

adhesion of marine animals and plants, and in compositions to be employed therein. Dated March 10, 1865.

In coating the bottom of an iron ship the surface should be in the first place scraped and cleaned, then muriate of ammonia or other salt or compound of ammonia is applied, or, in place thereof, water which has been acidulated by mixing with it the farina of rye or other grain, and fermenting the mixture; or water impregnated with carbonic acid gas, or acidulated water, or other solvent may be employed. The surface being thus prepared it is coated with a varnish consisting of shellac and copal or other gum, or similar material dissolved in methylated or other spirit or solvent, and mixed with nitrate of mercury, or other salt of mercury, which can be held in solution in the spirit or solvent, and which the sea water will not upon or decompose. The inventor prefers to employ the following composition:—2lb. shellac, 1lb. copal, 1lb. nitrate of mercury, 1 gallon methylated spirit. *Patent abandoned.*

692 J. and R. D. JONES. *Improvements in apparatus used for bending the ends of walking sticks, and the sticks or handles of umbrellas and parasols.* Dated March 10, 1865.

For the purposes of this invention a form or solid block is used; it is made to the curvature desired to be given to the bent end of the stick, and it is preferred that the form or block should be of a size to have several sticks bent thereon at the same time. A flat chain is used with such form or block. This flat chain is made with grooves on its surface, each groove being arranged to receive a stick, so that the end of each stick which is about to be bent is partly embraced by the groove on the surface of the flat chain. The form or block is also made with grooves, and so are also the jaws of a vice in which the sticks are held when bending their ends, and this vice has the form or block before mentioned attached to it. The ends of the sticks to be bent are first softened by inserting them into damp and warm sand, as has before been the practice. The several sticks are inserted into the vice, and are held at such a distance from their ends as is required to form the desired length of bend. The flat grooved chain at one of its ends is fixed to the vice, whilst its other end is fixed to a lever handle by which the chain and the ends of the sticks are bent against the form or block, so that when the ends of the sticks are bent on the form or block the chain supports the grain of the wood at the outer surface and prevents it being injured. In connecting the end of the chain to the lever it is adjusted by a screw to the length desired. The lever, when the bending has been effected, is retained by a lever hooked catch. The form or block which is solid is kept heated on its external surface in any suitable manner; heat is thus also communicated to the jaws of the vice by which the parts of the sticks held thereby are dried. The several sticks, when their bent ends have been held to the surface of the form or block for a sufficiently long time to become dry or set, are released. *Patent abandoned.*

693 P. MARVAUD. *Improved apparatus for promptly disconnecting horses from carriages and other vehicles.* Dated March 11, 1865.

This apparatus is constructed as follows:—The ends of the furbells of the forecarriage are forked, that is to say, they have each two branches, and between the branches a ratchet or keypiece is securely maintained by a spring, its other side pivoting on a bolt. At the end of each shaft is a strong bolt which is introduced between the branches of the furbells and secured by the above-mentioned keypiece. Adapted on the branches of each furbell is a cam or nut which is at the command of the driver, and in causing these cams or nuts to press against their respective springs, the ratchet or keypiece above mentioned is at once liberated, which permits of the escape of the bolt of the shafts, splinter bar, or carriage pole, as the case may be, and thus immediately disconnects the horses from the vehicle. The coachman works the cams or nuts just mentioned by means of a lever conveniently disposed for that purpose, and communicating with an armature having the form of, and placed beneath, the furbells of the forecarriage, a connecting rod transmitting the action to the cam or nut; the lever being also connected with the forecarriage, the vehicle may be directed as desired, the impetus carrying on the carriage a short distance. *Patent abandoned.*

694 O. JOHNSON. *An improved combined T piece and valve.* Dated March 11, 1865.

This invention consists in combining a T-piece and a valve or stop valve in one connected piece, that is, so arranging or fitting a valve or plug on a spindle to be operated by a screw-wheel, lever, or other handle, that it can be made to close against a seating and cut off the flow through the vertical part of the T, or can be arranged to shut off either of the other passages and direct the flow of the fluid through the said vertical part and one of the horizontal parts. *Patent completed.*

695 E. B. WILSON and J. HOWDEN. *Improvements in steam boilers and the furnaces thereof.* Dated March 11, 1865.

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

696 J. HIRD and J. WALKER. *Improved machinery or apparatus for scouring stones, marbles, slates, and bricks.* Dated March 11, 1865.

The object of this invention is to produce a smooth and even surface on the substances named in the title, and to avoid the grooves made by the usual system of scouring. For this purpose, within a convenient framework, rectangular by preference, the inventors place trains to bear wheels or rollers which carry a moving table having a reciprocating motion within the frame. The moving table is adapted to receive heavy blocks, though of course light ones may be put on, if desired. Over this table they place a framework into which small and lighter slabs are secured than those in the bottom, by means of tightening screws through the side of the framework. This upper frame they connect to a crank on the driving shaft by means of a connecting rod having ball joints near either end, and at right angles to the connecting rod which imparts the reciprocating motion to the bottom table. They also attach a second connecting rod to the upper table at right angles to the first named one, and actuate it by an eccentric or ordinary mechanical appliances. The apparatus being set in motion the operation is as follows:—The lower table has a simple reciprocating motion, whilst the upper one has a two-fold one, being moved both transversely and longitudinally by the connecting rods before named, thus obtaining a parabolic motion giving the results named. *Patent abandoned.*

697 J. GARELLY. *An improved machine for cutting*

button holes. (A communication.) Dated March 11, 1865.

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

698 O. M. KERR and N. SYMONS. *Improvements in the construction of railway plant to ensure the safety of passengers' lives in the event of accident or collision.* Dated March 11, 1865.

This invention consists in constructing the carriages in two independent parts, so that the lower portion shall receive the whole effect of any concussion, and the upper or passengers' compartments shall be made to yield in such a manner as to relieve the occupants from any sudden and injurious effects of a shock. Another part of the invention is designed to lessen the risk of accidents caused by the contraction and expansion of metals. The inventors propose to attain this object by making the wheels and tyres in sections, bending their inner edges with wood, gutta-percha, or other flexible material capable of yielding to the action of the temperature upon the metal portion of the wheel. *Patent abandoned.*

699 J. HENDERSON. *Improvements in the manufacture of iron and steel.* Dated March 11, 1865.

This invention relates, first, to the manufacture of iron in the blast furnace, and consists in mixing with iron ores, or other materials charged into the blast furnace, a given quantity of manganese, or by preference manganiferous iron ores, such as that known in this country by the names of red oxide of zinc or franklinite iron ore. The invention also consists in introducing the manganese, manganiferous, or other ores or other materials in a finely divided state into the molten metal while it is being operated upon by the blast used in producing Bessemer steel. To this end double tuyeres are used for the purpose of blowing in the pulverised ore with the decarbonising blast. The fine particles of ore or other materials thus become intimately mixed with the molten metal, and will thereby effect the desired change therein. *Patent abandoned.*

699 T. and H. W. WHITEHEAD. *Improvements in machinery or apparatus for hackling flax, hemp, or other similar fibrous substances.* Dated March 11, 1865.

The patentees claim, first, applying to hackling machines endless holders which are caused to grip the fibres to be presented to the hackles by elastic pressure imparted to them during their progress through the machine, and release the fibres after they have passed under the action of the hackles, as above stated. Secondly, the means herein described for obtaining a better grip of the material in the holders of hackling machines. Thirdly, constructing hackles, as described with reference to figure 1 of the drawings. *Patent completed.*

691 J. HENDERSON. *Improvements in refrigerating or freezing liquids.* Dated March 11, 1865.

The object of this invention is to obtain solid blocks of ice of a size and form suitable for transportation, packing, and sale, without the necessity of cutting or breaking and freezing such blocks, in much less time or by temperatures which would fail to produce ice of sufficient thickness in lakes, ponds, or rivers. This object is effected by exposing the water to be frozen in a series of pans made of some good conductor of caloric, by preference of thin metal, and of the form of the required blocks of ice. These pans are suspended by their rims so as to expose their entire outer surface to the action of the atmosphere. The freezing operation is facilitated by the second part of the invention, which consists in combining with the series of freezing pans means for causing a more energetic action of air around and over the said pans, either by causing the frames in which the pans are suspended to be moved through the air, or, as the equivalent thereof, causing currents of air to circulate around and over the said pans, such increased action having the effect of more rapidly conducting the caloric out of the pans, and thereby inducing a more rapid freezing of the water contained therein. *Patent completed.*

692 E. B. WILSON. *Improvements in furnaces and fire-places.* Dated March 11, 1865.

This invention relates, firstly, to a new method of construction particularly applicable to cupolas, and blast, and other furnaces. According to one modification the gases are taken off at or about the point where the blast is at present injected, and carried upward through channels left in the brickwork of the furnace, on the top of which a chimney or duct of any required height may be constructed. Under another modification of this part of the invention a chimney may be built in the centre of the furnace, and the gases be drawn off near to its bottom, the fuel and air for combustion being at the top. In some cases it may be found necessary to admit air through the sides at different heights, according as the circumstances of the operation going on may require. In the case of smelting brass and other metals, a chamber is sometimes arranged below the fuel chamber for the purpose of holding the pots, and in which chamber the heat is maintained by the combustion of the inflowing gases. The second part of this invention relates to certain improvements in fire-places, and consists in constructing them of fireclay in one or more pieces. *Patent completed.*

693 J. M. NAPIER. *Improvements in wine glasses and in stands or holders for the same.* Dated March 11, 1865.

These improved wine glasses are formed without the usual foot or base, and, instead thereof, the patentee provides suitable stands or holders for them, which stands or holders are each to be placed upon the table near the person who is to use it, and who can readily remove the wine glass, from its stand or holder to imbibe its contents and replace it. *Patent completed.*

694 G. CARTER. *Improvements in the construction of toast racks.* Dated March 11, 1865.

To the top of a suitable shaped pedestal the inventor connects a piece of metal somewhat similar in shape to a double-ended skewer, having a hole midway of its length made through it for connecting it to the pedestal aforesaid. The slices of toast are intended to be pushed one after the other on these skewer-shaped parts, and thus hold the same securely thereon. *Patent abandoned.*

695 J. TANN. *Improvements in fire and burglar proof safes, chests, doors, and iron rooms.* Dated March 11, 1865.

This invention consists, first, in rendering iron safes, chests, doors, and rooms drillproof by welding bars of iron and steel together and hardening them, and afterwards riveting them on plates of iron, either in one direction or in layers across each other, and either close together or leaving small spaces between each bar, the plates, with the bars on them, to be riveted inside the body and door of the safe door or room, or any

part thereof, or the bars may be riveted on the body of the safe itself, without the inner plate, but the patentee prefers the former method. Thus, when the drill or cutting instrument has perforated the outer casing of the safe or door, it will come in contact with or between the steel-faced bars, and thereby be broken and destroyed. The reason for welding the iron on the steel is that it may not be broken into small pieces and removed, and also that it may be straightened after hardening by hammering or any of the well-known methods. He also renders safes, chests, and iron doors secure from being opened by forming a continuous inward bevelled groove or rebate on the inside surface of the door, and a corresponding inward bevelled projection on the face of the lining, or the groove may be in the face of the lining and the projection on the inside of the door. *Patent completed.*

696 C. HUNTLEY. *Improvements in cricket, racket, and tennis balls.* Dated March 11, 1865.

This invention consists in sewing or stitching the leather cover or shell of the ball with catgut, or similar material understood by the general appellation of catgut, or other suitable gut, or with prepared hide, instead of with hemp or flax as is ordinarily done, by which means the ball is kept secure, and prevented from bursting open by the repeated blows of the bat. The ball is rendered waterproof by the application of a cover or lining of India-rubber, vulcanised or not, whereby, when the ball is used on a wet field, it will not absorb the moisture, and therefore will not become soft or liable to crack. *Patent abandoned.*

697 R. M. ROBERTS. *Improvements in apparatus for treating metals and metallic ores.* Dated March 13, 1865.

The patentee claims, firstly, the application and use of perforated compartments or sieves, as described, arranged on the periphery of one or more concentric rings or wheels mounted on a horizontal axis, and rotating thereon vertically in a reservoir of water in the manner described. Secondly, the application and use of a rocking pan or dish, as described. Thirdly, the combination of the said rotatory concentric compartments with one or more inclined tables and rocking pans and their accessories, either partially or entirely, substantially as described, so as effectually to separate one metal from another, or the metallic portions of ores from the extraneous matters with which they are combined. *Patent completed.*

698 J. BRAGG. *Improvements in traps to prevent the uprisings of noxious gases in sewers, drains, sinks, shafts, and other passages for faeces, and other matter.* Dated March 13, 1865.

