means of securing corks in the necks of bottles.

2235 S. Gilbert and S. Gilbert, jun., Wansford, Northamptonshire. An improved implement for cultivating or tilling land.

2236 G. Smith and C. Ritchie, Upper Thames-street. Improvements in brushes.

Dated August 31, 1865.

2239 M. Woodfield, civil engineer, York Chambers, Adelphi. An improved apparatus for carrying securely railway and other tickets, so as to afford a ready inspection thereof.

2241 W. H. Brown, Park Wood Springs, Sheffield, steel manufacturer. Improvements in the manufacture of cast steel or other metallic tubes.

2247 W. E. Newton, Chancery-lane, civil engineer. Improvements in obtaining spirits of turpentine, rosin, pitch, tar, pyroligneous acid, and other products from wood. (A communication.)

2249 J. Ward, Regent-street, London-road, Leicester, manufacturer. Improvements in the construction of lids or covers for saucapans and other cooking utensils, part of which improvements is also applicable to the lids or covers of housemaids' pails.

2251 J. Leslie, Manchester, fustian finisher. Improvements in cutting the terry or loops of "fastians," cords, and similar fabrics, which are also applicable to cutting velvets.

Dated September 1, 1865.

2253 E. Knowles and J. Lindley, Manchester, manufacturers. Improvements in ornamenting and protecting the edges of bed-quilts, counterpanes, toilet covers, carriage rugs, and other similar coverings, by edging, binding, or fringing by machinery.

2255 A. V. Newton, Chancery-lane, mechanical draftsman. Improved steam heating apparatus. (A communication.)

2257 W. Clark, Chancery-lane, engineer. Improvements in laying and maintaining submarine telegraph cables, and in apparatus connected therewith. (A communication.)

2259 C. Horsley, Wharf-road, City-road, civil engineer. Improvements in meters or apparatus for measuring water or other fluids, partly applicable for exhausting air or other gases.

Dated September 2, 1865.

2263 J. Elverson, Manchester, hat manufacturer. Improvements in apparatus for sawing curved designs.

2267 H. Ellis, Bangor, Carnarvonshire, surgeon. Improvements in the manufacture of compounds of silica, and in the production of silicated alkaline inks, colours, and dyes.

Dated September 4, 1865.

2269 J. Drabble, Southwark Bridge-road, patent axletree manufacturer. Improvements in apparatus used for removing axleboxes from wheels.

2271 P. Marraud, Rue de l'Echiquier, Paris, coach builder. Improved apparatus for promptly disconnecting horses from carriages and other vehicles.

2273 A. V. Newton, Chancery-lane, mechanical draftsman. Improvements in life rafts and surf boats. (A communication.)

Dated September 5, 1865.

2279 T. T. Ponsonby, John-street, Kingsland-road. Improvements in ornamenting and surfacing veneers and other articles of wood.

2281 W. Blünger, Southampton-buildings, Chancery-lane, engineer. Improvements in vessels or apparatus for melting sealing wax, glue, or other substances. (A communication.)

Dated September 6, 1865.

2283 L. Gachin, Hatton Garden, hair merchant. A new or improved method of, and apparatus for, heating instruments or irons for curling, waving, and frizzing hair, and for other purposes to which heated instruments or irons are applicable. (A communication.)

2285 J. Pilkington, Bolton, Lancashire, cotton spinner. Certain improvements in preparing and spinning cotton and other fibrous materials.

2287 R. A. Purkis, Pembroke Villa, Portwood, near Southampton, engineer, and G. Callaway, Selwood-terrace, Brompton. Improvements in sewing or stitching machines.

2289 T. Nicholson, Gateshead, Durham, engineer. An improved process of, and apparatus for, making caustic liquor or caustic leys.

2291 E. Green and E. Green, jun., Wakefield, boiler makers. Improvements in boilers and furnaces, and in cleansing the flues thereof.

PATENTS APPLIED FOR WITH COMPLETE SPECIFICATIONS.

Dated September 9, 1865.

2314 J. Casthélaux and N. Basset, Rue St. Croix de la Bretonnerie, Paris, chemists. Improvement in the manufacture of oxalic acid.

2315 G. T. Bousfield, Loughborough-park, Brixton. Improvements in the manufacture of flexible tubing or hose. (A communication.)

LIST OF SEALED PATENTS.

Sealed September 15, 1865.

761 J. Walls	801 W. Clarke
764 J. Vero	824 G. H. and J. A. Caetree
765 J. O. Stevenson	868 J. Williams
774 I. Philippshall	932 J. von der Poppenburg
777 R. T. Crawshaw and I. A. Lewis	1646 G. Smith, jun.
778 S. Chatwood	1672 S. Godfrey
779 W. Menelaus	1837 T. C. McKee
780 A. R. Mackenzie	1844 G. O. Collyer and C. L. Roberts
792 W. Berry	

Sealed September 19, 1865.

785 C. Farmer and T. Turner	841 G. F. Marchisio
787 W. Arthur	843 E. Wolverson
788 R. A. Brooman	844 H. C. Hurry
789 W. Clark	850 J. Dodd
791 J. Smith and S. A. Chease	851 W. Richardson
	853 W. Betts
793 B. J. Webber	866 J. C. Thompson and J. M. Green
799 W. J. Coleman	869 J. Norris, jun.
800 A. P. Tronchon	882 J. Wright
804 A. Paraf	889 R. Holm-vad and J. H. Boulton
805 J. Wright	891 J. Player
808 G. E. Donisthorpe	894 T. W. Nordenfelt
809 W. M. Baker	956 W. Bulstrode
815 D. Mackenzie	935 R. Garrett, jun.
816 L. A. Leins	990 J. Thompson
818 A. B. Baron von Rathen	1000 T. Skidmore
821 J. Lees and M. Mellor	1023 C. Vaughan
823 T. Roberts	1032 A. Turner
825 J. C. Morgan	1043 J. Walker
827 M. P. W. Boulton	1147 W. E. Newton
828 W. Simons and A. Brown	1228 W. E. Newton
	1387 A. V. Newton
838 D. Arnold	1897 M. L. Parry

NOTICES OF INTENTION TO PROCEED WITH PATENTS.

From the London Gazette, September 19, 1865.

1248 G. Josse. Paper hangings.

1258 A. H. Brandon. Receiving signals. (A communication.)

1273 J. Casey. Window sashes.

1274 J. H. Johnson. Safety lamps. (A communication.)

1277 P. Welch. Finishing printers' types.

1284 G. Hartley. Fasteners for stays.

1288 O. S. Baker. Paddlewheels. (A communication.)

1290 S. L. and A. Fuller and C. Martin. Carriage step.

1291 D. Adamson. Drilling boiler plates.

1294 H. W. Hart. Buttons.

1299 P. Braash and R. Irvine. Ornamenting candles.

1307 W. Jamieson. Power looms.

1310 J. Bennett. Iron.

1311 G. Mountford and E. Worroll. Cutting metal pipes.

1314 E. L. Girard. Felling felt hats. (A communication.)

1316 T. Smith and H. James. Woven fabric.

1321 E. Winder. Laying single line articulated railways.

1326 J. Eddy. Ploughs.

1327 T. Davis. Vessels for blacking.

1328 T. Craig. Breach-loading fire-arms.

1323 H. J. Burt. Head dress.

1340 G. Ennis. Saw mills.

1342 C. J. Appleby. Steam cranes.

1346 J. Daughish. Baking bread.

1382 A. Chevreton. Mail catching apparatus.

1385 W. Haigh. Cutting cardboard.

1405 J. H. Johnson. Cooling liquids. (A communication.)

1409 R. Muller, A. T. Weld, and J. F. Powell. Animal charcoal substitutes.

1434 J. H. Johnson. Making cores. (A communication.)

1465 H. Tipper. Shirt.

1501 F. and J. G. Richmond and H. Chandler. Cutting hay.

1507 W. Ofark. Aëiform fluids for lighting purposes. (A communication.)

1539 J. H. Johnson. Corks. (A communication.)

1548 H. H. and J. F. G. Kromschroeder. Dry gas meters.

1594 F. G. David. Printers' rollers.

1906 E. Schaub. Dressing yarns. (A communication.)

2279 T. T. Ponsonby. Ornamenting veneers.

2285 J. Pilkington. Spinning cotton.

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.

2491 G. Ritchie	2531 J. Pender
2510 A. Whytock	2541 S. Plaren
2514 J. R. Johnson and J. S. Atkinson	2549 R. Oranston
2516 J. Rowell	2562 J. W. Woodford
2526 A. V. Newton	2575 R. R. Jackson and J. Coupe

LIST OF SPECIFICATIONS PUBLISHED For the Week ending September 16, 1865.

No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.
2661	1	4	2666	2	6	2671	0	4	2675	0	4
2662	0	4	2667	1	2	2672	0	4	2676	0	4
2663	1	6	2668	0	4	2673	1	6	2677	0	4
2664	0	4	2669	0	4	2674	0	4	2678	0	4
2665	1	0	2670	0	4				2679	0	4

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.

LATEST PRICES OF MATERIALS USED IN CONSTRUCTION.

Timber, duty 1s. per load, drawback 1s.

Teak - load 411	0 6 13	10	Arabian, yellow -	413	10 11 0
Quebec, red pine -	3 5	4 16	St. Petersburg, do. -	11	0 12 0
yellow pine -	2 15	3 0	Finland -	8	0 10 10
St. John, N.B., yellow -	0 0	0	Nemal -	10	0 15 0
Quebec oak, white -	5 6	0	Kothenburg, yellow -	10	0 11 0
birch -	3 10	0	Palm, fine -	3	0 10 0
" elm -	3 10	0	Gedde, yellow -	10	10 11 0
Danish oak -	3 0	0	Sodorfamu -	9	10 11 0
" fir -	2 10	3 10	Christiana, per C.,		
Nemal fir -	3 10	3 15	14th, by 2 by 9 in.		
Pigs -	3 5	2 10	yellow -	19	0 23 0
Swedish -	3 2	2 14	Deck Plank, Danzig,		
Maste, Quebec, red pine	6 10	8 10	or 40 ft. 3 in. -	0	14 1 0
yellow pine 6	0	0	Pommes Stronarton	5	0 8 0
Lathwood, Danzig, fine	7 10	8 0	Ulla, do	41	0 0 0
Deal, per C., 12 ft. by 3	9 10	8 0	Spiral body -	105	0 0 0
by 9 in., duty 2s. per			Cod -	49	0 0 0
load, dra. 2s. 2s.			Whale, 8th Sea, pale	41	0 0 0
Quebec, white spruce	13 0	17 0	Oliver, Gallipoli -	32	0 0 0
St. John, " "	12 0	14 0	Cocanauk, Cochon	37	0 10 0
Yellow pine, per re-			Palm, fine -	34	0 10 0
duced C.			Lined -	37	10 0 0
Canada, 1st quality -	17 0	19 0	Rapeseed, King, pale	14	0 0 0
" 2nd -	12 0	14 0	Outsawood -	29	10 10 0

METALS.				IRON.			
		£ s. d.			£ s. d.		
Welsh Bars, in London -	per ton	7 15 0	to	8 0 0	24		
Nail Rods -	do	8 10 0		9 0 0			
Hoops -	do	9 15 0		10 0 0			
Sheets, single -	do	10 10 0		10 15 0			
Sheets, double -	do	11 0 0		11 0 0			
Bars, in Wales -	do	7 0 0		7 5 0			
Rails -	do	7 0 0		7 5 0			
Foundry Pigs, at Glasg. No 1	do	2 15 0		3 10 0			
Swedish Bars -	do	11 15 0		12 0 0			

STEEL.				COFFERS.			
		£ s. d.			£ s. d.		
Swedish Keg, hammered -	do	15 0 0		0 0 0			
Swedish Pigshot -	do	15 0 0		0 0 0			
Sheet & Sheathing, & Bolts	per ton	91 0 0		0 0 0			
Hammered Bottoms -	do	101 0 0		0 0 0			
Flat Bottoms, not Hammered -	do	96 0 0		0 0 0			
Oake and Tough Ingot -	do	83 0 0		86 0 0			
Heat Selected -	do	87 0 0		89 0 0			
Fine Foreign Copper -	do	91 0 0		0 0 0			
Yel. Metal Sheathing & Rods	per lb.	0 0 7 1/2		0 0 7			

TIN.				LEAD.			
		£ s. d.			£ s. d.		
English Block -	per cwt.	93s 0d		01s 0d	24		
do Bar -	do	94s 0d		18 15 0			
do Rodded -	do	90s 0d		0 0 0			
Banca -	do	90s 0d		0 0 0			
Straits -	do	84s 0d		0 0 0			

ZINC.				SILVER.			
		£ s. d.			£ s. d.		
Fig, English -	per ton	20 10 0		0 0 0			
Spanish Soft -	do	12 12 0		18 15 0			
Shot, Patent -	do	22 10 0		0 0 0			
Sheet -	do	29 0 0		21 5 0			
White -	do	36 0 0		0 0 0			
On the spot -	do	22 15 0		0 0 0			

THE MECHANICS' MAGAZINE.

LONDON: FRIDAY, SEPTEMBER 29, 1865.

RIFLED GUN COMPETITION.

THE systems of rifling advocated respectively by Commander Scott, R.N., Mr. Lancaster, Mr. Jeffery, and Mr. Britten, have been fairly tested one against the other, and also against the French system, in the recent competitive trials made with the 7-inch guns specially rifled for that purpose. As the only difference between the systems of Messrs. Jeffery and Britten was the method of attaching lead to the base of the projectile, one gun was sufficient for both, so that four guns only were prepared. The trial was limited strictly to the rifling of the guns; therefore, as far as possible, all other sources of difference were eliminated, and the Ordnance Select Committee fixed a uniform weight, form, windage of shot, and charge of powder. The competition would have been limited to the same amount of twist, but, as the expanding projectiles of Messrs. Jeffery and Britten would have been unfairly treated by a spiral as sharp as would suit the other competitors, each was allowed full latitude in this respect. Besides, the French system is that of a gaining twist, whilst that of the others is uniform. The guns were all muzzle-loaders, and were formed of solid steel tubes 3in. thick, a solid forged breech piece, and external strengthening coils. They were of an average weight of 149 cwt., the length of bore was 10ft. 6in., and they were vented 5'75in. from the end of the bore, this being the position at which, with a charge of 20lb., the greatest initial velocity is obtained. The Scott gun is rifled in five grooves, which are shallower on the loading than on the driving side; the rifling has a spiral of one turn in 294in. The Lancaster gun is oval-bored, the major and minor axes being respectively 7'60in. and 7'00in., the rifling making one turn in 360in. The gun provided for Messrs. Jeffery and Britten had thirteen grooves, each 1-26th of the circumference in width, the rifling making one turn in 805in. The French gun is rifled in three grooves, the rifling beginning in a straight line and gradually increasing until it leaves the bore with an inclination of one turn in 259in. With regard to the projectiles it may be briefly observed that those of Commander Scott have simply five iron ribs, with two very small copper studs inserted in the driving face of each, the cylindrical part of the shot being planed. Mr. Lancaster's shot were also turned over the cylindrical portion, and had four small brass studs on the loading quadrants. Both the Jeffery and the Britten shot were leaded at the base, and had wooden bottoms, Mr. Jeffery adding a band of greased flannel round the leaded part of his shot. The French projectiles had three large zinc half studs in front, supported by an iron back, and three smaller ones behind. These shot were supplied in three lots. The first supply consisted of solid shot weighing 110lb.; in the second supply the shot weighed 100lb. and were hollowed at the base; and in the third supply the shot were solid and weighed the same as in the second supply. The first lot were ordered with a smaller windage than is allowed for service shot, with the view of developing to the utmost the shooting qualities of the guns. The second and third supplies had the service windage, and were otherwise dealt with in a manner calculated to place the competition on a footing with actual service. In the second and third supplies there were special differences made in the Scott and French projectiles. In the former the iron ribs were faced with strips of zinc inserted in grooves planed in the body of the shot and further supported by two tenons let into the iron rib. In the French projectiles of the second supply a stronger mode of fastening the studs was adopted, support being given to

the back studs against the first shock of the powder. In the third supply the arrangement of the studs was altered upon Major Palliser's plan, by which the metal was changed from zinc to gun-metal, the smaller stud being placed in front and the larger one behind, both being attached in a different manner.

Having thus far particularised the various systems of rifled guns and their projectiles, we will turn to the general results of the competition. By the report of the Ordnance Select Committee recently issued, we find that in the solid shot practice a very short time sufficed to show that the systems of Messrs. Jeffery and Britten were unsuited for heavy charges: the lead was blown from the shot, and the shooting was so wild as to throw those systems out of the competition. The powers of endurance of the several guns were not tested by the shot practice, only 350 rounds having been fired from each, but, as far as that trial went, it proved that the guns were equal in point of endurance. The test, however, was sufficient to indicate that with steel-lined guns no fears need be entertained of the breaking down of the grooving by the abrasion of the ribs or studs in either of the systems, at all events when Commander Scott's soft bearings are used. It was found that the French gun was the easiest to load, although the Scott gun was in no way behind in this respect; with the Lancaster, however, the shot were somewhat difficult to get home. The shot were not found liable to injury from knocking about, but in this respect the Lancaster takes the precedence, the Scott plan No. 1 follows next, then the Palliser system, and lastly, the Scott plan No. 2. As regards initial velocities the French gun was found to have decidedly the lowest, and the Lancaster, on the whole, the highest; in every instance this gun was superior in this respect to the Scott gun, but was once exceeded by Mr. Jeffery and once by Mr. Britten. In considering the order of merit as to range and accuracy, the Committee deal with the results of the third supply of projectiles, because in the previous supplies the French shot were not studded on the best principles, thus placing the gun at a disadvantage. The same remark applies to the second supply of Scott projectiles reduced to 100lb. in weight by boring out from the rear. Some of these broke up in the gun from the weakening of the hollow projectile by the grooves in which Commander Scott placed his zinc ribs, and several others, on recovery, were found to be more or less damaged from the same cause. On the other hand, it must not be forgotten that the reduction of weight placed Mr. Lancaster at a disadvantage in respect to the length of bearing of his shot, which was reduced from 8in. to 7in. In the practice for range and accuracy with the third supply of 100lb. projectiles; the charges used were severally 12lb., 20lb., and 25lb. of powder, and the three elevations were 2°, 5°, and 10°. The general means, which collect into one the aggregate results, are as follow, the distances being given in yards:—Mean ranges: Scott, 2,685; Lancaster, 2,762; French, 2,704. Mean deviation from mean range: Scott, 47'6; Lancaster, 38'3; French, 27'2. Mean reduced deflection, or mean lateral deviation from the mean line of fire: Scott, 6'7; Lancaster, 7'4; French, 3'6. The rectangle formed by the product of the mean deviation from the mean range multiplied into the mean reduced deflection gives the relative figures of merit of the guns. In the case of the Scott gun, therefore, we find the rectangle to be 318'92, in the Lancaster 283'42, and in the French 97'92. The cost of projectiles in the three foregoing systems varies, the prices per 1,000 being—in the Scott system, No. 1, £442 14s., and No. 2, £727 1s. 1d.; Lancaster, £500 11s. 7d.; the original French plan, £574 6s. 9d., and the French on Palliser's plan £534 8s.

The next point to be considered is the capability of firing round shot which the several systems possess, and to this power considerable importance is attached, inasmuch as the

supply of rifled projectiles will always be limited, owing to their bulk, weight, and cost. Nor is it to be expected that they will be expended so freely as round shot, which will also be good enough for many instructional and other purposes, and can be carried in any desirable quantities. The round shot were specially cast, and weighed 43lb. 6oz. Mr. Lancaster prepared his round shot for firing with special wooden tops and bottoms of an oval form which accurately fitted the bore of the gun. But no material advantage resulted from their use, and such a special provision would on many accounts be objectionable. In the practice with round shot, both loose and rivetted to wooden bottoms, Commander Scott's gun had the advantage of both the others in point of range, but was very much inferior to both in uniformity of range and accuracy. It is a noticeable fact that a charge of 20lb.—nearly half the shot's weight—gave an increase of velocity of only 271ft., and only about 200 yards of additional range over the charge of 12lb. This latter charge, with the small windage allowed, gives a considerably higher velocity than that of the service 22-pounder or 68-pounder shot. So far, then, we find that the French gun with Major Palliser's studs gives by far the best result in point of accuracy. It proved the easiest to load, and, although somewhat inferior to Commander Scott's gun in respect to firing round shot, it was in every other respect equal or superior to it. The Committee also prefer it to the Lancaster gun, although Mr. Lancaster has since shown that his shot may be made very easy to load, without increase of mean windage, by taking the windage allowed chiefly off the third quadrant of the shot. It may here be observed that, notwithstanding the advantage the muzzle-loading guns had in point of length and weight over the service breech-loading 7-inch gun with a 12lb. charge, they none of them quite equalled the latter in point of accuracy, even with the shot of the third supply weighing 100lb., which are chiefly to be regarded; the French gun, however, was but inferior up to 5°. The guns being essentially shot guns, the trials from which the foregoing results are adduced were restricted to solid projectiles. Before finally reporting, however, the Committee deemed it necessary to try the guns with common shells, and also to pit their performances against those of a 149 cwt. 7-inch gun, shunt rifled; with this view, therefore, further experiments were made. The shells were fired with charges of 20lb. of powder, the mean weight of the common shell filled and plugged being 100lb.

In the trials with the shells the results were again in favour of the French gun, and thus confirmatory of the shot practice. It was found most easy to load, while the Lancaster was most difficult. With one exception, the recovered Lancaster shells were found to be split at the head, thus indicating a tendency of the projectile to jamb in the bore, and thus to bring severe pressure both on the gun and projectile. Mr. Lancaster, however, has since produced a shell of a different pattern; some were fired with 20lb. charges and did not burst prematurely. The shells recovered from the other two guns were apparently uninjured, showing there was no unfitness for shell firing in either system of grooving. After the shell practice, upwards of 400 rounds having been fired from each gun, the Committee came to the unanimous opinion that the Lancaster system should be rejected on account of the tendency to crush in the bore, its inferior accuracy, and the difficulty of loading. Of the two remaining competitors they considered the French system to be the better, not only on account of superior accuracy, but also upon the grounds that it is the easiest to load by day, and that at night the simple buttons on its projectile would find the grooves of the gun more easily than would the more numerous but smaller ribs of Commander Scott's projectiles. In point of cost, however, the Scott system is practically superior to the French as regards projectiles, as there is a difference of

1s. 10d. per 100lb. shot in favour of the former. The French gun therefore, being considered the best, was placed by the Committee in competition with a gun rifled on the shunt system from a design submitted by Sir William Armstrong. The length of the bore was the same as in the French gun, but the piece weighed 9 cwt. less; it was rifled in six grooves on the shunt plan, in the form in which it has been generally applied to large guns, with a slight improvement in grooving, which was effected by rounding some of the angles off. The twist was uniform, being one turn in 266in. or 38 calibres, about the same as the final twist of the French gun. The bore was slightly tapered, the diameter at the chamber being 0.04 of an inch larger than at the muzzle; the object was to give more windage where fouling has the greatest tendency to impede loading. The projectiles were 100 round-headed 110lb. solid shot for the shunt, and 100 similarly formed 100lb. shot for each gun; 60 ogival-headed shells weighing up to 100lb. were also served to each gun. The 110lb. shot were not fired in competition, but a comparison of the results of practice with solid 100lb. shot in both guns shows that the French had a slight advantage over the shunt both in range and accuracy. In the shell practice the shunt had a slight advantage in range, although the French still maintained the superiority in accuracy. The initial velocity given by the two guns appears practically alike, for, although the French has the advantage with 12lb. charges, the shunt has the best of it with 20lb. and 25lb., but it had by accident the benefit of a shot with slightly less windage than the other. As to cost the Armstrong projectile costs about 1s. 6d. less than that for the French gun, but as they were a special lot it may be assumed that the cost of the latter would probably be reduced by further experience in the manufacture. A return showing the comparative facility offered by the form of groove for rifling on each system shows the number of guns which can be rifled per week, and the cost per gun, to be as follows:—Scott, 10 guns, cost £4 5s.; French, 8 guns, cost £5 8s.; shunt, 6 grooves, 4 guns, cost £10 16s.; Lancaster, 2 guns, cost £17 10s.

The shooting qualities of the guns are so nearly alike that the Committee had to turn to other and more general considerations on which to rest their recommendation. They finally recorded their opinion in favour of the French system, and for three reasons. In the first place, on account of the simplicity of its studding on the projectiles, there being but six studs in the French shot, whilst in the corresponding shunt shot there are thirty. In the next, because of the simplicity of the grooving of the gun; and, thirdly, from a disposition to admit of the advantage of an increasing over a uniform spiral, on which point the views of the Committee were strengthened by the 7-inch gun trials. With regard to the heavy 7-inch guns now in course of manufacture, the Committee recommend that they should be rifled similarly to the French gun, the depth and width of the grooves being slightly decreased to permit a reduction in the size, and, therefore, the cost of the studs. The competitive shallow-grooved 8-inch gun they recommend should be rifled in three grooves with a gaining twist ending with 1 in 40; and if on trial this plan proves successful, then that the 8-inch guns ordered for the navy be similarly rifled. It is recommended that a 9-inch gun be rifled on the French plan for comparison with the two already rifled on the shunt system, and if no material difference is found in the shooting, then that the remainder of the 9-inch guns should be rifled on the former system. No provision is made for guns of larger bore than 9-inch, nor will any decision be given until the trials with the smaller bores are concluded. If, however, the French system should fail in larger calibres, the Committee consider the natural course would be to fall back on the Armstrong gun, which holds the second place,

and which is now in the service. To throw away the experience gained with these guns and the expense incurred in the preparation of patterns and means of manufacture without good cause, would be to postpone unnecessarily the great desideratum of a settled system, and plunge anew into tedious and costly experiments on a mere hypothesis of improvement. Such, then, is the general result of the competitive trial of the 7-inch gun; there are, however, a few matters of detail to which we shall further refer.

ENGLISH IRON ORES AND THEIR PRODUCTS.

THE pre-eminence claimed by England for her vast and stupendous works and manufactures is attributable to the use and application of iron in various forms, and the importance of the manufacture of that material cannot well be overrated. A consideration of the various ores used in this country and from which our irons are obtained carries with it both interest and utility. Until recently the ores almost exclusively used for the manufacture of iron were the clay ironstones of the coal measures. The black band is a carbonate of iron, and somewhat resembles the clay ironstone, but it contains more coaly matter, and in general more sulphur as iron pyrites. In Scotland and partly in Wales this ore is very largely used. It is found in beds or layers from 3ft. to 4ft. thick, whilst the clay ironstone only occurs in thin layers some few inches thick in the mine shale, and is necessarily much more expensive than the black band. In general these ores undergo the process of calcination. Previously to the introduction of the railway system the above were almost the only ores used, as they are always found associated with the coal. Richer ores, such, for instance, as the red hematite, were known, but from the difficulty of conveyance they were only used to a limited extent. When, however, railways were made the rich ores were largely imported, and not only increased the production of iron but diminished its cost, enormous quantities of the red hematite being imported into Wales and Staffordshire from Lancashire and Cumberland, where the ore occurs in a massive condition from 15ft. to 30ft. thick. In the furnace this ore yields from 50 to 55 per cent., whilst the clay ironstone does not yield on an average more than from 25 to 30 per cent. The brown hematite ores differ from the foregoing only in being a hydrated peroxide of iron; as a rule they are more siliceous, and yield from 38 to 45 per cent. of iron. They are derived in considerable quantities from the Forest of Dean, Cornwall, and Devonshire, where they are met with several feet in thickness. They are also found in some localities in South Wales, among others at Llantrissant and Pentrych. The principal deposit of the oolitic ores is that of Cleveland, where within a few years an immense iron district has sprung up. This ore occurs in a bed no less than 18ft. in thickness; 15ft. of this, however, are only worked, the remainder being left for roof. The ore is got partly by open and partly by subterranean workings.

In many works the cost of the Cleveland ore is very small, being not more than 2s. 6d. per ton on the top of the furnace, whilst the clay iron ores of South Staffordshire cost as much as from 12s. to 14s. per ton, and they are poorer than the Cleveland ores. The cost of the hematites depends upon the locality in which they are used; in Wales red hematite is about 20s. per ton, and brown 14s. to 15s. according to quality. The Cleveland ore is a mixture of a green carbonate of iron with a little silicate of iron; it is always calcined before being used in the blast furnace. The other oolitic ores are found in Northamptonshire and Wiltshire; some occur in Lincolnshire, and there is a little in Oxfordshire. These ores are not of the solid character common to the Cleveland ore, but are hydrated peroxides of iron of an oolitic and porous structure; owing

to this latter quality they absorb a large amount of water, frequently as much as from 20 to 30 per cent., including the water in chemical combination. The quality of the ore varies considerably; its yield may be taken at from 35 to 45 per cent. All the oolitic ores are characterised by the high percentage of phosphoric acid which they contain, in which respect they differ materially from the brown and red hematites. These are the principal ores used in this country; there are, however, various others which are used to a smaller extent. There is the Elba iron ore, which is an anhydrous peroxide of iron, called, from its structure, micaceous iron ore. There is also the magnetic oxide of iron, which is found only to a limited extent in this country, but is largely used on the continent for making the best qualities of iron; it is generally nearly pure magnetic oxide of iron, and the richest ore of iron known. There is likewise the spathose iron ore, white carbonate of iron, which makes a peculiar description of iron containing much manganese. This ore is a white carbonate of iron, and is used on the continent for making spiegeleisen.

The character of fuel is a consideration of such importance in the smelting of ores that a few remarks here will not be inappropriate. It is only in certain districts that raw coal can be used. When so used, or when mixed with a proportion of coke, its mechanical condition is of great importance. It is necessary that it should bear the weight of the materials without crushing, and also that it should not decrepitate; this latter property makes anthracite a less valuable fuel than it otherwise would be for iron smelting. It is generally necessary to coke bituminous coal before using it; if, however, it is only moderately bituminous, a proportion of coke may be mixed with it in the blast furnace. Too much care cannot be bestowed upon the operation of coking; this process used to be performed in open clumps, but the use of ovens is found to secure two advantages—a better yield of coke, and the ability to coke small coal. There is a notion that a very hard coke is essential for ironmaking; this, however, is not the case—it need only be sufficiently hard to prevent its being crushed in the furnace. There is yet another point to which careful attention should be given, and that is the question of the ash in the coal. As it is in intimate contact with the carbon of the coal and necessarily exposed to a high temperature, the various ingredients it may contain are under the most favourable circumstances for reduction. The consequences of any impurities contained in the ore are doubled when they exist in the coal ash. Beyond this the condition in which they exist as to their chemical combination is of importance. Thus, coal contains sulphur as iron pyrites, and sulphur in a free state, or combined with the carbon in some peculiar manner. The former is far more likely to alloy with the iron than the latter, as the greater portion of the free sulphur will be volatilised, whereas at least half of the sulphur in iron pyrites will still remain with the iron. In some works where a first-class description of bar or plate-iron is made, the cinders from the finery, the forge, and the mill are sold to other works, but in most cases they are all returned to the blast furnace for the manufacture of a lower class of iron. Cinders, however, can only be used to a limited extent, as, from the high percentage of sulphur and phosphorus they contain, they always reduce the quality of the iron. Sometimes the cinders are worked alone on the furnace for the manufacture of "kentledge," an exceedingly weak iron used as ballast for ships.

Let us now turn to the quality of iron produced by the various ores when the furnace is in normal working condition. A very superior iron is made from the clay ironstones; this superiority is partly attributable to the fact that the ores contain no free silica as sand or quartz, nearly the whole of the silica exists in combination with alumina as clay. They also contain a moderate amount of lime, magnesia,

and a little potash, which, by the addition of a small amount of limestone, form a readily fusible flux. The ore containing a little phosphoric acid makes the iron work easily and not redshort. The hematite ores generally contain quartz, little or no alumina, and only traces of lime and magnesia; their tendency is therefore to make an iron of a siliceous character, and which is generally redshort, owing to the absence of phosphoric acid. There are a few brown hematites which are calcareous, but they are generally siliceous. Phosphoric acid is present to a considerable extent in the oolitic ores; they are, in fact, distinguished by the high percentage they contain, and, as a rule, the cold short nature of the iron they yield. The Cleveland ore contains an excess of alumina which has the effect of rendering the cinder from the furnaces very infusible. To obviate this, siliceous ores may be mixed with the oolitic, or another process may be adopted; silica may be added as sandstone to the blast furnace; great caution, however, is necessary in this last method, which, by the way, we believe is protected by a patent. Very different from the Cleveland are the Northamptonshire and Wiltshire oolitic ores, which contain an excess of silica, and make a pig iron containing a higher percentage of silicon and phosphorus. Formerly, before railways had stepped in to change men's opinions on most matters, it was always considered that the ironstone should be carried to the coal. But increased facilities of communication and improved manufacture have combined to show that in many cases it is more advantageous to carry the coal as coke to the iron ore. So we find the result to be that, within the last few years, large works have been established to smelt the ore *in situ* in Cumberland, Lancashire, Northamptonshire, and Wiltshire. At these works pig iron is made at a much cheaper rate than from ores of the coal measures, and it is only by the use of large quantities of foreign ores and finery and forge cinders that the Staffordshire and Welsh works can at all compete with them.

The Cleveland district derives its supply of coal from Durham, and only by the superior quality and cheapness of their coal can the Welsh and Staffordshire districts at all compete in making bars with the Cleveland district. As regards cost they cannot compete at all in pig, either with this district or with those of Lancashire, Northamptonshire, or Wiltshire. At some works, as, for instance, the Welsh, several kinds of iron ores are used, and when this is the case any peculiarity in the quality of iron which an ore may produce may be much modified by the judicious mixture of them. Mr. Edward Riley, F.C.S., who has had considerable experience in these matters, suggests that the best results may be obtained by using the Cleveland ores with siliceous hematites. The cost, however, of the latter in comparison with the former is so great that they can only be used in Cleveland to a limited extent. The hot-blast is a question affecting the produce of iron from the ore, and one upon which a great deal has been said, and about which opinions greatly vary. It may, however, be laid down as a rule that the hot-blast does not injure the iron to any extent when the furnace is in proper working order. On the other hand, its benefit, by reducing the yield of coal, far outbalances any difference in the iron; hot-blast iron is, in fact, better adapted than cold-blast for some castings. In many cases, however, the hot-blast takes credit for a greater saving than is really effected by it: the increased makes of many furnaces are the result of a better burden or proportion of materials in the furnace, increased pillar of blast, and improvements in filling.

PISTON ROD GUIDES.

IF we conceive a sliding body imparting motion to a rotary body, we shall realise the action of the piston rod and crank of the steam engine. The inventors and improvers

of the many kinds of engines seem to have entertained these ideas from the commencement, for we find that the first beam engine had chains secured to a wooden beam with curved ends, as a guide to the piston. After that we are told James Watt introduced his now well-known parallel motion. This was an improvement in every sense of the word, for double action could be attained, or a thrust and pull on the beam. The principle of this motion is that a rod connected to a vibrating motion shall not be affected by the same; how far this is attained depends on the mathematical correctness of the parts. The length of the link in proportion to the stroke of the engine, and the length of the radius rod in proportion to the radius of the beam and length of the parallel bar, will greatly affect the perpendicular motion of the piston rod. In some cases the radius rod and parallel bar are equal in length, while in other examples the former has the advantage linearly. When the radius rod is longer than the bar in question, the adjustment of the former is attainable beyond the end of the beam, and a shaft can be introduced in the place of fixed pins or bearings. The connection of the piston rod to the cap is generally by a cotter; although in some instances a screwed connection is adopted. In order to dispense with the motion alluded to guides are used; this, however, is not universal, doubtless on account of the elegance of the one being in proportion to the simplicity of the other. With vertical engines, guides are imperative, unless the parallel motion be again introduced, which may be said to be too complicated for pistons moving at high speeds. The many kinds of guides for engines of this class are all the same in principle of action, that is, they retain the perpendicular motion of the rod. Some makers prefer a circular guide, in fact, a prolongation of the piston rod, the same working in an eye or bush. There is great objection to this arrangement, owing to the fact that the strain on the rod at each half stroke of the piston tends to deflect the rod of the same, owing to the fixed locality of the guide. Another mode is to prolong the rod as before, but with a separate portion on one side of the crosshead, the pin for the connecting rod being on the opposite side of the centre line. The guide in this example, as in the last, is fixed, but the piston rod is between the centres of action of the guide and connecting rods. It is obvious that with this arrangement the strains are more evenly distributed than with the circular guide, centrally located and extended so much beyond the centre line of the greatest strain. The evil of fixed guides is so apparent that ere long their adoption will doubtless be discontinued. The true definition of fixed guides is, that the strain on the piston rod is counteracted from a fixed point, and thus disarrangement and deflection are the natural results.

The mode of adjusting the surfaces is of great importance, as all rubbing surfaces in contact, wear in the direction of the strains enforced. In some cases sliding blocks are used, each end of the crosshead being inserted therein. The blocks work in a channel formed in the framing. By this it will be understood that adjustment was not regarded, and on the blocks and channel becoming worn a jerking strain on the piston rod was the result at each half stroke of the piston. The means adopted to adjust the surfaces in contact are various; in many instances compression or reduction of the space between the surfaces is adopted, while in other cases expanding the guide is resorted to. To define which is the better we must consider the strains and surface chiefly affected. It is universally known that the centre of action of the piston rod must be retained, so that to adjust one side of the guide only would be doubtless disturbing the plane line of the rod. In the event of shifting both surfaces, adjusting bolts and nuts must be introduced, thus entailing complication and increase of liability to looseness of detail. The better plan is to adjust the block, and by a single screw, wedge, or key, adjustment can be readily

maintained without increase of friction or disarrangement. The guide blocks now in general use have flat, curved, and V-shaped or angular surfaces. The channels in the framing are solid (so to speak), or adjustment is attained by the block only. The first-mentioned surface is the most general, each side or surface being a loose portion and connected by set screws, studs, or wedges. In the case of the curved surfaces, rods are used as guides, and the brasses either clasp the rods or are semi-circular in contact; the latter may be deemed the preferable mode, as the outer surface is not in contact unless there be excessive wear on the inner side. The V guide is perhaps the best example, as the shape of guide assists to retain the position of the block, whereas with the flat surface block provisions on the sides are imperative, unless the channels be recessed.

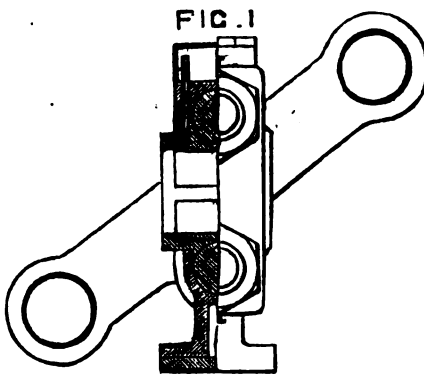
The next engines for consideration are those adapted for high velocities, or the horizontal type. In a previous article we described the friction of these and other engines, asserting at the time that the direction of the crank regulated the wearing surfaces. We now add that the same law should be always considered in designing the guide block. This detail for horizontal engines is much varied in principle and design. Some makers prefer double guides at the sides of the rods, while others resort to the primitive fixed guide, to which we have alluded. In the case of the double guide it should be remembered that four surfaces are always in contact, whereas with judicious arrangement two faces will be ample, sufficient area being of course considered. The action of the connecting rod is to lift and press down the piston rod, such action being of course due to that of the crank. When double blocks are adopted another evil exists, unevenness or inequality of adjustment, due of course to the requirements of simultaneous tightening of the guide surfaces. The single block also admits of a better connection with the piston rod, while the guides themselves can be located over and under the perpendicular line of the piston rod, an arrangement which admits of the greatest resistance to the strains imposed. For the better purpose of exemplifying our remarks we will describe in detail the arrangement now under question, which is particularly adapted for high velocities and reverse motions. The guide block is formed either of gun metal or malleable cast iron. The latter, although of late production, is being now extensively used amongst engineers and machinists. Its tenacity is somewhat startling; we have seen specimens tied into knots without fracture—in fact, equal to wrought iron. The space between the wearing surfaces of the block is sufficient to allow for the rise and descent of the connecting rod. The brasses clasp the guide on all sides, so that looseness is an impossibility. Adjustment is attained by wedges, with stop or set nuts at the front end, which can be further secured by set nuts and studs at the back if required; but this last may be termed an excess of safety, but nevertheless is more secure. The connecting rod, instead of being double at the connection, is single, and inserted in the block instead of clamping it. The pin or crosshead, as in other engines, passes through the block, and is secured at the smaller end by a nut, recessed in the side of the block; the larger end of the pin has a key to prevent its oscillating or shifting in the bearing. The brasses of the connecting rod are adjusted by a cotter and internal rod, the former being beyond the guides if required. The piston rod is secured to the block by a key or cotter, a projection being cast for that purpose. It will thus be understood that simplicity and compactness are maintained, and adjustment is available without disarrangement. The guide channel can either be closed at the sides or open for given spaces. The upper portion of the guide is secured to the lower by three bolts and nuts on each side; lateral disturbance is prevented by recessing the guides reciprocally where connected. This explanation suffices to show the superiority of the

arrangement now advocated, economy of construction and repair also being considered. The guides for oscillating engines are the gland, packing, and bush in the stuffing-boxes; the trunnions being also pivots to retain the location of suspension.

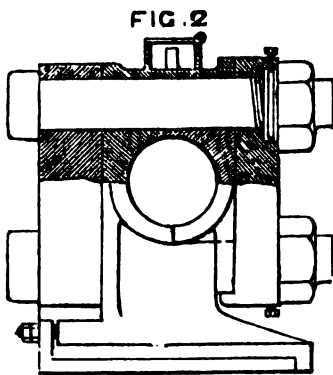
We will now consider the guides and blocks for marine engines. For direct-acting engines we find the trunk kind the most simple, guidance being now only considered; a deep bush, sufficient amount of packing and gland, will certainly be better than those of the shallower type. In this example, however, the origin of action and locality of the power are the same; it is therefore not too much to assume that a great portion of the strain is virtually direct on the piston instead of the guides beyond. With single piston rod engines the universal practice (for horizontal arrangements) is the guide channel located under the rod. The guide is of a bracket-like shape, the opening allowing the traverse of the upper portion of the block. The connecting rod is double or forked, to connect on each side of the block the pin passing through the whole, and rivetted in each eye of the rod. The block is in halves, and the bolts and nuts that secure them are extended to attach the piston rod at the back part; by this plan the wear of bearing of the connecting pin is regulated by the bolts and nuts alluded to. The guide surfaces in contact are adjusted by a shoe piece at the bottom, connected at an incline or as a wedge; studs and nuts at the front end are available to preserve rigidity of contact. Another guide block, arranged as the last, has the back portion solid, and the front loose or separate between the bolts only; by this method the foot and the back of the block are in one casting, instead of separate, as in the first of these examples. For twin screw propulsion, we should prefer our last described land engine guide. The guides and blocks for double piston rod return connecting rod marine engines are as varied in design and arrangement as for any other type or purpose. One universal example consists of double guides and single end connecting rods. The crosshead passes through the blocks, and is secured to the piston rods outside the guides, the connecting rods being within the same. With this arrangement four surfaces require adjustment, an evil to which we have before alluded. In the case of the blocks being solid the upper portion of the guide is only available for compressing or reducing the channel space. A second example is the single guide, or rather the surfaces over and under the plane line of action. The guide block is hollow centrally, to admit the end of the connecting rod. The crosshead passes through to the block and rod, and is secured to the piston rod on each side of the channel. For reversing engines there is not the least doubt this is the best arrangement yet known, as the resistance is direct with the strain, instead of at the side of the same. A third arrangement consists of the U-shaped block, the guide channel being under the centre line of connection. In this example the channel in section is as that for a punching machine, or angular at the sides. The connecting rod is suspended between the two raised portions of the block, and the crosshead is secured in the same by ordinary caps and bolts; it may be added that the height from the base line to the centre of the crosshead will greatly depend on the design and size of the connecting rod. In one example the connecting rod has a strap and cotter, and the latter works in a groove in the bottom of the guide channel in order to reduce the height from the base line. With the angular-sided guides adjustment is attained by shoes and studs available for expanding the parts in contact.

It will be observed that, in all the examples now given, the crosshead and pin are in one forging. Now, it is obvious that with such arrangements the crosshead will be subject to great torsion and shearing strains at one and the same time; hence the brasses, or rather the bearings, will be affected, and also the lower guide surfaces. The height of the centre of

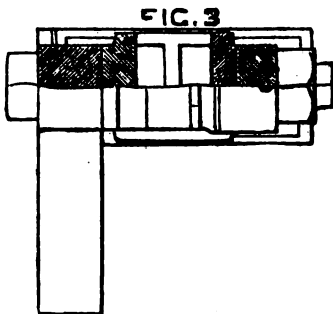
action from the base is a matter of importance; therefore the distance from the centre of the crosshead to the bottom surface of the guide block should be as short as practicable. It may be argued that, with the double-side guides, compactness of the surfaces are maintained, but it must be remembered that with that arrangement the frictional and bearing surfaces are greatly increased in proportion to the single type, to say nothing of the comparison of the portions requiring adjustment. For double or single piston rod engines the single guide block is undoubtedly the best yet known, but preference will perhaps be given to those with solid backs and loose adjusting portion between the bolts in front. When the block is centrally divided the strain imparted to the securing or cap bolts increases the friction on the crosshead or connecting pin bearing. The crosshead of the ordinary kind is an expensive portion of the engine, particularly in the construction and fitting, to say nothing of the bolts and nuts to secure it in its correct position. The accompanying illustrations represent a single block designed by Mr. N. P. Burgh, and which is suitable for a return-acting engine with the bracket-shaped channel. Fig. 1 re-



presents the front elevation half in section; fig. 2 is the side elevation, also half in section.



The plan is shown in fig. 3, the same as the two



former. The portion in front between the bolts is loose or separate from the block; the remaining portion of the block is in one casting. The connection of the shoe piece at the bottom is of the ordinary kind, adjustment being attained by the stud and nuts at the back end. The front and back caps are secured by the bolts and nuts, the latter being recessed in the front cap and adjusted by set studs. In the absence of the ordinary crosshead, the cap at the back has projections forged to receive the pis-

ton rods, so that a simple connection is attained. The strain imparted to the back cap is deflection and torsion, the former of course predominating. The tensile strain on the securing bolts is continuous, owing to the thrust and pull on the piston rods. By the back portion of the block being solid the bearing of the connecting pin is not affected. The guides of marine engines require great attention, as the least oscillation of the piston rods in the stuffing-boxes causes a leakage and thus reduces the vacuum. Simplicity of connection, perfection of adjustment, and a first consideration of the strains imposed should be always remembered, whether for a diminutive donkey engine or a colossal production of 1,500-horse power nominal.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

Multiplication of Copies of Photographs by Mechanical Means—Printing on a New Principle—Use of Guasoyol Stones as Fuel.

A DISCOVERY which a great many persons have been sedulously seeking for some years past has at length been made simultaneously by two gentlemen, both well-known photographers, Mr. Walter Woodbury and Mr. J. W. Swan. It is that of a simple and effective method of obtaining transcripts of photographic pictures by mechanical means, and precisely the same process seems to have been devised by both the gentlemen mentioned, each working quite independently, and without having the least knowledge of the other's labours. The first step in the process is to obtain a photographic picture in which the shadows shall be in relief and the whites depressed. This is done by printing from a negative upon a glass plate coated with a preparation of gelatine and sugar, sensitised by means of bichromate of ammonia. From a positive thus obtained simple washing with warm water will dissolve away all those portions of the bichromated gelatine which have not been acted upon by light, leaving all the dark parts of the picture in relief. Having been treated in this manner, the gelatine picture is now ready to be used as a mould from which to obtain, in some hard substance, an intaglio surface from which any number of exact copies of the gelatine picture may be got, upon surfaces of paper, glass, porcelain, or any other desired material, by a slight modification of the ordinary process of press printing. The cast from the gelatine mould which is thus to be used for printing from may be obtained either by electrotyping, or by pressure. If the electrotype method be used, the mould must either be covered with a coating of plumbago, by rubbing that substance over it, in circles, with a short hard brush, or must have precipitated upon it a coating of metallic silver. The latter may be readily obtained by pouring upon the mould a mixture of one drachm of a saturated solution of Rochelle salt with three drachms of a solution of ammonia-nitrate of silver containing about thirty grains of that salt to the ounce, exposing to light for a few minutes, and then flooding with a solution of gallic acid. When thus coated with either silver or plumbago the mould is ready to receive a coating of copper by the electrotype process, which coating, when deposited, must be separated from the gelatine and carefully mounted in gutta-percha. The mounting is effected by laying the copper cast, intaglio side downwards, on a sheet of thick plate glass, placing a sheet of gutta-percha, first softened by heat, on the top of the copper, laying another sheet of plate glass on the top of the gutta-percha, placing on the top of the whole a heavy weight, and allowing this weight to remain until the gutta-percha has hardened. A speedier method of obtaining a metallic reverse of the gelatine picture is that of pressure. When this method is adopted the gelatine mould is placed, bottom downwards, on a slab of cast iron having a perfectly even

surface; a plate of polished metal, not harder than type metal, and about one-eighth of an inch thick, is placed on the top of the gelatine mould; another slab of cast iron is placed on the top of the plate of soft metal, and the whole is then subjected to heavy pressure, either by being passed between steel rollers, or by means either of a powerful screw, or of a hydraulic press. By this means there is at once obtained a metallic printing surface, which requires no mounting. Mr. Woodbury has also obtained good results by using sulphur as the material of the cast to be printed from, heating the sulphur until of the consistency of treacle, pouring it in that state into the gelatine mould, and allowing it to remain there until quite cold and hard. The method of printing from an intaglio cast obtained by either of these methods will be understood from the following account of some experiments recently performed by Mr. Woodbury, before a party of gentlemen assembled at the house of the editor of the *Photographic News*:—"Mr. Woodbury was confined to the use of improved apparatus, his press, &c., from some misunderstanding, not having come to hand. The intaglio plates, one in copper produced by electro-deposit, and one in type metal produced by pressure, Mr. Woodbury brought with him. The electro-type cast, which was most suited for printing on paper, was in tolerably deep intaglio, the greatest depressions being about the depth of a thin card; the whole presenting somewhat the appearance of an engraved copper plate, but with less crisp or sharply cut lines. The type-metal *cliche* was much less deeply impressed, and was prepared with a view to printing on glass. In order to print, a little gelatine was just covered with water for a few hours; when the gelatine had imbibed thoroughly the water, it was melted by heat, and a little of the prepared Indian ink used for carbon printing added and mixed. A little of this gelatine, kept in a fluid state by warmth, was poured on to the centre of the intaglio mould, covering about one-eighth of its surface. A piece of fine, hard photographic paper was placed on the gelatine, and a stout piece of plate glass was then laid on the paper. In the absence of a press, a twenty-eight pound weight was then placed on the glass, and left for a minute or two to allow the gelatine to set. The pressure was then removed, and the print lifted up; the gelatine slightly set, leaving the intaglio as jelly delivers from a mould, and adhering to the paper, giving a print in varied gradations, just in proportion to the thickness of the layer of coloured gelatine. After taking a few impressions it is found desirable now and then to slightly grease the mould to ensure the print delivering perfectly without adhering or leaving any of the coloured gelatine behind." It will be perceived that this method of printing differs essentially, in principle, from any previous method of printing by mechanical means. The methods by which pictures or designs have hitherto been printed mechanically are three: "*block printing*," or the method of producing impressions by inking a block with raised surfaces, and obtaining a copy of such raised surface by pressure, upon paper or other fabric, as in wood engraving; "*intaglio printing*," or the method of producing impressions by filling up with ink lines or hollows in a metal plate, then cleaning the surface of the plate and obtaining a copy of the lines and hollows by pressure, which causes the ink to be transferred to paper or other fabrics, as in copper-plate printing; and "*lithographic printing*," or the method of producing impressions by applying ink to a design upon stone, the design having an affinity for the ink, whilst the other portion of the surface of the stone repels the ink, the design so inked being obtained upon paper by pressure." In each of these modes of printing, gradation of tint is obtained on one and the same principle. The ink applied is opaque, and the thinnest as well as the thickest layer of it should be black, the necessary gradations or variations of tint being pro-

duced by the design being formed of lines or dots, and by these lines or dots being of different sizes, and placed at varying distances apart. When the lines or dots are large and very close to each other, a very deep tint is produced; when they are fine and wide apart the tint is light. An absence of either lines or dots leaves the paper white, and a continuous surface to receive the ink produces a breadth of black. In Messrs. Woodbury and Swan's method of printing gradation of tint is produced upon a principle which has nothing in common with that upon which all previous methods of printing pictures, except the photographic method, have thus been based, but which is exactly the same as that upon which the effects produced in what photographers call "*carbon printing*" depend. In carbon printing, the reader may be reminded, "*gradation of tint is obtained by different thicknesses of a coloured translucent material on a white ground*. The deepest blacks consist of a sufficient thickness of this material to become practically opaque, and cover the white paper upon which it is fixed, without allowing it to show through; the next depth of tint is obtained by a slighter thickness, which allows a trace of white to show through, producing the effect of deep grey; the other tints by varying thicknesses, the thinner the layer of the coloured translucent medium, the more delicate the tint of grey, as the white ground becomes more and more apparent, gradually merging into the pure white of the ground as the layers become attenuated to nothing." The case is exactly the same in printing by Messrs. Woodbury and Swan's method, the differences of tint in pictures printed on their plan being produced by different thicknesses of the coloured gelatine which they use instead of the ink of the ordinary printer,—these differences of thickness being due to different degrees of depression in the intaglio plate printed from. The copies of photographic pictures which Messrs. Woodbury and Swan produce by mechanical means are thus much more than mere imitations of their originals, such as a skilful engraver might produce; they represent their originals exactly, and their effects are produced upon absolutely the same principle,—that principle being an entirely new one, as applied to press printing. We believe that their process will be found capable of very valuable economic applications, and we shall certainly watch its progress with great interest. It should be added that, although not more than thirty of their gelatine pictures can be produced in an hour by one press, owing to the gelatine requiring in each case a little time to "*set*," one person can nevertheless work off about one hundred and twenty impressions per hour, since he can very well attend to four presses at once.

A Mexican newspaper announces that the stones of the fruit of the guacoyol palm, which grows in enormous abundance on the Mexican coast of San Blas and in the valley of Banderas, have been found to possess great advantages for use as a marine steam fuel. It states that experiments have been made with these stones on board certain English vessels of war, with the result of proving that the stones have a value as fuel not inferior to that of their weight of the very best coal, while they have the advantages over coal of not dirtying either the holds in which they may be stored or the persons having to handle them, and of not being subject either to spontaneous combustion or to damage from leakage of the ship. At present, these stones can be purchased at San Francisco at about half the price of coal, weight for weight, and it is said that "*many thousands of tons*" of them could be collected annually.

During the month of July last, thirty-one Cornish pumping engines consumed 1,913 tons of coal, and lifted 13.9 million tons of water 10 fathoms high. The average duty of the whole was 48,900,000lb. lifted 1ft. high, by the consumption of 118lb. of coal. Ten engines exceeded the average duty.

THE BRITISH ASSOCIATION.

SECTION A—MATHEMATICS AND PHYSICS.

REPORT OF THE BALLOON COMMITTEE.

THIS report was read by Mr. Glaisher. It stated that the committee had been re-appointed last year in order, 1st, to examine the electrical condition of the air at heights; 2nd, to verify the law of the decrease of temperature, as found from summer day observations already made, with day observations at other seasons of the year, but principally in the winter and adjacent months; 3rd, magnetical experiments, observations with the spectroscope, the currents of the atmosphere, solar radiation at different heights, and bygonometrical observations, though secondary, were to be held as very important subjects of investigation; 4th, to arrange for observations at night, and to make such observations if possible. With respect to the first subject, no further progress had been made, the instrument prepared for the purpose not having been rendered available for use. Under the second and third heads some progress had been made, though not to the extent anticipated. As to the fourth object, no night observations had actually been made. To take such observations it was imperatively necessary to have some means of illumination, so that the instruments could be read. Various suggestions had been made on this point, but the best plan seemed to be to employ a Davy lamp. Two such lamps had been made for Mr. Glaisher of copper, so that the proximity of magnets did not affect them. Experiments had shown that these lamps might be used with perfect safety, and that they kept well alight, besides affording a source of grateful warmth not before possessed. All necessary arrangements were now made for night observations, though there were no results yet for presentation, and a series of such observations would be very useful. The same instruments, with the addition of a fine spectroscope and a delicately-mounted magnet, had been employed, as during the previous year. The instruments were attached to the outside of the car, and were easily read in that position. Up to the last meeting of the Association twenty-two ascents had been made, of which seventeen had taken place in June, July, August, and September, and five only in the other months of the year, viz., one in January, one in March, two in April, and one in October. Of the summer ascents, one had been made in the morning, and the rest in the afternoon or evening. The committee considering that day and high experiments in summer had better be brought together before more were made, Mr. Glaisher devoted all his efforts to secure as many ascents as possible between October and April, but he had succeeded in three instances only, on December 1st and 30th, 1864, and on February 27th last. The three ascents were made at Woolwich, and the paths of the balloon were shown in diagrams. The small number of ascents was due to winter being an unfavourable season for balloon experiments. But as with regard to the progressive diminution of temperature with elevation, the diffusion of vapour in the atmosphere, the density of clouds, their extent, and currents in the atmosphere, and all connected with the higher regions of the atmosphere in winter, we are in almost entire ignorance; it is the most important season for experiments. Proceeding to speak briefly of the three ascents, the report stated that the balloon left the earth on December 1st at 2.37 p.m., with a temperature of 48 deg., which remained almost unaltered till the height of 600ft. was passed. Having slightly increased up to that point, it then gradually declined to 31½ deg. at about a mile high. On December 30th the balloon left at 2.13 p.m., with a temperature of 42½ deg. In the first 500ft. it declined 2 deg.; at 1,000ft. it was 37 deg.; at 2,000ft. it was 33½ deg.; at 2,500ft. cloud was encountered, and the temperature was 31 deg.; at 3,300ft. at the upper surface of the cloud, it was 27 deg.; on getting above the cloud the temperature rose, and at 400ft. above it had increased to 31½ deg. On February 27th the earth was left at 1.58 p.m.; the temperature was 52 deg., and declined gradually to 35 deg., when a cloud 1,000ft. in thickness was reached. In passing through this there was no change of temperature, but above it the temperature increased with elevation. Comparison established that these results differed greatly from those obtained in summer, and showed that the laws of temper-

ature varied at different seasons. The courses in the three ascents were very nearly the same after reaching a certain point. The winds prevailing in the higher regions in January and February were W. and S.W. This was unfortunate in regard to the ascents, as it necessarily shortened their duration. Since that time Mr. Glaisher had been making preparations for night ascents. The ascents made, however, were important in proving the constancy of the S.W. current during the winter months, which was also confirmed by observations at the Royal Observatory. In the descent on December 30, Mr. Glaisher was unable to take any magnetic observations, as the balloon was in a constant state of revolution, but on the other occasions he had succeeded in obtaining results which corresponded with those found at other periods of the year. At every opportunity during these ascents, Mr. Glaisher had directed the spectroscope to the sun, and always saw a very fine spectrum with many lines, more numerous than on earth, and better defined. The spectrum usually extended from A to far beyond H. The spectrum was perfect, with a much narrower opening of the slit than on the ground, and lines could therefore be clearly resolved which could not be seen from the earth. A blackened bulb thermometer, placed near another carefully screened, for determining the temperature of the air, generally read the same as the latter. No tinge of ozone was shown on the test papers in any of the journeys. The report contained a mass of figures relating to the observations, which were detailed with every minuteness.

Mr. Glaisher's disappointment at finding his time for observation always cut short by the inevitable tendency of the balloon towards the sea, was compensated for when he considered the high importance of the continuance of south-west winds in winter. Constant observation last winter, from October to March, had found the wind always in the same direction, whenever it was possible to determine the motion of the upper air, no matter from what quarter the earth wind came. The high temperature we experienced in winter seemed due greatly to this current, which met with no obstruction in its course towards us, but blew directly hither and to Norway over the Atlantic. These winds only reached France when they had passed over the whole of Spain and the Pyrenees, and they had then become so much cooled that France derived comparatively little benefit from them. This apparently caused the more severe winters in that country. It was probable that our milder winters were due to these winds. After touching on the subject of the ultimate destination of the heat rays which constantly issue from the sun, Mr. Glaisher said that a few months previously he had thought that would be his last report on balloon ascents. He had devoted his entire leisure for three years to these experiments, and every day he was so occupied was a day taken from the month's holiday allowed him as an *attache* of the Royal Observatory. As, very properly, no personal expenses were allowed by the Association, he had had to pay them himself, and he had also had to defray the cost of the necessarily heavy calculations. He felt, therefore, that he had performed his share of these experiments, and that they might cease for the present, and fresh ones be made at a future day by others. But on seeing, in preparing this report, how deficient they still were in winter ascents and morning ascents, but, above all, in night operations, he had determined in consultation with the committee to make some night ascents at once, if possible, and therefore he would probably have to address them again at their next meeting.

SECTION B—CHEMISTRY.

ESPARTO FIBRE OR SPANISH GRASS.

DR. STEVENSON MACADAM, Edinburgh, read a paper on "The Composition of Esparto Fibre, or Spanish Grass, and its Employment in the Manufacture of Paper." During the last three years large quantities of a grass have been obtained from Spain, and been employed in this country in the manufacture of paper. It is collected from lands which are comparatively speaking waste, and when delivered in Great Britain costs about £5 10s. to £8 per ton. The recent high price of rags necessarily caused a demand for esparto fibre as a substitute for rags in the manufacture of paper; and, should the

demand continue, other countries than Spain, such as Barbary, which are known to yield the same grass, will no doubt contribute largely to the supply of the raw material. In the manufacture of esparto fibre into paper, the material is first carefully examined and cleaned, and is then subjected to the action of an alkaline solution of caustic soda. The proportion of soda employed is 1-8th of the weight of the grass, being 14lb. of caustic soda to the cwt. of fibre, or 2½ cwt. to the ton. The general size of boilers contains 12 cwt. of fibre, to which are added between 800 and 900 gallons of water, and 1½ cwt., or 154lb. of caustic soda. The boilers are either close or open, and the boiling process is carried on for from six to eight hours, during which time the soda dissolves away from the fibre the albuminous compounds, oil, resin, and silica; whilst the starch and gum are also abstracted, and the ligneous fibre is left as a soft and pliable material of a brown colour. After washing with abundance of water the fibre is worked up into paper in a manner similar to that followed in the case of rags, only a little more bleaching powder is required. The fibre, however, is rather short in nature, and hence paper made entirely of it is extremely liable to tear. It is customary, therefore, to give strength to the paper by mixing the pulp from the esparto fibre with the pulp from the rags, and a common proportion in equal parts of the esparto and rag pulps. The paper manufactured from the Spanish grass, and more or less rags, is largely employed as a printing paper, and the majority of the Scotch newspapers are now printed on the mixed fibre and rag paper. The liquid obtained from the boilers where the original esparto fibre is acted upon by caustic soda is a dark brown coloured liquid, which still retains one-third of its original soda as caustic. Attempts which have been made to employ this liquor over again, with the addition of more soda, have shown the impracticability of getting the whole of the soda to act. Indeed, in using the proportions stated previously—viz., 14lb. of caustic soda to the cwt. of fibre, or in a boiler 1½ cwt. of soda to the 12 cwt. of fibre—only 1 cwt. of soda is taken up and neutralised, and the remaining ½ cwt. is left as caustic. Trials which have been made to use only the 1 cwt. of soda in the boilers have not been successful. The spent soda liquor necessarily contains much organic matter in solution, and being of a caustic nature, it possesses properties which render it pernicious and destructive to fish, when it is run directly into a fishing stream. Even when diluted with water to the extent of many times its own volume, the liquid has the power of killing fish within a few hours. The large quantity of water required in paper manufacturing necessitates that they be placed on the banks of streams; and whilst the destruction of trout may be a matter of little moment, yet the discharge of much spent soda liquor into a salmon stream is of much individual and national importance, tending as it does to foul the water and diminish the proportion of oxygen gas dissolved therein, besides conferring more or less caustic properties upon the water. Several instances have occurred in Scotland of the destruction of salmon and salmon fry in this manner, and even where direct poisoning might not be traced, yet it is undoubted that such discharges and the consequent fouling of the stream must tend to deteriorate the health of the fish, diminish their growth, or probably drive the fish from the stream. Two plans have been suggested and put in operation for the arrestment more or less completely of the soda liquor. The first method is the boiling down of the ley, heating the residue with carbonaceous matter, such as fine coal or sawdust, and the recovery of the soda from the calcined mass; and the second process is the reception of the liquor in large open tanks or cesspools, where the liquid may percolate through a sandy and gravelly soil. Both plans have been carried into practice, and have been successful. These are some of the principal points connected with the employment of esparto fibre or Spanish grass as a substitute for rags in the manufacture of paper, and as the fibre is obtained comparatively cheap, and yields one-half of its weight of paper, the manufacturers regard this grass as a great boon.

ACTION OF ALKALI METALS ON GUN COTTON.

A PAPER on the above subject was read by Mr. W. S. Scott. The results of his experiments were that potassium on being dropped on gun cotton was attended by instantaneous explosion. This was when the cotton was perfectly cold, and in a room

at the ordinary temperature. He had experimented with sodium, and the results were similar. Other alkali metals also produced similar effects, so that the conclusion might be formed that simple contact of metals with gun cotton would always produce explosion. Mr. Scott illustrated his remarks by several interesting experiments exemplifying the theory he had propounded.

OZONE.

MR. J. SMYTH, Jun., read a paper "On an Apparatus for the Determination of Ozone." The experiments made by him were of a highly interesting character. He had observed indications of ozone, especially in the linens imported from Ireland, which gave noticeable indications of a great amount of ozone in the locality from which they had been sent. He had also observed that its presence was often more readily perceivable in clothes which had been placed upon the grass, and this was particularly observable after a shower of rain or a heavy dew. After a number of experiments July had been ascertained to be the best month, but whether it was owing to the heat or from the action of the light, or from the greater presence of ozone, was not for some time discernible. He therefore commenced to make additional experiments. He had carried them on for two years, the result of which he exhibited in a chart, showing the weather elements since 1864. He exhibited diagrams illustrating his experiments, and the apparatus he had invented, which appears to be superior to the others in use for the determination of ozone. Other instruments do not appear to have taken into due consideration the velocity of the wind, which is an important essential in the determination of ozone in the atmosphere. This Mr. Smyth's apparatus has greatly provided for, and is a decided improvement upon those instruments already in use.

ON RECENTLY DISCOVERED PHOSPHOTIC DEPOSITS IN NORTH WALES.

DR. A. VOELCKER said it was not so much whether such deposits could be obtained in great abundance as whether it could not be found in such abundance in this country as to make it profitable. It was a question at the present greatly affecting agriculturists, when manures were so greatly requisite. The deposits were discovered at Cwmgynean in the district of Llangynog, in North Wales, and consisted of about two miles of deposit. The deposit consisted mainly of a black phosphotic limestone and another of similar nature of black shale. This discovery would prevent the necessity of going in future to France for phosphates, as they could find them within three miles of Birmingham. This was a subject of considerable importance, when it was considered that all our phosphates were being exhausted.

SECTION C—GEOLOGY.

DURATION OF THE SOUTH STAFFORDSHIRE COAL-FIELD.

THIS paper, by Mr. Henry Johnson, of Dudley, was "On the Extension and Probable Duration of the South Staffordshire Coal-field." Both the extension and duration of this coal-field are questions open to a very great difference of opinion. If the extent was limited to the at present explored portion of the district, the duration might be tolerably accurately calculated, as all the coals that can be possibly reckoned upon in a descending order in this coal-field have long since been discovered. It is to the confines of the present coal-field, then, that any hopes for fresh supplies can be looked for, and it is a very interesting fact that on all sides of the coal-field explorations are being most successfully carried on, with perhaps the exception of the eastern boundary on Birmingham side. But the great depth at which the thick coal has been last worked in the neighbourhood of West Bromwich (about four hundred yards in depth) has probably retarded exploring operations in that direction. The result of operations which are going on in other portions of the coal-field is, however, being looked forward to with great interest, as affording sufficient evidence to warrant an attempt to reach the coal through the permians at Smethwick and Harborne. During the last ten years, more especially the last five, a great number of new workings have been made in the north end of Cannock Chase district, as also in the north-east at Aldridge, and at Himley and other places; but probably the most important recent trial sinkings are those on the south end of the coal-field, in the neighbourhood of Hales Owen, Congreave, Cradley Park, and Wassel Grove. In the event of the one at Hales Owen, belonging to Mr. S. Dawes, and that of Wassel Grove, belonging to Messrs. George Pell and Co., discovering the thick coal—both of which look very promising, and are now sunk to about halfway to the coal—more than four thousand acres of the thick seam

may be considered proved, and this assurance will no doubt give a fresh impetus to additional search even further south than those now in operation. Very rapid strides are now being made in developing the thin seams over several thousand acres of previously unexplored ground on Cannock Chase, which is now being intersected by canals and railways in every direction, and having direct communication with the more immediately coal-consuming district of the Black Country. These thin seams, however, are speedily exhausted, as compared with the thick coal seam. A scheme for proving the continuity of the coal-field underneath the permian on the downthrow side of the Great Western boundary fault at Blington, on the property of Mr. H. C. Vernon, is now in course of formation. It is proposed to form a fund for this purpose, by subscription, from all the adjoining landowners likely to be benefited by such a proof, upon the same principle as Mr. Dawes's scheme at Hales Owen. In this case it is proposed to drive from the existing coal-workings on the upthrow side the coal field, which lies at a depth of about 200 yards from the surface, across the fault into the permian district, some 200 or 300 yards horizontally, and then bore up or down in the hope of discovering the position of the coal measures underneath. There is, however, a much more comprehensive scheme for extending the coal-field, and exploring the whole permian districts lying between the South Staffordshire coal-field and the Warwickshire and Shropshire coal-fields, particulars of which may be found in Transactions of the Dudley and Midland Geological Society for June, 1865, p. 37. To attempt to estimate the probable duration of the coal-field, whilst these somewhat important recent additions are being added to it, would be impossible, but it may be observed that such additions are not keeping pace with the enormous consumption and consequent rapid destruction of the parent portion of the coal-field. In a very valuable paper, read by Mr. Matthews, in August, 1860 before the Institute of Mechanical Engineers, at Birmingham, after obtaining the best evidence on the subject, he estimated the then duration of all parts of the coal-field at an average of about forty years from that period. There can be no doubt but that in one-half that number of years a very large portion of the earlier developed part of the coal-field will be totally and for ever exhausted, as, for instance, the mines in the neighbourhood of Bilston, Coseley, Tipton, Wednesbury, Oldbury, West Bromwich, Brookmore, and Brierley Hill, are being fast worked out, and in twenty years hence will be well-nigh totally exhausted.

The Chairman thought Mr. Johnson's paper was a very valuable communication. He alluded particularly to the probability of finding the thick coal of South Staffordshire underneath the permians bounding the district. He had no doubt that the coal will be found all around the coal-field under the red rocks, as was found at Earl Dartmouth's sinkings near West Bromwich, and will be then found of even better quality than it is in the older portion of the field, because in the central part the coal is very much affected by its proximity to the igneous rocks.

SECTION G—MECHANICS. DISTRICT PRIVATE TELEGRAPHS.

A PAPER by Mr. N. J. Holmes was read on this question, which has latterly attracted considerable notice. It traced the history and various uses of the telegraph and its great importance as a vehicle of communication in towns, and then pointed out that the popular use of the telegraph depended upon the adoption of a more easy system of signs than was used by the ordinary telegraph companies. This desideratum was, he believed, secured by Professor Wheatstone's invention of the alphabetical telegraph in 1838. The communicator or transmitter, by which the operator with his fingers spells out the words letter after letter, consisted of a box fitted with a dial round the face of which the letters of the alphabet were placed; opposite to each letter was a key button shaped. In the interior of the box was a magnetic arrangement, the generation of the currents being consequent upon the revolution of an armature, kept in continuous motion when passed through its arrangements. A company had been formed four years ago for the promotion of this form of telegraph, the use of which in newspaper offices was rapidly increasing. Several papers had an independent system of their own between the reporters' gallery in the

House of Commons and their offices. The use was increasing among commercial houses generally. Though the company had been incorporated little over four years, its system extended throughout the United Kingdom. Upwards of 2,000 miles of private wires had been erected by the company, and 836 sets of instruments.

COMPRESSED AIR-ENGINE AND COAL-CUTTING MACHINE.

MR. THOMAS LEVICK read a paper "On Machinery for Compressing Air and the applicability of such Compressed Air for Working Coal-cutting and other Underground Machinery." The writer treated the subject in the following order:—1st, Various conditions arising from the compression of air; 2nd, the application of steam to compress air, with description of Jones and Levick's air-compressing engine; 3rd, the transmission of the air through the pipes to underground machinery; and 4th, a description of Messrs. Jones and Levick's coal-cutting machine. By the aid of diagrams the writer explained the working parts of an air-compressing engine, the air being compressed by means of a steam engine on the pit bank, and the compressed air taken down the pit in pipes to work the coal-cutting engine underground. The quantity of compressed air consumed by each coal-cutting machine, as determined from some indicator diagrams taken from a machine when at work, was 327·6 cubic feet per minute, at 30lb. pressure. The machine was working at the rate of ninety-eight blows per minute, showing an expenditure of air equal to three-horse power. The machines at Blaina Works are holed in a coal which the men refused to work at any price, and which though opened out has not been touched for years. The average performance of the machine in this coal is at the rate of eight yards per hour to a depth of three feet. The machine, when worked with a self-propelling motion and cutting outwards, would exceed that quantity.

Mr. W. Smith, C.E., asked what quantity of work the machine would perform with the cost of power, or rather how many tons of coal could be hewn by the machine in comparison with manual labour.—Another member asked if these machines had been tried at any underground work except collieries.—Mr. Levick explained that at present the colliers were paid by the day, but it would be desirable for future statistics to pay them at so much per yard. The cost of getting away the coal would be the same for machine as for hand-hewn coal. The difference in the cost of holed amounting to this—that while a collier could hole seven or eight yards a day the machine would do as much in one hour. As to its applicability or suitability for the purposes of excavating harder materials, he stated that the machine would work on any materials that the teeth of the instrument could penetrate. It had been tried on Bath stone with great success.—The President said the subject was one of great importance, not only for the economizing of the class of labour which is now employed in collieries, but also as a means of saving waste. The mode of operating by the machine was that it cut a very narrow groove on a level with the bottom of the machine under the coal, but it was impossible to do this by hand labour, for the collier makes a much larger aperture at the commencement which he narrows as he proceeds. There was one thing in connection with the working of the machine which he thought would be an improvement, and that was if the machine were worked at a lower pressure, which would only necessitate cylinders of a larger size; but no increase in the size of the pipes would be necessary.

PARIS UNIVERSAL EXHIBITION.

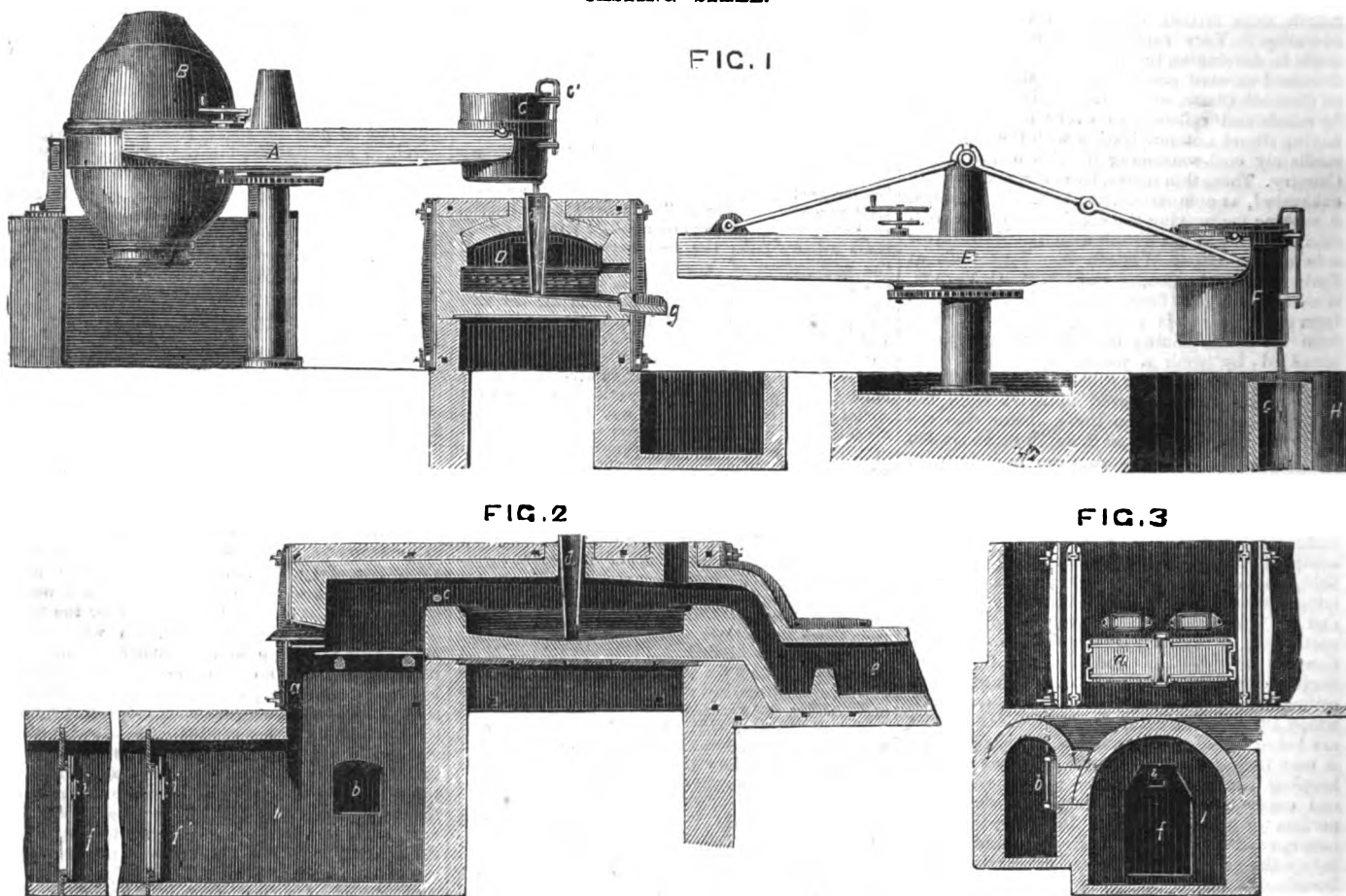
THE Committee of Council on Education have just published the Imperial regulations which refer to British exhibitors in the forthcoming Paris Universal Exhibition. The Exhibition will be held in a temporary building in the Champ de Mars, and will be opened on the 1st of April, 1867, and close on the 31st October following. It is only through the Council on Education at South Kensington that communications from British exhibitors will be received; and the 28th of February next has, it appears, been fixed as the last day for applications for space in the building. The plans showing the exact position of the English and other foreign courts will not be ready until the commencement of November. One feature new to international exhibitions will be introduced, viz., the formation of special parks by each country, which will doubtless form one of the principal attractions of the undertaking. Indeed, the arrangement of a park outside our last International Exhibition would, if it had been feasible, have greatly added to its attractions. The French are wiser than we are in this particular. A day spent in any building without a change of air is irksome to the most patient Englishman, but to a Frenchman it would be intolerable. It has been arranged that works by French and foreign artists executed since the

1st of February, 1855, will be received for exhibition; and that the nature and number of the rewards to be given for works of art, as well as the constitution of the international jury to act as judges will be hereafter decided. The prices of admission have not yet been determined on. There are a number of regulations which are similar to those of our last Exhibition. Rent will not be paid for space, steam power will be provided gratuitously, but the necessary apparatus to regulate the motion will have to be provided by exhibitors. The cost of packing and carriage of goods is of course to be borne by the exhibitors; and the insurance of goods is left to them. The international jury will be divided into nine groups.—*Building News.*

NEW GRAVING DOCK AT JARROW.