A trap constructed according to this invention consists of a round, oval, or any other suitably-shaped box or chamber connected at the top with a supply pipe or other passage, and at the bottom with a discharge passage, which box or chamber is divided internally by an oblique partition, to the front or lower edge of which is jointed a flap or valve capable of covering the opening between the fixed oblique shelf or plate and the opposite side of the chamber or box. This vibrating flap is fixed on the back, or constructed with a weighted lever which extends backwards beneath the oblique fixed plate, which has the effect of keeping the vibrating flap closed, when not acted upon from above. To prevent the dirt getting into the hinge of the vibrating flap or valve, the lower edge of the fixed oblique shelf may be formed with a step, to the front or lower edge of which the flap is jointed, when a piece of metal or other suitable material is laid in and secured thereto so as to cover the top of the hinge joint forming a guard thereto. This apparatus is placed within the sewer, drain, shaft, or other situation where it may be required. The sewer or other matter is allowed to fall through the top of the chamber, and, falling upon the vibrating flap or valve, it causes it to deflect, and allows the material to escape through the opening into the sewer or other passage, after which the vibrating flap immediately closes by its own action, thus preventing the escape of the noxious gases. *Patent abandoned.*

699 J. ATKINS. *Improvements in the manufacture of metallic bedsteads, which improvements are also applicable to the manufacture of other metallic articles.* Dated March 13, 1865.

This invention consists of improvements in connecting together certain of the parts of bedsteads and other metallic articles by the process of casting, the said improvements being also applicable to the joining of such parts of other metallic articles as may be conveniently joined by the process of casting. *Patent completed.*

700 J. WRIGHT. *Improvements in puddling, heating, and other furnaces.* Dated March 13, 1865.

This invention relates to puddling, heating, and other furnaces, the firebricks of which have movable or rising and falling bars, and consists of arrangements or combinations of parts having for their object the prevention of the formation of clinkers and the breaking up of any clinkers that may be formed in the furnace or fireplace. The invention consists, firstly, in fixing cast-iron boxes or troughs on either or both sides of the fireplace of the said furnaces, the said boxes or troughs having an opening to the outside or back of the furnace, and having an outlet either through the roof by means of a pipe or into the stack. By the circulation of air through the said boxes or troughs they are kept cool, and the formation of clinkers on the sides of the furnace is prevented. The invention consists, secondly, of an arrangement for cutting the clinkers off the bridge by means of a slide working through the boxes or troughs referred to in the first part of the invention. This slide works through slots in the boxes or troughs, and has a horizontal transverse motion. The said slide may be worked by means of a handle or handles on one or both sides of the furnace. The invention consists, thirdly, of arrangements for lifting the two outside firebricks in the furnace grate vertically to the height required for cutting off the whole of the clinkers on the sides of the furnace. *Patent abandoned.*

701 R. MARSDEN. *Improvements in machinery or apparatus for rolling, shaping, or forging metals.* Dated March 13, 1865.

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

702 H. HILL. *An improvement in securing safes and strong rooms.* Dated March 13, 1865.

This invention consists in securing safes and strong rooms by means of a slide in lieu of a hinged door, made to run in grooves, provided at a distance from the front of the frame of the safe or room at the top, bottom, and in the end opposite that at which the slide is introduced. The lock is fitted in the slide. *Patent completed.*

703 J. WEBB. *Improvements in the preparation of certain materials suitable for the manufacture of paper.* (A communication.) Dated March 13, 1865.

The patentee claims the application and use to and in the production of pulp suitable for the manufacture of paper of the woody fibre or structure of the Adansonia digitata. *Patent completed.*

704 W. OLARK. *Improvements in apparatus for holding and regulating the position of lamp shades or reflectors.* (A communication.) Dated March 13, 1865.

This invention relates to an improved apparatus for supporting the reflectors of lamps, by the aid of which these reflectors may be inclined in such manner as to direct the light to one side or the other. The apparatus consists of a zone or section of a sphere made hollow and grooved on its exterior surface, the same being fixed to the chimney of the candle lamp or gas burner on which it is applied; an oscillating ring is also mounted in axes at about the centre line of this zone to carry the reflector or shade, to which ring are fixed the parts for maintaining it in its relative position with the zone for producing the inclination of the reflector. *Patent abandoned.*

705 F. WISE. *Improvements in preparing certain colouring matters for dyeing and printing.* (A communication.) Dated March 13, 1865.

This invention consists in taking the substance known as rosaniline (which article is usually prepared from aniline and the homologues thereof) and in then mixing it cold with formic acid. The proportions which the inventor has found suitable are one of rosaniline to one of formic acid. The mixture is then heated to a temperature of from 284 to 410 deg. Fahrenheit, by which process it is made to become firstly scarlet red, then red orange, and finally yellow orange. If the operation be interrupted at scarlet red, and after the matter treated has been allowed to cool, aniline or its homologues be added, and the whole again heated to a temperature of between 356 and 410 deg. Fahrenheit, the result is a beautiful brown colouring matter. To obtain a violet colouring matter, he mixes the rosaniline with valerician acid (in the proportion, by preference, of about one to one), and heats the mixture carefully in a suitable apparatus to a temperature by preference of from 320 to 410 deg. Fahrenheit, the result of which is the colouring matter required. For the purposes of dyeing and printing, these colours may either be used directly, or they may be further purified and used by any of the well-known or other convenient methods employed for working aniline colours. *Patent completed.*

708 W. D. NAPIER. *Improvements in apparatus to facilitate dental operations.* Dated March 13, 1865.

In the process of stopping teeth with gold or other material, the greatest difficulty the dentist has to contend with is the accumulation of saliva which takes place in the mouth. This invention consists in the construction and use of apparatus by the employment of which the saliva is caused to flow away from the mouth as quickly as it is secreted. For these purposes a tubular or hollow frame, consisting of two hollow branches, is introduced into the mouth, and is retained in position by the lip of the patient. The stem of this frame is connected to one end of a flexible tube, by preference of vulcanised india-rubber, whilst the other end is connected to a short tube which descends through a stopper of a bottle or small vessel, so that the saliva, as it flows from the mouth through the ducts or passages in the frame, passes down the flexible tube into the bottle or vessel with which the tube is connected. The bottle or vessel is kept partially exhausted by a suitable pump connected therewith, by preference by a flexible tube. It is preferred that the pump should consist of a flexible hollow, spherical, or other shaped vessel provided with two valves, one opening inwards and the other outwards. By means of such or other suitable pump or exhausting apparatus the air is removed from the bottle or vessel, and, consequently the saliva is caused to flow away from the mouth both exteriorly and interiorly of the gums. And it is preferred that the arrangement of the apparatus should be such as to admit of the patient working the pump. *Patent abandoned.*

707 R. G. ATTRAY. *Improvements in apparatus for supplying regulated or measured quantities of water or other fluids.* Dated March 13, 1865.

For the purposes of this invention a vessel of the cubic capacity requisite for supplying a desired quantity of water or other fluid is employed, and by preference of a cylindrical form, with conical or hemispherical ends, but vessels of other shapes may be used; at the upper end of this vessel is fixed or formed a cylindrical supply passage, which, at its lower end, rests on a stationary valve which is supported by a valve rod, the upper end of which is fixed in and suspended from a bracket or other fixed support. The valve rod passes through a stuffing-box at the upper end of the supply passage. At the upper part of the measuring vessel is an air valve which opens by its own weight, but is closed by a float which is caused to rise when the vessel is full of water or other fluid. The water or other fluid is supplied to the measuring and supply vessel by preference by a flexible pipe or tube connected to a branch pipe on the supply passage before mentioned; or the vessel may be otherwise supplied with fluid. At the lower end of the measuring vessel is fixed an outlet passage, having a valve to cover or close its upper end. The stem of this valve rests on a crossbar fixed on the interior of the upper end of a vessel into which the outlet pipe of the measuring vessel has been fitted, and has been allowed to descend; it rests on and is supported by the upper valve, whilst the lower valve, by reason of its not being allowed to descend with the measuring vessel, becomes open, and the water or other fluid flows out therefrom. When the vessel is raised, the lower valve becomes closed, and the upper one is opened, and the water or other fluid flows into the measuring vessel. *Patent abandoned.*

708 F. A. REAENDLIN. *Improvements in breech-loading fire-arms, and in cartridges for breech-loading fire-arms.* (Partly a communication.) Dated March 14, 1865.

The patentee claims the arrangement or combination of the parts described and represented for adapting such breech-loading fire-arms as have hinged charge chambers, and which fire-arms are commonly called Mont Storm rifles, to fire self-ignition cartridges, or to fire either self-ignition cartridges or ordinary cartridges at pleasure, the locking down of the charge chamber and the discharge of the self-ignition cartridge being effected by one bolt or striker. Also the arrangement or combination of the parts described and represented for adapting such breech-loading fire-arms as have hinged chambers to fire self-ignition cartridges, the locking down of the hinged chamber and the advance of the pin or point for discharging the cartridge being effected by one bolt or striker. *Patent completed.*

709 J. DEAR. *Improvements in, and connected with, levers for railway switches and signals.* Dated March 14, 1865.

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

710 G. EVANS. *An improvement in heels for boots, shoes, and other like articles.* (A communication.) Dated March 14, 1865.

This invention consists in constructing heels of two main parts—one a metal frame to be screwed or otherwise attached, the other of a block of vulcanised caoutchouc, cork, or other like suitable material to fit into the frame, and removable in order to admit of its being taken out of the frame in case of wear or otherwise, and replaced by another filling, or to allow of the same filling to be reinserted in a different position to that it originally occupied. The frames admit of being removed from old boots or shoes, and of being applied to others. *Patent completed.*

711 R. A. BROOMAN. *Improvements in breech-loading fire-arms.* (A communication.) Dated March 14, 1865.

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

712 R. A. BROOMAN. *Improved processes for the production of photographic images capable of being inked with fatty ink.* (A communication.) Dated March 14, 1865.

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

713 A. BEZTSCH. *Improvements in apparatus for protecting telegraphic instruments from injury from atmospheric or static electricity.* Dated March 14, 1865.

Apparatus is now commonly used in which a fine wire is employed as the conducting wire between the line wire and the telegraph instruments, in order that if there be any discharge of static electricity through this wire, the wire may be burnt and the instruments remain uninjured. It is, however, important that this class of apparatus should be so constructed as to work continuously and independently of the will of the operatives. The inventor therefore constructs apparatus of this description in such manner as to remain permanently in the circuit, and to operate automatically in such manner that, when the fine wire which connects the line wire with the instrument is burnt, the wire is immediately replaced by another fine wire brought into circuit by a movement of the apparatus produced by a spring or other maintaining power. *Patent abandoned.*

714 E. D. HODGSON. *Improvements in the construction of safes for securing valuable articles from thieves and fire.* Dated March 14, 1865.

In constructing safes, in place of making the door to turn on hinges, as is usual, the patentee employs sliding doors arranged in the following manner:—The front of the safe is not left entirely open, as when a hinged door is used, but is enclosed with a front panel in which there are two openings or doorways, one on each side, and between the two openings for a distance somewhat greater than the width of one of the openings, the front of the safe is enclosed by the front panel. On the inner side of the front panel of the safe strong guides are fixed at the top and bottom, and in these guides two doors or slabs slide to close the openings in the panel; or, if the doors are heavy, they are fitted with friction pulleys, on which they run in the guides. To uncover one of the doorways or openings, its door is slid back behind the centre portion of the front panel. In order to secure the sliding doors opposite the doorways or openings, blocks are employed to come in between them, so that, on pressure being applied to one of the doors to slide it in its guides, these blocks take the pressure, for they occupy the space provided at the centre of the front of the safe for the doors to slide in. A convenient way of working these blocks is by means of a right and left handed screw, on turning which one block is raised and the other lowered; by turning the screw in one direction the blocks are brought into position to secure the sliding doors, and by turning it in the opposite direction the blocks are moved clear of the top and bottom of the doors. The right and left handed screw may be actuated by bevelled gear and a convenient handle. The lock may be arranged to secure the right and left handed screw by shooting its bolt through a slot in the screw. *Patent completed.*

715 F. H. WARLION. *Improvements in drying and sorting coals, peat, and mineral ores, in separating extraneous matters therefrom, and in apparatus used in those processes.* Dated March 14, 1865.

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

716 J. WILKIE. *Improvements in the manufacture of lace or net in twist loom machines.* Dated March 14, 1865.

This invention is more particularly applicable when making lace or net in Lever's machines, but is not absolutely confined thereto. The peculiarity of the present invention consists in the manner and in the order in which the warp threads are caused to twist with the bobbin threads. Each warp thread is caused, at the alternate times of its crossing from one bobbin thread to another after twisting with one bobbin thread, to rest two motions before crossing to twist with another bobbin thread, and then to rest two motions after having crossed to such other bobbin thread before commencing to twist. The two warp threads of a bobbin thread work in a similar manner one to the other, but in opposite directions, and at alternate times, so that when one of a pair of warp threads is resting immediately before and immediately after crossing from one bobbin thread to another, the other of the pair of warp threads is twisting with a bobbin thread in the ordinary manner. *Patent abandoned.*

717 G. T. BOUSEFIELD. *Improvements in apparatus for vaporising hydrocarbon liquids for illuminating and heating.* (A communication.) Dated March 14, 1865.

This invention relates to an apparatus for distributing the atmospheric air under the surface of the naphtha, so that vaporisation may take place more quietly and uniformly than when the air is forced in a considerable body underneath the surface of the naphtha, and bubbling as the air rises through liquid is prevented. In connection with the apparatus a bright metal condensing plate is used for collecting the impurities and the drip from the regulator, so as to carry them back to the apparatus. The second part of the invention is principally designed to overcome this sudden and undesirable or unequal flow of gas, and consists in placing a sponge or similar porous elastic substance in a chamber through which the gas must pass upwards in its passage from the vaporising apparatus. *Patent completed.*

718 L. GANTERT. *Improvements in dyeing, bleaching,*

and finishing yarns, threads, and cloths, and in the machinery connected therewith. Dated March 14, 1865.

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

719 A. V. NEWTON. *Improvements in securing low and uniform temperatures, applicable to public and private buildings, also to refrigerators, coolers, and condensers, and to ships and other vessels, and in the apparatus employed therein.* (A communication.) Dated March 14, 1865.

This invention consists in lowering and equalising the temperature of the air in public and private buildings so as to keep it as near as desirable at a mean temperature, by means of the cooling power of the earth at certain depths below its surface. In order to employ the low temperature which exists below the surface of the earth to cool the air in buildings, a current of water is first conducted to a proper distance below the earth's surface, and after it has been cooled, it is caused to ascend to the building to be cooled, or into a separate air-cooling chamber or refrigerator, from which the air may be passed into the building to be cooled. *Patent abandoned.*

720 J. P. BOOTH. *An improved manufacture of trimming, applicable to the ornamentation of ladies' dresses.* Dated March 14, 1865.

In making ornamental trimmings according to this invention, the inventor cuts out the pattern desired to be reproduced,—say, for example, the Indian pine, in silk or other appropriate material for the face, and in cotton for the back, and he lays between these fabrics a coating of down dyed, by preference, to match the colour of the facing material, and he sews the two fabrics together at or near their edges. A suitable number of these puffed or raised patterns being thus produced, he applies them to the garment to be trimmed, forming with them a border, or arranging them otherwise as desired, over the surface. The edges of the patterns may be turned in, or braid or piping may be used to cover the raw edges. Or the patterns may be let into openings cut in the fabric and attached to the back thereof. This novel kind of trimming, applied by preference in detached portions, will form patterns in relief, which may themselves be ornamented with stitching, if thought desirable. *Patent abandoned.*

721 I. BAGGS. *Improvements in colour printing, and in apparatus connected therewith.* Dated March 14, 1865.

This invention relates to certain improvements in printing in colours upon paper, calico, and other fabric and substances, and in apparatus employed therein, and whereby the performance of such operations with exactitude and economy of time is greatly facilitated. In carrying this invention into effect as many separate presses are employed as there are colours to be printed, such presses being similar or analogous to the ordinary hand presses and arranged either horizontally or vertically, the whole being actuated by a single horizontal shaft, or by any other machinery adapted to the purpose, and to which any suitable motive power may be applied. The paper to be printed is placed upon a series of iron or steel plates, the same being fastened or secured at equal distances from each other by means of central axes to an endless band of leather or other suitable material, or to an endless chain, the several parts of which are attached and secured to each other by the methods well known to those engaged in the construction of mechanism. The distances between the plates are the same as the distances between the presses, so that in any position of the band or chain the plates in operation are under the several platens of the presses. Stout iron blocks are placed under the several platens and plates for the purpose of receiving the pressure during the process of printing, such blocks being fixed when a band or chain is used. The apparatus is fed by hand, or a long roll of paper may be used, a series of impressions with the several colours employed being thus obtained. When different colours are required to be laid on each other, then, after the first set of colours is printed the colours are dried, and the sheets or roll passed through another apparatus arranged similarly to that before described, where the second set of colours is laid on or printed, and so on if more are required. *Patent abandoned.*

722 N. N. BOLT. *Improvements in water towers for blast furnaces.* (Partly a communication.) Dated March 15, 1865.

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

723 W. CLARK. *Improvements in electric piles and apparatus.* (A communication.) Dated March 15, 1865.

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

PROVISIONAL PROTECTIONS.

Dated June 19, 1865.

1645 O. Hook and A. Peace, Bridgewater, Somersetshire, engineers. *Improvements in propellers for ships and other vessels.*

Dated July 11, 1865.

1832 H. A. Dufrenoy, South-street, Finsbury, civil engineer. *Improvements in obtaining motive power.* (A communication.)

Dated July 19, 1865.

1884 G. Nimmo, Jersey, U.S. *Improvements in the manufacture of pots and crucibles wherein metals and other materials may be heated or melted.*

Dated August 3, 1865.

2008 J. W. Perkins, Norfolk-street, Strand, analytical chemist. *Improvements in the treatment of hydrocarbon or paraffin oils.*

Dated August 3, 1865.

2164 G. Little, Oldham, Lancashire, mechanical engineer. *Improvements in machinery for combing cotton wool, and other fibrous materials.*

Dated August 25, 1865.

2180 J. I. Barber, Sheffield. *Improvements in skates.* (A communication.)

Dated August 28, 1865.

2208 H. A. Bonneville, Porchester-terrace, Bayswater. *Improvements in the construction of flying toys, also applicable to other purpose.* (A communication.)

Dated August 31, 1865.

2238 E. Cowpe and D. Hancock, High Wycombe, Buckinghamshire. *A new or improved method of, and apparatus for, applying electro-magnetism as a brake power on railways.*

Dated September 1, 1865.

2254 J. M. Carter, Adjutant Royal Monmouthshire Militia, Monmouth. Improvements in shirts and other like garments.

Dated September 2, 1865.

2261 J. Sproul, New Barnet, Herefordshire. An improved method of laying or submerging ocean telegraph cables.

2262 K. J. Perceval, Belgrave-street, Argyle-square, late inspector in H.M.'s telegraph department. Improved means or apparatus to be used in laying telegraph cables in the sea or other deep waters.

2264 W. Barford, Peterborough, Northamptonshire, and T. Perkins, Hitchin, Herefordshire. Improvements in mills for grinding of the description known as Felton's American mill.

Dated September 4, 1865.

2272 J. Howard, W. Stafford, and W. P. M'Callum, Blackburn, Lancashire, engineers. Improvements in apparatus for preventing incrustation in steam boilers and for preventing explosion of such boilers, heating the feed water and consuming smoke.

2274 E. A. Brooman, Fleet-street, patent agent. An improved method of winding up watches and other timekeepers. (A communication.)

Dated September 5, 1865.

2275 J. Snider, jun., Devereux-court, Strand. Improvements in the construction of fire-arms, such improvements being also applicable to the alteration and adaptation of parts of existing fire-arms.

2277 J. Grand, Oullins, Rhone, France, ironmaster. Improvements in treating, working, or manipulating cast steel for the manufacture of wheel tyres, armour plates, or other articles requiring great hardness and tensile strength.

Dated September 6, 1865.

2282 H. H. Doty, Regent-street, Improvements in machines for splitting, shaving, and paring hides, skins, and leather.

Dated September 7, 1865.

2285 J. Smith, High Orompton, near Oldham, Lancashire, manager. Certain improvements in looms for weaving.

2287 W. Oldham, Meadow Foundry, New-lane, Meadow-lane, Leeds, engineer and machinist. Improvements in machinery for winding yarn cops.

2289 A. Morel, Boubaix, Nord, France, manufacturer. Improvements in machinery for combing wool and other fibrous material.

2291 J. Ashew, Charles-street, Hampstead-road. Improvements in apparatus for stoning rasins.

Dated September 8, 1865.

2293 A. Mackie, newspaper proprietor, and J. P. Jones, mechanic, Warrington, Lancashire. Certain improvements in machinery or apparatus for "composing" or setting type for printing.

2295 J. Webster, Birmingham, engineer. Improvements in hydropulps and hydrostatic pumps.

Dated September 9, 1865.