THE opening of the new graving dock at Jarrow—the largest dock of the kind on the east coast—took place on Saturday last. The dock, which is constructed to accommodate vessels of the largest tonnage, will prove a great acquisition to the Tyne. It is situated near the ship-building yard, at Jarrow, between the rolling mills and the blast furnaces. Extending in a southerly direction from the river it is 410ft. long from the edge of the invert to the first or lower step at the south end, the bottom having a slight rise of 1ft. 9in., or to the extent of nearly two steps in the whole length, and a declension of 8in. from the centre to the sides for the purpose of running off the water. In width it is 53ft. at the first step, and gradually widening as it rises it reaches an extreme breadth of 96ft. between the top steps. The steps are twenty-six in number, running up both sides and round the top end, each having 10½in. tread, and 12in. rise. The height of the dock at the entrance is 22ft. from the centre to the sides for the purpose of the pier wall; the crown of the stone floor within the dock being 3ft. below the centre of the invert, however, makes the total height inside the dock 25ft., giving an average depth at high water of 17ft. on the invert, and of 30ft. in the dock itself. Up the centre of the dock are placed transversely 81 graving blocks made of stone, each measuring 7ft. in length, 8ft. in width, and 2ft. 6in. in depth; of which, however, 3½in. only project above the finished floor at the crown. They are surmounted by substantial wooden blocks of about the same dimensions, upon which the keel of the vessel when in dock will rest. The entrance to the dock is 70ft. wide between the masonries, and 30ft. from north to south; and running across the centre, which is perfectly level, is a groove 2ft. 6in. wide and 1ft. 6in. deep, with grooves of corresponding dimensions up each side, into which a large caisson has been built to fit, so that when the latter is in its place, the dock is perfectly watertight. By means of the slight declivity on either side of the dock from the centre to the sides the water is conveyed into gutters, which, commencing at the head or south end, run from the centre down the east side to a culvert, through which it passes into the pump well which is on that side of the dock. On the west side it comes down in a similar way towards the north, and arriving at the invert, it is there passed through a culvert across the dock into another culvert on the east side, and so into the pump well. The gutters running the entire length are 8in. wide and 4in. deep. In addition to these is another culvert on the sluice principle, through which the water can also escape to a certain level, below which it is removed by a pair of Gwynne's centrifugal pumps; it has been found that by this means the dock can be emptied in three hours. An engine-house for the reception of the pumping machinery, boilers, &c., has been erected on the east side, in close proximity to the pump wells, which are 15ft. square and 27ft. in depth, the surrounding wall being 5ft. thick for about half-way up from the base, and 4ft. thick for the remainder of the height. The wall facings all round are of hewn granite of great thickness, all the blocks being firmly cemented together. A solid mass of concrete, several feet in thickness, surrounds the masonry, and this is succeeded by a puddle wall round both sides and south end, the whole being backed with gravel, clay, &c., to the top of the coping, forming on the surface a large area of wharfage. Nearly three years have been occupied in the construction of the dock, the whole work of which is from plans furnished by Mr. J. F. Ure; the contractor being Mr. W. Jackson, of York.

CASTING STEEL.



CASTING STEEL.

MR. E. L. S. BENZON, of Nicholas-lane, London, has recently patented an invention which embodies improvements in casting steel, and which has for its object the better preparation of the melted steel (especially in large masses) before it is poured into the moulds or into ingots. The invention is applicable to all steel in a molten state, whether uniformly or thoroughly melted or not, and whether melted by the old method in crucibles or otherwise, or produced by the Bessemer or other process, or partly by one process and partly by the other. The process is called an intermediate process, and by it the inventor is enabled to gather together in the same furnace molten steel, and make the same uniform for one or more castings, or for forming ingots of cast steel, by continuing the melting process till the mass is "overmelted" or "superheated," thus enabling castings of larger size to be made and also several castings or ingots of more equal temper than heretofore. When it is desired to add spiegeleisen to the molten metal, as proposed by Mr. Mushet, it is added to the mass in the intermediate furnace instead of in the Bessemer converting vessel, as heretofore. In all cases the process must be continued till the molten steel and the steel or iron added in the intermediate furnace is "overmelted" or "superheated," and the mass has become uniform. The practical experience of steel melters will enable the operator to determine when the steel is ready for pouring. The intermediate process in all cases softens the steel slightly, which allows (even if no alteration of temper in the intermediate furnace is intended) the steel in the crucibles to be melted harder in the first instance, which is an advantage.

The accompanying engraving shows the furnace for carrying out the intermediate process, and also the plan for adapting this invention to steel works in which the Bessemer process for making steel is employed. Fig. 1 is a transverse vertical section, showing the Bessemer converting vessel B, and the crane A, with the receiving vessel C, from which the molten metal is being discharged into the intermediate furnace D. This figure also shows another crane E, with another and larger receiving vessel F, into which the molten steel is run out from the intermediate furnace D, and is conveyed by the crane

E to the mould G to form the casting. Fig. 2 is a longitudinal vertical section of the intermediate furnace, and fig. 3 is an end view of the same. The intermediate furnace D is built so far below the floor of the steel melting house that the top of the furnace coincides with the floor of the former. The pits H, to receive the mould G, are placed convenient to the furnace; and suitable foundations for cranes are also placed beneath the level of the floor of the melting house.

In order to prepare the intermediate furnace for working, the furnace is heated by the fuel in the fireplace, to which end the doors a are opened, and by the natural draught thus obtained, the heat is brought up to almost a white heat. In order to afterwards increase the heat the doors a are closed and the valve b, in the blast conduit pipe, is opened. The blast is thus driven under the firebars by means of a fan or cylinder blast, and causes a very active combustion of the fuel and the heat in the furnace is thereby much increased. In order to increase the heat still more, and to burn more completely all the gases (arising from the fuel) two openings c c are made above the fire bridge. A blast from any convenient source is made to pass through these openings, which are controlled by suitable stopcocks. When it is necessary to rake the fire to clear the firebars or to supply coals to the fireplace, the valve b must be closed and the door a opened. The molten metal from the receiver C is poured into the intermediate furnace through the funnel d, which must be made red hot in a suitable oven before it is put into its place in the furnace, where it should be placed about fifteen minutes before it is required to be used. The molten steel is poured into the intermediate furnace through the funnel d, and after the necessary quantity of metal is in the furnace the funnel is removed, and the opening in the roof is closed by a removable lid or stopper. Before filling the furnace with steel, any cinder or other impurities which may have accumulated in it must be removed. Should any slag get into the exit flue e of the furnace, it is removed through the opening h. When the steel is ready for casting, the furnace is tapped at g; two or more tap holes are preferred, so that if it should be found desirable not to run off the whole charge of molten metal at one operation, the tap hole or holes that has or have been used may be plugged

up temporarily with fireclay; and as a tap hole which has been used cannot readily be reopened in the same place, another tap hole or other tap holes may be employed for running out the remainder of the charge. In order to operate upon steel melted in the ordinary crucibles or other melting furnaces, the contents of each crucible are simply poured through the funnel d into the intermediate furnace, or the contents of several crucibles are gathered in a receiver previously heated, and then that receiver emptied into the intermediate furnace.

After the Bessemer process has been completed in the converting vessels, the contents of the converter are emptied into the receiver C, held by the crane A. The crane is then raised by means of hydraulic power, and the receiver C is brought round over the funnel d of the intermediate furnace. The plug c' of the receiver C is then drawn up, and the receiver empties itself into the furnace. After the steel has been subjected to the required degree of heat in the intermediate furnace until it is "overmelted" or "superheated," it is allowed to flow through the tap holes g into the large receiver F, which is held by the crane E. When this receiver is brought over the mould G placed in the pit H, the steel is allowed to flow into the mould.

When it is desired to add to the steel coming from the Bessemer converting vessels, steel melted in ordinary crucibles, either for the purpose of improving the quality or of increasing the quantity of the mass, the crucible melted steel may be poured by single crucibles or from a receiver into the intermediate furnace through the funnel d, either before or after the Bessemer steel has been poured into the intermediate furnace. The contents of two to four or even more of the Bessemer converting vessels can be successively poured into the intermediate furnace according to the capacity of the furnace, and the construction of the steel works. The molten steel may remain half an hour or longer in the intermediate furnace, and in so long a time it is practicable to make a second conversion in the Bessemer converting vessels, and this extra quantity can be added to the first in the furnace.

If it be desired to obtain access to the under side of the firebars while the furnace is in operation, this must be done from the ashpit I in the air channel, to which there are two doors f and

WHEELS AND AXLES.

FIG. 1

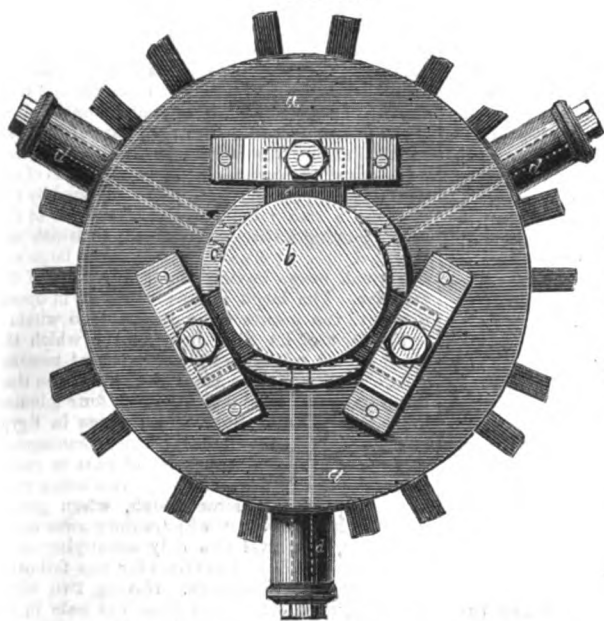
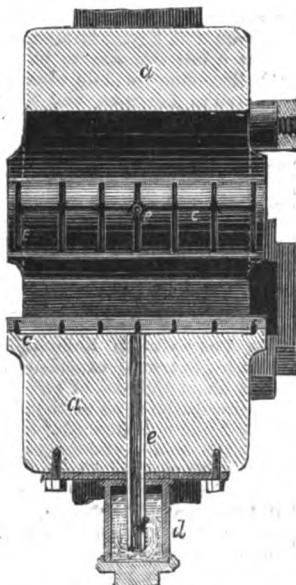


FIG. 2



f, fitted airtight, as shown in fig. 2. The fireman enters through the door *f*, and then closes the same, and opens a slide or valve *i* of the second door *f*¹, in order to counterbalance or equalise the pressure of air, after which the door *f*¹ may be opened. On returning, the fireman closes the door *f*¹, and opens the slide *i* of the door *f*. The compressed air in the space between the two doors will then escape, and the door *f* may be opened.

WHEELS AND AXLES.

HERETOFORE it has been generally the practice to fix or key the wheels of railway carriages to the axles so that the wheels and axles revolve together, but in some cases the wheels of such carriages have been arranged to turn on their axles whilst the axles are fixed or retained from rotating. According to this invention, patented by Mr. Williams Rice, of Market-place, Boston, Lincoln, the wheels are not only free to turn on their axles, but the axles themselves are free to turn also. The ends of the axles as heretofore are received into bearings such as are now employed, and are lubricated as heretofore, and the centres of the bosses or naves of the wheels are suitably formed to turn freely on the axles, they not being keyed thereon. The parts of the axles on which the wheels are received and the interior of the naves are prepared and fitted accordingly, and they are lubricated either from the same boxes as the other parts of the axles, or separate provision is made for lubricating those parts. In like manner the wheels and axles of other carriages may both be made free to turn.

In the accompanying engraving fig. 1 shows a side elevation of the nave or boss of a railway wheel, the axle therein being shown in section, and fig. 2 shows a transverse section of the nave or boss of the wheel without the axle. *a a* is the nave or boss of the wheel, which, in place of being made to be keyed fast on the axle *b* as is generally the case when axles such as those used in railway carriages are employed, the nave or boss is made to turn freely on the axle, at the same time the part of the axle which is within the boss or nave is formed and turned in a suitable manner for receiving the boss or nave and for allowing it to turn freely on the axles. Provision is also made for retaining the boss or nave of the wheel from sliding on the axle in a direction from end to end thereof. In the interior of the nave there are grooves *c c* for the free passage and distribution of lubricating fluid, or this may be accomplished by other arrangements. Suitable vessels *d d* are shown to be applied to the nave or boss to contain lubricating fluid, which is conveyed to the interior of the nave or boss by tubular passages and wicks *e e*, or other means of supplying lubricating fluid may be employed in place of the arrangement shown. The axle is turned down so as to form a fixed collar at *f*, whilst on the other side of the boss or nave a

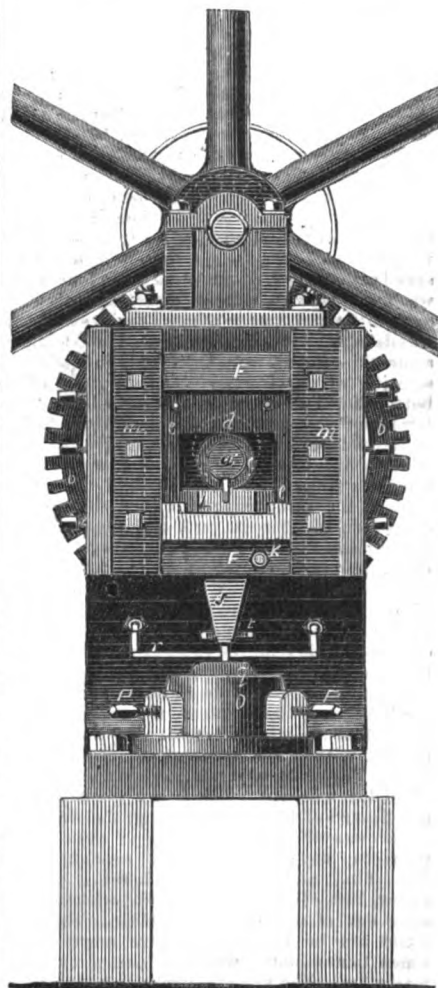
screw ring or collar *g* is applied, which, when screwed into position, is fixed by a key or otherwise; *h* is the ordinary neck of the axle, which turns in the ordinary bearings or boxes of railway carriages. In order that the interior of the nave or boss of a wheel may at all times fit the part of the axle on which the boss or nave turns, wedge-formed pieces *i i* are used, which are received into recesses in the nave or boss. These wedge-formed pieces are arranged to be set up from time to time by screws, screw nuts, and lock nuts, but the interior of the naves or bosses of wheels may be otherwise arranged so as to admit of adjustment when the interiors of the naves or bosses become worn.

PUNCHING MACHINES.

MR. W. BAYLISS, of Monmore-green, Wolverhampton has patented improvements in machinery for punching, pressing, and shearing metals, which may be applied to the machines already in use if necessary, and are confined entirely to the manner of actuating the part that carries the punch, shear, or die, and which parts in the machines as now constructed are constantly at work, by means of the eccentric, in connection with the gear and fly-wheels as they revolve or are in motion; and this continuous action of the punch, shear, or die, is objectionable for a variety of purposes for which such mechanical appliances are necessary, a great deal of scrap and other injurious consequences being unavoidably produced with the machines as ordinarily constructed. The improved arrangement entirely obviates these objectionable and expensive results, and consists in simply forming or applying on the front of the moving bolt or slide that carries the punch, shear, or die a metal support with end and side projections for guiding a piece of steel or iron of an equivalent thickness to the throw of the cam or the range of action to be given to the tool or die, and to this piece of metal or movable regulator a small handle is attached for the convenience of the workman. These improvements, though simple, are of great benefit and use for many descriptions of work on which such machinery is used, and may be constructed to work upwards or downwards, that is, in each or both directions if required, and may be set up vertically or horizontally or in any angular direction.

The engraving represents a front elevation of an ordinary punching and shearing machine, with the improvements applied to it, the gearing and fly-wheel, fast and loose pulleys, stand, and general form being similar to the apparatus now commonly in use. *a* is a circular eccentric pin formed on the outer end of the shaft on which the toothed wheel *b* is placed. On the pin *a* the wheel or roller *c* is placed. This eccentric pin with its roller *c* works in the square opening *e*, formed in the part *f*, which part is called the bolt or slide. To this bolt or slide the punch, shear, or other tool or appliance is applied con-

trally from its lower end marked *j*, and which punch or tool is held in by a small taper bolt, held in position against the side of the tool so as to securely hold it by the nut *k*. The part *F F* is adjusted centrally in position by the two parts *m m*, which are held in by the square-headed bolts. By this means a steady vertical action is permitted to the part *F*, and effected upward by the periphery of the wheel *c* on the eccentric pin *a*, pressing against the top side of the square opening *e e*, and so well does this part *F* fit that when elevated it will remain there, and not fall by its own gravitation; by this it will be seen that the eccentric pin and roller would continue to work around while the bolt or slide with the punch or tool will be quiescent or stationary at the will of the workman, who effects the depression of the tool by placing under the roller *c* when at its highest throw the movable bed marked *L*, so that, as the roller on the eccentric pin passes around, it depresses the punch, shear, or die to the extent of the eccentricity of the pin *a*, or the thickness of the movable bed *L*. This movable bed is actuated by a bent hook,



and is prevented from being pulled too far out by stops formed on it for that purpose. As the punch or tool is represented at its lowest range by means of the movable bed being placed in under the roller *c*, so it will be seen that as the eccentric pin passes around, so the punch or tool will be lifted; and when lifted by the elevation of the bolt or slide *F* the part *L* has only to be pulled out at the pleasure of the workman, when the shaft with its fly-wheel may continue to revolve without imparting any action to the punch until the workman has again adjusted his work and is prepared to call into action the desired tool. *O* is simply a bed held in position by set screws in the ordinary way marked *p p*, passing through ears cast or formed with the general stand. *q* is the die into which the punch passes, taking before it the metal it has removed in punching the hole through the work under operation, while the part *r* is simply a gauge, being a piece of iron bent at right angles and extending back and held on each side of the standard by set screws that it may be advanced or retired as required. A forked lever secured to the stand of the machine permits the punch to work down between the front forked part

marked *t*, simply to release the work from the punch when it is lifted up by the revolution of the eccentric, which eccentric with the working parts may be covered over with a front plate without interfering with the working of the machine; its position is indicated by dotted lines.

THE "BELLEROPHON."

THE above vessel entered on the preliminary official trial of her machinery yesterday week. When she started, her draught of water forward was 16ft. 4in., the quantity of coal on board being 174 tons, and other stores about 50 tons, and her displacement was ascertained to be 5,600 tons. Her screw was set at a pitch of 21ft. 8½in., with the emersion of the upper edge of 1ft. 11½in. On reaching the measured mile at the Maplin Sands, it was determined to test the vessel, although at the time the screw could only be brought to realise a maximum of 53 revolutions, while the contract guaranteed that the revolutions were to be 70 per minute. Four runs were taken with the following results:—First run, time, 3min. 57sec.; speed, 15.190 knots; steam, 22lb.; vacuum, 26½; revolution of engines, 59; second run, 4min. 54sec.; speed, 12.245 knots; steam, 22lb.; vacuum, 26; revolution of engines, 58; third run, 4min. 9sec.; speed, 14.457 knots; steam, 22½lb.; vacuum, 26½; revolution of engines, 57½; fourth run, 4min. 39sec.; speed, 12.903 knots; steam, 21½lb.; vacuum, 26; revolution of engines, 55½. The above readings would give an average speed of 13.698 knots, but from the circumstances stated, and from the fact that the engine showed a falling off in the working of the screw after each run, no proper estimate can be formed of the true speed of the vessel. At the close of the fourth run it was found that so many circumstances militated against the trial, among others inferior coal, that it was determined to discontinue the speed trial, and some experiments were then made in testing the steering of the frigate. The adoption of the balanced rudder on board a vessel of the "Bellerophon" class was at first considered to be a doubtful experiment, but the results of the trials were in the highest degree satisfactory. With the helm at port, and the angle of the rudder 32 deg., the helm was put over in four turns by eight men in 23 secs., and the complete circle accomplished in 4 min. 30 secs., and the half circle in 1 min. 50 sec., with the helm to starboard the rudder was brought to an angle of 37 deg. by 8 men in 25 sec. The value of the balanced rudder in a vessel of the "Bellerophon" class, which is required to steer readily to enable her broadside battery guns to be worked with advantage, will be apparent when, in the case of the "Warrior," for instance, the average time in making the circle is 8 min. On the following day the trials were resumed, during which, although the previous day's rate of speed was exceeded, it was nevertheless not what had been anticipated of her. On starting, the draught of water was slightly in excess of that on the previous day; her forward draught being 16ft. 6in., and that aft 23ft. 6in.; pitch of screw, 21ft. 8½in.; diameter, 23ft., with the upper edge out of the water 1ft. 11½in. The screw could not be made to revolve more than 53 times per minute, which appeared to be the maximum. The vessel's displacement was 5,630 tons, or less than 1,000 tons of her true displacement when at her deep draught. On the measured mile seven runs were taken, with the following results:—First mile—time, 5 min.; speed in knots, 12.000; steam, 22lb.; vacuum, 26½in., revolutions of screw, 57. Second mile—time, 3 min. 57 sec.; speed 15.190 knots; steam, 22lb.; vacuum, 26in.; revolutions of screw, 53. Third mile—time, 4 min. 59 sec.; speed, 12.040 knots; steam, 23lb.; vacuum, 26½in.; revolutions of screw, 56. Fourth mile—time, 3 min. 56 sec.; speed, 15.254 knots; steam, 24lb.; vacuum, 25½in.; revolutions, 58. Fifth mile—time, 4 min. 56 sec.; speed, 12.163 knots; steam, 24½lb.; vacuum, 26in.; number of revolutions, 57. Sixth mile—time, 4 min. 1 sec.; speed, 14.938 knots; steam, 24lb.; vacuum, 26in.; revolutions of screw, 58. Seventh mile—time, 4 min. 47 sec.; speed, 12.543 knots; steam, 24lb.; vacuum, 26in.; revolutions, 57½. Rejecting the first of the runs, so as not to interfere with the calculations, the first means of the above figures will be 13.615, 12.647, 13.708, 13.550, and 13.741 knots; and the second means 13.631, 13.677, 13.629, and 13.645 knots, giving the true mean speed of the ship as 13.645 knots per hour. With regard to the "Bellerophon"

not having made a minimum speed of fourteen knots, the cause must be sought for chiefly in the screw, the mistake being that the ship is fitted with a four-bladed screw only a little smaller than that supplied to the "Minotaur," which is 100ft. longer, and driven by engines of one-third greater horse power. Under the comparatively unfavourable circumstances, the trials, however, allow a fair estimate to be formed of what the "Bellerophon" will do when fitted with a screw adapted to her size, and the character of the machinery placed in the vessel to drive it. One extraordinary result of the trials was the development of a negative slip—the ship overrunning her screw to an unexampled extent. This phenomenon has given rise to much speculation, and many are the attempts to account therefor. A letter on the subject will be found in our correspondence columns.

STEEL RAILS.

THE Pennsylvania Railroad was the first in America to try the experiment of steel rails. A lot of about 150 tons of cast-steel rails was procured near the close of the year 1863, but some delay being experienced in slotting them to receive the chairs and spikes, they were not laid down until the early part of the past summer, when they were placed on sidings in the yards at Altoona and Pittsburgh, where they would be subjected to considerable use. These rails appearing very brittle, it was not deemed expedient to place them in the main track where they would be passed over by trains at high rates of speed; none of them, however, have been broken in the track, and they exhibit little or no appearance of wear. Some other steel rails have recently been ordered, of a quality combining more toughness with a sufficient degree of hardness, and experiments will be continued to test the relative merits of the several descriptions of rail. Much confidence is felt that the result of the trials will demonstrate the superiority of steel rails for general use. An experiment made some months since to convert the upper surface of iron rails into steel, without affecting the strength of the remaining portion of the metal, has not met with success. The President of the Pennsylvania Road, in his annual report, speaks of the successful trial of steel rails, but states that their great cost at present precludes their general introduction.

HEAVY AMERICAN LOCOMOTIVE.

THE Jersey City Locomotive Works have recently completed a very heavy engine for the Atlantic and Great Western Railway, which has some points of novelty in the general arrangement of the details. The weight of the engine is 42 tons, of which 13,800lb. are on the two small wheels forward, and the remainder on the three pairs of driving wheels. The wheels are 4ft. in diameter, and have Krupp's steel tyres. The cylinders are 18in. diameter by 24in. stroke, and the steam ports to the same are 1in. by 14in. The exhaust is 2½in. by 14in. The drivers are connected, and have flanges on the tyres, and the crosshead works on guides above the piston rod. The guides consist of two steel bars, about 2½in. square, and the crosshead has a bearing of nearly 20in. on them. There are brass gibs fitted to the crosshead, but the wear of them is a source of trouble. The boiler has 180 iron tubes, about 12ft. long, and burns soft coal. The tender weighs 20 tons, with coal and water. The water capacity is 2,000 gallons, and the coal 6,000lb. With this amount of fuel it is stated that the engine can run one division of the Erie Railroad, which is about 120 miles.

COMPOUND COTTON PRESS.

At the Engine Works of Messrs. Routledge and Ommanney, Salford, may be seen one of Ashcroft's patent combined steam and hydraulic cotton presses, with revolving boxes. In this new form of cotton press a combination of steam and hydraulic power is brought to bear upon the cotton to be compressed in a simple but effective manner. The entire apparatus stands in a space 38ft. high, 14ft. long, and 12ft. broad, and consists of a hydraulic press under the usual cotton-baling box, a steam engine being placed above it which gives motion to the whole. A second cotton box is placed in a position adjoining the first box, and is attached thereto with brackets, which revolve round one of the columns of the press and are supported by gun metal balls, thus

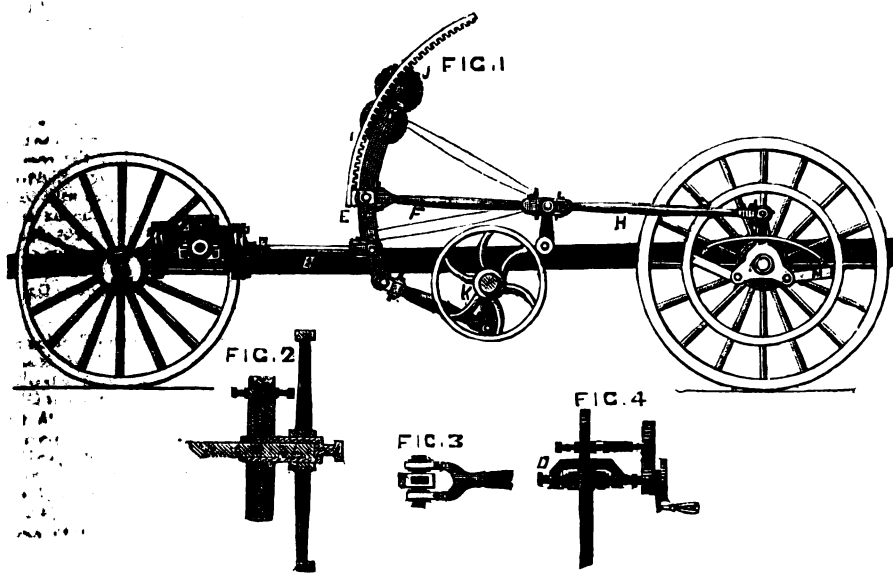
reducing the friction to a small point. The two boxes are of cast iron, strongly ribbed, and are planed interiorly to a perfectly true and smooth surface to avoid friction during the operation of pressing. The second box is thus outside the framing of the press, and is being filled with cotton during the process of pressing and hooping the bale in the first box. As soon as that operation is completed, the two boxes are swung round very easily by two men until the second takes the place of the first bale within the press apparatus, the operation being very similar to turning a locomotive on a railway turntable. The application of the steam and hydraulic power is produced by the action of a steam cylinder, at the head of the press, moving a strong crosshead, to which are attached four hydraulic pumps, two large and two small ones, having the full stroke of the cylinder. The large pumps continue in operation until the cotton is compressed to within a few inches of its final point, after which the small pumps complete the operation of pressing a bale of Egyptian cotton of 400lb. The time taken to press and hoop a bale is four minutes, the usual time in hydraulic presses in Egypt being about fifteen minutes. The advantages of this press are rapidity of rise of ram in consequence of the first few feet of the rise being made by the steam only, after which, when greater pressure is required, the hydraulic power comes into force, the total rise only occupying about forty-five seconds and the time for the fall of the ram is twenty-five seconds. Having two boxes, one is being filled at the time the bale in the other is being pressed and tied; on the completion of one bale the other box is easily moved under the press, in consequence of the boxes revolving on one of the columns of the press; great saving of time in consequence of the quick rise and fall of the ram, and the construction of revolving boxes; saving of freight, from the great density to which the cotton is pressed, viz.: from 23lb. to 30lb. to the cubic foot, against about 11lb. as obtained by the ordinary hydraulic press; saving of labour,—from the simplicity of the press the whole of the pressing can be managed by one man, who, with a lever, regulates the working of the press, in the place of the number of men required to work the ordinary pumps, press, and gearing; and, finally, the saving of fuel is estimated at one-fourth, in consequence of the arrangements of the working parts of the press and pumps and steam power to work the press being combined in one machine.

IMPROVED STEAM CARRIAGE.

THE ingenuity of inventors and engineers has, for many years, been directed to perfecting the steam carriage so as to adapt it for traffic on common roads, and thus open another field for usefulness to the steam engine. In years gone by steam carriages ran on common roads in England, and some were in operation for months, carrying passengers between different points with regularity. From various causes, the chief one being unpopularity, they were discontinued, and we believe there are none now at work in the United Kingdom except traction engines. In France it appears that a line of steam carriages has been established between two provincial towns, but no particulars are given of the engines or their details. In America the steam carriage has been the subject of much thought, and many valuable improvements have been made in it. Among the later machines may be classed the self-propelling steam fire engines of Lee and Larned, and Latta, of Cincinnati. One of Lee and Larned's engines is occasionally in use as a steam fire engine in New York, several of them were built years ago, but the "John Storm" is the only one now in existence; the others were torn to pieces after short service. Mr. Richard Dudgeon, of New York, built a steam carriage which ran publicly in that city on several occasions. It was destroyed by fire in the Crystal Palace. Mr. S. H. Roper, of Boston, has lately built a steam carriage which weighs but 450lb. These are not the only ones ever constructed there. Mr. Perry Dickson, of Erie, Pa., has recently invented a steam carriage for common roads that can also be instantly converted into a stationary engine without disconnecting any part whatever. The machine was constructed during the past winter, and is now in successful operation.

The distinguishing feature of this engine is the arrangement for graduating the power of

IMPROVED STEAM CARRIAGE.



the engine to the work to be done, so that heavy grades or stiff miry ground can be ascended or run over with ease. The arrangement of the machine to effect this is shown in the accompanying engraving, which we take from the *Scientific American*, and consists in applying the power of the engine nearer to or further from the axle, and in this way exerting greater force upon the wheels when unusual obstacles oppose them. This alteration can be made at any time while the engine is in operation. There is another novelty in the way the power is transmitted to the driving wheels. This consists in a toggle-joint movement, so arranged that one arm bites on the inner face of a metallic wheel bolted to the driver—thus dispensing with a crank and allowing the engine to work freely in all positions or inequalities of the ground; it also allows the side levers to make a short or long stroke.

In the engraving, fig. 1, the cylinder A is attached to the main frame B, and oscillates thereon. The piston rod connects to a quadrant C, which has centres or bearings at D, so that when the engine is in motion the quadrant will have a rocking movement to and fro. On this quadrant there is a sliding head E, to which the connecting rod F is jointed. This latter rod gives motion to a transverse rock shaft, from which the main rods H run to the driving wheels, as before explained. The connecting rod F is jointed, and has a forked end, which enables it to embrace the link, and the sliding head is furnished with a rack I, through which the head is raised up or lowered down on the quadrant; suitable means are provided to retain the sliding head E in its working position wherever it may be placed. Fig. 4 is a front view of the quadrant, showing the method by which it is operated, that is, through the wheels, J. There is a small fly-wheel K attached to the frame, which serves to steady the motion of the engine and operate the valves thereof; it is also a driving pulley to run any kind of machinery independent of the carriage, if it is ever needed. By these arrangements—that is, the sliding link for regulating the amount of power to be transmitted to the driving wheels, and the substitution of the toggle-jointed arm acting on the driving wheels for the crank motion, it is possible to use one cylinder instead of two, thus simplifying the apparatus, reducing the weight, and enabling the machine to be started at any time, for there are no dead centres to overcome, and the motion is easy and continuous. The machine is capable of going in any direction, either backward or forward, by throwing either set of the toggle-jointed arms M in or out, and it is steered in front by gear L there placed. When the sliding head is moved up until it is in line with the rock shaft it is then at the point of no motion, but the engine yet runs while the carriage stands still. In this way the power may be used for driving pumps or other machinery of any kind whatsoever, and this without disconnecting any rod. The inventor states that the engine constructed is eight-horse power, weighing fifty-three hundredweight—which is some ten hundredweight more than is necessary, it being the first

one ever made on his plan. He has ascended grades of one foot in four, and finds that climbing steep grades is only a question of time.

Correspondence.

NEGATIVE SLIP.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—The recent trials of the "Bellerophon" have proved that this vessel, with a four-bladed screw, has what is called negative slip. While the screw advances at a speed of 12½ knots, the vessel goes at the rate of 13½ knots; and, as this phenomenon remains unexplained, I will venture to offer an explanation which I have long believed to be the true one. It is quite certain that no paddle wheel steamer ever went even so fast as the wheels revolved, and therefore all slip with paddle wheel vessels is positive. This being the case negative slip can only arise from some peculiarity in the propeller. The four-bladed screw of the "Bellerophon" acts as an ordinary screw is supposed to do in driving the vessel forward, and a cylinder of water is driven aft by its action as a screw; but it acts also as a fan driving outwards a quantity of water by its centrifugal action; and, the vessel being in motion, this extra quantity of water comes from forward of the screw, and entering near the centre is driven outwards at right angles to the screw shaft. The more blades the propeller has, the more fan-like is its action, and vice versa. I think that an ordinary fan worked like a screw propeller would produce some motion on a vessel; it would at least be an interesting experiment.

I am, Sir, yours, &c.,
1, Clifford's Inn, September 26. T. Mor.

Meeting for the Week.

Mon.—Society of Engineers.—"On Sugar Machinery," by Perry F. Nursey, Esq., at 7.

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. R. 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.—V. Y.—F. C. R.—J. N.—H. W.—T. M.—G. O.—J. W. H.—J. N.—W. W.—E. E.—J. N.—J. W. H.

ANSWERED BY POST.—F. O. R.—G. C.—Capt. N. THETA's inquiries can only be answered by a Patent Office search.

Dr. W. FREUND (Prussia).—We believe the address of Mr. W. E. Carrett, the inventor of a coal-cutting machine, is Leeds.

THE PRACTICAL MAN.—Your letter is not authenticated.

Miscellaneous.

According to the British gunboat "Urgent," the Atlantic cable buoys have disappeared from the place where they were anchored.

The Liverpool, New York, and Philadelphia Steamship Company has contracted with Messrs. Tod and M'Gregor, of Glasgow, for a new steamer to be 15ft. longer than the "City of Boston" brought into use this summer. The new steamer, which will be named the "City of Antwerp," will be 327ft. long by 39ft. beam, and her engines will work up to 1,450-horse power. Mr. A. Denny, of Dumbarton, has launched a paddle intended for towing purposes on the Hooghly. She is to be fitted with powerful engines by Messrs. Denny and Co., and is the fourth vessel of the same class launched this year at Dumbarton.

On Tuesday last, the East London Railway Company took formal possession of the Thames Tunnel. This line, when completed, by the junction of the narrow-gauge lines on the north with those on the south side of the Thames, will afford to the east end of London the facilities already enjoyed westward of a shorter through route for all kinds of traffic, and especially coal, over the Brighton, Chatham, and South-Eastern lines.

Professor W. A. Miller recently stated before the British Association that an extensive branch of industry was now springing up in the improved methods of voltaic deposition of the metals. Well had by the use of an alkaline solution of tartrate of copper, contrived to coat iron and steel with a tough closely adherent sheathing of copper, by simply suspending the articles to be coated by means of a wire of zinc in the metallic bath. No battery was required. Lead and tin might in a similar manner be deposited on copper, iron, or steel, if the oxide of tin or of lead was dissolved in a bath of strong solution of caustic soda.

From a periodical return on French railways just issued by the Minister of Public Works, it appears almost certain that for the next seven years the work of railway construction will proceed at the rate of 500 miles per annum. The new lines on hand, and mapped out, do not sustain the productibility attained by the old networks; nevertheless, with the help of the State guarantee of 4½ per cent. upon the capital engaged they will be carried out systematically. The French demand for rails and railway iron and plant can then be calculated with great exactitude.

The *Shipping Gazette* says the discovery has been made in Paris that in the maps of the last century two small islands were indicated between Ireland and Newfoundland—one called by the French *Ile Verte*, at about lat. 47° N. and long. 29° W. from Paris; the other called *Ile Jaquet*, lat. 47° N., long. 42° W. In the maps of the present century these islands are not marked, but it is thought probable by the French that they still exist; if so they could be utilised in the laying down of the electric cable.

A special meeting of the coal and ironstone masters of the North Staffordshire district was recently held at Stoke-upon-Trent. The object of the meeting was to receive and consider the report of a committee, appointed on the 18th of August last, upon the subject of establishing a fund for supporting members of the association in resisting unjust demands on the part of their men. The committee reported that it was desirable to establish such a fund, to be formed by a contribution from the members, per ton of coal and ironstone raised, which should be available for an allowance to those masters who, with the sanction of the association, resist a strike of their men; and that the committee of management should have power to make calls in advance, so as to render the fund immediately available.

Another serious gunpowder explosion occurred last Saturday morning, the scene of the disaster being the Ewell Powder Mills, carried on by Messrs. Sharpe and Davy, situate a few miles distant from the village of Ewell, near Epsom. The accident occurred in the press mill, containing one hydraulic machine for compressing wet powder into cakes. Two labourers who were at work there are said to have been blown to atoms. Of the press house not a vestige remained, and the iron hydraulic press, which stood a fixture in the centre, was carried into an adjacent field by the force of the explosion. It is supposed that the explosion was occasioned by some grit or hard substance getting into the press and causing a friction, which ignited the powder. The explosion was seriously felt at every place within twenty miles of the spot.

Few results, perhaps, were more unexpected than those obtained by MM. Deville and Troost upon the permeability to gases of certain dense metals at elevated temperatures. They have proved that platinum and iron, when white-hot, become for the time porous, and are rapidly permeated by hydrogen, which will even pass out under the pressure of the atmosphere and leave a vacuum almost perfect within the tube.

The Society of Natural Science of Cherbourg has been occupied lately by an inquiry which interests farmers as well as the inhabitants of the seacoast, as to the best means of utilising sea wrack for agricultural and industrial purposes. The society has drawn out a programme in which the following questions are proposed:—1st. What is the best period for gathering sea wrack from rocks? Can it be collected twice in the year? Ought this sea weed to be cut off the rocks or torn from its roots? 2nd. What are the best means of meeting the interests of agriculturists as well as those of the manufacturers of iodine and of salt-varech? 3rd. What is the best manner of increasing the manuring properties of sea wrack? Replies to these queries, in the form of a pamphlet, must be sent in to Doctor le Jolis, Cherbourg, before the 1st July, 1866, and may be written in French, English, or Latin. The prize for the best answers will be a gold medal of the value of 500f. (£20).

As was predicted at the time the North Staffordshire puddlers and shinglers were on strike, the extraordinary wages they were proved to earn when at work, frequently amounting in the case of men of the latter class to 20s. a day, have brought upon them the unwelcome attentions of the Board of Inland Revenue. A large number of men have this year been assessed to the income-tax, and the majority have paid it with a pretty good grace, but two of the shinglers in the employ of Earl Granville at Hanley persistently refused to pay, and they were accordingly apprehended. The defaulters rather than undergo a sojourn in Stafford Gaol, paid the tax at the last moment, and heavy expenses besides.

The waters of the Seine are at present so low that at the lower end of the Quai de l'École, between the Pont Neuf and the Pont des Arts, a long strip of land may be seen above the water on which the beams which form the limit of the watering-place now rest quite dry. Notwithstanding this extraordinary lowness of the Seine, large boats can still come up to Paris, and the Seine at Tamise, which runs between London and Paris, has just arrived at the Port of St. Nicolas, but on entering the Seine it was found necessary to discharge part of her cargo in lighters.

A new toy has been lately invented in France which bids fair to supplant the roseate balloons so eagerly acquired by children. It consists of a serpent composed of quicksilver, sulphur, &c., which, lighted by means of a common lucifer match and projected into the air, performs a series of marvellous evolutions. But against the glittering fascinations of this tempting toy, the children of France are warned by an article in the *Courrier de la Moselle*, in which they are informed that while this flaming serpent whirls and meanders in the air it emits mercurial vapour of the most pernicious nature.

In consequence of rumours that the *Crumlin Viaduct* was not in a safe condition, Capt. Tyler, at the instance of the Board of Trade, has made an examination and applied tests which satisfactorily prove the stability of the bridge. The first test applied was that of running a train of seven engines and their tenders (weighing together 240 tons) from one end of the viaduct to the other at different rates of speed. This train exactly covered two spans of the viaduct. After this, seven engines, with their tenders, were placed on one line, and one powerful engine and its tender attached to fifteen large trucks heavily loaded with coal and iron (each truck and its contents weighing fifteen tons), were placed on the other line. These enormous masses, the greatest that could be put on, were simultaneously moved backwards and forwards at various rates of speed, the deflection and lateral oscillation being carefully noted. It is satisfactory to find that after eight years' wear, the deflection of the girders does not exceed what it was when the viaduct was first tested prior to its being opened for traffic purposes.