2297 W. Unwin, Sheffield. Improvements in the manufacture of iron.

2299 J. Anderson, Glasgow, railway manager's assistant. Improvements in apparatus for signalling and indicating on railways.

2311 H. Shaaks, Bridge-of-Weir, Renfrewshire. Improvements in the winding of knitting cotton, and in the apparatus employed therefor.

2317 E. C. Newbery, Steam Works, Helms-row. Improvements in articles of wearing apparel.

2319 J. Pennington, Manchester Villa, Oroxted-road, Dulwich. Improvements in apparatus used in opening and closing carriage and other windows.

Dated September 11, 1865.

2323 H. Hackett, Warrington, Lancashire, and T. Wrigley, mechanical engineers, and E. Pearson, agent, Manchester. An improved safety valve for steam boilers.

2325 C. A. M'Evoy, Bedford-square. Improvements in pipes used for smoking.

Dated September 12, 1865.

2331 J. Badger, Ironmonger, and J. H. Steff, foreman, Worcester. Improvements in the manufacture of harrows, cultivators, and other similar agricultural implements.

2333 G. Tangye, Birmingham, mechanical engineer, and J. Jewsbury, Kinner, Staffordshire, machinist. Improvements in pulleys for raising and lowering heavy bodies.

2337 W. J. Murphy, Lady's Well Brewery, Cork. An improved hydraulic brake for railway and other purposes.

Dated September 13, 1865.

2341 J. O. O. Phillips, Birmingham, surgeon dentist. Improvements in the construction of submarine telegraph cables.

2343 A. V. Newton, Chancery-lane, mechanical draftsman. Improvements in spinning frames. (A communication.)

2345 F. W. Prince, Piccadilly. Improvements in breech-loading fire-arms and cartridges.

Dated September 14, 1865.

2351 G. P. Harding, Bohemia House, Chiswick. Improvements in the manufacture of tubes for gunbarrels and other purposes, parts of which improvements are also applicable to the manufacture of rods or bars, and to the rifling of ordnance and fire-arms.

2355 J. Wakefield, Birmingham, machinist. Improvements in machinery for the manufacture of rivets.

Dated September 15, 1865.

2359 E. T. Read, engineer, H.M.'s Royal Navy, Ardrishalg, Argyleshire. Improvements in apparatus for cutting tobacco.

2363 A. V. Newton, Chancery-lane, mechanical engineer. Improved machinery for cutting stone. (A communication.)

2365 R. M. Lowne, Bartlett's buildings, Holborn. Improvements in vent pipes for oaks or vessels from which beer or other liquid is drawn off from time to time.

2367 F. Meyer, Paradise-street, Lambeth, and J. W. Freestone, Ram's-square, Wandsworth. Improvements in the manufacture of night lights and in apparatus employed therein.

Dated September 16, 1865.

2369 H. A. Bonnevillie, Forchester-terrace, Bayswater. Improvements in saw-alls. (A communication.)

2371 J. H. Johnson, Lincoln's Inn-fields. Improvements in machinery or apparatus for shaping metal articles. (A communication.)

Dated September 18, 1865.

2375 M. Henry, Fleet-street. Improvements in railway brakes. (A communication.)

2377 O. W. Jeyes, Lorton, Essex. An improved method of making effervescent drinks.

2379 E. Aitken, Great George-street, Westminster, civil engineer. Improvements in locomotive engines, parts of which improvements are also applicable to railway carriages.

2381 A. V. Newton, Chancery-lane, mechanical draftsman. An improved construction of projectile. (A communication.)

Dated September 19, 1865.

2383 J. O. Broadbent, Rochdale, Lancashire, engineer. Improvements in safety apparatus for cares and hoists.

2387 E. Clark, Great George-street, Westminster, engineer. Improvements in floating dry docks.

2389 H. Lloyd, Liverpool, carriage builder. Improvements in sunshades or canopies for perambulators and other wheeled carriages.

2391 E. A. Cowper and C. W. Siemens, Great George-street, Westminster. Improvements in apparatus for separating dust from the gases evolved from blast furnaces for smelting iron.

Dated September 20, 1865.

2399 J. Ty, Lincoln, engineer. Improvements in mills for crushing and grinding wheat and other grain.

2401 D. Spink, South-road, Weston-super-Mare. Improvements in founding or casting metals, and in moulds used for the same.

PATENTS APPLIED FOR WITH COMPLETE SPECIFICATIONS.

Dated September 22, 1865.

2421 W. Moseley, King-street, Covent Garden. An improved indicator for electric bells, and a new battery manipulator combined, for ringing electric bells and other signals.

Dated September 23, 1865.

2429 H. A. Bonnevillie, Forchester-terrace, Bayswater. Improvements in apparatus for lubricating machinery. (A communication.)

2436 T. V. Lee, Macclesfield. Improvements in preparing peat or turf for freights and fuel, and for machinery to be employed therein.

LIST OF SEALED PATENTS.

Sealed September 29, 1865.

722 N. N. Solly	962 G. J. N. Alleyne
906 J. D. B., and O.	963 H. Simon
Swarbrick	971 F. R. Ensor
907 L. Bridge	972 O. Esplin
908 J. Poole and T. Brown	986 P. Hugon
922 H. Lewis	991 E. Smith and J. W. Jackson
923 E. A. Brooman	1029 J. H. Johnson
924 G. Bart	1038 J. Haworth
926 J. Kennan	1049 J. S. Bickford
928 A. W. Pearce	1086 J. E. H. Andrew
940 F. Brown	1108 J. Y. Betts
945 J. R. Wigham	1161 G. Davies
948 A. and H. Illingworth	1234 N. Jenkins
949 W. Brookes	1909 W. S. Yates and A. Freeman
950 O. Martin	1941 A. V. Newton
951 E. Baynes	1958 W. E. Newton
964 W. Moody and W. J. Huband	

Sealed October 3, 1865.

966 W. Teall, L. Lepaige, and E. T. Simpson	1002 W. E. Gedge
967 J. I. Darriest	1007 G. Davies
969 O. W. Lancaster	1009 J. A. Frost
970 E. Ritherdon	1030 J. H. Johnson
976 E. H. Newby	1041 E. P. Warren
987 A. Muir	1055 A. Westhead
989 E. Welch	1120 H. E. Newton
994 J. Brown	1284 W. E. Newton
995 H. Edmonds	1881 H. E. Gilles
	1923 M. B. Schuman

NOTICES OF INTENTION TO PROCEED WITH PATENTS.

From the London Gazette, October 3, 1865.

1367 H. Rushton. Goat's hair.
1415 H. Adler. Clocks.
1419 T. Beanland. Sewing gills.
1420 J. Dale and A. Paraf. Calico printing.
1427 D. Welsh. Looms.
1429 D. Law and J. Bennett. Moulds.
1432 W. Madders. Ornamenting tablecloths.
1437 G. Bray. Gas burner.
1444 O. Cotton, F. Anderson, and D. Booker. Plain gossamer machine.
1446 W. E. Gedge. Stay. (A communication.)
1447 J. A. Heinrich. Rotative machines.
1448 E. Oanham. Oculpa furnaces.
1450 O. B. Spaeth. Extinguishing fire. (A communication.)

1452 O. Frazer. Sawing machines.
1453 S. Sequelin. Purifying animal oils.
1454 L. Brierley. Japaned surfaces.
1455 J. M. Rowan. Cast-steel railway tyres.
1457 E. A. Brooman. Reproducing copies of writings. (A communication.)
1458 E. A. Brooman. Measuring gas. (A communication.)

1460 L. Moser. Steel. (A communication.)
1461 T. Bissell. Breech-loading fire-arms.
1463 G. G. Bussey. Loading the shells of cartridges.
1469 T. Spence. Paints.
1490 T. A. Browne and J. Knight. Driving apparatus.
1512 H. Mallet. Lacs.
1517 T. Pritchard. Welded iron tubes.
1571 W. W. Hulse. Cutting metals.
1577 W. H. Harfield. Steering ships.
1588 J. Scholl. Gas burners.
1586 E. Finch. Rivets.
1718 J. K. Farnworth. Railway carriage windows.
2152 J. Bowden. Blacksmith's bellows.
2153 G. G. Dennis. Friction matches.
2221 W. P. Gregg. Roller skate.
2303 A. Mackie and J. P. Jones. Setting type for printing.

2315 G. T. Bousfield. Flexible tubing. (A communication.)

2337 W. J. Murphy. Hydraulic brake.

2349 S. Wales. Windows.

2429 H. A. Bonnevillie. Lubricating machinery. (A communication.)

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 250 HAS BEEN PAID.

2633 H. Hutchinson	2729 J. B. Palmer
2645 H. Ellis	2736 H. A. Marioni
2646 J. Bucknall	2824 J. B. Payne
2653 J. L. Hughes	2950 F. E. Sicks
2677 T. Greenwood	

PATENTS ON WHICH THE STAMP DUTY OF 4100 HAS BEEN PAID.

2183 J. J. Russell	2306 G. T. Bousfield
2195 H. Monier	

LIST OF SPECIFICATIONS PUBLISHED

(For the Week ending September 30, 1865.)

No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.
a. d.	a. d.	a. d.	a. d.	a. d.	a. d.	a. d.	a. d.	a. d.	a. d.
90	a. d.	2157	a. d.	2174	a. d.	2191	a. d.	2208	a. d.
2141	6 2758	2175	6 2782	2192	6 2809	2210	6 2836	2227	6 2873
2142	6 2759	2176	6 2783	2193	6 2810	2211	6 2837	2228	6 2874
2143	6 2760	2177	6 2784	2194	6 2811	2212	6 2838	2229	6 2875
2144	6 2761	2178	6 2785	2195	6 2812	2213	6 2839	2230	6 2876
2145	6 2762	2179	6 2786	2196	6 2813	2214	6 2840	2231	6 2877
2146	6 2763	2180	6 2787	2197	6 2814	2215	6 2841	2232	6 2878
2147	6 2764	2181	6 2788	2198	6 2815	2216	6 2842	2233	6 2879
2148	6 2765	2182	6 2789	2199	6 2816	2217	6 2843	2234	6 2880
2149	6 2766	2183	6 2790	2200	6 2817	2218	6 2844	2235	6 2881
2150	6 2767	2184	6 2791	2201	6 2818	2219	6 2845	2236	6 2882
2151	6 2768	2185	6 2792	2202	6 2819	2220	6 2846	2237	6 2883
2152	6 2769	2186	6 2793	2203	6 2820	2221	6 2847	2238	6 2884
2153	6 2770	2187	6 2794	2204	6 2821	2222	6 2848	2239	6 2885
2154	6 2771	2188	6 2795	2205	6 2822	2223	6 2849	2240	6 2886
2155	6 2772	2189	6 2796	2206	6 2823	2224	6 2850	2241	6 2887
2156	6 2773	2190	6 2797	2207	6 2824	2225	6 2851	2242	6 2888

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, 28, Southampton-buildings, Chancery-lane.

LATEST PRICES OF MATERIALS USED IN CONSTRUCTION.

Timber, duty 1s. per load, drawback 1s.	Timber, duty 1s. per load, drawback 1s.	Timber, duty 1s. per load, drawback 1s.	Timber, duty 1s. per load, drawback 1s.
Teak - load 411 0 413 0	Archangel, yellow - 413 0 414 10	Quebec, red pine - 3 5	14 St. Petersburg, do. - 11 8 12 0
Quebec, yellow pine - 3 5	15 St. John, N.B., yellow - 2 10	St. John, N.B., yellow - 2 10	Finland - 2 10 15 0
Quebec oak, white - 5 6	6 0	Gotenaburg, yellow - 10 0 11 0	White - 9 0 10 0
" birch - 3 10	4 10	Galle, yellow - 10 10 11 0	10 10 11 0
" alus - 3 10	5 0	Galle, yellow - 10 10 11 0	10 10 11 0
Danish oak - 3 10	5 0	Galle, yellow - 10 10 11 0	10 10 11 0
Quebec oak, white - 5 6	6 0	Galle, yellow - 10 10 11 0	10 10 11 0
Manila fir - 3 10	3 15	14 St. Petersburg, do. - 11 8 12 0	10 10 11 0
Riga - 3 10	3 15	15 St. John, N.B., yellow - 2 10	Finland - 2 10 15 0
Swedish - 3 10	3 15	16 St. Petersburg, do. - 11 8 12 0	10 10 11 0
1284 W. E. Newton	1881 H. E. Gilles	1923 M. B. Schuman	

METALS.

Welsh Bars, in London -	per ton	5 s. d.	to 5 s. d. per
Nail Rods -	do	7 15 0	to 8 0 0
Roops -	do	9 15 0	10 0 0
Sheets, single -	do	10 10 0	10 15 0
Staffordshire Bars -	do	8 15 0	9 10 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	7 15 0	7 20 0
Swedish Bars -	do	11 5 0	12 0 0
Swedish Keg, hammered -	do	15 0 0	0 0 0
Swedish Pigot -	do	15 0 0	0 0 0
Sheet & Sheathing, & Bolts	per ton	91 0 0	93 0 0
Hammered Bottoms -	do	101 0 0	0 0 0
Flat Bottoms, not Hammered -	do	95 0 0	0 0 0
Oake and Tough Ingot -	do	85 0 0	86 0 0
Best Selected -	do	87 0 0	89 0 0
Fine Foreign Copper -	per lb.	0 0 7 1/2	0 0 7 1/2
Yel. Metal Sheathing & Rods	per lb.	0 0 7 1/2	0 0 7 1/2
English Block -	per ton	92 0 0	94 0 0
do Bar -	do	93 0 0	95 0 0
do Refined -	do	94 0 0	96 0 0
Bansa -	do	95 0 0	97 0 0
Strait -	do	96 0 0	98 0 0
Pig, English -	per ton	20 10 0	0 0 0
Spanish Soft -	do	18 15 0	0 0 0
Shot, Patent -	do	22 10 0	23 0 0
Sheet -	do	20 0 0	21 0 0
White -	do	20 10 0	0 0 0
On the spot -	per ton	21 10 0	21 15 0
English Sheet -	per ton	27 15 0	0 0 0
Quicksilver -	per lb.	7 15 0	8 0 0

FRENCH & SMITH, Sworn Brokers

Brabant-court, Philip-lane, E.C.; and

4, Bunford-place, Liverpool.

THE MECHANICS' MAGAZINE.

LONDON: FRIDAY, OCTOBER 13, 1865.

THE FRENCH GUN OF THE FUTURE.

THE inefficient armament of the French ironclads which recently visited our shores has been the theme of comment in various quarters. Our own weapons of naval warfare have been contrasted with those of our late guests, of course to the disparagement of the latter and the exaltation of the former. But whatever of truth there may be in the fact that in point of guns we can claim superiority, there is little of satisfaction in it, inasmuch as with them we are as unable to penetrate modern armour, as our neighbours are with theirs. Our pre-eminence, however, in respect of possessing the best guns appears to be somewhat endangered, for according to report the French Government have been actively engaged for some time past in conducting a series of experiments with a gun constructed upon the principle known as that of varying elasticity, or in other words with the Parsons' gun. The Parsons' system, now being worked out in France, consists—as is doubtless well known—in strengthening old-fashioned cast-iron guns by lining them with a reinforced tube of steel, and thus rendering them fit for the present advanced requirements of the service, instead of allowing them to be thrown by as waste. It is now four months since we recorded a trial of this gun, which had then just taken place at Gâvre in France, and during which the gun showed extraordinary strength and endurance. The gun in question was originally a cast-iron 30-pounder weighing 6½ cwt.; it was converted into a 100-pounder rifle, the weight after the alteration being about 62 cwt., of which the steel lining tube weighed 15½ cwt., the original calibre of 6½ in. being preserved. The trial at Gâvre comprised, first, 510 rounds with a charge of 9 lb. of powder and 66 lb. cylindro-conoidal shot, and afterwards 500 rounds with 16½ lb. of powder and 100 lb. cylindrical shot. A great portion of the firing was at high elevations varying from 15 deg. to 20 deg., and at times the gun was allowed to heat by rapid firing, and was suddenly cooled by the application of cold water. In some of the rounds considerable air space was left in the powder chamber, but this and other severe tests failed to render the gun less serviceable at the thousand and tenth than it was at the tenth round. After this the charge was increased to 26½ lb. of powder and a 135 lb. shot, in order to test the breech fastening under this excessive strain. The gun sustained ten rounds with this enormous charge, and burst at the eleventh. From the great length of the charge, which occupied half the length of the bore, the first shock of the explosion extended to the chase of the gun not designed to sustain it. Hence, failure took place in this part, as indeed might be naturally expected, but the breech and reinforce were left intact. Large guns are now being made in France on the same principle as the experimental one, and, if they will stand anything like a proportionate charge, and manifest similar power of endurance, it is quite certain they will be more formidable than anything we can bring against them.

Such, then, is the somewhat startling evidence of the progress of artillery in France, and the circumstance is calculated to awaken two somewhat curious reflections. In the first place, if our authorities are not on the alert, those of France will certainly succeed in rendering their artillery superior to ours, and in the second place they will effect their end by the aid of an English invention. And this naturally leads to an inquiry as to how France became possessed of what appears from the experimental trials to be a really valuable invention, and one too which is the subject of an English patent. Why was it not submitted

to, or, if submitted to, why not entertained by, our own Government? Of all the money spent in the endeavour to improve our artillery, not one penny, as far as we are aware, has ever been charged to trials of the Parsons' gun. Of all the powder and shot burned and scattered at Shoeburyness, not one ounce, as far as we have observed, ever went to test the value of this invention. But now, as of yore, they manage these things better in France, and they have managed to find out the merits of the system, and are now hard at work giving them practical effect. The reason why they are so far before us in the matter can only be given by the War Office authorities, who, at any rate, have had the opportunity afforded them of testing the principle. But they declined, and as by this step we not only lose the advantage of the invention, but are laid open to the possibility of having it turned against us, it may be as well to inquire how the matter stands as between the inventor and the Government. From a statement published by Mr. Parsons, it appears to be no fault of his that our Government has not long since taken advantage of his invention, inasmuch as for three years he fruitlessly endeavoured to induce the authorities to take it up. After his proposals had been repeatedly rejected, his plans were submitted to the Emperor, who appears to have lost no time in testing the system. In May, 1860, it seems that Mr. Parsons intimated to the War Office that he had invented a method of strengthening cast-iron service guns. He was at once requested to submit his plans, which were to be treated confidentially. He acceded to the request, and at the expiration of four months received a reply to the effect that his plan contained no novelty; it certainly took a wonderfully long time to discover this fact. The correctness of this statement made upon such authority could not be questioned, and its result was to induce Mr. Parsons to abandon the patent he had commenced. The invention consisted of a method of lining cast-iron guns by inserting from the muzzle end an inner tube of wrought iron or steel by simple pressure, and without heating the gun. By this means, when properly fitted and proportioned, the strains on the two metals, owing to their different ranges of elasticity, and their relative positions in the gun, would be suitably distributed on each.

Notwithstanding the authority with which the War Office spoke, it appears that it spoke—to say the least of it—in error, for Mr. Parsons subsequently discovered that the method of treating cast-iron guns proposed by him had not, at the time he submitted it, been previously tried. So that there was not only novelty, but—as has since appeared—value, in the invention. Now upon looking a little into the matter we find that as early as September, 1854, Major Palliser had cast guns over wrought-iron tubes, and his experiments in this direction, so far as they went, were attended with satisfactory results. It was doubtless upon the faith of this invention of Major Palliser's, coupled with the fact that a gun had also been shrunk on a tube by first heating it, that the War Office concluded there was no novelty in Mr. Parsons' plan, which was a cold process. But although by no means a hasty conclusion, it was yet an erroneous one, for there was an essential difference between the two methods. This difference amounts to as much as exists between failure and success, for casting a gun over a wrought-iron tube involves such mechanical difficulties and objections that it has not been practised, even by Major Palliser, beyond his model. Mr. Parsons, however, being convinced of the soundness of his views, continued his investigations. In time, he came to the conclusion that a tube of sufficient thickness at the breech to bear the required strain could not be inserted from the muzzle end without materially reducing the calibre, and, with it, the power and efficiency of the gun. To obviate this he inserted and secured a reinforced tube from the breech

end, which not only enabled the original calibre to be retained, but offered facilities for applying any thickness of tube required, adjusting and fitting it at the important point, the breech end, with the greatest precision, and so uniting the separate parts into one mass as to produce the strongest combination of which the two metals are capable. At the same time the cost is reduced, as the tubes can be of less thickness at the chase, where great strength is not required. Mr. Parsons obtained a patent for this invention in June, 1862, and afterwards submitted it to the War Office, but repeated applications failed to obtain a consideration of his plans. And now Mr. Parsons appears to have run foul of Major Palliser—or Major Palliser of Mr. Parsons. According to the latter gentleman, in November, 1862, Major Palliser took out a patent for his (Mr. Parsons') old plan of 1860, and submitted it as his own invention, and this, too, in the face of its having been rejected as old two years and a half previously when Mr. Parsons proposed it. As Major Palliser's invention, however, the plan was adopted, and a number of experiments were tried at the cost of Government.

The first Palliser gun tried, Mr. Parsons states, was almost a *fac simile* of the one he submitted in 1860, the tube being inserted exactly in accordance with his directions, and the gun, when tested, fully confirmed his previous calculations of the increased strength to be thus obtained. "But," says Mr. Parsons, "had Major Palliser been satisfied with copying my plan he would have done very well, but his attempt to improve upon it by the addition of some unsound theories of his own resulted in a complete failure, for his second gun burst at the first discharge; and several others, although they succeeded better, scarcely stood a higher proof than some of the best cast-iron guns in their ordinary state." If the unsound theory to which Mr. Parsons refers is the introduction of a second and intermediate tube, we must refer him to his incomplete specification of 1860, in which he describes a similar arrangement. But whether the principle of the gun was that of Mr. Parsons or Major Palliser matters not so much as that it proved itself far inferior to that subsequently worked out by Mr. Parsons and tried in France. The 68-pounder (8-inch) cast-iron gun, first strengthened by Major Palliser, was bored out to 13 in., and received a wrought-iron tube of 9 in. bore and 2 in. thickness. The test consisted of ten rounds with cylinders of 68 lb. weight, and the service charge of 16 lb. powder, and ten rounds with cylinders of 136 lb., &c. It resisted the hundred rounds with cylinders increased by the weight of one shot every ten rounds, and afterwards burst at the seventh round with double charges and single cylinders. Major Palliser's second gun had an internal steel tube, and a wrought-iron tube between the steel and the cast-iron shell. The wrought iron yielded beyond the capacity of the steel to stretch, and the gun burst at the first round. In the early part of last year a 10-inch cast-iron shell gun, which had been rejected as worn out, was strengthened on this plan by the introduction of two wrought-iron coiled tubes, the bore being 6½ in. It was tested with increasing charges, and burst at the eighty-first round with a 612-lb. cylinder and 16 lb. of powder. After two years of experimenting at the public expense, Major Palliser undertook to convert a 68-pounder into a 100-pounder rifled gun. In effecting this, however, the calibre was reduced from 8 in. to 7 in., and thus the gun was rendered incapable of using its appointed ammunition, which was missing one most important point. On trial this converted 68-pounder, weighing upwards of five tons, failed before it had sustained anything like the test that the first gun Mr. Parsons made, a 30-pounder, and weighing a little over three tons, bore without detriment.