Professor Carlevaris, of Mondovi (Italy), has devised an economic method of employing the magnesium light. He stated in a recent memoir that when magnesium wire was ignited in atmospheric air, or pure oxygen, the most luminous effects were not manifest till a certain quantity of oxide had been formed and was raised by the heat produced to an exceedingly high temperature. The light in this case, as in the combustion of carburetted hydrogen, as in that of hydrogen in contact with platinum, and as in the Drummond arrangement, is derived from the solid particles raised by the flame to a great heat—a heat which dissolves and volatilises platinum, but leaves the oxide of magnesium solid, fixed, and intact. To raise the oxide to the temperature necessary to give the greatest light, it should be presented to the flame in as small a quantity and as large a volume as possible, which is done by employing a spongy oxide obtained as follows:—A piece of chloride of magnesium is exposed to the flame of the oxyhydrogen blow-pipe, in contact with a piece of carbon. The chloride of magnesium is rapidly decomposed, leaving the spongy oxide, which gives the light in question.

There is no doubt but that iron is just superseding timber for roofs in Bengal. In Bombay a large wrought-iron roof was put up some two years ago over a saw mill works. In fact, wood is so expensive compared with its durability that we believe, when iron girders are obtainable, no more wooden beams will be used.

Two meteorologists, the brothers Blatter, have just taken up their residence for one year in a small building on the St. Teodolo mountain, one of the Alps, at an elevation of 11,367ft. above the level of the sea, or 3,300ft. higher than the St. Bernard, for the purpose of making meteorological observations. This is looking at science from a very elevated point of view.

The Lehigh Coal and Navigation Company in America have had recently manufactured at the wire mill of Messrs. Hazard and Company two immense wire ropes. The largest of the two has been conveyed over the Lehigh Valley Railroad, and will be placed on the Canal Company's plane near Wilkesbarre. Its length is 5,200ft., which is within 80ft. of a mile; it is 15.8in. in thickness, and weighs 22,480lb.

The Boston and New Orleans Steamship Company recently purchased the wreck of the "Caledonia," which went ashore on Cape Cod—having cargo in both ends, and empty coal-bunks in the centre, she parted and filled with water in the middle compartments. The other compartments, however, were secure, and much of her cargo was removed after she broke. In this condition she was purchased in February, 1863, by three gentlemen. Many difficulties were experienced in the endeavour to get her afloat, and it was not until the following October, and after it had been discovered that she must be plated over the break in the bent state in which she lay, that, during a severe storm that set the sand bank surrounding her in motion, she moved out toward deep water. A year of delay followed, awaiting the construction of Simpson's Dock, the only one large enough to receive her. There she was straightened and about fifty feet cut from the centre, with the exception of the iron keel, which had only been bent. The space was then built up and plated in harmony with the original lines. After this she became the property of the company.

As the various industrial exhibitions recently held have only included the artisans in the districts in which they have taken place, to the exclusion of the skilled workmen of London, the latter are determined to have an exhibition of their own. So we find a committee, with the Lord Mayor at their head, taking active steps to promote a "City of London working classes Industrial Exhibition," which it is proposed shall be held if possible in November next at the Guildhall. A guarantee fund of £5,000 is proposed, and of this amount about one-third has already been subscribed.

The battle of the gauges is being fought over again in India. The head officials of the various Indian railway companies are discussing the relative advantages of the Indian gauge as compared with the English narrow gauge for railways. There are four gauges, viz.:—the English broad gauge of 7ft.; the English narrow gauge of 4ft. 8½in.; the Irish gauge of 5ft. 3in.; the Indian gauge of 5ft. 6in. For a country like India the officials are almost unanimous in preferring the Indian gauge to any other. It avoids the defects of the broad gauge, whilst it adopts most of the advantages belonging to the narrow gauge.

The experiments which have been made in France from time to time with China grass are being followed up by the necessary steps to carry the matter into practical operation. A company is announced as having been formed for the preparation, combing, and cottonisation of China grass. The composition of the new company proves that the expectations raised respecting the economic application of this well-known but little used fibre are entertained by practical men.

Messrs. Guinness and Company employ in their brewery about 300 men, through whose hands no less than 500,000 gallons of water, either in its crude form or manufactured state, pass daily. Thirty tons of coal per day is the average consumption of fuel, and this with the water is used to extract the virtue from, in round numbers, 1,600 cwt. of grain per day. The "pieces" in which the manufactured article is stored number sixty-five, besides twenty others in course of erection, and these contain from 1,500 to 2,000 hogheads of 52 gallons each.

Referring to the negative slip of the "Bellephophon," "X" in the *Times* says that he has experienced it considerably in large steamers with four-bladed screws, and the reason he assigns for it is that the screw propels a larger body of water from it than is required to overcome the resistance of the vessel in passing through the water at the same speed as the screw, and that the vessel must therefore pass through a greater space of water than is due to the travel of the screw to supply the superabundance of water thrown backwards by it. This, of course, involves an increase of speed of the vessel in proportion to the increased quantity of water required to supply the screw.

The sailing frigate "Terpsichore" 18, which is to be handed over to Mr. Donald McKay, of Boston, U.S., for the purpose of showing the value of torpedoes as an agency for destroying vessels of war, has been denuded of her stores and gear, so as to leave her a mere empty shell. To test the value of the torpedoes thirty of them will be placed under the frigate and discharged, these consisting of six large and twenty-four smaller shells, which are now in course of manufacture for the purpose. The test shell will be planted in the mud, below the vessel's keel, forty-eight hours before exploding. Eighteen of the smaller torpedoes will be charged with 60lb. of powder, and six with 75lb. each; the six large torpedoes will be charged with 460lb. weight of gunpowder, the whole being sufficient to destroy the largest iron-clad ship in the English navy. The powder used for the torpedoes is the same as that in use for the ordinary rifle.

The largest vessel ever built on the Tees has recently been launched from the yard of Messrs. Pearce, Lockwood, and Co., Stockton. She is called the "Chilian," and her length over all is 355ft. 6in.; breadth moulded, 42ft.; clear depth, 28ft. 6in. About 8,000 tons gross register, classed 22 years in red in the Liverpool Underwriters' Registry, and has been built under special survey for the British and South American Steam Navigation Company, Liverpool. She will be elegantly fitted up for 70 first-class passengers, each berth being heated by steam from the main boilers. She will also have accommodation in the 'tween decks for 200 second-class passengers. She will be barque rigged, and on deck will have four large steam winches. Her patent windlass will also be worked by steam. The engines are by Messrs. Fiesick and Hackworth, and are of the inverted cylinder description, fitted with Mr. G. Y. Blair's arrangement of surface condensation, and all the latest improvements. The cylinders are 63in. in diameter, 42in. stroke, and calculated to give out a power of not less than 1,400 horses.

It appears that macadam is made on a large scale in New York by saturating carbonate of magnesia in silicate of soda or soluble glass—soda is selecting a good quality of magnesia being the only requisite for success. The profits are immense—a pipe made of the "foam of the sea," as smokers verily believe, costs for material about five cents, leaving the balance for labour.

In reference to a paragraph in our last upon roughing horseshoes in Paris, Mr. J. Hope writes to suggest, as a means to make the shoes bite the macadamised pavement, that four or five longitudinal grooves should be made in the shoe with a small circular saw, when the dirt will jam in and there stick, thus preventing the shoe from slipping. The bite might be further assisted by having cab stands and stable floors covered with sharp sand or crushed flint: the grooves might be about an eighth of an inch deep and regrooved when worn out.

Colonel Minié, of rifle fame, has just been named officer of the Legion of Honour, a grade in that order which almost every field officer in France holds who has done anything that can possibly entitle him to it. It is remarked as singular that one who has done so much for the armament of the French troops should have waited until now for this recognition of his services.

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.—613, 634, 666

BUILDINGS AND BUILDING MATERIALS.—610, 619, 646, 669, 663

CHEMISTRY AND PHOTOGRAPHY.—618, 630

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

ELECTRICAL APPARATUS.—None

FIBROUS FABRICS, including machinery for treating flax, pulp, paper, &c.—608, 617, 622, 637

FOOD AND BEVERAGES, including apparatus for preparing food for men and animals.—615, 632, 645

FURNITURE AND APPAREL, including household utensils, time-keepers, jewellery, musical instruments, &c.—605, 606, 608, 623, 627, 640, 645

GENERAL MACHINERY.—604, 620, 628, 641, 662, 665

LIGHTING, HEATING, AND VENTILATING.—666, 668

METALS, including apparatus for their manufacture.—600, 644, 649, 650, 654, 657, 667

MISCELLANEOUS.—612, 621, 625, 626, 631, 635, 639, 642, 643, 646, 655, 664

ROADS AND VEHICLES, including railway plant and carriages, saddlery, and harness, &c.,—600, 614, 636, 638, 651, 655

SHIPS AND BOATS, including their fittings,—605, 634
STEAM ENGINES, &c.,—607, 611, 643, 647, 651
WARFARE,—642, 649

607 L. THOMAS. *Improvements in side propellers for ocean and river vessels.* Dated March 4, 1865.

This invention consists in the employment of discs constructed in such manner that they carry upon their outer surface propelling fins or wings. The discs are to supercede the paddle wheels as at present in use, and the fins the ordinary paddle board floats. The discs are carried on shafts worked or rotated by motive machinery within the vessel, and the paddle pieces one or more of these discs on both sides of the vessel at or about the position in which the paddle wheels are usually placed, or at any other position at the sides of the vessel should they there be found more efficient. He makes the discs of a hollow or cellular construction. *Patent completed.*

608 H. A. BONNEVILLE. *Improvements in drying apparatus.* (A communication.) Dated March 4, 1865.

This invention consists in an improved apparatus for drying linen and similar articles by means of a current of heated air made to circulate in a contrary direction to that of the articles to be dried. *Patent completed.*

609 H. A. BONNEVILLE. *Improvements in apparatus for rinsing and drying by centrifugal force.* (A communication.) Dated March 4, 1865.

The patentee claims, firstly, the double use of the improved machine for rinsing and drying by centrifugal force, by means of a tube which enters a movable perforated axis, in order to introduce into the drum a liquid which is caused by the centrifugal force to pass through the contents of the said drum or cage. Secondly, the mode of bearing, rolling, and lubricating the shaft of the drum, preventing the entry of the grease in the drum, and the rocking of the latter. Thirdly, the mode of stopping by the speed of the shaft itself, and of the cage by means of a friction lever, and of a spring, both enveloping the shaft in contrary directions, and serving by their tension and their friction for progressively lessening, not only the speed, but also the force of impulsion of the apparatus, and for producing an almost immediate stopping without shock. *Patent completed.*

606 H. A. BONNEVILLE. *Improvements in washing machines.* (A communication.) Dated March 4, 1865.

This invention consists, firstly, in making the axis of the drum or cylinder (which has a pentagonal form) hollow, so as to be able to introduce water at any moment, whether the machine works or not. Secondly, in the use of a grating or wire cloth table which serves for introducing the articles to be washed, and for removing them from the machine by a door or opening closed by thumb screws or other contrivance when the machine works. Thirdly, in the application of square bars of glass or other material unobtainable by the alkaline or acid solution used. These bars are placed longitudinally around the inside surface of the drum, and serve for raising the articles a little further out of the water than the bare sides of the drum would do. The articles being introduced, and a rotary movement given to the drum by means of a pulley fixed to the axle, the articles are alternately drawn from the water and allowed to fall to the bottom of the drum passing through the water agitated by the rapid rotation of the said drum or cylinder, thus assuring a perfect cleansing without the least danger of tearing. The operation finished, the articles are withdrawn by letting down and withdrawing the wire cloth table or grating. *Patent abandoned.*

606 J. H. JOHNSON. *Improvements in stopping bottles.* (A communication.) Dated March 4, 1865.

This invention relates to an improved mode of and apparatus for stopping or closing bottles containing still liquids, namely, liquids which are not charged with fixed air or gases, and consists in the employment in combination with a bottle of suitable form, and a ball (of larger diameter than the inside of the bottle neck) made of india-rubber, or other suitable elastic material, contained inside the bottle, and capable of floating upon the liquid therein, of an instrument composed of three or more diverging elastic wires firmly secured to a handle to be held in the hand of the operator, or vertical slide carried in a bracket or support, and worked by a lever. The ball, which serves as a stopper, is contained inside the bottle, and the free ends of the wires above referred to are to be introduced into the bottle through the neck, their object being to engage with the ball and pull it up into the contracted neck of the bottle. *Patent completed.*

607 J. H. JOHNSON. *Improvements in steam generators.* (A communication.) Dated March 4, 1865.

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

608 H. TAYLOR. *Improvements in the manufacture of lace or other fabrics made on bobbin, net, or twist lace machines, and in machinery or apparatus employed therein.* Dated March 4, 1865.

The patentee claims, first, the manufacture of lace or other fabric on bobbin net or twist lace machines, substantially as described. Secondly, the combination and employment of extra warp threads and a cutter or cutters for the purpose of cutting away the surplus portions of threads and drawing the ends of the portions used in the direction of the opposite selvage when making scollops, as described. *Patent completed.*

609 D. J., and J. MORRIS. *Improvements in apparatus for coupling and uncoupling railway waggon or carriages.* Dated March 4, 1865.

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

610 L. LE G. COTTAN. *An improvement in fitting sliding partitions in stables and other buildings.* Dated March 4, 1865.

This invention refers more particularly to partitions forming part of stalls and loose boxes for horses, and consists in constructing the grooved sills in which the bottom of the partition of wood or other work is received and slides. With one or more dovetail wedges. When in place these wedges form part of one side or wall of the groove of the sill but they admit of being removed to allow of any part of the partition that may have been injured by kicks or otherwise, being taken out and replaced by a fresh part

when the return of the wedges secure the parts in their position. *Patent completed.*

611 E. A. BROOMAN. *Improvements in machinery for obtaining motive power from ammoniacal gas.* (A communication.) Dated March 4, 1865.

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

612 W. OLULOW. *Improvements in the manufacture of sheep shears.* Dated March 4, 1865.

This invention relates to certain improvements whereby machinery is applied to the manufacture of sheep shears with great economy of time and material. The bars of iron employed for the formation of the bows and shanks are prepared of the proper and necessary width and thickness, but having some portions thereof made of greater thickness than the remainder, either in the process of rolling or otherwise, such thicker portions of the bars being at such distances from each other as to allow of the bows and shanks being cut from the bar so as to have a greater substance at the extremities of the shanks to which the blades can be welded. The bars for the bows and shanks may be rolled or prepared by any of the known methods, the parts from which the bows are to be formed being spread or widened by passing them crosswise between rolls, or by hammering, or in any other manner suitable to the purpose. The iron so prepared is then heated and the bows and shanks formed thereon at one operation by means of upper and lower dies worked by any of the known contrivances or machinery adapted for the purpose of punching or pressing. The metal for the blades consists of bars of iron and steel combined by the ordinary process of welding, and afterwards drawn or rolled into rods of the size required, which may, if desired, be cut into such lengths as can be conveniently submitted to the next operation. The pieces of which the blades are to be formed are then punched or cut out of the rods or portions thereof thus prepared (after the same have been heated) nearly to the shape required by means of any of the known machinery or apparatus adapted for the purpose. The ends of the blades which are to be welded on to the shanks are then shaped by means of a print or prints on the anvil face, worked under a hammer, or by any other suitable machine or apparatus, and afterwards welded to the shanks already formed. The blades are then finally spread out to their proper or finished shape by means of suitable apparatus or machinery. *Patent completed.*

613 E. HUNTER. *Improvements in combining marine steam boilers.* Dated March 4, 1865.

This invention, which is applicable when applying steam boilers in ships or vessels of large tonnage and of considerable transverse section, consists in arranging a set of marine steam boilers in three rows in a direction fore and aft the ship. The boilers of the central row are double—that is to say, they have furnaces and firedoors on each side, so that the firing takes place on both sides. The boilers of each of the other rows are single—that is to say, they have furnaces and firedoors only on one side, viz., the side opposite the central row of boilers. Between the central row of boilers is a passage of sufficient width to admit of the stokers supplying fuel to and stoking the fire both of the central row of boilers and the opposite row of boilers. In place of having coal bunkers between the sides of the ship and the backs of the two rows of boilers, it is preferred that each coal bunker should be away from the backs of such boilers, in order that the two gangways or passages between the three rows of boilers may be as wide as possible, not only to give the stokers as much space as may be, but also to facilitate the bringing of coals into these passages or gangways. The uptakes or flues of the boilers of the side rows are carried over the passages or gangways between the three rows of boilers and they are connected with those of the central rows of boilers. The steam pipes also of the boilers of the side rows of boilers are connected with the steam chambers of the central row of boilers, dampers and stop valves being used to shut off any one or more of the boilers from the others. *Patent abandoned.*

614 J. WHITLEY. *Improvements in casting steel railway wheel tyres.* Dated March 4, 1865.

For the purposes of this invention a mould is used, which, when at work, is caused to revolve at a high speed, which, however, is not new. This mould is caused to revolve in a horizontal plane, and the inner surface of the inner periphery of the mould is as heretofore of a like contour or section to the periphery of the tyre. In place of using these rotary moulds in a cold or comparatively cold state, the mould is first heated to a high heat, say, a good red heat, and is used in that condition. When desired, a steel tyre after it has been cast in the revolving mould may be retained in, and be allowed to, cool down with the mould; and thus by protracting the time of cooling more or less anneal the tyre; or the tyre may be annealed after it has been removed from the mould. Steel tyres thus manufactured, when not sufficiently true, or not of the gauge desired, may be rolled or further formed after casting. *Patent completed.*

615 W. E. NEWTON. *An improvement in putting up tobacco for smoking, and in the implements or pipes for smoking the same, and in making tobacco paper.* (A communication.) Dated March 4, 1865.

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

617 A. AKEBOYD. *An improved process and apparatus for dyeing and preparing cotton, worsted, and silk warps.* Dated March 4, 1865.

This invention has special reference to the warps used in weaving fancy goods of various shades and patterns, where it is requisite that some threads of the warp should remain white—for instance, in checks, whilst the remainder are dyed black, or any other desired colour, and is particularly useful in warps in the getting up of patterns as examples, where it is desired to have a great variety of patterns from one warp. The process consists in dyeing the warp in lengths instead of all at once by the apparatus now to be described. To the periphery of a wooden roller provided with an iron axis running on a suitable framework (and placed in front of the warp beam of an ordinary warp dressing apparatus), the patentee attaches pegs at such distances from each other as the pattern required may necessitate. Over these pegs he passes to the receiving warp beam each ends of the warp as do not require to be dyed, or which require dyeing another colour than those contiguous to them. The remaining ends of the warp to be dyed are passed on to an ordinary beam, the dye liquor required being placed in suitable vessels underneath the same by

means of a winch upon the end of the axis. He raises up those threads in contact with the pegs which do not require dyeing, or which require dyeing a different colour, and ties the same together, lowering the roller by an ordinary mechanical appliance, in order that the ends to be dyed may be conveniently dipped. The stick used in dressing is now passed through the warp and run up to the extremity of the length to be dyed. An ordinary alley is then introduced for the purpose of separating the threads more effectually. The threads to be dyed are now dipped in the liquor placed underneath to such length as may be required, the "stop" being made by tying the threads together, or any other convenient method. The length so dyed may now be passed together with those threads passing over the pegs (which it is not required to dye) on to the warp beam, and dressed in the usual manner. Another length may now be dyed any other desired colour, and so on to the end of the warp. When it is desired to dye the threads passed over the pegs, those already dyed may be passed over other pegs and raised in the manner before described. The weaver is thus enabled to weave a variety of patterns, changing his warp beam for each pattern being unnecessary. *Patent completed.*

618 E. PATTET. *A method of, or process for, producing a new kind of photographic picture, to be called "biographs."* Dated March 4, 1865.

This invention consists of the method or process herein after described for the production of one photographic picture from two photographic images, the one superimposed upon the other, which picture possesses great relief. Pictures so produced the patentee designates biographs. If he desires to produce a life-sized portrait, he proceeds in the first place to take a double negative of the sitter by means of a pair of lenses and a camera obscura in the usual way of taking ordinary stereoscopic negatives, and having obtained a satisfactory double negative he separates the two pictures and transposes them, placing the right hand picture to the left and the left to the right; and in this order he causes light to be passed through them in a dark room or camera obscura, and receive the rays so passing through the pictures by a pair of lenses placed at the same distance from them as the pictures were when taken, and the two pictures now become enlarged, coalesce, and are superimposed upon each other at or near the distance from the lenses at which the sitter was originally placed when the double negative was taken. The actual distance is governed by the focal length of the lenses. If the same lenses are used for the biograph as were used in taking the double negative, the distance is the same as that at which the sitter was placed. The compound image is received on a sensitive photographic surface situated parallel to the negatives, and at such a distance from the lenses as to receive the sharpest image the lenses will give. There is thus produced a portrait which is a negative by reflected light and a positive by transmitted light. This picture may now be varnished, painted, or backed with any white, opaque, or semi-opaque substance, as wax, cement, plaster, or paper. *Patent completed.*

619 C. F. VARELY. *The protection of houses and property from burglars and others, parts of the invention being applicable for other purposes.* Dated March 4, 1865.

The object of this invention is to give to the police, watchman, or others, either on the premises, at the police station, or other appointed place, notice of the opening, shutting, moving, or tampering with any safe, door, window, or other movable thing by means of electric signals. For further security all or any of the doors, windows, or movable furniture in the same house may be made to form part of the circuit, and so arranged that the opening or moving of any of them shall give the same signal. By this arrangement, and if the signal is placed at a sufficient distance, the burglar or other person causing the disturbance will not have any knowledge of the signal. *Patent completed.*

620 E. A. BROOMAN. *Improvements in pumps.* (A communication.) Dated March 6, 1865.

This invention consists in constructing pumps as hereinafter described. Upon two hollow columns or pillars, which serve as the section and discharge pipes of the pump, the inventor mounts a horizontal cylinder, the interior of which is in communication with the interior of each of the hollow columns. Within the cylinder a drum is caused to rotate on horizontal axis; this drum is always in contact at one point with a longitudinal packed rib on the inner surface of the cylinder, which shuts off direct communication between the two hollow columns; the drum is not in contact with the cylinders at any other point, but carries four or other convenient number of spring pistons, which as the drum rotates bear against the inner surface of the cylinder; these pistons are fitted in pairs at diagonally opposite points of the drum, each pair being connected by a tube passing through the axle of the drum; a spring is fitted behind each piston and keeps it in contact with the surface of the cylinder. As the pistons in their revolution approach the longitudinal rib before mentioned they recede into the drum until they have passed the longitudinal rib, the corresponding piston being forced out on the opposite side. The cylinder is closed at each end by a plate, one of the plates is formed with an aperture and stuffing-boxes to receive the axle of the drum, and the other plate has on its inner face a socket to receive the other end of the axle. These plates are fixed to the cylinder by bolts, india-rubber or other washers being interposed to make the closing hermetic; the inner face of each plate has an annular groove filled with leather for the ends of the drum to bear against. The cylinder is formed with two openings near its upper part for use in priming or starting the pump when required; these openings are closed hermetically by plates. One of the hollow columns is in communication with the well or other reservoir from which the liquid is to be pumped, and each column is formed with a socket to receive a pipe when required; where the liquid has to be raised from a great depth he fits the column in which it is to be raised with a valve to prevent return of the liquid. The action is as follows:—The drum with the pistons being caused to rotate by a crank handle in connection by touched gearing with the axle of the drum or in any other convenient manner, the pistons produce a vacuum in the first column, the liquid rises therein, is carried by the pistons round the upper part of the cylinder, and enters the other column, from which it may be led to any point required. The action of the pump may be reversed if desired—that is to say, the drum may be driven in the reverse direction, so that the discharge pipe becomes the suction pipe and vice versa. *Patent abandoned.*

621 S. PHILLIPS and J. GROVES. *Improvements in sails.* Dated March 6, 1865.

In constructing safes of the kind called belted safes, the inventors make on the inside of the bar of which the belt is made a projecting flat rib parallel with the edges of the bar, the said rib being rolled in one piece with the said bar. The outer door shuts down on the outer edge of the said rib, and upon this rib they rivet a plate of iron for the purpose hereinafter explained. The edge of the plate is not flush with the edge of the rib, but in the finished safe stands somewhat further back than the rib, the said rib and plate forming, as it were, steps inside the safe, and parallel with its edge, against the inner one of which steps the inner door of the safe shuts, and against the nearer one of which the outer door shuts. The plate against which the inner door shuts has formed in it a series of dovetail grooves, and the edge of the inner door has dovetails formed on it or secured to it, which dovetails take into the dovetail-shaped grooves in the before described plate when the door of the safe is shut. If a burglar attempt to insert a chisel or wedge between the side of the safe and the outer door, so as to separate them, he is prevented by the dovetails described, which, engaging in their respective grooves, lock the edge of the door and the side of the safe firmly together. If he succeed in forcing a very thin wedge between the side of the safe and the door it would be stopped by coming against the rib rolled on the bar, and be prevented coming near the inner door carrying the dovetails. In unbelted safes the dovetails on the inner door may be made to engage in dovetail grooves in the inner plate of the safe without the use of the rib hereinbefore described, which they employ in making belted safes. They prevent the insertion of a chisel or wedge between the hinge of the safe door and the side to which the door is hinged in the following manner:—They make the edge of the hinged side of the door nearly semi-cylindrical in figure, and they make a nearly semi-cylindrical groove along that edge of the safe to which the door is hinged; when the door is shut its semi-cylindrical edge fits in the semi-cylindrical groove, and the narrow space between them into which anything can be forced being curved, the insertion of a wedge or chisel is prevented. They make the angles of safes of angle iron, on the outer angles of which a supplementary small angle iron is formed, the said small angle iron being undercut. The outer plate of the safe is inclined on its edges, and is made to slide under the undercut bars of angle iron at opposite edges of the safe. The said plates are afterwards riveted in their place. *Patent abandoned.*

622 S. and W. SMITH. *Improvements in machinery or apparatus for combing wool and other fibrous substances.* Dated March 6, 1865.

This invention relates, first, to the combing machine known as Heilmann's, in which bars of iron with gill pins soldered on to them for the purpose of combing are employed. The improvements consist in the use of cards set either in leather or composition, and of graduated pitch, that is to say, commencing with a coarse card and finishing with a fine one, the object being to clear the wool or other fibre of the larger knots by means of the coarse cards, the smaller knots being taken by the fine cards whilst held in the "nip." The improvements also consist in making this cleaning cylinder larger in diameter in order to increase cleaning surface, and at the same time a tuft of wool or other fibre is being drawn by the rollers, one end of the same being cleaned by the said card roller. They provide and employ three falling bars instead of one, as now employed, the first one being coarse, and the remaining two graduating in fineness, the third one being the finest of the three. The second part of the invention relates to the combing machines known as Lister's nip comb, in which machine the fallers are fitted with very fine teeth very close to each other, in order to clean the wool properly, and in consequence thereof, when the "nip" gets hold of a tuft of wool, it either breaks the wool or the latter slips from the jaw. Now these improvements consist in making all the "fallers" coarse in pitch and teeth, and placing some movable "fallers" between the usual set and the nip, causing one or more of them to rise at each action of the nip. These fallers are made with very fine pins to compensate for the coarseness of the others, and may be actuated in various ways, but they prefer to raise them by springs, and to lower them in the ordinary manner. Also when drawing a sliver from the circular comb they employ a second or intersecting comb having fine teeth, if those of the circular comb are coarse, or vice versa. *Patent completed.*

623 T. S. SPERRY. *An improvement in covered springs for clothing, and in the means for manufacturing the same, applicable also to other purposes.* Dated March 6, 1865.

This invention consists, first, in the employment of slender wire, instead of fibrous material, for the covering of springs for clothing, more especially the tempered flat steel wire known as skirt wire. Secondly, in a method of feeding forward the central or main wire, and in covering the same by the simple act of winding the covering wire around it. Thirdly, in a certain arrangement of an abutment extending around very close to the inner wire in machines for so feeding, so that the coils of covering wire as they are successively applied wedge themselves directly between the abutment and the coils previously laid. Fourthly, in means for restraining a too rapid feed or longitudinal motion of the main wire by a backward draught of the covering wire as it is wound on, so as to avoid risk of open spaces in the covering. Fifthly, in the means of holding the inner wire firmly against the twisting strain at a point very close to where the covering is applied, so that a powerful tension may be given to the covering wire or wires if necessary. *Patent completed.*

624 F. CRUCKSHANK. *Improvements in coatings for the prevention of the fouling to which iron and other ships and structures are ordinarily liable in sea water.* Dated March 6, 1865.

This invention relates to the prevention of the fouling to which iron and other ships and structures are ordinarily liable in sea water, and it consists in employing for that purpose cyanide of mercury made up or incorporated with a suitable medium to form a coating or paint to be applied to the surface to be protected. The medium with which the cyanide of mercury is incorporated may be varied, provided that it is of a resinous, bituminous, oleaginous, fatty, or saponaceous character. *Patent completed.*

625 T. CRAIG and D. CARLOW. *Improvements in numbering machines.* Dated March 6, 1865.

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

626 W. J. OLIVER. *An improved means of securing and protecting the india-rubber rings of buffer springs of railway carriages, which invention is also applicable to air-pump and valve seatings and lids faced with india-rubber.* Dated March 6, 1865.

This invention relates to the class of buffer springs for railway carriages consisting of a number of vulcanised india-rubber rings or collars separated from each other by plates or washers of metal, an aperture being formed through the india-rubber rings or collars, and through the plates or washers of metal, through which aperture the buffer rod works. It is found that the india-rubber rings or collars by the friction and rubbing of the plates or washers of metal are destroyed by being split and broken. The object of this invention is to secure and protect the said rings or collars of india-rubber and prevent friction. This the inventor effects by covering or coating the said plates or washers of metal with vulcanite or ebonite, to which covering or coating the ring or collar of india-rubber is inseparable, being attached and secured by a solution of india-rubber and vulcanising. *Patent abandoned.*

627 A. PORTS. *Improvements in machinery for scutching and refining flax and other vegetable substances.* Dated March 6, 1865.

This invention relates to a previous patent dated 1st March, 1863 (No. 563), and consists, principally, of the following mechanical arrangements, namely, in the construction of the cylinders, the blades thereon, and the teeth of the blades. Each cylinder is composed of four wooden bars that reach from end to end of the cylinder with suitable centres of iron to which the bars are fastened; the said centres are bored out and fitted on a turned shaft that goes from end to end, and is supported in brasses on a suitable framing. On the edges of the aforesaid bars of wood blades are fixed, which may be made of cast or malleable iron, steel, or other suitable metal; those blades that are intended to act on the fibre project a little further from the centre than the wood, and on some of the blades are formed undulating shaped teeth—that is to say, the top and bottom of the teeth have the same curve. Some of the wooden bars aforesaid are mounted with blades from end to end; some of them on a portion of the middle only; some of the blades are toothed from end to end, and some only on a portion of the middle, having a piece of the same blade at each end left plain to prevent it acting too severely on the ends of the fibre. Between the two large wheels of the machine, when the flax is changed off the first wheel on to the second, a hook of iron is fixed in a suitable position; the point of this hook always remains in the lower groove of the second large wheel, and serves the purpose of depositing the scutched end of the fibre in the said groove, which prevents it from being scutched a second time in the second pair of cylinders. The cylinders can be driven by either plain pulleys or cone speed pulleys, such as are used in lathes to vary the speed thereof. *Patent abandoned.*

628 W. RIDDLE. *Improvements in hooping or binding bales.* Dated March 6, 1865.

In performing this invention the patentee passes the hoops already bent at the ends through a rod or presenting bar, with holes or slots corresponding in the positions with the grooves of the press before introducing them into the grooves of the press. The rod or bar is made with suitable holes or eyes in it for this purpose. The bar with the hoops projecting from it is then raised by a man at each end of the bar, and thus one of the ends of each hoop is brought up to one set of the lashing grooves of the press or follower. A number of hooks or loops (as many as there are hoops) attached to what may be termed a fetching bar is passed from the opposite side of the press through the same set of grooves, and the persons holding the presenting bar immediately hook on all the hoops simultaneously to the hooks or loops as soon as the ends project through the grooves. The fetching bar being now drawn backwards, draws with it the hooks or loops, and with them all the hoops through the grooves simultaneously. They are drawn through beyond the bale on the other or opposite side of the press to that at which the ends of the hoops are presented; a door or plate on this side of the press is then shut down to retain the ends of the hoops against the side of the bale. As soon as this is done, the slotted bar by which the ends of the hoops were presented to the grooves of the press is moved to near the other end of the hoops, when the bar is caused to make a half turn on its own axis, and is brought back to the press, so as to present the other ends of the hoops to the other set of grooves in the press; these ends are then moved through the grooves by what the patentee has called the fetching bar in a manner similar to that in which the first mentioned ends were brought through the other set of grooves in the press. The ends of the hoops are now brought side by side and secured by a metal lath or strip of metal, as described in the specification of letters patent granted to the present patentee, dated May 8th, 1862 (No. 1376). Instead of pulling the hoops through the grooves by a fetching bar, they may be pushed through the grooves by a suitable instrument actuated from the same side of the press as the presenting bar. *Patent completed.*

629 T. NICHOLSON. *Improved apparatus for making caustic liquor or caustic lye.* Dated March 6, 1865.

This improved apparatus for making caustic liquor consists of a number of vats arranged in a consecutive series of, say, six vats. The first vat, No. 1, is charged with the usual ingredients, such as carbonate of soda and lime. Hot water is then run on from a cistern. A steam pipe runs alongside the vats, and is provided with cocks to admit steam from a boiler, not in among the liquor, but into an outer case or jacket. After having sufficiently boiled the liquor to render it caustic it is allowed to settle. A quantity of carbonate or soda and lime is then put into No. 2 vat. A cock or valve is adapted to the partition between vats Nos. 1 and 2, so that by continuing to run on water into No. 1 vat, the contents, which is effected by blowing in steam until the liquor is sufficiently boiled or made caustic, as in No. 1. The process is continued until No. 6 is filled; then, if the liquor is considered to be sufficiently strong, or as strong as practicable, it may be syphoned off. By this time the liquor will be forty degrees strong, but if it is required to have it stronger, the sludge in No. 1 vat may be dried off. When dried off the solid matters may be shovelled out and easily disposed of. When vat No. 1 is empty, fresh carbonate of lime may be put in, and the cock or valve between Nos. 1 and 2 is shut; water may then be run into No. 2 vat, having first opened a cock in the return pipe, and the liquor will run along the pipe to No. 1 vat. When there is

sufficient in for boiling, it is made to boil and afterwards allowed to settle; more water is then run into No. 2 until it is full. If the liquor in No. 1 vat be sufficiently strong, it is syphoned off; if not, No. 2 cock in the partition is shut, and the contents of No. 2 vat dried off and proceeded with as before. By means of this improved apparatus the ingredients or carbonate of soda and lime may be washed until there is nothing left in them. If six vats would not be sufficient, more may be employed, but after six different waters are run into each vat the carbonate will be all gone. *Patent abandoned.*

630 G. NIMMO. *Improvements in the manufacture of crucibles and pots in which metals or other substances may be melted.* Dated March 6, 1865.

This invention consists in the manufacture of crucibles in a plastic mould which gives shape to the pot externally and absorbs the moisture from the pot, causing it to dry uniformly, and at the same time shrink away from the mould, so as to separate easily; the plaster mould preventing the air acting upon the outside of the pot until after the moisture has been mostly absorbed, prevents the pot from splitting or cracking from unequal contraction in drying. The patentee mounts the plastic mould in a revolving chuck, and employs a rib attached to a lever for spreading the plastic crucible material on the inside of the mould, and at the same time hardening, consolidating, and polishing the crucible on the inside by means of the said rib. *Patent completed.*

631 W. CLARK. *Improvements in preparing or treating hides for tanning.* (A communication.) Dated March 6, 1865.

This invention relates to improvements in the preparation of hides previous to the tanning operation, after being deprived of the hair by means of lime. The pores of the hides generally contain lime, either in a caustic, carbonic, or sulphuric form, and also in an insoluble condition. According to this invention the inventor eliminates these matters which prevent the hides from being properly tanned, either obstructing the pores, or from the formation by means of the tan of tannates of lime. This elimination is effected without injury to the hides by means of a very weak solution of sulphuric acid, after depriving the latter of the iron it contains. The hides are steeped in this solution for a suitable time, when the whole of the lime, whatever may be its form, is transformed into sulphuric lime. This latter, which impregnates the pores of the hides, is decomposed by means of a solution of common salt or chloride of calcium (Na. Cl. 2) or a solution of chloride of potassium (K. Cl. 2), or oxymuriate of potash, the said solution being completely deprived of iron. On this decomposition being effected he entirely removes the lime or other foreign matter by washing the hides in pure water. *Patent abandoned.*

632 W. BUNGER. *Apparatus and means for ascertaining the quality and condition of grain and seed.* (A communication.) Dated March 7, 1865.

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

633 E. W. YOUNG. *Improvements in the construction of bridges.* Dated March 7, 1865.

This invention consists in forming joints or hinges in bridges constructed on the bracket or cantilever principle at two points in the superstructure, that portion of the bridge between the two points, and forming the central portion of the span, being a truss or girder. The advantage hereby obtained is, that when the bracket or cantilever at the one end of the span is loaded, and thereby depressed, no strain is communicated to the bracket or cantilever at the other end of the span, it being relieved by the rolling, bending, or turning of the structure at the above mentioned joints or hinges. *Patent completed.*

634 R. A. BROOMAN. *Improvements in tubular boilers.* (A communication.) Dated March 7, 1865.

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

635 J. H. WILSON. *An improved method of, and means or apparatus for, measuring the human body, to be called "the tailor's self-adapting somatometer."* Dated March 7, 1865.

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

636 L. PERKINS. *Improvements in apparatus for heating and cooling atmospheric air and other aeriform bodies, and for heating ovens, and for heating and ventilating buildings.* Dated March 7, 1865.

The patentee claims the use of tubes sealed at both ends, and containing water or other volatilisable liquid, in heating and cooling atmospheric air and aeriform bodies, in heating ovens, and in heating and ventilating buildings, as described. *Patent completed.*

637 A. E. A. AUBERT and G. E. M. GENARD. *Improvements in the manufacture of shoes and other coverings for the feet.* Dated March 7, 1865.

The patentee claims, firstly, the manufacture of soles moulded from vulcanised caoutchouc, whatever be their shape or their composition, and whether their state of vulcanisation renders them stiff or supple to any degree. Secondly, the application of these soles in the manufacture of boots and shoes and other coverings for the feet having leather uppers, whether the soles are fixed to the uppers by sewing or by screws, rivets, or otherwise, as described. *Patent completed.*

638 W. CLARK. *Improvements in cork-cutting machinery.* (A communication.) Dated March 7, 1865.

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

639 W. CLARK. *Improvements in shoes for horses and other animals.* (A communication.) Dated March 7, 1865.

In carrying out this invention, the inventor forms the shoe of a small bar of iron, steel, or other hard substance, and gives it increased thickness at the toe and heel, it being suitably bent to the form of the hoof, and fixed in a groove made therein by means of nails or screws. The shoe is let into the lower part of the wall of the hoof around the sole. *Patent completed.*

640 H. W. WIMSHURST. *Improvements in the construction of joints for boxes, drawers, and other like articles, and for planks and timbers, and in machinery to be used in the preparation of such joints.* Dated March 7, 1865.

In performing this invention, the patentee aims at ob-

taining the largest available contact surface for the parts to be brought into contact, and this he effects by making parallel slots or cuts equidistant from each other across the edges of the pieces of wood that are to form the joints, and in general of a depth equal to the thickness of the wood employed. He thus produced on the edges a series of tongues or projections with parallel sides. The invention cannot be described without reference to the drawings. *Patent completed.*

641 J. DODGE. *Improvements in steam hammers, applicable to the manufacture of files, to welding flyers of cotton machinery, and to other purposes.* Dated March 7, 1865.