Now, as the case stands, it certainly presents some very curious features. It seems incomprehensible how a system rejected in

1860, when advocated by Mr. Parsons, should be accepted and to some extent adopted in 1862 when it appeared with Major Palliser's name attached to it. For all we can see Major Palliser would have been unable to patent the arrangement had not the verdict of the War Office, that there was "no novelty" in the invention, deterred Mr. Parsons from proceeding with his patent of 1860. The only difference we can detect is the slight taper of the bore in Major Palliser's system, and the use of a hollow screw nut or washer round the muzzle of the tube, and which screws into the cast-iron gun, and so drives the tube home and retains it in place. This is an arrangement which Mr. Parsons does not specify, although he indicates a more practical method of effecting the conversion. But that this plan is inferior to that patented by Mr. Parsons in 1862 needs no argument when the practical facts speak so strongly for themselves. How is it, then, with the results of the French experiments before them, the War Office authorities still reply to Mr. Parsons' applications by informing him that it is undesirable to try experiments with his system? How is it, too, that in the absence of anything like practical results Major Palliser's project is still patronised and experimented with? It seems to us that the War Office has no experiments to perform with the Parsons system; they have all been performed across the Channel, so here it is without excuse. There are certainly mysteries at every stage of the matter which we cannot attempt to explain away. The practical and present results, however, are that France has the advantage of us in the conversion of her old guns, and this advantage will greatly increase when the system is applied to the construction of heavy new guns. Of these advantages we might long since have availed ourselves, to the utilisation of both guns and ammunition of old patterns, and the saving of the public money. But "they manage these things better in France." We shall go on quietly watching our neighbours' progress, and shall probably soon hear some more startling particulars respecting the French gun of the future.

NOTICES OF BOOKS.

IT is somewhat late in the day to be discussing a volume which ought to have appeared at the commencement of the year. But the Editor of "Engineering Facts and Figures" tells us at the outset that the delay in the appearance of his work this year is attributable to a variety of circumstances; amongst others, his lengthened and serious illness. But although in some respects it would have been desirable to have had the work at the appointed time, yet its practical value is in no way damaged by the delay. This arises from the circumstance that the contents are not of an ephemeral character, but that, on the contrary, they possess a permanent value. For the future, however, we are promised a regular issue, arrangements having been made with this special view. Mr. Brown has taken advantage of the delay to introduce several important papers which have appeared during the current year, and for these his readers will doubtless thank him. The present volume is divided into sixteen chief parts, each division being devoted to one main subject, and being again sub-divided according to the various details of the matter. As may be supposed, the whole range of engineering, civil and mechanical, is dealt with, and considering the mass of matter Mr. Brown must have had to sift through, it is not too much to say he has succeeded admirably in his selection, inasmuch as the facts are both interesting and useful. The work consists mainly of articles which the editor has transferred from the pages of the MECHANICS' MAGAZINE, the Engineer, the Practical Mechanics', and

other journals, both English and American, which are devoted to engineering and scientific literature. Besides these there are valuable extracts from the transactions of various scientific societies. The whole forms a very serviceable collection of engineering data, which must prove alike useful in the workshop and in the study of the practical man.

An excellent practical manual of the present condition of gas manufacture has just been placed before the public in a second edition of Mr. Hughes's "Treatise on Gas Works," which has been revised by Mr. W. Richards, C.E. Here, as in every other branch of industry, considerable change has occurred during the last few years, so that the work is much altered, and its original appearance greatly improved by the introduction of several wood engravings illustrative of the various apparatus. The author first treats of the early history of gas lighting and the application of coal gas to useful purposes. Under this latter head we may observe that within thirty miles of Pekin there is a coal field having beds of salt associated with the coal, and streams of gas rising naturally from the coal are conveyed to the salt works by means of bamboo tubes and there used for the boiling and evaporation of the salt. Other pipes convey the gas for lighting the streets and houses. A similar instance occurs in the village of Fredonia, N.Y., where the inflammable gas issues from a small stream, called Canada Way, over which a gasometer is erected for collecting it. The first authentic record of an experiment on the distillation of coal appears in Dr. Hales's work on "Vegetable Statics," published in 1728, where he states that from the distillation of 150 grains of Newcastle coal he obtained 180 cubic inches of gas, which weighed 51 grains, being nearly one-third of the whole. This result, which is rather more than 8,500 cubic feet per ton, agrees very nearly with the production of gas actually realised from Newcastle coal at the present day. The year 1792, however, may be set down as that in which gas lighting was really invented, as in that year Mr. Murdoch manufactured gas, and with it lighted his house and offices, at Redruth; he also lighted a small steam carriage by the same means. This was followed by the lighting of the Soho Works with gas. Six years later coal gas began to be used as an economical substitute for lamps and candles, and in 1810 the London and Westminster Chartered Gaslight and Coke Company was incorporated by Act of Parliament, and from that time gas lighting was gradually developed. The succeeding chapters of this work are devoted to a consideration of the chemistry of gas lighting; the coal employed for gas-production; the carbonisation of coal; the choice of sites for gas-works; and then follows a descriptive account of the various processes of manufacture and the apparatus employed at each stage; each chapter containing a mass of information. The treatise is a most complete one of its kind, but there are so many practical experiences in gas making and lighting which might with profit be gathered up and made available for the purpose that we should be glad to see a work on this subject on an extended scale, for which there is ample room.

We have occasionally drawn attention to a class of individuals who have a fancy for claiming the inventions of other people. These good folks have the hazy shadow of an idea flitting restlessly and without form through their minds, and directly they find another man has with labour and pains worked out practically what they could not even think into shape, they at once lay claim to the invention. And they are no doubt honest in their convictions, although they are very far from correct in their conclusions. Of this class was a certain individual, who, on read-

ing in our columns the description of a clock of peculiar construction which the inventor exhibited in the New Zealand Exhibition, informed us that he invented the same thing years ago, but had not time to work it out, so begged us to publish him as the inventor. Of this class, too, appears to be Mr. Charles Wentworth Forbes,* who also desires to distinguish himself in the field of invention at other people's expense. In short, Mr. Forbes claims to be the inventor of the revolving turret for fighting ships, Captain Coles being of course nowhere in the matter. Now we shall not do much violence to common sense if we exactly reverse these two positions, because everybody, except Mr. Forbes, knows and believes the affair to be the opposite of what Mr. Forbes represents. However, we will take our author's version and see what it amounts to. The sum and substance of Mr. Forbes's invention appears from his pamphlet to consist in a locomotive battery for coast defence, and the working of heavy guns on the turntable principle. For three years he laboured hard to convince the Government of the importance of these ideas, but without success. We cannot find any proposition which could be construed into a revolving turret, or justify us in according to Mr. Forbes the merit of inventorship. In fact, a very general is the author that even in submitting his plans to Government he failed to furnish such practical details as would enable the committee to understand the matter. We do not affect to raise the question of inventorship as regards the revolving turret; that remains where it was before Mr. Forbes rushed into print. We only notice the circumstance as one a little more prominent than the general run of those which frequently come under our notice, where individuals labour under the impression that the bare enunciation of an idea entitles them to be placed on the honoured list of inventors.

Turning to better things we gladly welcome the first part of a new edition of Mr. Bourne's treatise on the screw propeller.† This treatise is as well known as it is appreciated for it is the best work extant devoted exclusively to this subject. But in course of time changes occur, and within the last few years improvements have succeeded each other with great rapidity, so that portions of the former treatise have become obsolete, and it needed weeding. No better time than the present could have been selected by the author for the issue of a new edition. It is to be greatly enlarged, and so improved by the addition of new matter that the author promises us virtually a new work. It is to be continued monthly, and completed in twenty-four parts. If the twenty-three parts yet to come are brought up to the standard of that just issued the public at any rate will be far from losing considering the moderate price charged. The present number is devoted to the historical account of the screw propeller, which, although of recent application with us, appears to be a very ancient contrivance, and have been familiar to the Chinese for ages. In European countries, however, it seems to have been derived either from the windmill smoke-jack, or from the archimedean screw. The earliest arrangement appears to have been made about 1683 by Hooke, who devised a water-mill screw, which was neither more nor less than the vanes of a windmill set to operate in water. Various improvements were effected by Hooke from time to time, and the subject was taken up by others until in 1785 Bramah worked out an arrangement for propelling vessels by a screw at the stern. His plan the main appears to be that which has subsequently come into general use. The illustrations of the present part consist of a large

* "Engineering Facts and Figures for 1864; an Annual Register of Progress in Mechanical Engineering and Construction." By ANDREW BERTH BROWN, M.E. London and Edinburgh: A. Fullarton and Co., 1865.

* "A Treatise on Gas Works and the Practice of Manufacturing and Distributing Coal Gas." By SAMUEL HUGHES, C.E. Second Edition, with Illustrations, revised by W. Richards, C.E. London: Virtue Brothers, Paternoster-row, 1865.

* "The Revolving Turret not the invention of Captain Phipps Coles, R.N., but of Charles Wentworth Forbes." London: Dorrill and Son, Charing Cross, 1865.
† "A Treatise on the Screw Propeller, Screw Vessels, Screw Engines as adapted for purposes of Peace and War." By JOHN BOURNE, C.E. New Edition. London: L. Mans, Paternoster-row, October, 1865.

folded plate showing longitudinal and horizontal sections and builder's lines of the "Great Eastern," and a full-page plan and elevation of the engines of the "Warrior" ironclad; in every respect the part before us is well got up.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

Value of the Sulphur in the Swansea Copper Smoke; Mr. Spence's Method of Saving it—Extreme Fusibility of some Alloys of Cadmium—Riband-shaped Conductors for Voltaic Currents—New Researches on Indium—Reduction of Potassium by means of Aluminium—Artificial Rubies.

IN last week's "Notes" we estimated the value of the sulphur dissipated in the Swansea "copper smoke" at a quarter of a million sterling per annum. We based this estimate on the calculation made by Leplay, which is quoted in the first volume of Dr. Percy's "Metallurgy." Mr. Peter Spence, of the Pendleton Alum Works,—the largest alum works in the world, we believe,—has put forth, however, a much higher estimate of the value of the sulphur in the copper smoke. The quantity of copper ores smelted weekly at Swansea is about 5,000 tons, and the proportion of sulphur in them averages from 24 to 28 per cent. "This," says Mr. Spence, "is equivalent to 3,300 tons of brown oil of vitriol, and this weight I would undertake to produce therefrom. The present value of this weekly quantity is £9,900," which is at the rate of £514,800, or more than half a million sterling, per annum. Mr. Spence proceeds: "This quantity of acid would meet the requirements of our staple chemical manufactures, or nearly so; while these manufactures have never been so pressed for a supply of sulphur ores as now. Spain, Portugal, Germany, Belgium, Norway, and even Iceland are being ransacked, but have so far failed to yield them in sufficient quantity. Shall this dearth on the one hand, and needless waste on the other, continue?" There is certainly no good reason why it should.