The object of this invention is to enable the workman to prevent the falling of the hammer at pleasure, and for any period of time that may be required. With this view the inventor applies a catch which passes under the hammer when it is elevated, and, therefore, supports it in its raised position. To this catch he connects a treadle or lever by which the catch may be removed when the hammer is to fall. *Patent abandoned.*

642 F. TOLLEUSEN. *Improvements in breech-loading fire-arms.* (A communication.) Dated March 8, 1865. This invention is not described apart from the drawings. *Patent completed.*

643 J. DRAM. *Improvements in marine steam engines.* Dated March 8, 1865.

In order to remedy "racing" and to provide for a steady and uniform working of the engines proportioned to the resistance to be overcome, the patentee proposes to fix a tube or cylinder on each side of the vessel for each engine and paddle-wheel, or at the stern, as may be necessary for the screw of steam vessels. In this tube or cylinder an air ball or float of metal or other material is to be placed; through this tube or cylinder is passed a vertical shaft or rod with guides; this shaft will act upon the throttle valve or equilibrium valve, as the case may be, by means of rod and levers and gag handle to attach to the ordinary throttle valve handles. The principle of the invention consists in this, viz.:—When the paddle wheels or screws are raised out of the water, the air ball or float before described will fall, and the levers and rod attached to it, and acting upon the valve, will shut the steam off in proportion to the depth of the paddles, and on the other hand, when the paddles are fully immersed, the air ball and levers are raised into such a position as to allow the full quantity of steam to enter the cylinders. *Patent abandoned.*

644 J. and J. WADSWORTH. *Improvements in machinery or apparatus for cutting and shaping metals, making nails, rivets, and similar articles.* Dated March 8, 1865.

This invention consists, under one arrangement, in the employment of a revolving shaper working in connection with a stationary shaper. The revolving shaper is placed on the end of a shaft working in suitable bearings, and the stationary shaper is placed concentric or eccentric with the revolving shaper, the position depending upon the shape of the article to be manufactured, in all cases a sufficient space being left between the shapers at the entrance to allow the metal to pass in between them. When nails, sprigs, spikes, or pins are to be made, the inventors place the stationary shaper eccentric with the circular shaper, and form on both shapers longitudinal corrugations or teeth for the purpose of causing the metal to revolve and carry it forward as it is being reduced in thickness or diameter, and when a head is to be formed they form corresponding circular recesses in each shaper. The prominent edge of the revolving shaper works nearly close to the prominent edge of the termination of the stationary shaper for the purpose of reducing the article to a point and cutting it off. *Patent abandoned.*

645 A. O. HENDERSON. *An improved method of preserving meat.* (A communication.) Dated March 8, 1865.

This invention is carried out as follows:—The patentee having chosen suitably-shaped pieces of meat, previously seasoned, they are placed in a crust made of flour, a little water, butter, and eggs, and salt; the crust and its contents are now placed in a suitable metal case, and subjected to the heat of an oven for a sufficient time to completely cook them. This is usually effected in about two hours; on withdrawing them from the oven a small quantity of good brandy is introduced into what may be termed the paste; the metal cover of the case is then soldered down, and the whole is subjected to the water bath for two hours' boiling. In spicing the meat to be preserved he employs salt, black pepper, thyme, laurel, or bay leaves, and various other spices, making use of a sufficient quantity to render it agreeable to the palate. *Patent completed.*

646 G. IRELAND. *Improvements in stoppers for closing bottles, and for other like purposes.* Dated March 8, 1865. The documents relating to this invention are with the law officers under objection, and cannot at present be seen.

647 F. WISE. *An improved packing for piston rods and other rods.* (A communication.) Dated March 8, 1865.

This invention consists of a body or cord composed of canvas or other textile fabric or fibrous material, round which is woven, interlaced, or braided, a fabric composed of fine wires, as hereafter described. The packing thus formed is applied to stuffing-boxes in the usual manner, and presents a durable metallic surface capable of yielding when the packing is compressed. *Patent abandoned.*

648 J. SHANKS. *Improvements in watercloset apparatus.* Dated March 8, 1865.

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

649 M. MORGANS. *Improvements in converting cast iron or pig iron into wrought iron or steel, and in machinery to be used therein.* Dated March 8, 1865.

This invention is described and illustrated at page 150 of the present volume of this journal. *Patent completed.*

650 R. HOWSON. *Improvements in certain apparatus employed in the smelting of iron ores.* Dated March 8, 1865.

This invention relates to the stoves which are used for heating the blast before it enters the smelting furnace. In stoves hitherto used for this purpose the air to be heated has been made to pass through pipes or chambers of various forms, and it has been introduced and made to traverse through such pipes or chambers for the most part in a direction parallel to the heated surfaces thereof, so that a portion of the passing air might go through without coming in actual contact with the heating surfaces. These improvements consist in so arranging the pipes or cham-

bers of stoves that the air to be heated will impinge upon, and come in forcible contact with, the heated surface or surfaces of the stove at about a right angle thereto, so that by this means every portion of the air is brought in direct contact with the heating surface or surfaces of the stove. The inventor prefers to carry this into effect by introducing the cold air into an inner chamber which has a series of perforations, so as to direct it against the heated sides of an outer chamber at that part exposed to the most intense heat of the fire. *Patent abandoned.*

651 W. CLARK. *Improvements in motive power engines.* (A communication.) Dated March 8, 1865.

This invention relates to a means for utilising the expansion of gases and vapours at all pressures and temperatures by combining the rectilinear to-and-fro motion of several pistons united together for the production of rotary motion therefrom, and so as to obtain motive power acting constantly in the same circular direction without the aid of intermediate parts, which absorb a large part of the motive power through friction or otherwise. *Patent abandoned.*

652 F. W. TURNER. *Improvements in machinery for grinding corn and other substances, and in horse gear or apparatus for driving the same, which horse gear is also applicable for driving other machinery.* Dated March 8, 1865.

This invention will probably be described in a future number of this journal. *Patent completed.*

653 A. E. TAYLOR. *Improvements in iron safes.* Dated March 8, 1865.

One portion of this invention consists in so constructing and applying the door of the safe that it shall present no available crevice for the introduction of wedges or instruments for forcing or bulging the sides, whereby the door or other part may be opened. For this purpose, instead of hinging the door as usual, the inventor mounts and fits it behind a front framing which laps over the edge of the door all round, and is formed with a rebate so that wedges or other sharp instruments, if forced in at the junction, cannot penetrate to more than a very slight depth, and which will be quite ineffectual in attempting to force the face. The door is fitted somewhat in the manner of a drawer (but in a vertical position), and moves to and fro in an opening formed through the side of the safe across the front, so as to enclose it. He mounts the door on wheels for the convenience of moving its weight, which, being strong, must of course be heavy. *Patent abandoned.*

654 W. CLAY. *An improved manufacture of iron forgings.* Dated March 8, 1865.

In order to produce metal that will admit of forgings being made without the usual defects, the patentee proposes to use pig iron which has been cast, by preference, in clean iron moulds; or he operates upon refined or plate iron. Either of these irons he boils or puddles in a furnace heated by means of combustible gases, whereby the introduction of extraneous matters such as those above mentioned is avoided. *Patent completed.*

655 W. T. HAMILTON. *Improving and facilitating the proper action of the hands of players upon the piano, organ, harmonium, or other like keyed instruments.* Dated March 9, 1865.

This apparatus is called a "radial hand-guide," its distinctive principle being that it provides for the guidance of the hands by suspending them so as to move freely at the extremities of the radii, rather than as in the usual methods along a fixed rail. The apparatus consists of an upright frame of any rigid material, elevated over the keyboard, and resting upon a foot frame provided with slides and a screw or screws by which it is fitted and fixed to the top ends or sides of different sized instruments. A small horizontal frame hinged to a cross bar at the top of the upright frame hangs at a height of four or five feet over the keyboard, and affords a position for the centres of the radii at any desired distance apart, that of two octaves being preferable. This cast frame contains two systems of compound levers (one for each hand) intersecting each other, and articulated together by pivots at the several angles, upon the principle of what is commonly known as the "grape scissors." The uppermost angle of each system is attached by a pivot to the lever frame, whilst its lowest angle is the centre from which a ring or loop is suspended at the level of, and a few inches in advance of, the keyboard, by a radial cord or rod. The wrists, being placed in these rings or loops, are supported in their proper position vertically, but free to move either forward or laterally. When the movement is lateral, the upper side angle of the system comes in contact with the lever frame, and the whole is elongated, the centre being carried downwards and sideways in proportion to the extent of the lateral movement. Upon the return movement the system gradually resumes its original form, bearing up the centre by force of a spring composed of several india-rubber elastic bands which pass from a hook at its middle angle over two pulleys at its two upper side angles. The action of the levers is to compensate the increasing tension of the springs as well as to shift the centres. *Patent completed.*

656 B. COLLINS. *Improvements in cutting sheets of india-rubber and like materials into strips or threads, and in machinery or apparatus for the purpose.* Dated March 9, 1865.

This invention consists in simultaneously cutting and unwinding the part cut from the roll, by which the inventor is enabled to cut several strips or threads, or to cut the entire width of the roll into strips or threads at one operation. *Patent abandoned.*

657 R. MUEHST. *Improvements in the manufacture of steel and homogeneous iron.* Dated March 9, 1865.

The essence of this invention consists in refining or purifying melted pneumatised pig or cast iron in the course of converting the same into steel or homogeneous iron by the joint alternating action of the pneumatic blast, and successive additions of spiegelisen, or spiegelisen and titanite pig metal, each elimination of the carbon and manganese of the spiegelisen by the pneumatic blast when spiegelisen alone is used being accompanied by the elimination of the sulphur, or of a portion of the sulphur, which may be contained in the pig or cast iron operated upon, and each elimination of the carbon, manganese, and titanium by the pneumatic blast when spiegelisen and titanite pig metal are used being accompanied by the elimination of the sulphur and phosphorus, or of a portion of the sulphur and phosphorus, which may be contained in the pig metal operated upon. *Patent completed.*

658 E. CARBON. *An improved system of closing spalter dashes.* Dated March 9, 1865.

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

659 W. CLARK. *Improvements in revolving fire-arms.* (A communication.) Dated March 9, 1865.

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

660 J. T. HARRIS. *Improved iron doors, especially adapted for use in ordinary buildings.* Dated March 9, 1865.

Apertures to suit the size and number of panels desired are cut out of flattened sheets of plate iron of any required thickness leaving the stiles and rails defined as in ordinary framed doors. Each plate thus prepared is riveted or otherwise secured to sufficient angle iron of a dimension equal to about half the desired thickness of the door when completed; any number of panels, as may be arranged in first cutting or stamping through the plate, are formed with the pieces then cut out or other similar pieces which are also riveted or otherwise secured to angle iron suitable to the required depth of the panels. Cast or wrought mouldings of any requisite pattern are dropped into the panels and the whole firmly attached to the stiles and rails by screws or rivets put through the plate panel and angle iron into the moulding from the back. Two entire plates thus panelled and prepared are placed together and held in position by two or more riveted pins passed through four or more pieces of angle iron attached to the muntins and rails inside, and then the two complete plates or entire half faces of doors are thoroughly secured by a continuous band of hoop or other iron, screwed or otherwise attached to the angle iron around the entire outer edge of the stiles and rails. Hollow stiles, rails, and panels are thus formed to each door, which may be filled with fire-resisting composition when desired. The panels need not necessarily be sunk, but may be flush with the face of stiles and rails. The doors may be fitted with mortise or rim locks and furniture, as ordinary wood doors, and may be having folding or otherwise, or made to slide. The doors may be hung in wood, iron, slate, or other frames, as desired. These doors may also be made with a cast ground or frame work. *Patent completed.*

661 W. H. JAMES. *Improvements in carriages and in carriages for the same.* Dated March 9, 1865.

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

662 R. G. FISHER. *Improvements in covering roofs and other enclosures with sheet metals.* Dated March 9, 1865.

The patentee claims, first, constructing rolls having projecting shoulders and grooves into which the ends of the sheet metal fit, and covered with sheet metal, made to lap round the under surfaces of the said shoulders, as described. Second, the employment of a cap for covering the joint of two lengths of sheet metal upon the roll, which cap is fixed at one end only to the sheet metal, and has at the other end, or at both ends, a hollow moulding, as described. *Patent completed.*

663 W. J. DORNING. *Certain improvements in the method of securing the extremities of bands or hoops used in packing bales and in the means employed for such purpose.* (A communication.) Dated March 9, 1865.

This invention consists in bending the two ends of the bands into the form of hooks, and so that when brought together they shall clasp into each other; a flat ferrule or band to confine and cover the joint is then slipped over the said clasped ends, which completes the fastening and prevents it opening when the bale is released from the press. *Patent completed.*

664 W. H. HUDSON. *An improved burglary alarm.* Dated March 9, 1865.

The object of this invention is to cause the alarm to sound continuously (say half an hour if required), so long as the door, lid, or window remains open, and to prevent the possibility of the sound being stopped by any person who is not in possession of the key of the apparatus. The sounding mechanism of the apparatus may be any ordinary arrangement of spring clockwork, which will sound a bell continuously on being released. *Patent abandoned.*

665 W. D. ALLEN. *Improvements in the manufacture of railway wheel tyres, and in the implements or tools employed in such manufacture.* Dated March 9, 1865.

This invention consists in forming rings or hoops to be rolled into railway wheel tyres with their peripheries beveled so that their diameter is greater at one edge than at the other; a ring or hoop so shaped may be with great facility rolled into a tyre, as the larger diameter edge of such ring or hoop will in the rolls most readily form the flange of the tyre. *Patent completed.*

666 J. OLIVER. *An improvement in the construction of hot air stoves for blast furnaces.* Dated March 9, 1865.

This invention consists in dispensing with iron pipes altogether in the construction of these stoves or ovens, and in substituting therefor air flues or passages of similar form and arrangement composed of bricks, tiles, or blocks moulded in freelay, or from the materials of which silica bricks are made, or from the earthen or silicified or similar substances of a refractory or fire-resisting nature, and so secured together as to make the flues airtight throughout. *Patent completed.*

667 E. LEAHY. *Improvements in the strengthening and ornamenting of collapsible or soft metal tubes.* Dated March 9, 1865.

The inventor forms the tubes in any well known or approved manner, and he then corrugates them in the direction of their length. The formed tube he inserts in a corrugated tubular mould, and he then applies internal pressure to the tube, either by an india-rubber or other elastic plunger, or by water or other fluid. The effect of this internal pressure will be to force the soft metal into the corrugations, and thus materially to stiffen the tube. Or he uses a corrugated core and reverses the direction of pressure. *Patent abandoned.*

668 G. F. ANSELL. *An improved mode of, and apparatus for, ascertaining and indicating the presence of explosive gases.* Dated March 9, 1865.

The patentee claims applying the principle of the diffusion of gases to indicate the presence of inflammable or explosive gases by adapting to suitable indicating apparatus a porous air vessel or chamber in which the volume of the enclosed air may be increased, as described. *Patent completed.*

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THE MECHANICS' MAGAZINE.

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COTTON GINNING.

IN every one of the numerous processes which cotton undergoes in its conversion from the raw material to the manufactured article the greatest care is required, and the most delicate manipulation demanded, in order that the fibre may not be damaged. It is liable to deterioration from causes which present themselves at every stage. Thus at the outset the operation of picking appears a very innocent affair, and withal so simple as to render injury here practically impossible. Yet it is really the case that if the pod or husk is not left on the plant but is picked off with the cotton, it soon becomes very brittle and breaks up, and the fragments mixing with the fibre do it much injury, as it is difficult to separate the two again. The first mechanical operation to which the cotton is subjected after it has been picked is that of "ginning," which consists in removing the cotton fibre from the seed. The chief point in this operation is to prevent damage to the fibre and to bring it out as long as possible, thereby enhancing its commercial value. Doubtless of old the process was to take the fibre off the seed by the thumb and finger, and, if properly done, by no better means can it be effected. But the process is and of course has long been far too slow and tedious, one pound being the average day's work of a man. So machinery interposes and keeps supply on a par with demand. From the ancient finger-and-thumb process to the present finished mechanical appliances is a long stride; the intermediate space, however, is filled up by gradations of improvements. In the dawn of mechanical application the cotton gin consisted of nothing more than a simple stick of hard wood carefully rounded, and a flat stone. The fibre was rolled on the stone, the seeds being driven out before the roller, the diameter of which was too small for it to mount on to the seeds. In course of time this rude contrivance was superseded by a machine, which—although one of the simplest kind—from its construction, was really entitled to be so called. This was the Indian churka or roller gin, which has been in use for something like two thousand years. It consists of two rollers each of so small a diameter that a seed will not enter between them, the angle formed by their surfaces where the seeds touch them being considerably greater than the angle of friction. The fibre is laid hold of at the point of contact, and, as the rollers revolve, is drawn through between them, being pulled off the seed. The Hindoo bow is another instrument for clearing the seeds from the cotton. This instrument is made of bamboo, and is fastened by strings to a wall about five feet from the ground. A second bow of larger size, and strung with thick catgut, is attached by a cord to the centre of the first, below which it is hung about three feet. The operator, sitting down, lays hold of the bow with his left hand, and with an ebony club strikes the string of the bow so as to cause the foul cotton spread on the floor around him to be tossed violently into the air, and thus deprived of its impurities. The coarser, stronger stapled cotton of Upland (Georgia, America) was originally cleansed by the vibrating stroke of the bowstring. The cord being raised by the hand, and suddenly made to recoil upon the seed cotton, separated the seeds and opened up the wool.

The Indian churka is still used by the natives in India, and it is stated that by means of the common implement they gin upwards of 75 per cent. of the cotton produced in India. It takes, however, about twenty persons to produce 1 cwt. of clean cotton per day, or about 9½ lb. per hour, not quite half a pound each

per hour. The top roller of the churka is now commonly made of iron or steel ¾ in. diameter, and is sometimes finely fluted, the bottom roller being of hard wood and from 2 in. to 3 in. in diameter. Like as in every other department of manufacture, so in cotton ginning invention has been actively at work, creating and bringing forth abundantly machines of varied construction. The numerical strength of the designs for separating cotton fibre from the seed is something very great. Not so, however, that of those practically carried out, and now chiefly used, which consist of three varieties—the old Indian churka, the M'Carthy gin, and the saw gin. The M'Carthy gins are a widespread race, but the family likeness is tolerably well preserved throughout. This gin consists of a roller covered with seahorse hide, which is a very expensive material, costing something like 25s. per square foot. Against the roller a steel doctor blade is kept continually pressed by springs, the seeds being knocked off by a vibrating beater. By means of the adhesiveness of the leather the fibres are seized and drawn under the steel plate until the seeds come in contact with its edge. The vibrating bar or knife then ascends, and passing the edge of the plate pushes off the seed and sets free the fibre, which travels with the roller and is delivered over a rod in front. Messrs. Platt and Richardson's 40-inch handfedder M'Carthy gin, single knife, for power, produces about 30 lb. of clean cotton per hour, Smyrna or Indian, or 40 lb. per hour of Egyptian or American. A 12-inch gin double knife and worked by hand, as improved by the same firm, will produce 8 lb. of the former and 12 lb. of the latter cotton per hour. The saw gin was invented about 1790 by Mr. Eli Whitney, of the State of Georgia, at a time when the cry of the cotton producers was great for a method of cleaning cotton which would enable them to keep pace with the demand of the times. This gin consists of a number of circular saws mounted about an inch apart on a revolving cylinder. The teeth of the saws are very pointed so as to claw hold of the fibre in their passage through narrow slits in the table. Another cylinder faced with brushes works in an opposite direction and clears the cotton from the teeth of the saws. The work done by one man with a Whitney eighty-saw machine driven by a two-horse engine is stated to be 5,000 lb. of seed cotton per day of fourteen hours. This would be about 1,250 lb. of clean cotton per day, or about 90 lb. per hour.

The foregoing gins, however, are open to several objections. In the best machines of the churka class, the yield per day is very small, and as the rollers cannot be fed with perfect regularity they take hold of the cotton wherever it happens to lay thickest. In consequence of this imperfect holding, and owing also to the distance from the seed at which the fibre is held, considerable breakage occurs. By this means the average length of the staple is shortened. A further drawback, too, arises from the circumstance that soft or unripe and imperfect seeds are frequently carried through with the fibre. In the M'Carthy gin the fibre is only drawn in under the doctor-blade by the superior friction of the leather roller over the friction of the blade, consequently the fibre is but imperfectly taken hold of and the beater drags out some of the fibre in beating off the seeds; hence the cotton is delivered in a broken and injured condition, the natural consequence of the severe rubbing it has undergone between the blade and the roller. The fibre by being shortened of course loses somewhat of its value in the market. The saw gin has a fault at the outset; it leaves a portion of the cotton on the seed, and, beyond this, it likewise breaks the fibre which it does take off to a very considerable extent. This is the case even with cotton of such a tough nature as New Orleans, whilst it is altogether unsuited for ginning tender or long fibre cotton on account of the quantity it destroys. Notwithstanding this, the saw gin is extensively used in America for short stapled tough fibre. This

is principally owing to its ability to get through a large amount of work, although that work is done in a very inferior manner. It was set to work on some Indian and Japanese cotton, but, as it chopped up the fibre in a most merciless manner, the attempt so far may be considered a failure. It may be, however, that cotton grown and ripened at a high temperature acquires brittleness of fibre, the more so if the soil has not been kept well moistened. Although a great number of inventions have appeared in the States which were meant to improve upon or to supersede the original Whitney gin, it is a fact that the cotton gins in general use there are facsimiles of it.

Within the last four years the cultivation and growth of cotton has increased in many parts of the world other than that to which we used to look for our main supplies. Hence arose an increased demand for gins at home, which drew attention to their unsatisfactory condition, and led to various improvements. Amongst others Mr. E. A. Cowper took the matter in hand, and resolved on eradicating the imperfections which he found present in the best gins. He has succeeded in carrying out his views, and his name is a guarantee of the highly scientific character of the apparatus, although its principle is based upon the very oldest and simplest notion—that of the action of the finger and thumb. But the machine in its present improved condition was not an immediate or direct creation; it has been developed through various stages to the perfect form in which it now appears. The Exhibition of 1862 gave birth to the notion of improvement, for there Mr. Cowper observed its necessity, and the idea he worked upon was that of pushing out the seeds by manual labour, as this method caused little or no damage to the staple. Acting upon this train of thought his first machine was nothing more nor less than two series of fingers working in between each other, and alternately holding down the cotton and pushing out the seed. Various modifications of this form have at last resulted in a machine the principle of which is the taking hold of a portion of fibre between the finger and thumb and pushing the seed away first a short distance with another finger, and then taking hold of more fibre and repeating the movement until the clean seed is ejected. The result of these operations is that the whole of the fibre is detached without injury, and from a given sample the length of the staple obtained exceeds that of other good gins by from one-eighth to three-sixteenths of an inch. There are no rubbing parts in the machine, so that the cotton is delivered in nearly the same condition as it left the plant; seeds of course excepted. This is called the look-jaw gin, and an illustration showing a section of the working parts will be found on another page. One of the jaws is formed by the nipping blade, whilst a metal roller, a beater, and strips of ordinary leather constitute the other jaw acting with the nipping blade. Steel plates having finely pointed surfaces are fixed to the roller between the strips of leather; motion is imparted to the beater from a shaft with cranks and rods, whilst the nipping blade is moved by eccentrics and rods. The nipping-blade is made to travel in a path describing an elliptical curve by links, and a thin-edged bar fills up the space between the back of the beater and the roller. A doffer to remove the cotton from the pointed steel surfaces, and a delivery spout for the seeded cotton, complete the arrangements of the gin.

When in operation the nipping-blade and the roller travel at the same surface speed, and in the same direction when the former is approaching the latter to nip or look the fibre between itself and the leather on the roller. The action of the beater is so timed that at the precise moment that the fibre is secured, the seeds are pushed away a short distance. The fibre is thus separated close up to the seed, and at this moment the nipping-blade moves a short distance from the roller, returning to

its normal position. The roller carries the cotton fibre onward, and fresh fibres of the feed supply are combed in by the steel-pointed plates. The distance to which the nipping-blade has been removed is insufficient to let the seeds pass in, although a large tuft of cotton enters in readiness for the next action between the nipping-blade and the next strip of leather on the roller. It will thus be seen that, although the action is only intermittent, and the jaws are locked upon every mouthful, it yet does a very large amount of work per hour. It is as greedy a feeder as the saw gin, but then its arrangement is such that the destructive action of the saw gin is entirely absent. In the M'Carthy gin the expense of maintenance is very considerable, as the sea-horse hide requires frequent renewal. This item frequently amounts in a year to as much as the cost of a new gin, whilst in the look-jaw gin the leather is of the most ordinary kind, and requires renewing far less frequently than the walrus hide in the M'Carthy. The steel plates, too, will probably last for five or six years without being sharpened, and the nipping-blade not being subject to friction, but simply to pressure, will doubtless last as long. Owing to the absence of friction the measure of the force required to work the look-jaw gin nearly corresponds with that necessary to separate the fibre close up to the seed. Every variety of cotton has been tried in the look-jaw gin, and with each description it behaves equally well; from its construction it is only reasonable to expect such results. A small hand gin which we inspected at work turned out about 13lb. of short stapled Indian Dharwar and twice that quantity of Egyptian per hour, the speed being only fifty revolutions per minute. This yield is from one to two pounds per inch of width per hour, and as will be seen doubles and trebles the work of an ordinary M'Carthy gin. Beyond this there is the increased value of the cotton, which is worth as much as a penny per pound more than that produced by other machines, owing to its escaping injury by breakage, rubbing, or felting. The damage done by the ordinary saw gin has long been recognised, but it is still continued in use for the tougher and stouter fibred New Orleans. The simple reason of this is that it does a greater amount of work than any other ordinary gin. But the damaging results of bad ginning are gradually forcing themselves upon the minds of the cotton fraternity, and must in time lead to the general adoption of more perfect machines.

RIFLED GUN COMPETITION.

DURING the recent competitive trial of the 7-inch 149 cwt. guns, to which we referred at some length last week, several minor though not unimportant facts were elicited. Thus, in the powder chamber of each gun a peculiar defect was developed. This was no less than the eating away of the centre of the end of the powder chamber. Now as the form originally given to these chambers was conical it may be that this circumstance has led to the defect, or it may be attributable to the softness of the core of the steel lining. But whatever the cause, the effect was common to all three systems of rifling, and was more plainly developed in Commander Scott's gun. This, however, can scarcely be attributable to any peculiarity in the Scott system of rifling. The inference is that the circumstance is purely referable to the varying qualities of the steel. At the conclusion of the trials the defect in the Lancaster gun measured .35in. in depth, that in the French gun 1.5in. whilst that in the Scott gun measured as much as 2.8in.

In a further trial of the accuracy of the Woolwich, formerly the French, gun twenty rounds were fired with common shells, which had been fired before and re-studded. The experiment was made with the view of determining, if possible, whether the smaller stud contributes to accuracy by assisting to rotate the shot or only by preventing its oscillation in

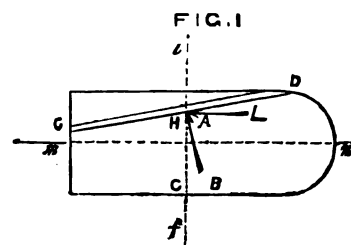
the bore. In the French plan the smaller stud is situated behind, but in Major Palliser's plan, as tried in the Woolwich gun, it is placed in front. To ascertain the point the smaller stud which was in front, and, as intended by Major Palliser, ought to give rotation near the muzzle, was considerably reduced in size. With this reduction it was expected that it would not touch the driving edge. This, however, proved a fallacy, for on examining the shot after their recovery, it was clear that this expectation was not realised, as the smaller studs were all worn and had evidently taken the rifling. So far, then, the experiment did not answer, although the practice made was of some importance in support of the Committee's recommendation of the French, or rather the Woolwich gun. The twenty rounds were fired with 20lb. charges, 100lb. shells filled with sand and plugged, the elevation, corrected, being $5^{\circ} 7'$. The mean recoil was 3.0ft.; mean time of flight, 7.36 sec.; mean range, 2,700 yards; mean difference of range, 13.8 yards; mean observed deflection, 11.3 yards; and mean reduced deflection, 2.1 yards. The uniformity of this practice is remarkable, and has rarely been exceeded. In a subsequent trial of the Woolwich gun, to determine whether a reduction of the front studs to such a degree as should prevent them giving rotation to the shells would interfere with the shooting, the reduction was effectual. On this occasion upon examining the recovered shells it was found that the front studs showed no symptoms of having touched the driving side of the groove. The practice was very nearly as in the previous trial, and tends to the opinion that the use of the studs is to steady the shot in the bore and not to rotate them.

In the naval service salt water cannot at all times be kept from the projectiles, hence a question arose having reference to the relative serviceability of the projectiles of the different systems. The question was, whether the studs on projectiles would become loosened by the action of salt water. With a view to solve the problem, three recovered shot were submitted to the following severe trial. The lacquer was first removed from the lower portion of the projectiles, and they were then alternately immersed in salt water and exposed to the air for three days at a time. This treatment was continued for a period of two months, after which they were exposed to the air for another month. At the conclusion of this searching test no indication whatever was to be found of any of the studs having become at all loosened. This result at any rate proves the serviceability of studded shot for sea service, and also that they are exempt from any special liability to deterioration by being kept in store. From this, too, it may be inferred that shot of uniform exterior possess no advantages over the studded shot in the foregoing respect.

THE FORCE GIVING ROTATION IN RIFLED GUNS.

ALTHOUGH it is now more than ten years since the general adaptation of the principle of rifling to cannon was first seriously conceived and attempted, it is only just at the present time that certainty as to the best method of utilising the idea seems to be resolving out of doubt and obscurity. An immense number of comprehensive experiments on various systems have been tried, nearly every possible form and contrivance of gun and projectile has been tested, and a large amount of data for the formation of theory and for the ascertaining of the laws which rule in the matter has been accumulated. Accurate solution of the problem was so important that the utmost stringency of test was considered necessary, and theoretical knowledge was so insufficient and so liable to absolute and serious mistake that it seemed safer to try almost all conceivable methods and to investigate all possible ideas than to trust to the dicta of mathematics for their adoption or rejection. There

are two principal features in rifling—the sectional form of the bore, and the nature of the spiral. Nearly every possible form and variation from the circle seems to have been tried for the sectional form of bore; every shape conceivable seems to have been tested without much regard for any indication of theory. The form of the spiral has also been variously experimented on, both with regard to the nature of the curve, and to the amount of its pitch. On the sectional form depends immediately the method in which rotation is given to the shot, as to the details of direction of pressure, friction, &c.; while on the nature of the spiral depends the amount or velocity of rotation given. In rifled guns, rotation is generally given to the shot during its passage down the bore by pressure of parts of it against the spiral grooves cut in the length of the bore. But perhaps the simplest way to consider the question is to divide it, and to examine separately the peculiarities contingent to different forms of section, and to different natures of spiral. It is quite allowable and accurate, in the case of rotation of a body round its centre of gravity, to consider separately the motion of the centre of gravity and the motion of rotation round it, and the forces effecting these two separate motions may also be resolved into two independent sets. We may leave out of the question the motion of advance of the shot down the bore, and, considering the shot as if its centre of gravity were at rest, examine merely the forces which give it rotation and which are consequent on its pressure against the groove cut in the gun. If, for instance, the spiral took one complete turn in the length of the gun, the shot would be given one turn during the short period of time occupied by its passage down the bore on the explosion of the powder charge, and, leaving out of consideration the motion of advance of the shot, we assume that this revolution is caused in the same period of time by pressure of the grooves, which we may assume to be in motion in the direction of rotation, and any one of which will in the short period of time referred to have made one complete revolution carrying with it the shot. The force causing rotation is really not contained in a plane of transverse section of the shot and bore, but makes an angle with it. In fig. 1, C D, repr-

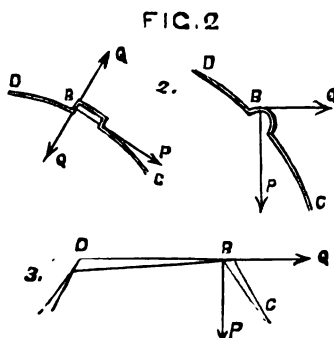


senting a rib on a cylindrical shot, the pressure from the groove A B being at right angles to the plane C D (according to the general law which affirms that the reaction of pressure on a plane surface is perpendicular to it), makes an angle with a plane of section e f drawn through the shot perpendicular to m n, its axis or that of the bore. A B may, however, be resolved into two forces, one G H acting in the plane of section e f, the other K L at right angles to G H and parallel to m n the axis of the shot, and these two forces being at right angles to one another may be considered independently. The force G H may then be taken as the force tending to produce rotation, while that represented by H L only tends to impede the motion of advance of the shot.

We assume, then, the centre of gravity of the shot at rest and coincident with the axis of the bore, and the grooves in motion in a plane of section transverse to the bore. In any form of bore, and with any description of shot as to the metal composing it, the forces tending to cause rotation are—pressure of the groove on the bearing of the shot in a line not passing through its centre, and sometimes friction consequent on the pressure from the groove. Pressure of the circumference of the shot against any other portion of the bore but that

of the grooves or spiral will tend to impede rotation by the friction consequent on it. For it is apparent that the grooves are the only portion of the bore which can fairly be assumed to rotate, as they are the only portions which change their position relative to the initial position of the shot during its passage down the bore. The grooves, in fact, move round with the shot, while the rest of the bore can only be considered as at rest. If there were no grooves, and a shot pressing against the bore were forced by some means to rotate during passage down it, it is evident that there would be friction from this cause resisting the motion of rotation. Although such friction does not directly impede the motion of advance, it does so indirectly by increasing the amount of pressure necessary to give rotation, and thus increasing the frictional resistance to motion of advance consequent on it. This is no doubt an important consideration in the case of lead-covered shot, which are either compressed into intimate contact with the bore, as, for instance, in the Armstrong gun, or when the soft metal is "set up" or expanded against the sides of the bore by force due to its own inertia. In small arm rifles there would for this cause be an advantage where the bore is all groove, as with the Lancaster or Whitworth rifles; in the bores of these there is no surface which does not constitute part of the spiral, and there is therefore no resistance to rotation from such a cause.

If D B C be a portion of the bore of a gun shown in a plane of transverse section, then in any form of grooving or section D B C,

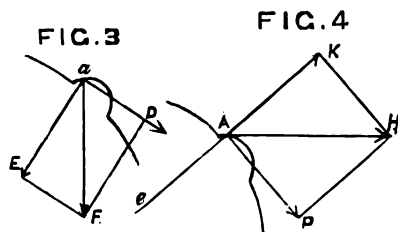


the forces acting on the shot at B, the point of its contact with the groove bearing, will be B P perpendicular to the curve A B C at the point of contact, and B Q tangential to the curve at the same point. B P represents the direction of the pressure, B Q that of the friction; and these are the two forces which tend to cause the rotation, on the supposition that the grooves are moving round and forcing the shot with them. It will be seen that where the line of the groove at the point of contact is radial, friction if from any cause it existed owing to motion of the shot bearing up or down the groove, would only act radially and through the centre of the projectile, and would in consequence have no effect in causing rotation.

Since, when a body rotates about an axis, every point in it describes a circle round that axis, the force effectively applied at the circumference of the shot to cause rotation will be in the direction of the circle in which the point of application of the force has to move, that is, in a direction continually tangential to the circle of its motion. Any force exerted in the direction of a radius to the circle acts directly on the centre of gravity, and has therefore no effect in causing rotation. In whatever direction, with reference to the tangent of the circle of motion, the force be impressed, it may be resolved into two forces at right angles to, and consequently independent of one another, one acting tangentially and therefore effectively to cause rotation, the other acting radially, and being therefore without such effect.

In fig. 3, if A F represent the direction in which force is impressed perpendicular to the plane of bearing at the point of contact, and it represent likewise the amount of that force, then the parallelogram D A E F being com-

pleted, where D A is tangential to the circle of which the centre of the shot is the centre, and A E is radial to it; the impressed force is resolved into its tangential and radial



ponents; and D A : A F represents the ratio of the force tangentially effective to that applied; and D A = A F sin. θ , or R = P sin. θ , where R represents tangential force, P the force applied, and θ the angle included between its direction and the radius. The useful pressure varies, then, with the sine of the angle between the line of pressure and the radius.

Friction acts in a direction tangential to the line or curve of the groove at the point of contact, and consequently perpendicular to the line of pressure; and as friction is a constant fraction of the amount of pressure on which it is consequent, it is a function $e P$ of the pressure P when e is the fraction or coefficient of friction for the materials of shot and bore.

If H A, fig. 4, be tangential to the curve of groove at point of contact A, and A D tangential to the circle of which the centre of the shot is the centre, and A E be radial, then completing the parallelogram D A K H, D A : A H represents the ratio of amount of friction resolved tangentially to that actually in existence. The angle H A D = F A E = θ ; therefore, D A = A H cos. θ , and as $e P$ represents the whole friction, therefore D A, or the force of friction resolved tangentially, is equal to $e P \cos. \theta$. Therefore, if F be the total force acting on the shot bearing tangentially to the circle of motion at the point of contact,

$$F = P \sin. \theta + e P \cos. \theta; \text{ and}$$

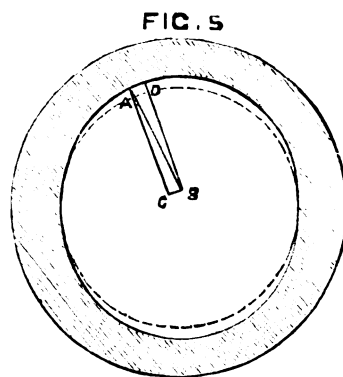
$$P = \frac{F}{\sin. \theta + e \cos. \theta}$$

expresses the ratio of force applied to that effective. It may be seen from this formula, that as the pressure P is given a more radial direction, and the angle θ approaches 0, the increased amount of friction usefully directed diminishes to some extent the necessity for tangential force. As θ approaches 0 the formula tends to the value $F = e P$, for sin. θ becomes 0, and cos. θ becomes 1; so that the greatest strain which can be engendered in the effort to give rotation will be $P = \frac{F}{e}$, as

the exertion of that amount of pressure will cause sufficient friction to turn the shot. If we take the coefficient of friction for iron at $e = 1.6$ th, $P = 6 F$, so that the greatest amount of groove pressure that can be required to cause rotation with any shape of section is not more than six times the force which will produce that effect if applied in the most effective manner at right angles to a radius. This explains the way in which rotation is enforced in guns when the normal pressure from the grooves is nearly radial in direction, as, for instance, in the Lancaster gun. P will have a variable value depending on the rate of increase of the velocity of the motion of advance, with which that of rotation is inseparably connected, and modified by casualties, such as bounds of the shot in the bore, &c. Doubt exists as to the value of e the coefficient of friction, at very high pressures, and it is asserted that it may be sometimes greatly increased. This will affect the matter in two ways, for though it will increase the amount of resistance to the motion of advance of the shot owing to the friction resulting from groove pressure, yet if the groove bearing give a normal pressure not nearly tangential, there will be more friction

useful for rotation, when the coefficient e is large. If, for instance, $e = \frac{1}{2}$, $P = \frac{F}{e} = 2 F$ is the greatest force which can occur in development of the necessary tangential force F.

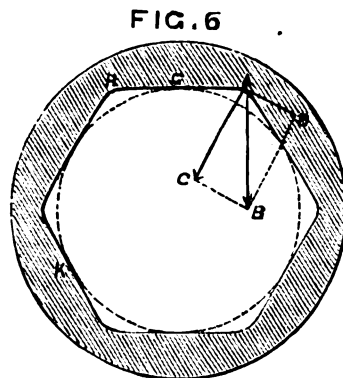
Fig. 5 represents the section of a Lancaster



gun, A being the point of contact of shot and bore. A D represents the effective tangential pressure, while A B represents the whole force applied, and A C is the component resolved radially and ineffective; or A B is P, A D is R, and the angle B A C is θ .

By the formula, $P = \frac{F}{\sin. \theta + e \cos. \theta}$. Here

$\theta = 7^\circ$ about, and $P = 3.5 F$ nearly. The important part taken by friction in this case is very marked, for the tangential force due to pressure only is not more than 1.12th of the force applied at the bearing. In the Whitworth gun the angle B A C = $\theta = 30^\circ$, when the point of contact is taken as at an angle of the polygon, and here $P = 1.5 F$ about. One of the chief features of the Whitworth gun is the "mechanical fit," as it was termed, of the shot; the inventor having endeavoured almost altogether to avoid windage, and to bring in contact a considerable portion of the side A H of the bore and of the shot. In the recent guns of this kind, the corners of the polygon have been more cut off as at H, and a portion



of the side, as A G, is slightly inclined, so as to render it more prominent, and to bring a large bearing of the shot into contact with it, as shown at K. The point which may be taken as the central locus of the pressure which gives rotation is between A and G, and if θ be taken as about 15° , $P = 2.3 F$. It has been asserted that the "mechanical fit" may prevent rotation by causing force to be exerted on the reverse side of the grooving. Even, however, if there were contact, the amount of the force would be so slight as to be insignificant, while, too, it would be balanced by pressure from a similar cause acting on the other side of the groove.

The French and Scott systems of rifling are somewhat similar, but the French has only three grooves, while the Scott has five or more. The Scott groove, too, has its bearing less radial than the French, and the groove is rather shallower on the loading than on the driving side. In the Scott gun taking θ as 50° , $P = 1.14 F$, about. In the French gun P may be taken as very nearly equal to 1. In the "shunt" gun grooves of various shapes

have been tried, in recent ones the angle θ is about 40° ; and therefore $P=1.3 F$, about. The coefficient of friction has been assumed above as $e=1.6$ th, but where soft metal is used on the shot bearing it may be increased. When, too, there is compression, as in the "shunt" gun, by a "nipping" groove, the friction may be increased. As has been already stated, in shot coated with soft metal, which is expanded or compressed against the sides of the bore, pressure against portions of the bore not forming part of the spiral will generate friction impeding rotation. It has been stated, that in the Armstrong gun the friction of the shot, owing to its compression, was about two tons per inch of the shot's circumference. If the lands were considered equal in surface to the grooves, this would give half such a force, or one ton per inch of the shot's circumference as a force resisting rotation. It would, however, be balanced by the frictional pressure in the grooves tending to cause rotation, while the rotation would actually be effected by the nearly tangential pressure from the driving sides of the grooves.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

M. Gerstenhöfer's Furnace for Preventing Loss of Sulphur in Smelting Copper Ores—New Researches respecting the Properties of Aluminates of Lime—Aluminates as Materials for Crucibles and other Vessels—Use of Peroxide of Iron in Fleitmann's Process for obtaining Oxygen—Actual Existence of the supposed Metal Ilmenium—Production in Enamel of Copies of Photographs—Economy of the Method of Concentrating Syrups by Cold.

ONE of the principal copper-smelters of Swansea is making arrangements to test on the great scale the practicability of one of the many plans which have been suggested for saving the sulphur which enters so largely into the constitution of ordinary copper ores, and which the copper-smelters have hitherto allowed to escape into the atmosphere, in the form of sulphurous and sulphuric acids, to the utter destruction of all vegetation in the neighbourhood of their works, and the utter loss of the value of the sulphur itself,—that value, in the case of the sulphur which is driven off from the furnaces of Swansea alone, amounting to not less than a quarter of a million sterling per annum. There can be no doubt that our copper-smelters ought, as Dr. Percy says, to be "the great sulphuric acid manufacturers of the country," and one of them, Mr. Vivian, seems at last to have determined to add to his business as a copper-smelter that of a manufacturer of that acid the quantity of which consumed in any country has been said to be the best test of its degree of civilisation. Mr. Vivian proposes to effect this object by means of a special construction of furnace which has been invented by a German, M. Gerstenhöfer, and the English patent for which he has purchased. This furnace, we are told, "consists of a rectangular chamber, filled with rows of bars, having one of their faces parallel with the top of the furnace, and so arranged that no two bars in succeeding rows shall be directly over one another. The ore is introduced from above, in a finely divided state, and the supply is regulated by rotating feed-rollers fixed in the roof of the furnace. These feed-rollers are placed over the first row of bars, and as the ore falls through it piles up on them, until it at last flows over and falls then on the row of bars below, and the supply, being thus kept evenly flowing from above, gradually fills the whole furnace. Between the feed-rolls and the bars are channels in the side of the furnace, by which the products of the calcination may escape; and besides these, there are other apertures which may be opened as necessity requires for cleaning the bars, as also other minor arrangements which do not interest in this explanation. Below the tiers of bars—and here it may be mentioned that the higher the furnace the more perfect will be the calcina-

tion—there is an open space into which, at the commencement of the calcination, a grate with some ignited fuel—say, wood or charcoal—is introduced, and this fire is well fed with fuel, until the charge is thoroughly ignited, when the grate is withdrawn, and the charge burns by means of the ignition of the sulphur evolved. This combustion is kept up by a current of air forced from beneath up through the furnace, and the products of combustion are thus carried over, through the set of channels in the top of the furnace, away into the sulphuric acid chambers. The channels by which the gases are here conducted are so arranged as to heat the current of cold air forced into the bottom of the furnace. The calcined ore having passed through the furnace, falls into a space below, from which it can be drawn off into waggons, and so transferred to the next operation." M. Gerstenhöfer sets forth as follows the advantages which he believes to be gained by the use of his furnace:—"First, the ores are operated upon in a very divided state, so as to expose a large surface to the action of the air, and this surface is always being renewed; second, the air which must be admitted is forced to come perfectly into contact with the ores; third, the ores are brought into the furnace by mechanical means, continuously in such quantities as may be required, so as to maintain a continual roasting process; fourth, the air or draught is also brought into the furnace by mechanical means, in order to be able to regulate the draught, according to the quantities of ore, and also to prevent the influence of storms, which are sometimes very troublesome in working with grate furnaces; fifth, the heat produced by the ores is not led away uselessly by the gases, but is employed to heat the new ores and the air." Some smelters seem to be of opinion that, even supposing M. Gerstenhöfer's furnace to work otherwise successfully, the cost, which its use involves, of grinding the ores fine, together with that of the blast required, and of the necessary attention to the machinery employed to regulate the supply of ore, will exceed the value of the product obtained in the sulphuric acid chambers into which the sulphurous vapours generated in the furnace are to be led. Thanks, however, to Mr. Vivian's enterprise, we shall soon know from experience how far this anticipation is well-founded. We incline to think that there is very little foundation for it indeed.

M. Fremy has been investigating the causes of the hydraulicity of hydraulic cements, and in the course of his researches with respect to this matter, an account of which has just been published, he had occasion to study the properties of the aluminates of lime somewhat more closely than they had been studied previously. The results of his observation of these compounds are of considerable interest to metallurgists. He finds that aluminates of lime containing a considerable proportion of base eagerly absorb, and strongly retain, both sulphur and phosphorus, and so that the presence of such aluminates in the slags of iron furnaces will probably be beneficial to the quality of the iron operated upon. This is a suggestion which well deserves to be put to the test of careful experiment on the great scale. Calcareous aluminates of the class mentioned crystallise, have a saccharoidal fracture and strongly alkaline reaction, and combine with water with disengagement of heat. Aluminates containing smaller proportions of lime M. Fremy finds to be more fusible even than similarly constituted silicates of the same base. Thus, he says, "I obtained perfectly fused aluminates of lime by heating in the blow-pipe furnace mixtures of eighty of lime and twenty of alumina, and of ninety of lime and ten of alumina. Even a mixture of ninety-three of lime and seven of alumina fritted, and almost fused." Both the alumina and the lime which he used in his experiments were almost chemically pure, the former being obtained by calcination of ammonia-alum, and the latter by calcination of Iceland spar. He concludes that alumina is

almost as effective a flux for lime as silica is. If this is really the case the fact is one of great importance to metallurgists.

Déville, we believe, is the only chemist who had previously devoted much attention to the aluminates of lime. He found that exceedingly refractory crucibles could be made of them. His method of procuring the particular aluminate which he considers to be most serviceable for this purpose consists in exposing to the highest temperature of a good air-furnace an intimate mixture of equal parts of alumina and pounded marble. The product is scoriaceous and translucent, and resembles dried flour paste. Déville takes equal parts of this product, of alumina which has been hardened by exposure to an intense heat, and of alumina which is capable of forming a plastic mixture with water, as is the case with that prepared from ammoniacal alum at the lowest temperature which will drive off the ammonia and sulphuric acid therefrom, and of this mixture makes crucibles which do not soften below the temperature of melted platinum. "For very high temperatures," says Dr. Percy, "less aluminate should be used; but it is desirable that the mixture should contain from five to ten per cent. of lime." Déville states that crucibles made of this mixture, "when once baked, will stand every test. They resist sudden and great changes of temperature, and almost every kind of matter, even sodium, which may be heated in them." Aluminates of lime prepared by M. Fremy's method would certainly seem to be more fusible than the aluminate of which Déville speaks thus, but it is conceivable that they should be as little liable as Déville's compound to be acted on by other substances. In that case, their greater fusibility would be an advantage, since it would render it all the more easy to construct large vessels of them,—and a material of which large vessels could be made, which would bear a tolerably high temperature without being acted upon by either the air, the fuel, or the substances heated in them, would be invaluable in some of the arts.

A few months ago, as the readers of these "Notes" are aware, Fleitmann announced that oxygen gas could be obtained very cheaply by the action of a minute portion of peroxide of cobalt upon a solution of commercial chloride of lime, or bleaching powder. Mr. R. W. Artlett has been experimenting upon this process, and it occurred to him to try what action upon chloride of lime solution would be exerted by other peroxides than that of cobalt. He found peroxide of iron to have precisely the same effect as peroxide of cobalt, and, like the latter, to lose none of its efficiency by use. When peroxide of iron is used, however, a slightly higher temperature is required for an equally rapid disengagement of gas than suffices when cobaltic oxide is employed. Oxide of copper is equally efficient, "and if the oxide be not at hand," says Mr. Artlett, "a few drops of nitrate of copper may be added to the chloride of lime solution, and the gas will be given off abundantly immediately on the application of heat." Peroxide of manganese does not answer so well, part of the oxygen abstracted from the chloride of lime by its action going to form permanganic acid, instead of being set free.

In the year 1845, R. Hermann announced that he had found in the mineral columbite, associated with niobium and tantalum, a metal which had not till then been recognised, and which he named ilmenium. Blomstrand, Rose, and other chemists, experimenting upon the same mineral, failed to find in it any metal except tantalum and niobium, and hence the existence of the metal which Hermann imagined that he had discovered has since been generally doubted by chemists, who have supposed that what Hermann took to be an oxide of a new metal was simply impure niobic acid. Hermann, however, has all along felt certain of his ground, and in the last two numbers of the "Journal für Praktische Chemie" some further researches of his

are described which seem to place the existence of ilmenium, as a distinct metal, beyond question. So far as is at present known, however, the metal does not exist abundantly enough for there to be much prospect of its ever being of any great importance in the arts.

The process of printing from a photographic original which was described in last week's "Notes" has been applied, with the utmost success, to the ornamentation of porcelain, and to the production of pictures in enamel, and the like. When thus applied, the intaglio mould is printed from by means of a mixture of gelatine and vitreous colour, and a print is thereby obtained which may be readily transferred to any glass, porcelain, or enamel surface, and which can then be burnt in without difficulty. This method of obtaining pictures in a vitreous material seems likely to receive very extensive applications. In addition to its more direct advantages, it has this incidental one, that the copies of photographs produced by it are imperishable.

In speaking, a few days ago, of M. Reynoso's process, mentioned here some weeks back, of concentrating syrups by the application of cold, the *Monteur* stated that the percentage of sugar obtained by it is nearly double that yielded by the old methods of concentration. It added that M. Reynoso, by the application of improved methods of cultivation to his estate in Havannah, obtains from it fifteen thousand kilogrammes of sugar per hectare, instead of three thousand kilogrammes per hectare, which is the usual yield.

ON SUGAR-MAKING MACHINERY.

By PERRY F. NURSEY.

THE first meeting of the Society of Engineers, session 1865-6, was held on Monday evening last, when the following paper was read:—In an age when knowledge was power of a tyrannical and oppressive character it was tolerable that a veil of impenetrable mystery should be drawn around the early germinations of science by her ligated votaries, and that the pursuit of knowledge should be allowed only to the few, while the mass wondered ignorantly on in mingled terror and admiration. But it is not tolerable that in our day any system of practically applied science should be designedly mystified and jealously guarded by a few monopolists, or that in any branch of manufacture a special limitation should be observed, lest perchance a ray of light the more should gleam upon the path of the inquirer in his search for practical knowledge. Nevertheless, that such is the case is the experience of many who have fruitlessly sought for information upon the subject of the present paper. The well-known secrecy observed by those engaged in the manufacture both of sugar and sugar machinery has undoubtedly given an advantage to a few engineers whose charges and whose workmanship are not always what they might be if a moderate amount of competition were introduced; but to the many information has been peculiarly inaccessible, owing to the scant and often vague and designedly mystified way in which the mechanical part of the subject is treated in the few articles which have been written upon it, and owing also to the difficulty—nay, impossibility—of obtaining particulars from those who possess them. But the day of crafts and mysteries has well nigh passed away, and although the sugar faction may be the last to yield to the universal demand for knowledge, yet the time must come when the barriers of their exclusiveness shall be broken down, and the weakness of their strength become apparent; for, after all, the process of sugar manufacture is a very simple matter. To Mr. Burgh is due the credit of having published the first practical treatise on sugar machinery, and this, too, in utter disregard of the susceptibilities of the sugar faction, with which Mr. Burgh—to use one of his favorite expressions—was doubtless "practically acquainted." The author's materials, however, were gathered before Mr. Burgh's work came out, or possibly the present paper would never have appeared. The difficulty experienced by the author in obtaining information upon the subject induced him subsequently to extend his researches, and he has gone with some care into the matter with the view of submitting the results to the society. A greater delay than he antici-

pated has occurred in the production of the paper, which, however, it is hoped may be found to contain some useful information upon the manufacture of sugar and the machinery employed therein. It is proposed to notice briefly the history of sugar, its varieties and its chemistry, and, at greater length, its manufacture, under which head the various mechanical appliances will be considered, and estimates of machinery will also be given.

The author then proceeded to give a general outline of the history of sugar and its manufacture from the earliest times. He then enumerated and described the several varieties of sugar. In a third section he noticed the subject from a chemical point of view, after which he observed that the manufacture of sugar from the sugar cane might be classed under four heads:—1, cultivation of the cane; 2, extraction of the juice; 3, purification of the juice and its concentration; and, 4, its crystallisation or granulation.

ARTICLE I.—CULTIVATION OF THE CANE.

Cultivators distinguish three great varieties of canes—the Creole, the Batavian, and the Otaheite. The Creole cane is indigenous to India, and was transplanted thence to Sicily, the Canary Isles, the Antilles, South America, and the West Indies. It has dark green leaves, and a thin but very knotty stem. The Batavian or striped cane, which has a dense foliage, and is covered with purple stripes, is a native of Java, where it is chiefly cultivated for the manufacture of rum; it is also met with in some parts of the new world and the West Indies. The Otaheite variety grows most luxuriantly, is the most juicy, and yields the largest product. It is cultivated chiefly in the West Indies and South America; it ripens in ten months, and is harder than the other varieties.

The sugar cane being originally a bog plant, requires a moist, nutritive soil, and a hot tropical or sub-tropical climate. It is propagated by slips or pieces of the stem, with buds on them, and about 2 ft. long. It arrives at maturity in twelve or sixteen months, according to the temperature; the leaves fall off towards the following season, and the stem acquires a straw-yellow colour. The cane is cut by some planters before the flowering season, but it is more usual to cut it some weeks after. The plantations are so arranged that the various divisions of the field may ripen in succession. The land should be supplied with manure rich in nitrogen, but not containing much saline matter. After the harvest the roots strike again, and produce a fresh crop of canes; but in about six years they require to be removed.

The time for cutting the canes varies with the soil and season, and the different varieties of cane. In a state of maturity the canes are from 6 ft. to 15 ft. in length, and from 1½ in. to 2 in. in diameter. The usual signs of maturity are a dry, smooth, brittle skin, a heavy cane, a grey pith, and sweet and glutinous juice. Canes should be cut in dry weather, or the juice will be found diluted with an excess of water. When cut they are tied up in bundles, and conveyed to the crushing mill, particular attention being paid that the supply should not exceed the demand, otherwise the cut canes would ferment and spoil.

The sugar cane grows from pieces or slips of itself, containing germs, and these develop rootlets at the joints, which draw sustenance to the young shoot as it increases. In the course of time the buds in the radicle, or root-joints of the first cane, throw out roots, and form a radicle for a second stem; and in this way, under favourable circumstances, several canes are produced from the parent stock for a period of about six years, and sometimes for several more. They, however, diminish every year in length of joint and circumference, and are inferior in appearance to the original plant; but they yield richer juice, and produce finer sugar. Opinions vary as to the distance canes should be planted from each other, some planters recommending 6 ft., others 8 ft., and others again 10 ft. spaces; but the system of wide planting is gradually superseding the old close planting, with great advantage to the cultivator.

One variety of cane much cultivated in Jamaica came from Otaheite. With a favourable soil and good cultivation it grows to a height of 13 ft. or 14 ft. in the first year, being 6 in. in circumference, and having joints 6 in. apart; they will produce 2½ tons to 3 tons of dry sugar per acre, but a good average is 2 tons per acre. The China cane is very hardy, standing both cold and drought,

and with plenty of rain giving out as many as thirty shoots. The Bangalore cane is considered the finest in the Straits of Singapore, or, perhaps, in the world. It has been known to produce 7,200 lb. of undrained sugar per acre, equal to 5,800 lb. of dry sugar for shipping. Dr. Livingstone states that sugar is cultivated in the Shire Valley, as well as in many parts of Africa near the Zambesi, and may be had for as little as one halfpenny per pound.

Dr. Evans gives the products of an acre of canes in Barbadoes as—

Weight of canes.	Weight of juice.	Extract.	Extract per 100 lb. of juice.	Extract per 100 lb. of canes.
30 tons	60,480 lb.	10,886 lb.	18.0	18.38
30 "	47,040 "	8,467 "	18.0	12.8
30 "	33,600 "	3,500 "	10.0	5.0
30 "	33,600 "	7,280 "	21.6	10.6

An acre may be said to yield 30 tons of canes. The following table gives the produce in juice and sugar:—

Juice obtained per cent.	Juice in the	Pounds of sugar.				Subtract for molasses and skimming at 12 per cent.	Pounds of dry sugar yielded by 1 acre.			
		At 12 per cent.	At 14 per cent.	At 16 per cent.	At 18 per cent.		At 12 per cent.	At 14 per cent.	At 16 per cent.	At 18 per cent.
70	47,040	8,468	9,408	10,348	705,792	888,776	8,816	9,496		
75	50,400	9,092	10,080	11,068	757,840	924,833	9,240	10,164		
80	53,760	9,876	10,752	11,627	806,896	994,871	9,856	11,173		

This supposes the juice to stand at 10 deg. Beaumé; at the same time all the numbers given are above the amount actually obtained in practice, which it is very difficult to ascertain. But a very fair specimen of the yield per acre is 4,000 lb. of sugar, and 170 gallons of rum 20 per cent. over proof.

Of the 18 to 22 per cent. of sugar in the cane, it is generally believed that only 8 is obtained crystallised. If only 50 per cent. of the juice is taken from the cane, and 30 still remain in it, it is clear that three-eighths of the sugar are taken away in the megass and burnt as fuel. The value of sugar to the planter cannot be far short of £20 per ton, and he could procure coal at an infinitely lower price. But, loss as this seems, it would not be so important if the ashes of the megass were thrown on the soil. The climates which grow sugar grow ligneous fibre rapidly, and it is well to use it for fuel where possible. But the soil should not be deprived of its inorganic constituents.

Our West India sugar manufacture, as a whole, appears to be in an unsatisfactory state, and the depressed condition of our colonies has been referred quite as much to the defective culture of the cane, and the injurious methods of expressing and evaporating the juice, as to political causes. The land has been very imperfectly worked by hand-hoeing, and the expressed canes, instead of being returned to the land as manure—for which they are as eminently fitted as they are practically necessary—are used as fuel in evaporating the juice. The cheap rate at which coal can be obtained from Great Britain makes it desirable that this practice should be abandoned, and the cane trash or megass put to its legitimate use. The manufacture has been unaided by the application of those mechanical and chemical means which have so prospered European enterprise, and the unimproving planters have drawn upon themselves those pecuniary difficulties which must result to those who insist upon standing still while others progress. If from beetroot 7 per cent. of refined sugar can be extracted, it is not too much to expect the same skill to produce 10 per cent. or 12 per cent. from the sugar cane. By improved methods of treatment the planters in Java and Cuba, and in some few instances in our own colonies, are extracting and sending to market 10 per cent. to 12 per cent. of raw sugar from the 100 lb. of canes. This result of the employment of better machinery, and more refined chemical applications, is a striking comment upon the West Indian practice, whereby of the 18 per cent. of sugar contained in the average cane juice, not more than 6 per cent., or one-third, is sent to market in the form of crystallised sugar. This loss is accounted for by the fact that of the 90 per cent. of juice contained in the cane, only 50 per cent. or 60 per cent. is expressed, one-third being left in the megass, as before noticed, and used as fuel; by the loss of one-fifth or more of the sugar in the juice by imperfect clarifying, and in skimming; and by the crystallisation of

only from one-half to two-thirds of the juice when boiled down and set to cool, the remainder running off as molasses, and although these and the skimmings are fermented and distilled for rum, there is still a considerable loss. In the interior of Java, where fuel is scarce, the molasses is worthless, but in the West Indies it is a marketable article, and may be distilled with profit.

The object of the colonial sugar boiler is to convert the juice as speedily and with as few operations as possible into raw sugar, hence he has shown but little care for improving upon the old system of manufacture, which is attended by loss at every stage. While science has been actively engaged in perfecting the manufacture of beetroot sugar, she has, until lately, done comparatively nothing for that of cane sugar; but now that attention has been fairly given to the matter, it is found that much of the beetroot apparatus is fitted for cane sugar.

The means by which a better result is to be attained are, undoubtedly, the use of improved cane mills, whereby 70 per cent., and even 75 per cent., of the juice can be expressed; of improved methods of clarifying—of charcoal filters before boiling, which supersede skimming of steam and vacuum boilers, by which burning is prevented and rapid concentration is effected—of centrifugal drainers to dry the sugar speedily and save the molasses—and of coal or wood as fuel where the megass is insufficient for the purpose.

ARTICLE II.—EXTRACTION OF THE JUICE.

The sugar exists in the cells of the cane in a state of solution, and is extracted therefrom by pressure. Like as with other branches of industry, science has of late years stepped in here, and greatly facilitated the process of extraction and manufacture. It may be as well to give here a summary of the processes employed in the preparation of raw sugar:—The canes are passed through the mill, and the juice thus extracted from them runs from the mill into a tank, whence it is pumped into cisterns for supplying the clarifiers, heated by steam, where it is purified. From thence it is run into bag-filters, by which the mechanical impurities are removed. It is then run into charcoal filters to remove the colouring matter of the juice. The filtered juice is then run off into tanks, and is drawn thence by vacuum into the vacuum-pan, where it is granulated, and from whence it is finally discharged for packing. When the steam clarifiers are not employed, the cane juice is run into a series of pans or "teaches," over open fires. This apparatus is also known as a "battery," and forms another method of purification.

The original crushing apparatus of India was a kind of squeezing mortar, made out of the hollow trunk of a tamarind tree, and worked by a yoke of oxen, the pestle or stamper being a strong beam 18 ft. long, and rounded at the bottom so as to squeeze or crush the canes in the mortar. Mills similar to those used for crushing oil seeds were used—as were also several other forms of apparatus—before rollers were introduced. Stone and iron rollers were first used, with the axes in a vertical position, but the horizontal was soon found to be the more convenient and economical. The importance of a systematic mechanical arrangement appears to have awakened attention during the reign of Charles II., for in 1663, Lord Willoughby and Lawrence Hyde (second son of Edward, Earl of Clarendon, High Chancellor of England) associated themselves with one David de Maroato, an inventor, and obtained a patent for twenty-one years for making and framing sugar mills. In 1691, John Tizaok patented an engine for milling sugar canes, &c.; but in this, as in the previous case, it is not specified how the mill should be made. Later on in 1721, William Harding, a smith, of London, who had been many years in Jamaica, and was skilled in the manufacture of sugar mills, having observed their imperfections, how that they were chiefly made with large wooden cogs cased with iron, endeavoured while abroad to improve their construction, but failed for want of competent workmen. On his return to London he made models of sugar mills which were approved of by the Royal Society. These mills were fitted with cast-iron rollers and cog wheel gearing, and were worked by water power; from description they appear to be the type of mills of the present day. Some forty-five years later Yonge and Baroley, ironfounders, of Allhallows-lane, City, applied friction wheels to sugar mills. In 1773, John Fleming, a mill carpenter, proposed an arrangement of windmill

sails which turned a vertical timber shaft shod with iron, and which gave motion to two hard wooden rollers, between which the cane was guided and squeezed. In 1807, H. O. Newman, of St. Christopher, West Indies, designed a mill to be worked by horse power. He used cog and crown wheels to give motion to three vertical rollers, and the arrangement was considered one which greatly augmented the power and execution of this class of machinery. In 1821, John Collinge, of Lambeth, improved cast-iron sugar mills by casting the rollers on wrought-iron shafts, instead of keying them on as previously done. In 1840, James Robinson patented improvements in sugar mills, which consisted in using four rollers, one large one and three smaller ones beneath, placed horizontally and gearing by cogs into each other. Up to that time three rollers only appear to have been used. He also proposed to use six rollers, which are fed from an endless band passing over the rollers. He cast the rollers and shafts in one piece, cored out to admit steam to facilitate the extraction of the juice from the cane during crushing. He also proposed to tin the interior of vacuum pans, &c. Various other arrangements have been patented, but it is unnecessary here to enumerate, much less to describe them. The foregoing examples give an idea of the progress of the subject during nearly 200 years. The last ten years have seen rapid strides made in improving the make of mills, and the general arrangements of sugar works.

Before proceeding to consider the mills at present in general use it will be as well to notice Bessemer's cane press, which entirely dispenses with rollers, to the use of which Mr. Bessemer objected on the ground that the time allowed by them for the pressure on the cane was too short to displace all the fluid from the congeries of cells in which it was stored, and that, moreover, the amount of pressure on different parts of the cane is unequal, since the rind and knobs are harder and more woody than the rest of the cane. Mr. Bessemer's press consists of a crank shaft with three throws upon it, an oscillating steam cylinder, and solid pistons on plungers fitting in gun metal tubes, which are perforated by small holes, the interior orifices of each hole being smaller than the exterior, to prevent choking up. Above the tubes are hoppers, down which the canes pass vertically; and as the plunger makes its stroke in the direction of the crank, the end of the plunger cuts off from the cane a piece equal to the height of the tube, while its further progress forces the newly-cut portion against a mass of already crushed cane, whereby the greater part of the juice is forced out; but as the cane contains solid matter, the plunger, in finishing the stroke, must force the whole mass of crushed cane forwards a distance equal to that occupied by the solid portion of the newly-interposed piece, which movement of the mass displaces at the open end of the tube an equal portion of the mass which occupies it. During the cutting off and pressing of this juice the plunger will have moved forward under the hopper, and a portion of the cane within it will have fallen down within the tube. The reverse motion of the plunger also cuts off a length from it and forces it against the mass of cane trash, expressing the cane juice as before. In this way the reciprocating motion of the plunger acts on two pieces of cane at every stroke, and a similar operation also takes place at the same time in as many tubes as may be placed side by side over the cistern. In this cistern is a self-regulating heating apparatus for raising the juice to the temperature required for defecation within two minutes after its expression. The cane trash is produced in a condition favourable for fuel; it falls upon a carrier, and, after being conveyed through a drying apparatus, is delivered at the furnace door of the evaporating pans. It is stated that the juice obtained by this method is larger in quantity, less coloured, and more free from small broken fragments than when the pressure is performed by means of rollers. This press, however, has not come into general favour, its adoption being very limited.

Wind has been very much used as a motive power for driving the cane mill, but it is objectionable on account of its irregular velocity, which renders it inferior to any other description of power for crushing. It has been ascertained, by comparing the results from forty-four mills in Guadalupe, driven by different kinds of power, that with windmills of inferior construction, the cane mills produced only 50 per cent. of juice;

with the ordinary windmills the yield was 56·4 per cent.; animal power gave 58·5 per cent.; water power averaged 59·3 per cent.; and steam, 61·8 per cent. Recent improvements have, however, brought the yield up to 75 or 80 per cent. Steam power, therefore, is coming into general use for cane mills, and many improvements have been effected in engines specially constructed for this class of work.

The sugar mills generally employed are of three descriptions chiefly—the horizontal roller mill, the vertical roller mill, and the hydraulic press; the latter has, however, received but very limited patronage. The vertical mill has the advantage of being more easily cleaned than the horizontal, but is less easily fed, and is more costly in construction, than the horizontal three-roller mill, which is the form of construction usually employed. Mills have been constructed with five and with four rollers. In the five-roller mill three are placed below and two above. It is considered that this mill will extract 10 per cent. more juice from the cane than the three-roller one; but the megass is thereby much broken, and a much greater power is required to work the mill. In the four-roller mill, where two rollers are placed above and two below, the driving power is not much greater than that required in the ordinary three-roller mill, and a superior amount of juice is obtained. It is therefore probable that the four-roller mill will gradually supersede those now in general use.

A cane mill of improved construction for ordinary use consists of a bedplate of cast iron, weighing not less than 2 tons 5 cwt. It is cast with a concave bottom, to receive the cane juice, and has a delivery cast on the side for discharging the juice into the tank, whence it is pumped to the clarifiers by the pump, which is worked from a crank on the shaft of the upper roll of the mill. Fitting strips are cast on each side, and faced to receive the side frames. The bedplate is bolted down to the foundations with four 3½ in. bolts, passing through the side frames, and held down with plates and keys, and also with four 1½ in. holding down bolts, 6 ft. 9 in. long. The side frames are of cast iron, and weigh not less than 36 cwt. each; they are cored through to receive the bolts, and are cast with bosses for adjusting screws 2½ in. diameter, by which the space between the rolls is regulated. The upper roll is distant from the two lower ones about one-fifth to one-quarter of an inch. The frames are accurately faced at bottom and fitted to the bedplate. They are held down by the bolts, which also hold down the centre caps of the upper roll. Spaces are left in the frames to attach a trash-turner, which is placed between the two lower rolls, and under the top one, to guide the cane between the upper and second lower roll. Openings are left to place the rolls; and cast-iron filling up pieces are provided, accurately fitted and held in place by diagonal bolts, 2½ in. diameter. A wrought-iron feeding table, and wrought-iron megass delivery, are provided. The three cast-iron rolls are each 2 ft. 2 in. diameter. Each roll should weigh not less than 35 cwt., and be rough-turned. The two lower rolls are cast with flanges on the outer sides, to prevent the cane juice spreading beyond the rolls. Each roll is cored 8 in. square through the centre, and is hung with eight keys to the shaft. Wrought-iron rings are shrunk on to the shafts outside the rolls to prevent the keys starting. The shafts are of the best wrought iron 8 in. square, with 7 in. journals, and have square ends for hanging pinions to connect the rolls. A clutch box is cast on the pinion for connecting to the intermediate shaft. The bearings are of the best gun metal, accurately bored, and fitted in the side frames with a flange on each side, steel plates are fitted at the back of the bearings to receive the thrust of the adjusting screws, which are passed through spaces in the side frames. Three spur pinions, each 2 ft. 2 in. diameter, 3·14 pitch, and 8 in. broad, are hung, each with eight keys, to the ends of the roller shafts to connect the rolls for work. The intermediate shaft is of cast iron, 8½ in. square, 9½ in. square at each end, and is connected to the shaft of the upper roll by a square clutch box, and to the intermediate gearing by another square clutch box. The intermediate gearing consists of a spur pinion 1 ft. 9 in. diameter, 3·14 pitch, 9 in. broad, bored out and fitted to the engine shaft, and makes forty revolutions per minute, and works into a spur wheel which is 7 ft. diameter and 9 in. broad, and is hung to a shaft with eight keys. The shaft is of cast iron, 8½ in. diameter, and the journals are 7 in. diameter by 9 in.

long, with collars left on each side. The distance between the inside of bearings should not be less than 4ft. 4in. This shaft makes ten revolutions per minute, and runs in plummer blocks, which are fitted with gun metal bearings and are provided with wall plates and holding-down bolts 1½in. diameter, to fasten them down to the brick-work. The pinion is 1ft. 9in. diameter, 3¼ pitch, 9in. broad, and is hung to a shaft with four keys, and works into a spur wheel which is 7ft. diameter, 9in. broad, and 8¼ pitch, and has six arms, and is hung to a shaft with eight keys. This shaft is of cast iron 9in. diameter; one end is formed 9½in. square for connection to the mill. The shaft runs in two plummer blocks which are fitted with turned gun metal bearings, and are provided with wall plates and holding-down bolts. This shaft makes 2½ revolutions per minute, that being the speed at which the rolls are required to revolve. Motion is obtained from the engine, which is high pressure, and of 16 nominal horse-power, having a fly-wheel 14ft. diameter, weighing 3 tons and making forty revolutions per minute. Steam is supplied from a Cornish boiler, 20ft. long, 6ft. diameter, and 3ft. tube, fitted with pressure gauges, safety valves, whistle valve, damper, &c. Such, then, is the apparatus required in the extraction of the juice from the cane, comprising in brief, a 16-horse power steam engine, and a 20ft. Cornish boiler. Manufacturers, of course, vary in their details of construction, but the general features remain the same, this being found the most efficient and practical arrangement. The method of working is as follows:—The canes are introduced between the rollers from the feeding table, and are crushed between the top and the first bottom rollers. Guided by the trash turner they pass to the top and the second bottom rollers, between which the juice is expressed, and the fully-crushed cane or megasse is delivered away by the delivery table. Care is taken that the expressed spongy cane does not again come into contact with the juice to re-absorb it. It is of importance that the rollers should revolve slowly. The result of repeated experiments has shown that, with a speed of 8 revolutions per minute, only 48 per cent. of juice has been obtained, but, by reducing the speed of the same mill to 2½ revolutions per minute, 70 per cent. of juice was obtained. The velocity of the rollers should be rendered as uniform as possible, not by diminishing the amount of the motive power, but by a carefully regulated supply of canes in the feeding. The absolute amount of work done, however, materially depends upon the quality of the cane. A fair working result from a 16-horse power mill and apparatus would be between 5 and 6 tons of cane per day of twelve hours. Some years ago a method was patented by Mr. Michiel for extracting the sugar from the cane without the use of the mill. It was proposed to cut the canes into thin slices and treat them with lime water. The object of this was to render the nitrogenous constituents of the cane insoluble. On treating the canes, thus prepared, with water, a syrup is obtained of a purity much greater than possessed by that obtained directly by mechanical means. Probably the mechanical difficulty experienced in slicing the canes has prevented the adoption of this method. Captain Margetson, R.N., has proposed to cut the cane in pieces, and dry it as beetroot is dried, sending the substance home for the extraction of the sugar. It might be worth while experimenting in this direction.

(To be continued.)

TORPEDO TRIALS.

We have recently noticed the preparations which have been made for Messrs M'Kay and Beardslee's experiments, by sinking torpedoes, and placing the "Terpsichore," an old 18-gun ship, in Gillingham Reach. On Wednesday last the experiments were made, the results being eminently successful. The torpedoes used were of two kinds, the one called "electrical buoyants" and the other "percussion," thereby denoting the agency by which explosion is effected. They were in both cases formed of hollow wrought-iron, watertight cylinders, and varied in size and power. The largest contained a charge of 440lb. of powder, and the smallest 68lb., the former being about 10ft. long by 1ft. in diameter and the latter about 3ft. long and of reduced diameter. To each torpedo a cylindrical float is attached to give it buoyancy, and when it is desired to submerge the shell to any particular depth before firing it the rope connecting the two can be easily adjusted. In the

experiments, a number of torpedoes which had been placed at the bottom of the river were successively exploded. The effects varied. Some sent up a greater volume of water, spray, and smoke than others. Some threw up a tall column of water. In all cases the violence of the explosions denoted that if any vessels had been over the explosives they must have been destroyed or at least sunk. The full effect of the torpedo was shown in the sinking of the "Terpsichore." A torpedo was placed beneath her, and at about 4 p.m., after considerable preparation, the torpedo was exploded, as usual, by means of an electric current. The shock to the ship was very violent—she seemed to be lifted out of the water somewhat, and her upper deck to be forced upward, where the explosion took full effect; she also reeled under the shock. A large hole must have been made in her bottom, for she began rapidly to fill, going down by the head; and in two minutes and a half she had settled down as far as she could sink; but the tide having run down by the time the explosion occurred, there was not depth of water sufficient to completely submerge the vessel. Of course the preparations for destroying the ship could not be made on a hostile vessel attempting to enter a port or river; but if by arrangement beforehand a torpedo could be exploded under a ship, the result of this trial shows that it must be sunk. The "Terpsichore" was empty, but a laden ship in deep water would rapidly have sunk if treated as she was. The experiment fully demonstrated the great destructive power of the American torpedoes.

WELDLESS TYRES, CIRCULAR ROLLING, AND RAILWAY WHEELS.*

By F. J. BRAMWELL, C.E.

In this paper the writer gives an account of the mode of making tyre hoops for railway wheels prior to the invention of weldless tyres, and states that such mode consisted in bending a straight tyre bar into a hooped form, the ends of the bar having been previously prepared if the weld to be made were any other than a "butt" weld, and then in uniting these ends together by welding in one of the methods known as the "scarf" weld, or the "double V," or the "bird's mouth," or the "single V" weld, that each one of these welds required the operation to be performed when the tyre was removed from the fire, and that they were all of them objectionable on other grounds—the "scarf" and the "bird's mouth" welds because their edges were liable to be burnt, the "double V" and the "single V" because they each required two lines of weld to be made sound instead of one line; that the "butt weld" before alluded to, as it did not require any considerable preparation of the ends of the bar, admitted of that bar being delivered by the tyre manufacturer in a hoop form, by which an economy was effected, inasmuch as the tyre manufacturer bent the bar while hot from the rolling mill, and that further the weld being effected while the tyre was actually in the fire, this circumstance permitted the fullest advantage to be taken of the heat; and that moreover the means employed were such as to obtain clean surfaces for the weld, which required only one line to be made sound and was not liable to have the edges burnt. That for these and other reasons the writer believed the butt to be the best weld of all, but that nevertheless even this best of welds was from the risk of unsoundness a source of danger. The writer then briefly describes the process of "blocking" the welded tyres for the purpose of stretching them to uniform sizes, and also with the view of ascertaining the soundness of the weld, and then alludes to the operation of shrinking the tyre on to the wheel centre, either preceded or not by a boring process, and then speaks of the fastening on of the tyre and of the completion of the wheel by the turning of the exterior of that tyre.

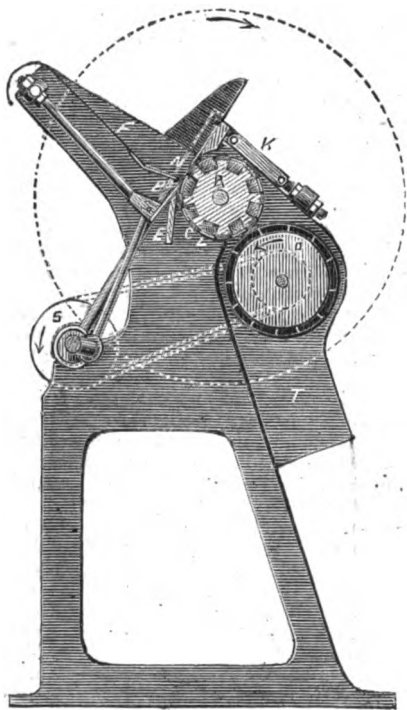
The writer then gives a description of the mode in which in the year 1844 he proposed to make tyres without a joint weld, now known as "weldless tyres." This mode consisted in winding a long bar of iron into a helical coil of very nearly the size and shape of the required finished tyre hoop, and then in placing this coil in a circular furnace having an opening or "gash" of the form of a sector of a circle when seen on plan, such sector subtending about 60 deg. or 90 deg., and having placed within it a quick-going mechanical

hammer provided with tools of nearly the shape of the finished tyre, and adapted to operate on that portion of the hoop that lay out of the furnace and in the sector. By this means the writer proposed to weld the whole circumference of the coil by bringing welding hot portions successively out of the interior of the furnace into the sector-shaped "gash." The writer proposed to finish off the ring forging thus made by means of the circular rolling machine which had been invented by Mr. Bodmer in the year 1839, and which, as far as the writer knows, was the first machine ever devised by which the continuous rolling of a ring could be effected. The writer points out that Mr. Bodmer did not propose to make a weldless ring, but on the contrary intended to make that ring by welding together the ends of a bar, and that the object of his invention was to finish tyres by rolling instead of by turning them in a lathe. The writer then states that, although between the years 1844 and 1855 some few persons brought forward propositions for making weldless tyres, nothing really was done, as far as the writer knows, in the way of manufacturing; that in the latter year the writer proposed the subject to Mr. William Owen, of Rotherham, a large manufacturer of railway wheels, who after a long consideration commenced to make weldless tyres in the year 1860; that prior to this, viz., about the year 1858, the manufacture of such tyres was begun by Jackson, Petin and Gaudet, in France; that Mr. Owen, and the limited company who have succeeded him, have carried out the making of weldless tyres to a very large extent, using machinery nearly the whole of which has been designed by the writer, and that they are now increasing their works. The writer then gives a description of the process pursued by the Owen's Company, which consists in making a helical coil of about half the diameter and three times the width of the intended tyre, the heating of this coil in a furnace, and then putting it into a mould on the anvil of a steam hammer, and by the action of the top tool upon it welding it into a block of about half the diameter and twice the thickness of the finished tyre; the removal of this block to a circular rolling machine on Bodmer's principle, but combined with hydraulic power of such character as to be capable of rolling out the tyre to its proper decreased thickness and increased diameter.