Mr. Spence invented about four years ago a "Copper Ore Calcining Furnace," which has over M. Gerstenhöfer's furnace, which we described last week, the great advantage, besides several others, of not requiring that the ores calcined in it should first be ground. This furnace Mr. Spence has had in constant work for the last three years, all the sulphuric acid which he has used during that period, whether at his works at Pendleton or at those at Goole, having been produced by its agency. It is of considerable length, measuring about fifty feet from end to end, and consists of two chambers, one above the other, separated by a thin partition of fire-brick. The fireplace is at one end of the lower chamber, the other end of which communicates with the chimney, and the products of combustion are confined to that chamber. It is in the upper chamber,—between which and the lower chamber no communication exists,—that the ores are calcined. In each side of his upper or ore-chamber are six apertures, laced at equal distances apart, and ordinarily closed by suitable doors. These apertures are for the purpose of enabling the workmen to move the ores gradually from one end of the furnace to the other. At the end of the ore-chamber is an opening through which a current of air is forced continuously while the furnace is in action; the other end communicates with a sulphuric acid chamber. In commencing working, a batch of ore, usually about ten hundred weight, is introduced through the pair of doors which are farthest from the fireplace, and so at the coolest part of the furnace,—for, by reason of its length, and of the position of the fireplace, the furnace is very much hotter, of course, at one end than at the other. Having been spread evenly on the floor of the upper

chamber, this first batch of ore is then allowed to remain undisturbed for two hours. At the end of that time it is raked eight feet forward, and a second batch of raw ore is introduced into the place the first has thus been removed from. At the end of a second two hours the first batch is moved a further eight feet forward, and the second batch is also moved eight feet, making room for a third batch; and so the process goes on continually. At the end of twelve hours the first batch is withdrawn, and thereafter a batch is withdrawn, as well as a batch introduced, every two hours. The action of the furnace is thus uninterrupted, and it calcines about six tons of ore every twenty-four hours. The ores, as they pass from one end of the furnace to the other, are exposed to a gradually increasing temperature, whereby clotting is entirely prevented, and under the influence of the heat to which they are thus gradually subjected the sulphur in them combines with the oxygen of the current of air which is passed over them, to form sulphurous acid, which is afterwards converted into sulphuric acid, in the usual way. The cost of calcination by his furnace Mr. Spence states to be only 2s. 1½d. per statute ton of ore, which is less than the cost of calcination by the furnaces at present in use, while for every five tons of ore calcined in Mr. Spence's furnace £9 worth of sulphuric acid is obtained, at a cost of not more than £1, from constituents of the ore which the ordinary furnaces turn to no account whatever. Whether Mr. Gerstenhöfer's furnace will prove capable of yielding better results than Mr. Spence has thus for the last three years been obtaining from his, may be fairly doubted. Be that as it may, we really seem at last to have reached the beginning of the end of the enormous waste which has so long been going on at Swansea of a substance which is quite as important to the chemical arts as iron is to the mechanical ones.

The most fusible alloy at present in use is a compound of two parts by weight of bismuth with one of lead and one of tin. It is called "fusible metal" *par excellence*, by reason of its melting at so low a temperature as 93·75 deg. Centigrade. Dr. C. R. von Hauer has found, however, that by the addition of cadmium to alloys of bismuth with lead and tin, compounds may be produced which will fuse at a lower temperature still. An alloy of four equivalents of cadmium with five equivalents each of lead, tin, and bismuth is quite liquid, he states, at 65·5 deg. Centigrade. In parts by weight this alloy would consist of cadmium 224, lead 517·5, tin 295, and bismuth 1050. An alloy of three equivalents of cadmium with four each of tin, lead, and bismuth fuses at 67·5 deg. Centigrade, and an alloy of one equivalent of cadmium with two equivalents each of these three other metals at 68·5 deg. Centigrade, which is also the fusing point of an alloy of one equivalent each of all the four metals. Dr. von Hauer made these alloys by fusing their ingredients in a covered porcelain crucible at the lowest practicable temperature. Their melting points were determined,—under hot water, and also by placing a thermometer in the fused mass, without water,—after they had been melted and cooled several times. They all become *pasty* at lower temperatures than those given above; the temperatures quoted are those at which the alloys are perfectly *fluid*. It should be added that, unfortunately, all these alloys very rapidly oxidise when placed in water. It is generally taken for granted that in the voltaic circle electricity circulates in the mass of the wire through every part of its transverse section, and is not confined, as is the case with frictional electricity, to the surface only. Mr. John James Waterson has been led to examine whether or not there is any experimental evidence that the fact is as thus supposed, and he has come to the conclusion, not only that there is no such evidence, but that what evidence there is respecting the matter tells the other way. The grounds of this conclusion he has

set forth in a communication which appears in the September number of the "Philosophical Magazine," and in which occurs this very noteworthy passage: "Barlow and Harris have proved that the power of magnets resides on their surface, and, of course, inductively in the space exterior to that surface. What if this should also be the case with the current force in a submarine cable? would it not lead to the adoption of flat conductors? would not a strip of silver-leaf or copper-foil one-sixteenth of an inch in breadth conduct as well as the wires of the Atlantic cable? Theoretical considerations lead me to believe that it would, and that with a strip half an inch in breadth we should have a conductor equal to a wire of nearly half an inch diameter. Ample surface of conduction with corresponding low electro-motive force (or, as it may otherwise be expressed, low *electric pressure*) seem to be essential to the permanent success of long submarine cables; and as strength of core is not required, it seems to me that the riband form of conductor might well deserve a trial by those practically interested in the question." The value of this suggestion,—which we incline to estimate highly,—might be very readily tested.

Professors C. Winkler and Schrötter, who are the only chemists, other than its discoverers, MM. Reich and Richter, who have yet experimented on that latest-discovered and as yet least-known of all the elements, have each recently published some new researches on indium. Winkler finds the atomic weight of that metal to be 35·918, instead of 37·07, which Reich and Richter estimated it at. Schrötter states that the magnificent blue line in the spectrum of indium, from which the metal derives its name, does not coincide with any of the dark lines in the solar spectrum, and hence deduces the conclusion that this element does not exist in the atmosphere of the sun. Both Winkler and Schrötter agree with the discoverers as to the physical characteristics of the metal, which seems to closely resemble cadmium in colour and lustre, but to be softer than cadmium, marking paper easily. The streak produced by it on paper is bright, with a very slight shade of grey. Reich and Richter believed that indium was not precipitable by sulphuretted hydrogen, but Schrötter finds that that gas will precipitate it from any solution which is sufficiently dilute and not too acid. The precipitated sulphide cannot be distinguished, as regards colour, from sulphide of cadmium. Indium seems, indeed, to bear in all respects a very close likeness to cadmium.

According to the "Zeitschrift für Chemie und Pharmacie," Beketoff has found that potassium may be reduced by means of aluminium more readily than by any other agent yet tried. If we had cheap aluminium, therefore, it would enable us to cheapen potassium; but, of course, aluminium will never be used on any extensive scale for the reduction of potassium so long as aluminium has itself to be obtained by means of sodium. The potassium compound best adapted for reduction by aluminium is the hydrate.

Many chemists have endeavoured to produce artificial diamonds, but hitherto with invariable insuccess. Most of the other gems, however, have been produced artificially, the artificial stones having exactly the same composition and properties as the natural ones. Rubies have till now been the most difficult gems to produce artificially, but MM. Ste. Claire Deville, Caron, and Troost have just communicated to the Academy of Sciences a method by which they can be made with ease. A mixture of fluoride of aluminium with a small quantity of fluoride of chromium is placed in an earthen crucible which has first been carefully lined with calcined alumina, after the fashion in which it is customary to line crucibles with charcoal. In the centre of this crucible, in the midst of the mixture of fluorides, is placed a small platinum crucible containing boric acid. The outer crucible having been well covered, the whole is ex-

posed to a temperature sufficiently high to volatilise both the boracic acid and the fluorides. The vapour of the boracic acid then decomposes that of the fluorides, with formation of fluoride of boron and deposition of crystals of the mixed oxides of aluminium and chromium. If the fluorides were originally mixed in the right proportions, these crystals will have exactly the same composition, and exactly the same colour, lustre, specific gravity, and other properties, as the most perfect natural rubies.

THE COAL-FIELD OF SOUTH STAFFORDSHIRE.*

By PROFESSOR J. BEETE JUKES.

THE PROFESSOR said he wished to limit the subject of his lecture to the elucidation of the point that while there were doubtless large tracts of coal measures, containing good beds of workable coal, concealed under the red rocks of the midland counties, there were certainly some tracts, and possibly many, where there were no coal measures beneath those red rocks. There would be nothing in this that was not familiar to all theoretical or soundly practical geologists, but he thought the point was one which was not sufficiently attended to. He would endeavour to explain the matter in such a way as should render it clear to those even who were not geologists. He then referred to geological maps, sections, and diagrams illustrative of the order of succession of the different groups of beds with which he had to deal, and of their relations one to the other. Each of these groups of beds had been formed by the deposition of sands, clays, and silts in water, chiefly that of the sea, limestone being formed at intervals by the growth of marine animals, and coal occurring occasionally in one group, the produce of the debris of plants chiefly, if not wholly, terrestrial. After the formation of each of these great groups of beds an interval occurred during which not only was the deposition suspended, but the previously formed beds were disturbed by forces acting from within the earth, such as are indicated by earthquakes, and greatly eroded by denuding agencies acting from without—namely, by the sea, and by the air, rain, rivers, and all other atmospheric agencies. By these latter actions new surfaces were formed on the previously existing rocks, and when they were again depressed beneath the sea, and fresh deposition took place upon these surfaces of erosion, that relation was produced which geologists designate as unconformability. This unconformability of one set of beds to another was always proof of an interval during which the lower set were disturbed and more or less destroyed. The red rocks of which he had to speak were divisible into two groups, the uppermost of which were called new red sandstone or triassic beds, and the lower pernian. The new red sandstone formed the base of the mesozoic or secondary series; the pernian the top of the palaeozoic or primary series; and this, with the coal measures, carboniferous limestone, and old red sandstone, may be called the upper palaeozoic, while the silurian beds and all below them may be called lower palaeozoic. The carboniferous limestone was certainly formed in a sea which spread over the greater part of the British Islands, but an island or islands formed of the lower palaeozoic beds then stretched across the midland counties from Wales, through Shropshire, South Staffordshire, and Warwickshire, into Leicestershire, and perhaps still further to the east and south. In consequence of the existence of this land in the carboniferous limestone sea, little or none of that rock was formed in the districts named. Subsequently, however, this land was depressed beneath the water in which the coal measures were formed, and the uppermost beds of that group spread in level sheets over that land, so that the whole district was covered with coal measures from South Wales into Scotland, a few very small islets of lower palaeozoic rocks probably peering through the coal measures in North Wales and Shropshire, in Charnwood Forest, in Cumberland and Westmoreland, and in the highlands of the Scotch border. There was then a period of disturbance and denudation, in which the coal measures were rent and faulted, and certainly a good deal eroded. Upon this eroded surface the pernian beds were deposited, but we have no proof that any large mass of pernian beds was deposited on any other