The writer then goes on to show that not only is the manufacture of weldless hoops completed by circular rolling one that insures soundness and safety, but that also in consequence of dispensing with the "crop ends," and of the passing backwards and forwards of the bar being rolled both of which accompany and are drawbacks to ordinary rolling, such manufacture of weldless hoops is really an economical mode and might be advantageously employed for the manufacture of all heavy straight bars, rails, and plates, which would in the first instance be rolled into the ring form, and then, that ring being cut through, would be made by flattening it out in the same way that sheets of glass are made by laying open cylinders. The writer then alludes to the making of steel tyres by the various processes used by Krupp, Bessemer, Vickers and Owen. The writer then points out how beneficial the use of weldless rings would be for boiler work, as they would dispense with the longitudinal seams which are the source of weakness in boilers. The writer then describes the improvement in manufacturing solid wrought-iron wheel centres invented by Mr. Arbel, of France, and practised by the Owen's Company, Limited, which consists in putting together the various parts forming the rim, spokes, and boss, and heating the same in a furnace from which they are removed into a die where by the action of a powerful hammer, having when its moving parts are fitted so as to make the centres of engine wheels, a weight of more than 25 tons and a maximum drop of 6ft. The writer then describes a common kind of wheel centre in very general use, wherein wrought spokes are combined with a cast-iron boss, and points out the objection to this mode; he then states the improvement of Mr. Lahousse, of Belgium, as practised by the Owen's Company, by which the advantage of a wrought boss can be obtained at a rate as economical as that of a cast-iron boss, and shows that is done by enveloping cold or moderately heated wrought-iron spokes in the highly plastic halves of a welding hot wrought boss, by which the spokes are firmly embraced and held fast.

* Read before the British Institution.

"LOCK-JAW" COTTON GIN.

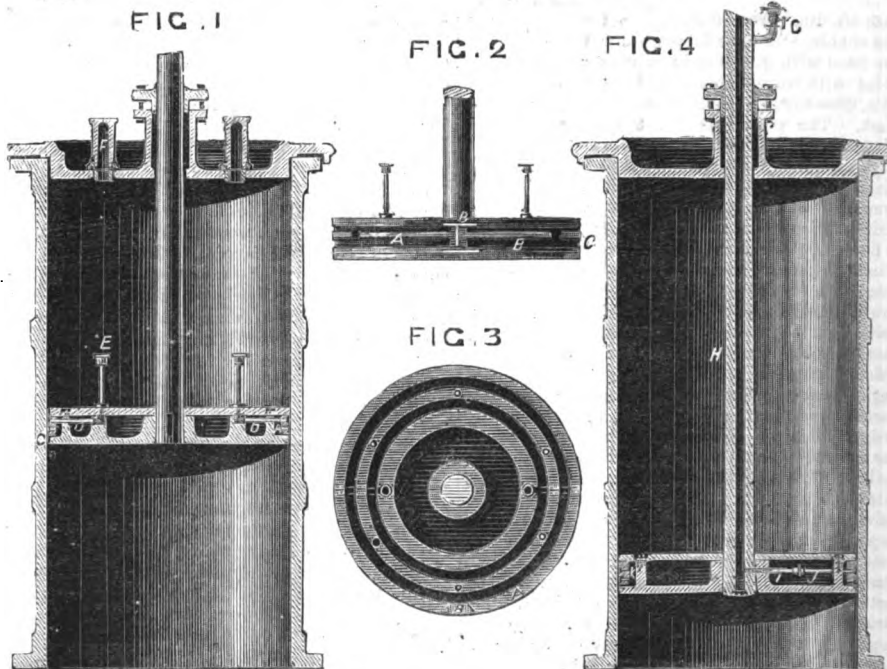


THE above engraving represents a section of the Patent "Lock-Jaw" Gin, the invention of Mr. E. A. Cowper, of Great George-street, Westminster, and which formed the subject of a paper recently read by that gentleman before the British Association. The gin consists of moving nipping-blade N (forming one of the "jaws"), a metal roller R, and the beater B, the strips of common leather L forming in succession one side of the pair of jaws, to act with the nipping-blade; there are also affixed to the roller between the strips of leather, steel plates having fine combs or pointed surfaces C, and there is a crank shaft S, with cranks and rods to move the beater B, and eccentrics with rods to move the nipping blade N. K K are links to cause the nipping-blade to move in a properly curved elliptical path; E is a thin-edged bar to fill up the space between the back of the beater and the roller; D is the doffer to take off the cotton fibre from the comb surfaces; T is a tin spout down which the cotton is delivered.

WATER-TROUGHS FOR CATTLE TRUCKS.

At the present time, when the cattle disease is the all-absorbing topic, any suggestions either for prevention or cure are acceptable. We, therefore, think it a fitting opportunity to notice a patent which has been taken out by Mr. W. Reid, of Granton Pier, Edinburgh, for a very simple, but nevertheless highly important, improvement in cattle trucks. Hitherto, cattle on a long journey have been deprived of water, there being no means of supplying it to them other than by untrucking them—an operation attended both with loss of time and danger. Mr. Reid's plan obviates the necessity of taking the cattle out of the trucks for the purpose of drinking. It consists in placing troughs round the rail on the top of the boarding of the truck, which troughs can be readily filled with water by means of hose from the tanks at railway stations where stoppages are made. The troughs are at a convenient height for cattle to drink out of; and any impurity that may happen to fall into the water is readily swilled out through outlets at the ends of the troughs. By this invention, a train full of cattle will be served with water in the course of a very short time, each wagon being drawn along past the tank as it receives its supply. In the Cattle Diseases Bill, which was thrown out of Parliament last session, there was a clause rendering it imperative upon railway companies to give water to beasts on a long journey; but, although there is now no compulsion, the present outbreak renders it highly necessary, and Mr. Reid's method makes the matter so easy, and, at the same time, it is so inexpensive—as it can readily be adapted to the trucks now in use—that railway directors should at once give it a trial. For sheep and

LUBRICATING CYLINDERS.



pigs, of course, the troughs would have to be arranged at a lower elevation. When not filled with water, they could be used for cake or other feeding substances.

LUBRICATING CYLINDERS.

THIS invention, which has been patented by Mr. John Drury, of Elland, near Halifax, engineer, relates to the pistons and air pumps of steam or other engines, and the improvements consist in a peculiar form or construction and application thereto of metallic packing, capable of receiving and retaining oil or other lubricant for distribution thereby on the inner surface of the cylinder or pump barrel. Fig. 1 in the engraving is a vertical section of a steam engine cylinder and piston, constructed and arranged according to this invention; fig. 2 is a side view of the piston; and fig. 3 a plan of the same, with the cover removed. The packing A is in one ring, cut at one place to allow expansion, the joints being protected by two blocks or plates B. Two grooves C are turned or formed in the external surface of the ring, which may communicate with each other by cross grooves. D are pipes fixed in the ring communicating with the upper groove and extending through the piston cover upwards sufficiently to pass through openings in the cylinder cover when the piston is at the top. Steamtight caps E are screwed on these pipes to prevent steam entering the tubes, and the openings in the cylinder cover are enclosed by steamtight covers F. When a supply of oil or other lubricant is required, it is only necessary to stop the engine when the piston is at the top of the cylinder, take off the covers F and the caps E, pour the oil or lubricant into the tubes or pipes D until they are full, then replace the caps and covers.

Fig. 4 is a vertical section of a cylinder with piston and rod, showing the method of supplying oil or other lubricant through the piston rod to the surface of the cylinder. G is an ordinary grease cup, attached by a pipe to the piston rod H, which has a hole bored longitudinally through it, and plugged up at each end; I is a pipe fixed into the rod, and connected by coupling joint to another pipe J, which is screwed into the packing ring K, thereby forming a passage from the grease cup to the groove in the ring. This method of lubricating is equally applicable to air pump buckets, to piston valves, and other slide valves having metallic packings.

THE BRIDGE OVER THE NIEMEN AT KORVNO.

WE this week present our readers with plans, elevations, and details of the above bridge, which is constructed on the plate girder principle, and is remarkable for the length of the spans, and the peculiar formation of the piers. It is, in fact, very much like the Victoria Bridge at Montreal, with the exception of the spans of the girders

and the piers that support the intermediate portions of them. The bridge is built rather on the skew; so that the axis of the piers is made parallel with the axis of the current; and as the Niemen carries down great hummocks of ice in the spring, it is found necessary to protect the piers by ice-breakers, that are supported on iron cylinders of the same diameter as those that form the piers. There is little art in the design of this bridge; it is composed simply of two longitudinal girders, resting upon vertical supports, which are as bald and tame as possible; yet the simplicity of the means employed contributes to give an air of sublimity to the composition of the bridge. The girders are, however, different from those of the Victoria Bridge, to which they have been compared, inasmuch as they do not form parts of a tube with rectangular cells at the top and bottom; they are simple girders, which support the roadway at a lower level, and are kept in place at the top by a system of cross-braces. The piers were formed of cast iron, and they are sunk in the manner that is now so common on the continent, viz., by the means of compressed air, and their interior is then filled in with concrete; they bear on their upper surface the rolling carriages of the girders and the iron casing of the ice-breakers, which are indicated in detail in the illustration. Much ingenuity has been displayed in the contrivances for carrying the roadways, as will be seen on reference to the details. It may be as well to add that the ice-breaker is composed of wrought-iron plates, and that the struts between the piers are of cast iron. The roadway is formed to receive a double line of the usual gauge of 4ft. 8½in.

In the detail drawing we have given the section of the girders, showing the manner in which the roadway is carried, and the girders themselves are kept in their positions at the upper part; they are formed of solid plates, and are riveted together with T and angle iron, in the usual style. The bearings upon the piers are made stouter than the rest of the girder, and the bottom flange is also increased in thickness at the points of bearing, gradually diminishing towards the centre of the opening; whilst the upper flange is increased precisely in that part, diminishing towards the bearings. The character of the points of support may best be understood by a reference to the drawing; they are, however, composed of a series of steel rollers that are free to move in grooves cast in the bed-plates that receive them. The nature of the piers, and of the ice-breakers, is also shown in this drawing, together with the manner in which they are filled up with concrete; this is made with good hydraulic lime; and, as in all cases on the continent, it is made up into mortar, firstly, and then mixed with the broken stone or ballast, instead of being mixed at once with the stone, in the usual English style. The girders were built in place, and were let down upon their bearings by means of hydraulic presses, that raised them from the tem-

BRIDGE OVER THE NIEMEN AT KOWNO, ON WILNA AND DUNABURG LINE, RUSSIA.

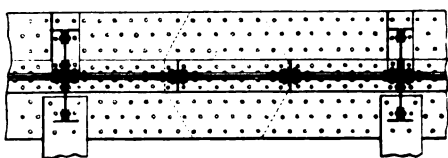


Fig. 1

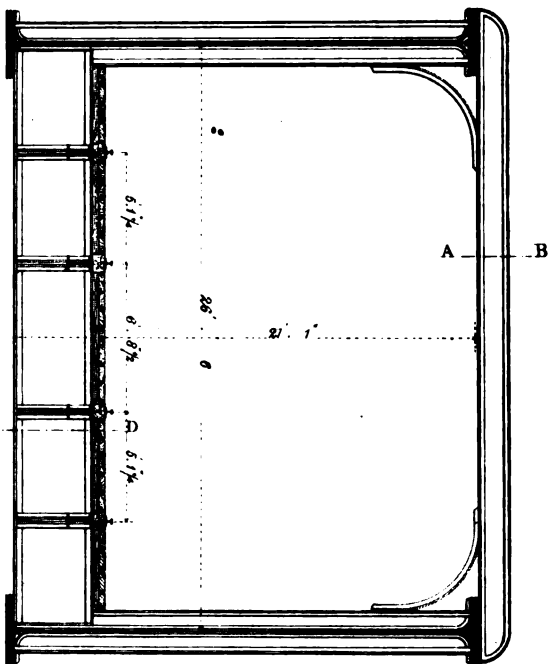


Fig. 2.

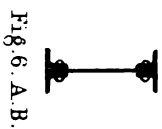


Fig. 6, A.B.

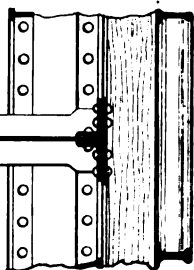


Fig. 7, C.D.

Scale for Fig. 1.

Scale for Fig. 2.

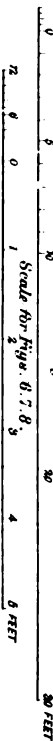
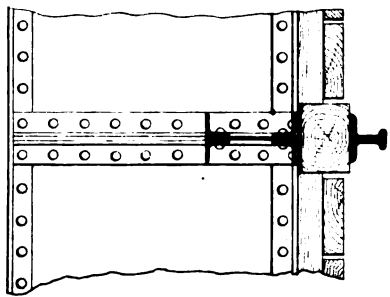


Fig. 8.

Scale for Fig. 8.

Scale for Fig. 8.

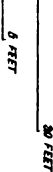


Fig. 3.

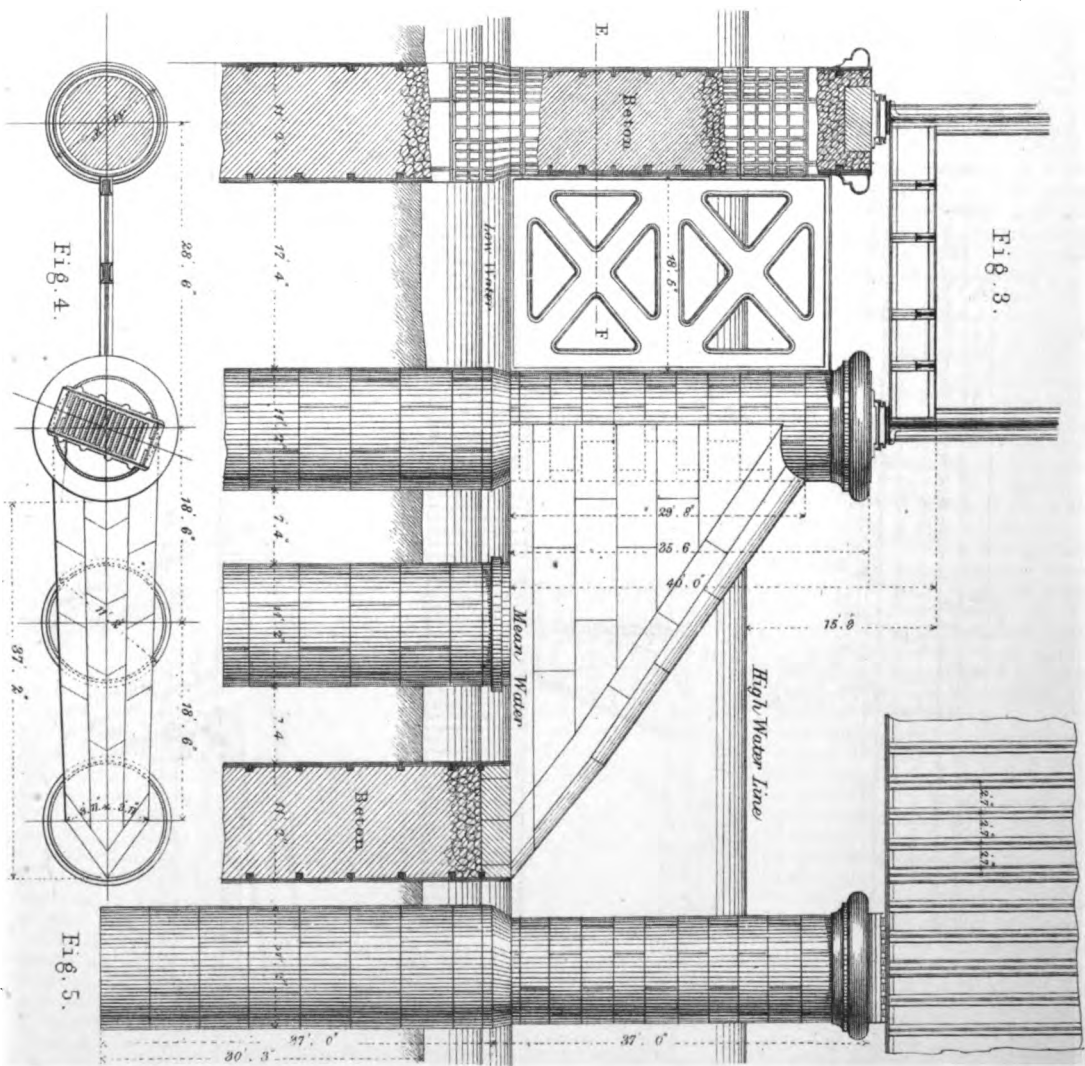


Fig. 4.

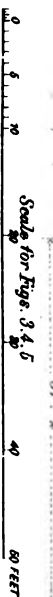
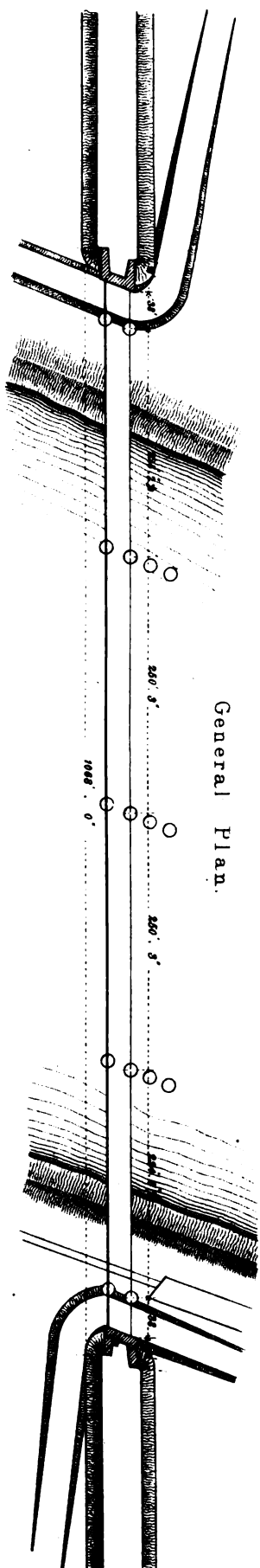


Fig. 5.

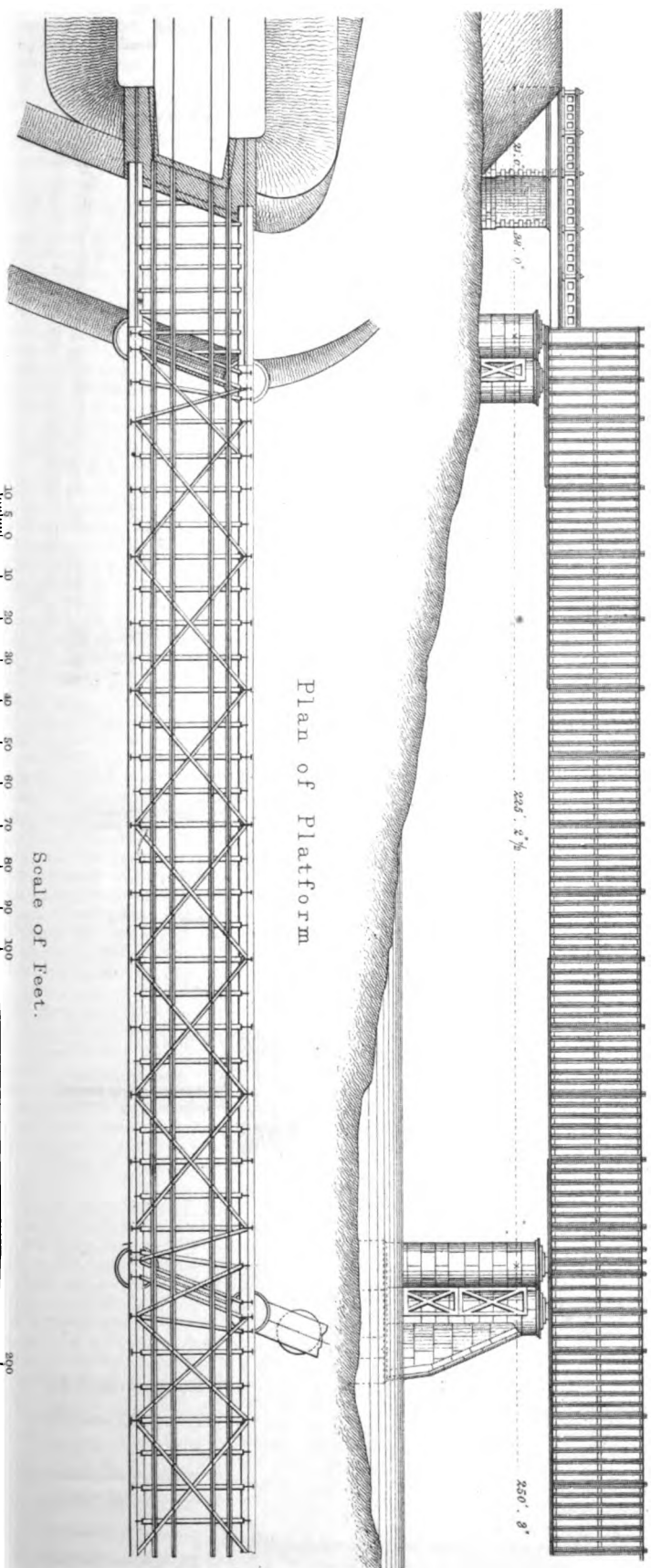


— BRIDGE OVER THE NIEMEN AT KOWNO, ON WILNA AND DUNABURG LINE, RUSSIA.



General Plan.

Elevation of Land Girder.



Plan of Platform

Scale of Feet.

0 10 20 30 40 50 60 70 80 90 100 200 300

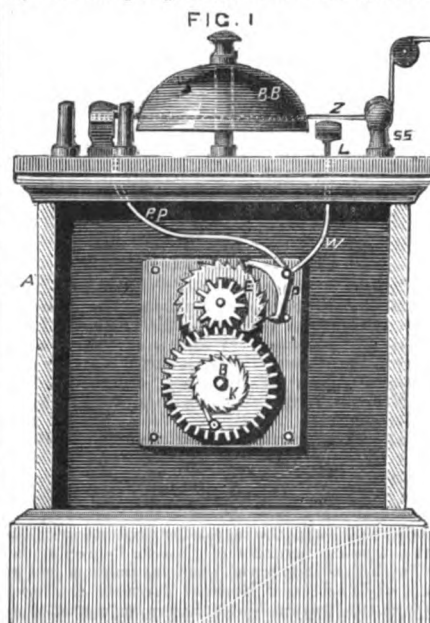
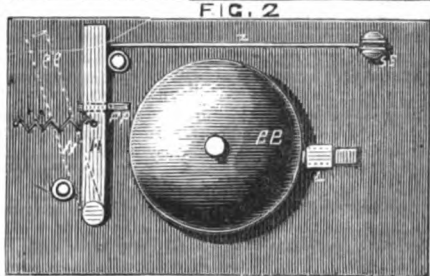
poor supports, and then lowered them upon the rolling carriages that were provided for them; the arrangements for this purpose were very complicated, and were hardly worth imitating if another bridge of this description were to be built. As to the construction of the girders that carry the roadway, there is nothing particular about them; they are only remarkable for the strict logic that is observed in all their parts, and the relations that are everywhere carried into effect between the strains that are brought to bear upon the details of them. A slight attempt at the introduction of taste may be detected in the capitals of the piers; but, after all, the designers of this bridge have evidently attended far more to the strict requirements of strength than they have to any considerations of beauty in designing the structure.

FIRE AND BURGLAR ALARM.

THE fact that losses of both life and property from fire have of late been on the increase serves to draw special attention to any practical contrivance for mitigating the evil by giving timely notice of an outbreak. Of such a nature is the self-acting fire alarm and thief detector which has been invented and patented by Mr. W. Gilbert, of Enfield. The apparatus, as we saw it, is very simple in construction and effective in operation; it is self acting and does not involve the presence of an electric battery or any other extraneous agent to ensure its correct working. The invention refers to a peculiar application of a fusible wire or cord connected with the several rooms of a house, parts of a ship, or other place, and attached to an alarm in such a manner as, when acted upon by heat, it will be dissolved or melted, by which the train of wheels connected with the hammer and bell is liberated and the alarm given. The following is one way in which the fusible wire or cord is prepared:—When a material is required capable of being fused at a low temperature the proportions are gutta-percha, sixteen parts; chloride of sulphur, two parts; sulphuret of antimony, three parts; and copper bronze, one part, dissolved in chloroform, naphtha, oil of turpentine, or other solvent, by gentle heat; afterwards submitted to a temperature of from 250 deg. to 300 deg. Fahr., for from two to seven hours in a closed vessel, which compound will melt at from 90 deg. to 120 deg. Fahr., according to the temperature and time applied in preparing it. For higher temperatures the following are used:—hyposulphate of lead, two parts; calcined magnesia, from two to five parts; gutta-percha, ten parts; caoutchouc, ten parts; sulphuret of antimony, two parts; and chloride of sulphur, four parts, treated as above, which substance will fuse at from 120 deg. to 200 deg. Fahr., and is a conductor of heat and not liable to be affected by moisture, gasses, or time. It is made into the form of cord or wire by passing it between grooved rollers or drawing it through a die. For higher temperatures than 200 deg. Fahr., a metallic fusible wire composed of bismuth, four parts; lead, two parts; tin, two parts; and mercury, one part, melted together, is used. This will fuse at from 212 deg. to 500 deg. Fahr., by the omission of the mercury and bismuth more or less.

In the accompanying engraving fig. 1 is a front elevation of the apparatus, and fig. 2 is a plan or top view. A, fig. 1, is an outer wood case glazed in front, enclosing the alarm movement. At the centre of the apparatus two plates contain between each other a pin B, on which is attached a spring, which is the prime mover of the wheel gear, on which is fixed a ratchet wheel K to enable the spring to be wound up similar to a clock spring, and a toothed wheel S having thirty-two divisions, which drives a pinion, whose spindle passes through both the holding plates, and carries the escapement wheel E, containing twenty-four divisions; P is a pallet which regulates the motion of the escapement wheel E, the movement of which produces an oscillating motion, which communicates movement to the wire W, furnished with a hammer L. When the machine is in motion the hammer L plays on the bell B. A wire P is fixed on the same spindle as the wire W, at P, by which the hammer is held at rest by the lever H, which is held in a position to prevent the motion of the wire P by a fusible wire or cord Z attached to the end of the lever H at a. The fusible wire or cord Z passes through the pulley S, where it is carried forward through a number of rooms or apartments, being fixed in

the same way as bell wires are usually fixed, a constant strain being maintained on the fusible wire or cord by a spring attached to the lever H at N, so that, should the fusible wire or cord Z be acted upon by heat sufficient to melt it, a separation will take place and liberate the lever H, and the spring N will move it back, as indi-



cated at *ee*, so as to allow the wire P P to oscillate and the hammer L to play on the bell B until the spring is spent. By a simple arrangement the apparatus is connected with doors or windows, and thus not only an outbreak of fire, but also any attempt at forcible entry is at once indicated.

PROGRESS OF GUN COTTON MANUFACTURE.*

By MR. PRENTICE.

GUN COTTON, called by Liebig "the explosive of the future," has lately become a matter of great interest, engaging the attention of scientific men in this and other countries, has formed the subject of popular lectures, and has already been brought into practical use by many of our hard-working miners and quarry men. This is mainly to be attributed to the striking manner in which the subject of Austrian gun cotton, prepared by the process of Baron Lenk, was introduced at the Newcastle meeting of this Association two years since, when in the chemical section Dr. Miller, Dr. Gladstone, and Professor Abel, and Mr. Scott Russell in the mechanical section, so ably called attention to the detail of its manufacture, and gave accounts of its mighty energy. This is only another instance in which the British Association proves its utility in assisting to develop practical results from scientific investigations. During the past twelve months considerable advance has been made in the application of gun cotton as an explosive material. Reports from various mining works indicate a steady progress towards the general use. At first it seemed probable that gun cotton would be effectively and economically employed only in hard rock such as granite. Doubtless in such material its full power was most easily developed. Experience showed, in working amongst soft rocks and coals, that the form in which gun cotton had been prepared was not the best for obtaining satisfactory and economical results. The charge was confined in a small space, and acting on a short length of the hole

or drill, showed immense force, but expended a considerable portion of it in enlarging the base of the hole, while the remainder had only the effect of splitting the rock, instead of throwing over the burden. The mechanical application to which gun cotton seems so ready to submit was consequently varied. By the introduction of a core of wood, the charge of cotton was made to occupy double the length of hole, the wood filling the internal space of the charge, so that in the explosion a much larger surface was acted upon, while the gases were well confined. In this manner work is now executed in coal and in slate, obtaining even in soft material the full force which was at first claimed for gun cotton in hard rock only, namely, six times that of an equal weight of gunpowder. Comparative trials have clearly demonstrated the superior power and advantages of gun cotton. In Wales, driving through the "hard" overlying the slate vein, one of the contractors reports that his level or tunnel could be advanced $9\frac{1}{2}$ yards when the men worked with gun cotton, while eight yards was the most accomplished in the same space of time when gunpowder was used. This point deserves the fullest consideration, for although gun cotton used in holes, as ordinarily prepared for powder, is found to answer satisfactorily, there is no doubt that when judgment is exercised, and the work put before the holes is proportionate to the enormous power of the charge, a given distance will be advanced with a less number of holes, with consequently a further considerable reduction in the cost. In close underground work the fullest advantages are still more manifest. There is no smoke, neither are there those deleterious products which cause the use of gunpowder to be so noxious and injurious.

In 1864, the Commissioners appointed to inquire into the condition of mines in Great Britain rendered their report to both Houses of Parliament. In reference to the air in mines, and the sanitary effects of gun cotton and gunpowder respectively, Dr. Angus Smith, F.R.S., reports:—"As gunpowder is evidently one of the most deleterious ingredients affecting the air of mines, the Commission was desirous that the products of combustion of gun cotton should be examined, in order to find if that substance promised to perform the work of blasting with a less injurious influence on the air; for if gun cotton could be used of a kind which gives out none of the oxides of nitrogen an advantage of the most pleasing kind would be gained. The solid matter, the crystals and carbon, would cease to trouble the miner, as well as the sulphur compounds that follow every explosion. To examine this Lord Kinaird had arranged a meeting of captains of mines at Dolcoath, Camborne, with whom I was to act, examining the products of combustion. Accident prevented me going down the mine, but Mr. Richard Pearce, of the Royal Institution, Truro, took the apparatus down, passed the air through the solutions, and brought up specimens immediately after the explosions. Several solutions were examined, the amount of air passed through being 1,470 cubic inches, but only a trace of oxides of nitrogen could be found in any, and with difficulty. Considering that nitrates could be found in a few cubic inches of air after the explosion of gunpowder, the result must be considered excellent. Whilst the experiments were going on underground, I selected a hut somewhat about the height and breadth of a 'close end,' and about 10ft. long, as fitted for making similar trials above ground. In this was laid a large mass of granite; a hole was bored in it by a miner, and it was fired with gun cotton. The explosion was pronounced successful, but although it was believed by the miners present that the gun cotton had done all to the stone that powder could possibly have done, they were surprised that the roof of the hut was not blown away. They held this as a proof that the action of the cotton was different from that of the powder. Probably the vapour of water condensed before reaching the roof. We all entered the hut instantly. The place was full of a light coloured or nearly white vapour, with a rather pungent smell, having in it nothing at all resembling nitrous gas, or indeed any acid substance whatever. I could think of nothing similar to this containing nitrogen. After all there was not much of it, and it was far from resembling in intensity the smell of gunpowder after explosion in such a place. If the senses could detect any nitrous gases in the vapour, I would not speak in favour of it, but after remaining in the midst of it till it disappeared I am compelled

* Read before the British Association.

to defend it against any such charge. The man who bored was very much pleased, and all the workmen with whom I spoke preferred very much the vapour of gun cotton to that of gunpowder. There was now a new riddle. Why was there smoke, and what was the smell observed? No one seemed to know the smell of a fuse; it is never used by itself, and although sometimes it burns without lighting the charge, the men do not enter such places till the smoke is gone. In order to settle the point, the hut was shut up, a burning fuse being enclosed in it. When we entered it after two minutes, there was the same white smoke and the same smell before described; it was now explained to be that of distilled or half-burnt canvas and tar mixed with the gunpowder of a fuse. So strong was it, that I do not hesitate to say that the smell of the gun cotton was not in the slightest degree perceptible; in other words, it had no perceptible influence on the smell in the hut. Such a fuse is not necessary. It is not used everywhere, and in reality seems rather to be a peculiarity of some districts; those manufactured in Camborne, for most places being different in composition. In every trial in which the effect on the senses or the breathing, and, as far as we can judge, on health, was considered, gun cotton has come off with the highest character. I feel much confidence in speaking thus highly in its favour."

Considerable interest in this subject has been excited in foreign countries, as well as in distant British colonies, in some of which the use of gun cotton manufactured in this country is established. With reference to the manufacture two things call for special remark. First, as to the stability of the material. To satisfy ourselves of this we submitted it to Mr. Hadow, of King's College, and the following was his report:—"Gentlemen, I have carefully examined the sample of gun cotton rope, supplied as a sample of your manufacture, and am able to report favourably upon it. The gun cotton proves, on analysis, to be the highest and most powerful explosive of the series of substitution compounds formed by the action of nitric acid on cotton. It contains the maximum amount of peroxide of nitrogen, corresponding with the formula $C_{36}H_{10}N_{10}O_{40}$ (9 N—H 21 O 4) O 30. This was proved by submitting a portion, carefully dried in vacuo, to the reducing action of an alcoholic solution of the double sulphide of potassium and hydrogen, when it gave an amount of cotton almost exactly corresponding to that which calculation requires (100 parts gave 54.80, calculation requires 54.54 of cotton); and secondly, by treating another portion, likewise weighed after drying in vacuo, with a mixture of the strongest nitric and sulphuric acids for three hours, when the presence of any of the lower substitution compounds would have been detected by an increase of weight after washing and drying (the next lower substitution compound gaining 5.3, and the next lower 11.8 per cent. by such treatment). The sample, however, gained nothing in weight by the immersion; on the contrary, as experience has proved to be the case with gun cotton that has reached the highest stage of substitution, a loss was sustained of 0.95 per cent., which corresponds very closely with what experiment shows to be the loss sustained always through solution by immersion of the strongest gun cotton for three hours in the mixed acids. To determine its stability, it was placed in a tube with blue litmus paper, side by side with other samples, each contained in a separate tube furnished with litmus paper. These were then simultaneously submitted to the temperature of boiling water. Some of the samples showed immediate signs of decomposition by reddening the litmus paper, and in a short time filling the empty part of the tube with the red vapours of peroxide of nitrogen; while the sample you supplied showed no trace of decomposition until about forty minutes, before which time some of the more decomposable specimens had even exploded. From this result it may be concluded that your gun cotton possesses a high degree of stability, and of all the samples I have examined it is the least likely to change during prolonged storing. The sample was found perfectly free from all uncombined acids—it had, in fact, a very feeble alkaline reaction (due to silicate of soda), only discoverable by testing with care. Washed with water it loses about 3.08 per cent. in weight, the loss consisting of silica and silicate and sulphate of lime, partly suspended, partly dissolved, together with traces of organic matter, evi-

dently introduced, since the treatment with acids, as it is non-nitrated, and chars slightly on evaporation to dryness. The gun cotton after washing still retains about 1.64 per cent. of silica and sulphate of lime. In the preceding statement as to the amount of cotton obtainable from the gun cotton, and as to the weight after immersion in acids, the amount of ash and soluble matter was ascertained both before and after treatment, and was deducted in the calculations. In reply, then, to your questions, it may be stated that your sample consists of a definite chemical compound, the highest of the series; that it has been carefully prepared, being remarkably stable at 212 deg.; and is quite free from uncombined acids."

(To be continued.)

LAKE SUPERIOR IRON.

DR. LAMBORN, the secretary of the American Iron and Steel Association, has published the following report of his recent visit to the iron regions of Lake Superior. The proper development of the iron industry of the United States demands a steady and abundant supply of first-class charcoal metal, suitable for working into car-wheels, cannon, tyres for locomotives, boiler-plate, and for the vast present and prospective requirements of the steel-maker in the departments of cast steel, puddled steel, and above all, for use in the Bessemer or Pneumatic converter. The relative quantity of charcoal to mineral coal iron produced in the United States has decreased with the increasing production of the vast anthracite furnaces of Eastern Pennsylvania, and with the discovery of pure bituminous coal in Ohio, while scores of charcoal furnaces, scattered through the Eastern States, have gone out of blast through the appreciation in the value of timber land, caused by the demand that has sprung up for fuel for other purposes, through the building of ways of internal communication and the demand for surface for agricultural use. These causes are year by year making the Eastern States less suitable for a large charcoal iron production. Where, therefore, are our manufacturers in the early future to look for their supply of this necessary raw material? England sends to Sweden, Norway, Russia, and Nova Scotia for her best brands.

If we follow around the same northern isothermal zone, in which these countries are located, we reach upon our great lakes a region designated by nature in the most extraordinary manner as our future domestic source of vast amount of excellent charcoal iron, and it is with no desire to disparage the importance and value of the charcoal district of Northern New York, Connecticut, Northern New Jersey, and Central and Western Pennsylvania, that this letter is written, but rather with the hope of drawing the attention of the skilful ironmasters of those districts to a most promising field for enterprise and the exercise of their peculiar knowledge,—a field already inviting development, and which must continue to increase in importance as long as the iron and steel industry of the United States continues to enlarge. The belt of country along the southern shore of Lake Superior, extending 40 to 60 miles into the States of Michigan and Wisconsin, is one of the richest mineral regions on the globe. A district producing copper on the North already sends to market annually some 16,000 tons of the metal—a region producing with argentiferous galena and sulphide of copper, silver and gold, is in process of development southward of this copper belt, while from Lake Monistigue, in Schoolcraft County, to a point as far west at least as the Penoque iron range, 100 miles westward of Otonagon, are found immense deposits of iron ore of all varieties common in igneous rocks, magnetic oxide, red hematite, brown hematite, as well as the water-formed bog ores. These first-mentioned ores, where developed, occur in vast beds adjoining hornblende dykes and in chloritic slates, and they exist in such quantities that they may be considered as practically inexhaustible. One-eighth of all the iron now made in the entire United States is dug from the mines of Marquette County, and yet ten years ago a piece of Lake Superior copper was a curiosity to most of our practical metallurgists. With the completion of the St. Sault Marie Canal, which was opened ten years ago this month, the projects for developing the iron ore trade assumed a definite shape. The few tons of mineral that had been carted around the portage at the mouth of the lake had proved its value, and the first year saw 1,445 tons sent below for smelting. The enlargement of the trade has been steady and rapid, as the following statement will show. In 1855, 1,445 tons were exported; 1856, 11,594 tons; 1857, 26,184 tons; 1858, 31,135 tons; 1859, 65,679 tons; 1860, 116,948 tons; 1861, 45,400 tons; 1862, 115,720 tons; 1863, 185,276 tons; and in 1864 235,125 tons were exported; making a total of 834,534 tons, which, assuming the ore to yield an average of 80 per cent. (the standard desired by the shippers is a yield of 66.2-3rd per cent. in the furnace), would give 500,760 tons of cast iron. The development of

the manufacture of pig from charcoal, in the county of Marquette, has been even more remarkable, as the difficulties to be encountered in building large structures, erecting new machinery, and collecting necessary labour in a distant and hyperborean region are numerous and serious. The earliest iron made was produced directly from the ore in what is known as the Catalan Forge. This manufacture was commenced in 1847 by Everett and Jackson, at the Jackson Forge. After it, followed the Marquette Forge and the Collinsville Forge, and lastly, the Forestville Forge, all in the same vicinity, near Marquette. They made iron with more or less success for a few years, but are now in ruins, for so greatly dilapidated that much time would be required to repair them.

The production of pig iron from charcoal commenced at the Pioneer Works, near the Jackson Mine, in 1858; 1,627 tons were sent to market that year. This manufacture has increased by the erection of new furnaces, until at present the Pioneer, the Collinsville, and Forestville, the Morgan, the Northern, and the Greenwood furnaces are in activity. The progress of the trade has been as follows:—In 1858, 1,627 tons were exported; 1859, 7,258 tons; 1860, 5,660 tons; 1861, 7,970 tons; 1862, 8,590 tons; 1863, 8,908 tons; and in 1864, 13,832 tons. Up to the end of 1864, therefore, 53,845 tons of pig iron had been sent to market from Marquette county. By comparing the production of this region with that of other iron districts it will be found that it produced in 1864 more pig metal than Connecticut or Massachusetts in the same year, and 60 per cent. more than New York in 1860. Reckoning ore and metal together, the mines of Marquette threw into consumption in 1864 154,905 tons of metal, or 3-5ths as much as the total pig iron production of the United States, according to the census returns of 1860, and, as above stated, 1-8th of all the pig iron produced by the United States in 1864. Regarding the method and cost of mining and smelting in this new and isolated region, a few facts will, I am sure, be welcome to our Eastern makers, as well as to that numerous class of Western ironmasters who only know the district through the thousands of tons of rich and pure ore that reach their furnaces from within its limits. I shall not pause to discuss the interesting geological features of the country surrounding the iron beds, nor the so-called interesting points connected with the genesis of the ore itself; but will proceed at once to a consideration of the economic features of the mining and export of the merchantable mineral. The Jackson Company, which exported last year 70,937 tons; the Cleveland Company, which exported 58,838 tons; and the Lake Superior Company, which exported 83,848 tons, are the three principal companies now in operation. The Pittsburgh and Lake Angeline, the New York, the Parsons, and the Marquette mines, have sent more or less ore to market, while a dozen others are in process of development. They are all situated in what is known as the Agio range, and those first mentioned are between 14 and 17 miles from the harbour of Marquette.

The total quantity of ore already extracted, chiefly from the three first mines, is not less than 925,000 tons, yet nothing but "surface" or "patch-work" has yet been done, all the mineral has been quarried from shallow openings in the sides of the iron hills; no pumping machinery has yet been erected, and only recently have adits for drainage been begun. The surface rock indicates in many points that but a portion of the most easily obtainable ore has been quarried, and it is safe to estimate that several millions of tons are proved to exist in the three or four oldest mines, with every likelihood of vast quantities in the beds below water level. In addition to this are hundreds of localities where iron is known to exist in a belt of thirty miles in length, and at more than a dozen localities companies have been formed or mines commenced. Great skill is not necessary in working these ore quarries. The operation consists in blasting from a ledge of ore large masses which are subsequently broken into fragments by other blasts, by the sledge, or sometimes in the most refractory cases by means of a fire of huge logs. At the Jackson mine a hole 18ft. in depth and 3in. in diameter, loaded with powder and exploded last March, brought down 4,000 tons of ore. The holes are all bored with good steel drills, managed by two strikers and one turner. The fragments of ore are loaded into one-horse carts, hauled a few hundred feet to the railroad, thrown into 6-ton 4-wheel cars, and carried to the wharfs at Marquette, where they are unloaded into pockets or hoppers, shoots, and thence into the vessels that transport them to the furnace on the lower lakes; or are transferred by wheelbarrow from the hoppers to the vessels or steamboats. The labourers at the mines receive 2 dollars per day, work ten hours, and pay 20 dollars per month for their board. The average product of each labourer—including all whose names are on the pay roll—miners, drivers, trackmen, repairers, &c., is 2 to 2½ tons of ore per day per man. In some cases an average of five

tons per day per man has been taken out by a small gang. 91c. per ton freight is paid on the railroad to Marquette, and the price of ore on the vessels is now 5 dollars per ton.

The mines are generally worked by the companies owning them. One exceptional company leases its mine for twenty years, paying 20 per cent. per ton royalty, and contracting to take out 10,000 tons per year. Two means of transport to water communication are now offered to the mines of this region—one 14 to 17 miles long to Marquette by the Marquette Bay des Noquettes Railroad, the other from 62 to 65 miles long, by way of the new Peninsular road, which has just been completed for the purpose of carrying ore to Escanaba, on Little Bay des Noquettes, an inlet at the head of Green Bay. The cost of freight on this route is 1 dollar 5c. per ton from the mines to the vessels, and it reaches a harbour on the lakes which is said to be open four weeks longer than that of Marquette, and is so much nearer the lower ports that ore may be shipped at, it is thought, 1 dollar per ton cheaper than by the Marquette route; the saving being in time, in tolls, and in towage passing through the Sault St. Marie Canal. No ore had yet been shipped by this route, but several hundred tons were, at the time of my visit, awaiting the arrival of a vessel. The shipping arrangements here are of the most excellent character. 20,000 tons may be stored in the pockets, and it is claimed that a vessel may be loaded in one hour after reaching the port. Ships drawing 14ft. of water may lay under the shoals, while the Sault Canal carries only 10ft. to 11ft. of water, which restricts the trade of Lake Superior to vessels below a certain tonnage. The freight from Marquette to Cleveland is 3 dollars per ton; thence to Pittsburgh, 2 dollars to 2 dollars 50c.; so that ore may be laid down at the great iron manufacturing city of the Union at from 10 dollars to 11 dollars per ton. The lowest rates that have prevailed, I am informed by my friend H. B. Tuttle, of Cleveland, were those of 1861, when ore could be placed in Pittsburgh at 7 dollars a ton, as follows:—Cost at Marquette, 2 dollars 50c.; freight to Cleveland, 2 dollars; freight thence to Pittsburgh, 8 dollars; insurance, commission, &c., 50c.; total, 7 dollars.

In the manufacture of pig iron we find in Marquette County the metallurgical traditions and customs of New England predominating. The iron workers have migrated westward as nearly as possible on the line of their own parallel of latitude. Pennsylvania has comparatively few representatives either among those who furnish capital, or those who furnish skill. The furnaces are all charcoal, driven in some cases by water, which is abundant and can be used during the severest winter—and in some cases by steam—taking the gas from the furnace for fuel. The blast is driven in at two pounds pressure per square inch, and at a temperature of 620 deg. Fahr. The charcoal is made almost entirely in kilns 25ft. to 30ft. in diameter, and 25ft. to 30ft. high, shaped like a straw bee-hive and capable of burning 30 or 40 cords in seventeen days; 20 to 25 of these kilns are required for each furnace, and they are scattered through the forest in the neighbourhood of the heavy timber. Maple and birch, with some hemlock, are the woods charred—24 cords are found to produce 100 bushels.

The long winters with their five consecutive months of snow, during which charring in pits is attended with many difficulties, render this plan the most expedient. Charcoal is now being delivered at the furnace at 11c. per bushel, by contract. The flux used is a limestone found near the railroad and which does not cost over 35c. per ton of iron. The ore produces from 55 to 65 per cent., a soft hematite from the Jackson mine being the favourite mineral of all the smelters. It requires 125 bushels of charcoal to reduce one ton of iron, and the furnaces produce from 10 to 18 tons in 24 hours. The cost of making iron is now about 30 dollars per ton, but it is asserted that under the most favourable circumstances iron has been made at 14 dollars per ton, and contracts have been entered for its manufacture by furnace owners with their managers at 16 dollars 50c. per ton delivered on board at Marquette. The foregoing facts will enable any one familiar with the iron business to judge the relative advantages of the region under discussion as a locality for the production of pig iron.

The future of the manufacture is encouraging, and in case the internal revenue taxes, joined with an inadequate tariff, do not force the business across the Atlantic, it will develop even more rapidly in the future than in the past. Land, from which may be cut an average of 60 cords of wood per acre, may be bought at from 2 dollars 50c. to 4 dollars per acre in hundreds of places along the shore of the lakes. We have seen that there are already two competing lines of railway leading from the mines to the lakes. The lakes are free to all navigators who may desire to carry ore, and in five years there will be from 12 to 15 mining companies competing for the market. This combination of circumstances will secure the delivery of ore at any point on the shore of the lakes that may be selected, at rates most advantageous to the manufacturer, while the various increasing uses for

charcoal iron will always cause an ample demand for the product of his furnace. The iron trade is now oppressed by such a combination of imports on metal of foreign and domestic production that the future seems gloomy enough for everyone connected with the business; but if we could hope from our Government for one-half the care and protection given by England to her manufacturers of iron and steel, during a period one-half as long as was necessary to develop her works properly, results of an extraordinary character would ensue. A careful study of the vast natural resources of Michigan, Wisconsin, Missouri, Indiana, Ohio, and Pennsylvania, and a comparison with the iron-making facilities of Great Britain, show that we would be able to supply our home consumption at rates unprecedentedly low, and at the same time sell our iron and our steel in all the markets of the world—even to the artisans of Birmingham, Wolverhampton, and Sheffield.

Correspondence.

WATERING CATTLE WAGGONS.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—Before the cattle disease was introduced or broke out in this country, Mr. Reid, of Granton, near Edinburgh, took out a patent for watering cattle which were going a long journey by fixing troughs around the cattle waggons about the height of the animals' heads, for which Mr. Reid deserves great credit, especially just now when it is likely that the Government will compel railway companies to have water for animals going long journeys. But I think that a simpler and far cheaper way to give cattle water under these circumstances would be to have a trough or troughs of a good length, say covering ten or twelve waggons, to be set at a suitable place or places on each line, and to be hung or otherwise attached by a suitable apparatus, say something like boat davits, so that the troughs might be brought close to the waggons at a proper height for the cattle to get at the water.

I have many reasons for thinking that the troughs would be better separate from the waggons—the following, amongst others. The whole cattle waggons in the country would have to be altered at a great expense, while the troughs or the separate watering places would only be one or two on the leading lines in the kingdom. Another reason is that if the troughs were fitted to the waggons on Mr. Reid's plan, they would be very often filled with the droppings of the cattle and would take some time to clean out before the cattle could get to drink. Further, the troughs being in two divisions, owing to the doors being in centre of waggons, would cause the water hosepipe to be shifted twice for every waggon, or every single waggon to be shunted to the pipe. Other reasons might be adduced in favour of my suggested plan, but I think the above will suffice to show its superiority.

I am Sir, yours, &c.,

Edinburgh, September 29.

A. J.

THE CATTLE PLAGUE.

SIR,—The following assertion as to the cause of the cattle plague will be found to bear the touchstone of truth. In all cases the cows are found "to hang the head down, to knock it about, as if suffering intolerable pain, loud moaning, and a staring countenance." All these are symptoms of worms, and their seat is in the ears. (I may state that if the pus or matter that issues from the ears of human creatures is examined by the microscope, worms of different sizes and figures are easily detected.) Now in cattle these are, without doubt, produced from the ova or small eggs of insects that are hatched by the warmth of the part, together with the assistance of the corrupt matter, wherein they happen to be lodged, and it is, therefore, where cows are "deficient" in the ear wax that they are more liable to have the *membrana tympani*, or the fine thin skin called the "drum of the ear," pierced by these insects, causing such intolerable pain as to cause the cows to knock their heads about as if they had the "mad staggers" or "fever of the brain." It is highly probable that it is the very same insect that infests the heads of sheep, always numbering from ten to fifteen. Their white bodies are marked across with black lines (particularly the largest of them) and two black spots near their extremities, and these insects abide most commonly in a hollow part of the *os frontis*, near the insertion of the horns, but are sometimes found even in their "nostrils," as were detected in the flock of Mr. R. F. H. Harvey, M.P., on his estate near Norwich. Sometimes they get up in the heads of sheep, and drive them mad. What I strongly advise is that vinegar should be poured in the ears, say two teaspoonfuls, night and morning for three days, and after that sweet oil, once a week, during the prevalence of the epidemic; a ball composed of equal parts of "cordial ball and worm ball" to be given twice during the week.

In conclusion, I must offer an apology or excuse for the "Vets," who have been severely handled by the Press, as it is an extremely difficult matter for them to arrive at the true knowledge of distempers in animals, because the poor creatures cannot answer any questions, therefore their only resource is to the motion of their heads, gestures of the body, &c. At the same time, I cannot help expressing an opinion that a higher standard of education is demanded of them. The most skilful of their profession (the late Mr. Youatt) was, I believe, a schoolmaster. It is a received maxim that medicine should begin where philosophy ends; and it is undoubtedly an essential qualification in a veterinary surgeon to be a good philosopher.

I am, Sir, your obedient servant,

October 2.

JAMES BRUCE.

NEGATIVE SLIP.

SIR,—In your impression of the 29th ult., Mr. Moy has advanced his theory on the subject of negative slip, but I think the action he describes would tend rather to increase than diminish slip; because if water is continually being drawn from the after run of the ship the preponderating pressure would be forward. I think with Mr. Moy that the evil is dependent on the centrifugal action of the propeller, but in this way. It is evident that the centrifugal action is induced by the friction of the blade, but most especially on the propelling surface of the blade, hence a stratum of water is continually being driven towards the periphery of the blade, and acting as a continuous wedge. That centrifugal action is within certain limits an advantage, may be inferred from the facts,—1st, that few centrifugal propellers depending on the form of the blade for their action have attained any extensive adoption; 2nd, that it is often found advisable to remove the leading corner of the blade. This may be accounted for as above, as the stratum would have a tendency, from the form and motion of the propeller, to leave at the following edge. But I think that it is only when the centrifugal action is excessive that the evil alluded to is produced. I should feel obliged to see the opinions of those who have the opportunity of practically investigating the subject.

Yours truly,

HELIX.

Greenwich, October 4.

SUGAR REFINING.

SIR,—In your issue of September 22nd, you inserted a letter from me wherein I pointed out the defects in the general method of revivifying animal charcoal, and suggested an improved process. Permit me now to draw attention to another circumstance of great importance to sugar refiners. I have had twenty-five years' experience in sugar refining in England and on the continent. On my return to London a short time back, I had an opportunity of viewing a sugar house, and to my astonishment found that the refiners still continue the old method of placing their sugar moulds on pots—a method which causes a great loss to refiners, and which has been discontinued on the continent for at least twenty years. Abroad the adopted and superior method is to stand sugar moulds on loaf beds, with gutters under them to receive the syrup, so that the moulds need no shifting until they are ready for brushing off. The syrup runs in the gutters to a cistern, which is placed on the lower floor, and in a cold place, to keep it from fermentation. The loss to the refiner by using pots must be great; considering that every pot on its outside is coated with sugar and syrup, and the inside a quarter full of crystallised sugar, which remains in the pots for months before it becomes saleable, so that there is always a considerable large dead capital lying in the house, and when gathered—perhaps once in a year—its good quality has changed into acids, and its greatest part has become treacle.

By standing the sugar moulds on loaf beds, the benefit to the refiners is of great importance:—First, there is no removing of the moulds, and gathering syrup from pots into pails. Secondly, there is no spilling of syrup when gathered. Thirdly, no overflow of the pots, which so frequently happens by using them. Fourthly, no loss in the quality of the syrups, as it is kept in a cool place instead of being in the pots on the heated surface. Fifthly, the different qualities of syrups can be strictly separated, which, by using pots, is impossible. Sixthly, no smell of acid ever occurs in the refinery, as the floors can be kept as clean as those of a dwelling-room; and, lastly, refiners would be enabled to place one-fourth part more moulds in their houses.

Yours, &c.,

C. GERKEN.

9, William-street,
Cannon-street-road, London.

TO CORRESPONDENTS.

The MECHANICS' MAGAZINE is sent post-free to subscribers of £1 ls. 6d. yearly, or 10s. 10d. half-yearly, payable in advance. Post-office orders made payable to Mr. R. 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, 4d. 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 Editors, 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.—W. S. J.—J. P.—F. T.—J. H.—R. A.—J. N.—G. O.—G. G.—H. O. and Sons.—E. R.—A. J.—J. B.—J. H.—Messrs. P. and G.—L. H. P.—H. T. D.—Capt. N.

Miscellaneous.

Mr. George Richards Elkington, of the firm of Elkington, Mason, and Co., died on the 22nd ult., at his seat, Pool-park, Denbighshire. This gentleman, who was a man of retiring habits, and in no sense what is termed a public man, was the first to introduce the now popular process of electro-plating and gilding, which has been so largely developed and improved by the skill and enterprise of this firm.

The value of watertight compartments in steamers was well illustrated in the case of a collision on Lake Huron, one of the unfortunate vessels having been taken into port sixty miles or more from the scene of the accident, an unsightly wreck forward, great plates of iron hanging by shreds, bent, twisted and torn, but the joints of her first partition tight as a steam boiler.

A new and improved tunnelling machine, to be worked by compressed air, is now in course of construction, at the engineering works of Messrs. Hawks and Co., at Gateshead.

A new rudder on Lumley's patent is being constructed for the screw troopship "Orontes," at Portsmouth dockyard, and will be fitted to that vessel on her return to England from her present China voyage. The Lumley rudder, which is fitted to Her Majesty's ships "Columbine," "Scotia," and six other vessels in the navy, is one of the most simple, yet efficient, forms of steering that can be applied to single screw ships, yet, strange to say, none of our large ironclads have yet been fitted with it.

The water pipes in several parts of Paris are being replaced by tubes of a larger calibre. This operation is being performed at present on the Pont au Change and the Pont St. Michel. These tubes are placed either under flags or under paving stones covered with cement. All along the Boulevard du Palais the water pipes are placed in the sewers. When the subterranean canalisation of Paris is completed, the sewers will enclose not only the water and gas pipes, but likewise the electric wires by which the telegraph offices communicate with each other.

From America we learn that the plan of the trial of the engines of the "Algonquin" and "Winoski," as laid down, is to have the ships as precisely alike as possible in draught of water and every essential respect. For four days they will run the engines on a given quantity of coal, carefully noting results, then for four days more each vessel will be allowed to burn as much coal as she possibly can, no limit being stated. After this trial, lasting eight days, the ships will be fitted just as their designers desire, and they will proceed to Throgg's Neck and run a race around Fisher's Island and back. The circuit will be made three times, by which time it is expected that all hands and the public will be satisfied.

The Bernott Patent File Company are now, after surmounting obstacles inseparable from so vast and peculiar an undertaking, manufacturing files by their new automatic machinery. The apparatus for rolling the most difficult forms of taper files has been perfected. It is now in course of erection at the works at Smethwick, and will shortly be in operation.

The recent proposal to erect a statue in honour of Dr. Simpson, as the discoverer of chloroform, has given rise to some comments in the French journals, which state that, although Dr. Simpson was the first to use chloroform as an anæsthetic in surgical operations, the substance itself was discovered by M. Soubiran, professor at the Paris School of Medicine, during his experiments on the reactions of chloride of lime on alcohol. These experiments were made in 1831, and Dr. Simpson did not introduce chloroform as a substitute for sulphuric ether till 1847, a year after M. Fleurens had discovered its stupefying effects on animals.

There is now a very large spot, distinctly visible to the unassisted eye at sun-setting, traversing the sun's disc. As it must be of enormous magnitude we hope to hear of further observations thereon.

We understand that there never was, more than now, a larger consumption of tin plates. Not only are most of the tin-plate workers who produce wares in common use very busy, but, on every hand, there is an extension of the use of this material for packing purposes. The large quantity of goods, of an edible kind in particular, which are now sent from the manufactories in canisters and boxes made of tin plates is something astonishing.

A letter received from an Italian engineer and published in the French papers announces that the workmen employed in piercing Mont Cenis have come upon a bed of extremely hard quartz, which turns the edge of the best tempered steel, and it is feared that this obstacle might retard the opening of the tunnel for four years. As long ago as the month of May or June the engineers were expecting to come upon quartz, but, as geological surveys of the mountain had long since been made, the impediment must to a certain extent have been reckoned upon. Perhaps the quartz has proved harder than was expected, but early in the year they were lucky in finding an unusually soft vein of rock. It is to be observed that foreign engineers have expressed an opinion that the tunnel will take longer to complete than the sanguine Italian managers anticipate. It is satisfactory to think that the summit railway is likely to be made before the end of next year, and will shorten to four hours the passage of the mountain.

Excited by the reports of the immense fortunes made out of the oil wells of America, the Russians are beginning to turn their attention to the working of petroleum in their own country.

The London and Paris papers have lately been engaged in a spirited discussion upon the comparative merits of the English and French navies. The latest contribution has been furnished by Captain Cowper P. Coles. Whilst differing with much that has been advanced by the French critic in the *Opinion Nationale*, he admits that our navy would be beaten upon the question of collective speed, for our vessels could not attain a higher rate than nine or ten knots per hour, but the French could travel at from twelve to thirteen knots in the same period. The French critic remarked that the multiplicity of portholes in the vessels of the Imperial navy was a "serious inferiority," and Captain Coles accepts that remark as quite sufficient evidence of the superiority of his turret system over every other mode of carrying guns in iron-clad ships. It was upon this point that he first rested his claims to attention; and he now repeats the assertion that the "Royal Sovereign," in consequence of being built upon the turret principle, could successfully confront any other vessel of either the English or French navy.

An official return states that the production of arsenic from the Cornish mines to the end of 1864 was 1,855 tons, value £1,393 10s.

The *Comte Cavour*, a Turin journal, announces that the problem of perpetual motion has been solved by M. Louis Caucré Rizzo, a mechanic of Straßburg, who, the same journal asserts, has invented a machine which finds its motive force within itself without any external aid. Nay, more; it is to be seen at work in Naples, where it has been applied to raising water, but M. Caucré hopes to render its application universal. Meanwhile, it seems, he has obtained a patent for fifteen years from the Italian Government. We require further particulars of this wonderful machine before we can record our belief in perpetual motion resulting from a motive force inherent to and supplied by the machine itself without any exterior agent.

Machinery, which for a long while past has been exported in unprecedentedly large amounts, declined in the exports of July, the value of the steam engines exported during that month being £139,930, against £148,459 in the corresponding month of last year. There was, nevertheless, an increased exportation of steam engines to France, Spain, Russia, India, and Australia, and of other kinds of machinery to Belgium, Spain, and Australia, the shipments to other countries showing a decline.

Mr. J. Chubb has just invented a method of securing safe doors from the application of the professional burglar's wedge. The frame, in place of being made flush as hitherto, projects beyond the door, so that the door will be recessed; and further to protect the door and the keyhole or holes through the door of a strong room or iron safe, a hardened steel bar is applied externally to the door, and from side to side thereof, the bar being fitted within a groove across the door. This bar is of a curved convex form externally, and flat on the side where it comes next the door. At each side of the framing of the door a projecting socket is formed, into which the bar slides after the door has been shut and fastened or locked. In order better to insure that no thin steel wedges shall be introduced, the sides of the groove across the door in which the bar is fitted are under cut.

Another of the iron mortar boats, which have long been laid up in Chatham dockyard, is to be converted into a lighter for dockyard service at Deptford.

The last of the All-England ploughing matches for the week took place last Friday, at Hinton, near Farringdon, Berkshire, on the farm of Mr. Peacock. There were four competitors—viz., Messrs. Ransome's man, Barker; Messrs. Howard's man, Purser, and two first-class local men. Although the land was dry, the work done was of unusual excellence, and the power of both the Ipswich and Bedford firms was fully put forth. After a keen competition the judges awarded the champion prize to Messrs. Ransome's man. Lord Radnor's ploughmen also highly distinguished themselves. One was a competitor in the All-England class, and his work was judged equal to Purser's, the judges highly commending them and giving them both an extra prize. Another of the earl's men, in the class for the best ploughmen in the district, won the first prize with a Ransome's plough against fourteen competitors.

Letters from Paris state that an account of the intense heat, the Seine will soon become, if not a boulevard, at least a street. As it is children walk across it, lovers of the antique and amateurs of curiosities take advantage of the unusual state of things to search for hidden treasures, and many have been rewarded by finding pistols, clocks, and kitchen utensils in great numbers.

It might be supposed there was now little danger of the explosion of shells fired at the siege of Sebastopol and which had remained exposed ever since to the rains and snows of the Crimea; but the *Odessa Courier* says that accidents continue to occur from the bursting of such shells, and states a case of recent occurrence. Some boys found a shell in the neighbourhood of Bastion No. 4, and began to roll it in the direction of the town. It struck against a stone and instantly burst. Luckily no one was hurt, although one of the boys was so near the shell that his clothes were set on fire by the explosion.

The Crystal Palace Gas Company have announced their intention to reduce the cost of lighting the street lamps by half-a-crown a year each, besides lowering the charge for gas for private use to 4s. 7d. per 1,000 cubic feet. The South Metropolitan Company's reductions are 2s. 6d. per year upon each lamp, and to 3s. 4d. per 1,000 cubic feet for common consumption. The South Londoners may congratulate themselves upon this result of a general demand for good and cheap gas.

On Monday morning, a new railway, which is a single line, commencing at Alton Station, and terminating by a junction with the London and South-Western Railway, about a mile from the Winchester Station, was opened for public traffic. The length of the railway is about 18½ miles, being the distance between Winchester and Alton. On the same day another new railway, the Horsham and Guildford line, a branch of the London, Brighton, and South Coast, was also opened for passenger traffic. Horsham, Slinfold, Baynards, Oranley, Bramley, and Guildford, are now in communication with the Victoria, London Bridge, and Kensington termini, and the Brighton station of the London, Brighton, and South Coast Railway.

The organs of the ironmasters, who so confidently asserted that free trade would be the ruin of all engaged in the iron trade in France, now boast that English manufactures cannot compete with Frenchmen in the continental markets. The *Courrier du Bas Rhin* publishes a letter from Graffenstaden in support of its assertion, which states that the Baden Government having advertised to receive proposals for the supply of forty-six locomotives for railways to be constructed in that duchy, an English company offered to supply them for 70,710l. each. A Baden company demanded 55,700l., but the proprietors of the ironworks at Graffenstaden offered to supply them for 45,000l., so that the English company got no share of the contract.

In the extensive underground floors of a new barrack now erecting in Paris, the vaultings are being formed with what is called *Betons agglomérés*, the exact composition of which is kept secret by the inventor, M. Coignet. The walls are full thirteen feet apart, and the concrete is laid on timber centring, and trodden and beaten down with great care. The vault and flooring thus formed is about two feet thick at the spring of the vaulting, but only about ten inches on the crown, and it is found sufficiently strong for all practical purposes. It has also this great advantage, that the ceiling can at once be whitened and the floor laid with tiles or cement without further preparation.

The "North American Review" says that there are now in America and Europe more than a hundred and fifty manufactories of india-rubber articles, employing from four to five hundred operatives each, and consuming more than ten millions of pounds of gum per annum. The business, too, is considered to be still in its infancy. Certainly it is increasing. Nevertheless there is no possibility of the demand exceeding the supply. The belt of land around the globe, five hundred miles north and five hundred south of the equator, abounds in trees producing the gum, and they can be tapped, it is said, for twenty successive seasons. Forty-three thou-

sand of these trees were counted in a tract of country thirty miles long and eight wide. Each tree yields an average of three tablepoonfuls of sap daily, but the trees are so close together that one man can gather the sap of eighty in a day.

During the past two years there has been a continual drain of emigrants from the iron and coal districts of South Wales, the great majority of them leaving for the States. Such was the drain at one time among the working population that a positive scarcity of hands was experienced at many of the works, and considerable inconvenience and loss were the result to employers. Since the close of the American war, however, the emigration movement has been gradually checked, and, in fact, a good number of the emigrants have returned to the mother country, and they give a deplorable account of the state of the labour market in the States. The warnings that appeared from time to time in the *Times* have thus been verified, and now, when it is too late, many of the emigrants regret that they ever left the land of their birth. There is no doubt that a higher rate of wages is paid in America, but the depreciation in paper money and the dearthness of all the staple articles of food, reduce the earnings so much that a working man is, after all, better off in the industrial districts of Great Britain.

A scheme was proposed at an influential meeting at Sunderland on Monday last, to raise a new railway company for the Northern district, independent of the North-Eastern Company, and construct a direct railway line from the Tyne to the Tees. The Sunderland people have for some time discussed the feasibility of a high-level bridge across the Wear, and a direct coast line in connection with the North-Eastern system; but its projectors seem to have become convinced that the North-Eastern Railway directors would be slow to move in such a direction, and that an independent company and a new route would therefore be preferable. The project would absorb £1,000,000 of capital.

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.—685, 692, 700, 722
BUILDINGS AND BUILDING MATERIALS.—672, 686, 695, 698, 702, 714, 719
CHEMISTRY AND PHOTOGRAPHY.—677, 706, 712
CULTIVATION OF THE SOIL, including agricultural implements and machines.—671, 675
ELECTRICAL APPARATUS.—678, 713, 723
FIBROUS FABRICS, including machinery for treating fibres, pulp, paper, &c.—673, 680, 690, 716, 718
FOOD AND BEVERAGES, including apparatus for preparing food for men and animals.—691, 694
FURNITURE AND APPAREL, including household utensils, time-keepers, jewellery, musical instruments, &c.—682, 687, 693, 699, 710, 720
GENERAL MACHINERY.—674
LIGHTING, HEATING, AND VENTILATING.—704, 717
METALS, including apparatus for their manufacture.—689, 697, 701, 715
MISCELLANEOUS.—669, 670, 684, 696, 703, 705, 721
ROADS AND VEHICLES, including railway plant and carriages, saddlery, and harness, &c.—676, 679, 683, 688, 709
SHIPS AND BOATS, including their fittings.—661
STEAM ENGINES, &c.—707
WARFARE.—708, 711

669 V. DELFERDANGE. *An improved method of connecting together tubes or pipes used for conveying gas and water, and for other purposes.* Dated March 9, 1865.

This invention relates more particularly to an improved method of connecting branch pipes to main pipes. The modes heretofore commonly practised for effecting this have been either by flanges bolted together, or by sockets filled with lead or cement for large pipes, and for small pipes by cutting a screw on the branch pipe, and securing the same into a screwed hole formed in the main pipe. By adopting the above methods, great difficulty is experienced in disconnecting pipes thus connected together. This objection the patentee proposes to obviate in the following manner:—For example, he forms an oblong, oval, or other shaped long hole in the main pipe, and spreads or widens that end of the circular branch pipe which is to be connected to the main pipe until it assumes a form somewhat similar to the aforesaid hole in the main pipe; this end of the branch pipe has a screw cut about it, and carries a nut and loose metal washer, and, resting upon this washer, another washer of vulcanised india-rubber or other suitable elastic material. To connect the branch pipe thus fitted and formed to the main pipe, he inserts the end of the branch pipe into the aforesaid long hole in the main pipe, and turns the branch round one quarter of an entire turn, then tightens the nut against the washer and hole in the main pipe. By these means the enlarged end of the branch pipe, being crosswise of the narrow part of the hole in the main pipe, may be securely connected thereto and disconnected therefrom at will. *Patent completed.*

670 J., E. G., and C. H. FREEMAN. *Improvements in the preparation of turpentine and varnishes.* Dated March 10, 1865.

These improvements in the preparation of turpentine, when they are to be used for manufacturing purposes, consist in treating them with air or ozone by agitating them together in any convenient vessel. The improvements in the preparation of varnishes consist in the melting of the gum or gums employed in the making of varnishes, whatever they may be, in vacuo, by means of superheated steam, or otherwise, adding to it or them while in this state dryers, until the whole becomes of a proper consistency, after which the usual dryers and turpentine or other spirits are added, when the varnish or varnishes may be treated with ozone, as described. *Patent completed.*

671 E. A. PHILLIPS. *An improved rotary spader or digging machine for tilling land.* (A communication.) Dated March 10, 1865.

The nature of this invention consists, chiefly, in so constructing and arranging the working parts that, by the forward movement of the machine, the fork, tines, or spading blades, which are connected to the travelling wheels, and which are partially controlled by fixed or stationary cams, enter the ground as they revolve, thereby effectually and speedily lifting, breaking, and pulverising the soil. *Patent completed.*

672 W. SMITH. *Improvements in the construction of fastenings or bolts for window cashes and other purposes.* Dated March 10, 1865.

This invention primarily consists in the employment for fastenings or bolts generally, but especially for fastenings for window cashes, of a rod with a flattened head or lump, by preference of a T, or Z shape formed at one end, the shape being regulated according to the purpose to which the fastening or bolt is to be applied, and with a handle or knob; or sometimes without, as the other, as hereafter described. When the rod carries at one end a knob or handle, the patentee inserts a pin in the rod, and passes the latter through a tube slotted similarly to a bayonet joint, a helical spring being inserted round the rod, and abutting at the other end against the pin on the rod, in such manner that the rod may be pushed forward and the bolt inserted in an aperture formed for that purpose in the opposite cask. On turning the rod, and with it the lump at its end, the latter is prevented from retreating by means of its shape, and the pin is secured by the slot in the tube; the fastening is then secure. *Patent completed.*

673 E. LEIGH. *Improvements in cotton gins.* Dated March 10, 1865.

This invention consists, in the first place, in the application to cotton gins on the Mearns principle of a sliding plate having a deep serrated edge on one side when used for single gins, and both edges serrated when employed for double gins; or a grid may be used. This plate the inventor prefers to make of a curved form, to give rigidity with lightness. He causes this plate to work rapidly to and fro in a line parallel with the ginning roller by suitable mechanism, and sets the serrated edge up to the doctar, by the action of which the cotton fibres are stripped from the seeds, and the usual beater is dispensed with. Secondly, he employs a glass ginning roller, constructed as follows:—He casts in a suitable mould a number of short glass cylinders of about 5in. diameter, with holes through them of about 3in. diameter. These cylinders, which are about 2in. or 3in. wide, are fixed upon a shaft with plaster of Paris or other suitable cement, and are also connected together so as to form a roller of any desired length. They have spiral grooves or other indentations, or both combined, cast upon the outer edge, so as to nip the cotton, and carry it under the doctar, acting in lieu of the ordinary leather covered roller. Thirdly, in gins having beaters he dispenses with the ordinary crank arms or connecting rods by using a shaft slightly cranked the whole width of the gin. This shaft works in a cast-iron box or trough made in the U form, besides having a little elasticity. This box is firmly attached to the beater arms, which it operates by the eccentric shaft, and the little elasticity in the box permits of its being screwed up to fit the shaft with nicety. The bottom part of the box contains a little oil to keep the crank-shaft in lubrication by means of a sponge or otherwise. *Patent abandoned.*

674 J. L. FIELD. *A machine for cutting or forming the tips or points of candles, and for other like purposes.* Dated March 10, 1865.

For this purpose the inventor makes use of a cutter attached to a spindle to which rapid revolution may be imparted either by a winch-handle and multiplying gearing or by other convenient or suitable means, and in front of the cutter he forms or attaches a ring or short cylinder, which acts as a guide and support for the candle or other object operated upon. This ring is made suitable in size for the largest diameter of candle intended to be operated upon, and is provided with a ring or bush fitting into it for each smaller size of candle or other object required to be pointed, such rings or bushes being formed or bored to fit each such smaller size of candle or other object. The cutting part of the machine is enclosed in a box or casing, provided with a hole through which the candle or other object to be pointed is inserted, and the cuttings guided by the box or casing fall through an opening into a drawer beneath, and which is contained in a box or casing which serves at the same time as a stand for the working parts of the machine. *Patent abandoned.*

675 G. WRIGHT. *An improved agricultural implement.* Dated March 10, 1865.

This invention relates to an instrument for "forking" land, and consists of the following mechanical arrangements:—In a suitable framing mounted on running wheels, and upon the axle of said wheels, the patentee places loosely two or more discs of metal, the outer discs being placed asunder nearly the width of the inside of the framing aforesaid; around these discs, and at equal distances asunder, he connects and fixes times or prongs one in each hole, either straight or curved. The implement thus formed may have shafts and be drawn by a horse, the effect being to cause each row of times or prongs to enter the ground and fork it up as the implement is advanced. *Patent completed.*

676 T. STARTIN. *Certain improvements in Venetian blinds for carriages, and which said improvements are also applicable to certain blinds or screens for other purposes.* Dated March 10, 1865.

The following is a description of the improvements as arranged in connection with a Venetian blind suitable for a carriage window, in which case the strips or laths forming the screen or blind are fitted between the sides of a thin frame for sliding down in the ordinary way, in which the glass frames of carriage doors slide down. The strips or laths are united to the side rails of the frame

by small wire or other centres or axes projecting from each end, working in corresponding holes in the inner edges of the side rails of the frame. All this is common in the construction or making of such kind of Venetian blinds, whether for windows or other purposes. The improvements are entirely confined to the means of actuating the strips or laths of such blinds for the purpose of opening and closing the same, and consists in the use of a strip of metal or other suitable material long enough to extend at right angles to the series of movable laths, which strip of metal is formed with a series of small eyes, not only equally divided, but exactly the same distance apart from eye to eye as the axes of the strips or laths, and into these eyes small metallic pins work, secured on the flat or face side of each lath. From this it will be seen that, by pulling down or elevating the strip of metal, all the strips or laths will be simultaneously opened, closed, or set in any desired angle. For the purpose of protecting the action of the laths from undue force, the vertical strip is attached to a compound hinge joint and plate at the top or bottom end, as may be desired, which plate with the compound or double hinge or joint is secured to the rail of the frame in which the laths work. *Patent abandoned.*

677 T. REISSIG. *Improvements in ascertaining the presence of "fixing" agents in photographic productions, and in removing the said fixing agents therefrom.* (A communication.) Dated March 10, 1865.

This invention relates firstly, to a test whereby the operator is enabled to determine whether hyposulphite of soda or other such fixing agent has been removed by washing or other process employed in the practice of photography. With this view he places the prints after they have been washed or otherwise similarly treated, or the fluid in which they have been washed, in communication with the poles of a galvanic battery, by which means the fixing agent becomes decomposed, and sulphur (if the fixing agent above mentioned has been used) appears at the negative pole. If silver be employed for this pole, the effect is more apparent. As this part of the invention depends upon the elimination of the injurious part of the fixing agent, it is evident that it may be used for the removal of the last traces, or of larger quantities. Secondly, the invention relates to a mechanical method of removing the said fixing agents. For this purpose the photographs are caused to rotate at a considerable velocity, so as to throw off the liquid they contain by centrifugal force. *Patent abandoned.*

678 H. W. COOK. *Improvements in electric telegraphs.* (A communication.) Dated March 10, 1865.

This invention relates to certain improvements in the Chevalier Bonelli's well-known system of type telegraphy, by which improvements he is enabled to obtain with one wire, and in other respects the same apparatus, many of the advantages he obtained by the use of several wires, the message, however, being printed in symbols instead of in Roman characters, as is the case when there are several wires used. *Patent abandoned.*

679 A. WESTHEAD. *Improvements in apparatus for enabling the passengers in a railway train to communicate with the guard.* Dated March 10, 1865.

For this purpose the inventor places in the guard's van a reservoir of compressed air, which the guard by means of a pump or otherwise can replenish from time to time as may be required. On each of the carriages of the train a pipe is fixed, and a whistle is mounted on this pipe. When the carriages are put together into a train, connections are made between the pipes on the several carriages by means of lengths of vulcanised india-rubber tubing, which are sprung over the ends of the pipes; in this manner a connection is made between the reservoir of air in the guard's van and the pipes from end to end of the train, and these pipes are kept constantly full of compressed air. In each compartment of every carriage a cord is provided, on pulling which a cock is turned so as to allow the compressed air to escape through the whistle and cause it to sound, and it will then continue to sound until the cock is turned back to its original position, which cannot be done by the occupants of the carriage. As the same time that the whistle is thus caused to sound, a catch is released, and a spring throws out upon the side of the carriage or the compartment thereof a signal arm or frame which the guard looking from his van can see. *Patent abandoned.*

680 J. SAMUEL and S. MILBURN. *Improvements in the machinery for preparing flax, hemp, and other fibrous materials requiring like treatment.* Dated March 10, 1865.

In constructing machinery according to this invention, pairs of crushing rollers are used, which may be plain, grooved, or roughed on the surfaces, or some may be in one condition whilst others are in other conditions. In order to give motion to these pairs of rollers, each pair is geared together by toothed wheels at one end. The upper roller of each pair is weighted in the usual manner of weighting, like crushing rollers. The crushing rollers are hollow in order to allow of steam or other means of heating being employed. Three pairs of such crushing rollers form a convenient number, but the number of pairs of crushing rollers used in a machine may be varied. One or more of the pairs of crushing rollers is or are caused to receive a quick and very short reciprocating endway motion in addition to the rotatory motion given thereto, in order that the flax, hemp, or other fibrous substance may be rubbed between the surfaces of the pairs of crushing rollers, and this quick reciprocating endway motion is communicated to each pair of rollers by means of a lever which has its fulcrum on the framing of the machine between the top and bottom rollers; and the bearings or brasses of the axes of the two rollers of a pair are connected respectively to the lever above and below the axis or fulcrum of the lever, by which, when the lever is caused to move to and fro on its axis or fulcrum, motion will be given to the bearings or brasses of the two rollers, and, consequently, to the rollers themselves in opposite directions, and to facilitate this short to-and-fro motion rollers are applied to the brasses or bearings of the axes of the rollers. The flax, hemp, or other vegetable substance is fed up to these reciprocating crushing rollers, and is by them crushed and rubbed, and, as the fibrous material progressively protrudes beyond and passes from the crushing rollers, it is acted on by beaters constructed in the following manner:—Each beater is a bar, by preference of a circular section, and one, two, or more of such beaters is or are mounted on a revolving block or shaft to which it or they is or are attached by flexible elastic straps or connecting arms, which are by preference formed of vulcanised india-rubber. *Patent completed.*

681 E. P. ROBERTS. *Improvements in coating the bottoms of iron ships and other surfaces to prevent oxidation, the*