rock than coal measures in the midland counties, though in Yorkshire and Durham it rests on the millstone grit. After the deposition of the pernian beds, another interval occurred, in which there was yet more disturbance and destruction, and the coal measures especially suffered so much as to be separated into the isolated patches forming our present coal-fields. The coal measures which originally spread over the old red sandstone of South Wales and its borders, connecting the Forest of Dean coal-field and the South Welsh coal-field with those of the Cleve Hills and the forest of Wyre, were then probably removed. And it was then that the great arch of coal measures which spread over the Derbyshire and Yorkshire hills was swept away, and the lower rocks exposed, and a similar destruction caused of the carboniferous rocks which formerly spread far into North Wales. That this destruction of the carboniferous rocks took place in the interval between the pernian and the triassic periods is proved by the triassic beds alone resting on the denuded edges of the millstone grit and carboniferous limestone in South Derbyshire, in North Staffordshire, and in the Vale of Clwyd, and the borders of Denbighshire and Shropshire. The triassic beds (or new red sandstone) were probably spread over a still larger surface than that which is now covered by them. Upon the top of this new red sandstone, as on a level floor, were laid down in succession the lias, the oolites, and the cretaceous series which spread over the south-east of England. These also once extended far to the north-west of their present limits. The old dislocations (or faults) which had been found in the carboniferous rocks during the first period of disturbance were again acted on at subsequent periods, and new cracks and fissures probably produced, causing great vertical dislocations in the newer beds, but there has not since the triassic period been in the midland counties any great bending or tilting of the strata, the new red sandstone seldom departing more than 10 deg. from the original horizontal position in which its beds were deposited. The practical problem for solution is, under which part of the new red sandstone do coal measures with workable coal still remain? How thick is that new red covering in those parts? Do the pernian rocks also occur there between the new red and the coal measures? This problem is one which may fairly be put before Her Majesty's Geological Survey, under Sir R. I. Murchison, with the expectation that some approximation to its solution shall be authoritatively stated. Though not authorised to speak for the Director-General, or his colleagues, Mr. Jukes would for himself be inclined to accept the responsibility to a certain extent. The Geological Survey should be able better than anyone else to say, first, what is the approximate thickness of the new red sandstone at any locality; secondly, whether pernian rocks would be likely or not to occur below it at that locality, and how thick they would probably be; thirdly, whether it is more or less likely that a good thickness of coal measures should remain undestroyed beneath those two groups of red rock in that locality. Mr. Jukes referred to diagrammatic sections, showing three possibilities for the upper palaeozoic rocks beneath the plains of Cheshire; the first with a good thickness of coal measure underneath the new red sandstone, isolated patches of pernian only occurring here and there; the second in which, the new red sandstone and pernian remaining the same, the carboniferous rocks were thrown into greater undulations, and the coal measures occasionally denuded, so that the new red sandstone rested directly on carboniferous limestone; and the third in which the new red sandstone above, and the coal measures below, remaining the same as in the first, a much greater thickness of pernian rock intervened continuously between them, causing the coal measures to lie at an additional depth of many hundred feet below the surface. In his opinion these three supposed cases were almost equally probable, and several combinations of them might possibly occur, rendering the cases still more complicated, and the search for coal one of great hazard and uncertainty. What was true for the plain of Cheshire between the coal-fields of Denbighshire and North Staffordshire was also true for the other areas of new red sandstone between those coal-fields, and those of Shropshire, South Staffordshire, Warwickshire, Leicestershire, and Nottinghamshire. About the latter district, however, there were large spaces in which it could be predicted with considerable certainty that the new red sand-

stone had no coal measures beneath it, but reposed directly on millstone grit, carboniferous limestone, or on one of the lower palaeozoic groups. As regards the thickness of the new red sandstone, it is probable that each of the two sub-groups into which it is divisible attains a maximum thickness of 1,000ft. or 1,500ft., though it is doubtful whether they ever both have that maximum at any one locality. In sinking for coal, anywhere in the red marl, then, it would be only prudent to allow 600 yards or 1,800ft. for the thickness of the new red sandstone, and 300 or 400 yards additional for possible pernian rocks. A possible thickness, then, of 1,000 yards will have to be pierced before arriving at that point at which the occurrence of coal measures is possible. If they do occur, a still further depth of 300 or 400 yards may have to be reached before a good workable bed of coal be found. At the Duke of Newcastle's pits at Shireoak Colliery, near Worksop, after piercing the pernians they sank 1,280ft. (more than 400 yards) before reaching a good workable coal. But after sinking the first 1,000 yards it is quite possible in Cheshire, Staffordshire, and Warwickshire that the pit would come down into coal measures containing no coal, or into some of the rock groups inferior to the coal measures, the latter beds having been there washed away by denudation before the covering of red rocks was deposited. If we look at the geological map, and observe the way in which the coal measures, once so widely spread, and so continuous, are now separated into detached coal-fields by areas in which lower rocks appear at the surface, and recollect that the part not covered by the red rocks may be only a fair representation of the general condition, that which is covered by them, we shall be at once aware of the uncertainty of finding coal at all beneath any given district of new red sandstone in the midland counties. Suppose the new red sandstone spread over Derbyshire and Denbighshire, as it does over Cheshire, it is obvious that in large parts of the former counties it would repose directly on millstone grit, on carboniferous limestone, or on upper silurian rocks. There is a possibility that it actually does so in large parts of Cheshire, Shropshire, Staffordshire, Worcestershire, and Warwickshire, as it certainly does in South Derbyshire and the adjacent districts. An important element for the solution of the problem is the exact determination of the nature of the boundary faults of the midland coal-fields. If these are mere lines of dislocation, all the coal-beds in the coal-field must be found beneath the adjacent red rocks at some depth or other, and these red rocks must have spread over the coal-field with the same thickness which they have outside it. If, however, these lines are of the nature of old cliffs, then it is quite possible that the coal measures with their valuable contents may have been more or less completely destroyed, and the red rocks merely taken their place. Viewed in this light, such operations as those proposed by Mr. S. Bailly, of Walsall, and by Mr. Beckett, to drive through the boundary fault near Emsayton, and then bore, are very important. Lord Shrewsbury not long ago bored on the downthrow side of the fault at the back of Brereton Church, near Rugeley, passing through 629ft. of new red sandstone, and through 351ft. of genuine coal measures below it, but without meeting with any bed of coal such as he is working at his pits a quarter of a mile off. Any exploration in near proximity to one of these boundaries, however, is likely to be more valuable in giving us information as to what we may expect further on than in directly profitable results. Numerous trials have been made of late years in different parts of the red rocks, which could only have a foolish waste of money as their result. Lord Stamford bored 565ft. in the new red sandstone of Highgate Common, near Enville. Another gentleman bored 390ft. into the same rock at Swindon; another 565ft., beginning in the red marl at Great Chatwell, near Lilleshall. The late Mr. Unett sank and bored 664ft. into the pernians of Smethwick. A boring also was made in search of water to a depth of 617ft. in the new red sand pernian, at Goldthorn Hill, near Wolverhampton, and numerous other similar trials have been made. All such experiments, if made in search of coal, are quite futile. Anyone intending to try for coal beneath the red rocks must be prepared to sink boldly 1,000 yards before he has a chance of meeting with the coal measures. It is quite possible that the red rock covering (taking trias and pernian together) may have

* Read before the British Association.

that thickness at any spot that may be selected. There is, then, a chance, and only a chance, of the speculator finding himself in the coal measures with good beds of workable coal still beneath him. But there is also a chance of finding coal-measures destitute of valuable beds, or of not finding any coal measures at all, but coming down into millstone grit, or carboniferous limestone, or some lower palæozoic rock, the coal measures having been removed by denudation before the red rocks were deposited. In such a hazardous speculation we cannot expect private individuals to engage. It must either be undertaken by a combination of proprietors such as is now being carried out by Messrs. J. S. Dawes within the limits of the South Staffordshire coal-field, near Hales Owen, or it must be undertaken at the expense of the nation. Mr. Jukes declared his own opinion to be that the national importance of determining the extent and position of the coal-fields beneath the red rocks of the midland counties is so vast that the exploration must be made at the national expense, with, of course, every fair provision for its repayment by those most immediately benefited by it.

PROGRESS OF GUN COTTON MANUFACTURE.*

By MR. PRENTICE.

(Concluded from page 222.)

THE second thing calling for remark relates to the greater safety to the workpeople employed. The British Association was last year informed of the introduction of the wet process, by which the gun cotton was manipulated through all its stages in a damp or wet state. The suggestion that this plan should be adopted was made by Dr. Miller, when, with Dr. Frankland, Dr. Thomas Richardson, Professor Abel, and Mr. Scott Russell, he visited the manufactory, and inspected the operations. This has been extended even to the point of storing under water. The magazines at the factory now containing the stock of gun cotton ropes, cut up into mining charges, consist of tanks with tons of the material submerged in many more tons of distilled water. As orders are received charges are taken out of the water, and in a few hours are ready for packing and delivery. It being therefore unnecessary that any large quantity of explosive gun cotton should be kept on the works, great safety is attained, and the chance of any alarming accident is entirely removed. In the application of gun cotton to rifles and sporting guns considerable experience has been gained. The latest trials have been very successful, and indicate that we are arriving at the principles by which cannon cartridges also may be successfully prepared. From the scientific point of view there are no instantaneous forces generated either mechanically or chemically, and motion or any process of composition or decomposition can only take place by degrees; but from the practical point of view there are compounds which decompose with such immense velocity, which require such an extraordinary small space of time for their decomposition, that for all intents and purposes they may be considered instantaneous. Such compounds are called fulminating. Experiments with gun cotton show that it may be made, practically speaking, instantaneous in its decomposition. Using high densities (30—40lb. per cubic foot) in an open condition, or in other words producing many channels through the dense mass of the compound, the destructive effect of such confined masses of gun cotton is, in every respect, similar to the strongest fulminates. It is well known that fulminating compounds cannot be used for propelling projectiles, on account of the destructive effects produced upon the guns. The whole point of the possibility of the application of gun cotton therefore turns upon the question, whether or not a certain quantity of gun cotton can be made to decompose in the given time required by a mass to move through a certain distance, when propelled by a force limited to the strengths of the gun. It would lead too far to enter into the details of the trials which have satisfactorily showed that the time of decomposition of a certain gun cotton charge may be increased considerably beyond the requirements of the artillery—or the compound may be made too slow for purposes of artillery. It has been found that the gun cotton charge must be divided into at least two individually different parts, which, for the sake of clearness, may be called the exterior

and the interior charge. The mechanical composition of both these is materially different; the exterior being a small fraction of the whole (from about one-sixth to one-third) in an open condition of low density (8lb. to 10lb. per cubic foot) in relation to the space in which it explodes. This generates the initial pressure required to start the shot from rest. The interior charge on the other hand being sufficiently separated from the other, by a strong resisting medium, and ignited at one or more ends by the explosion of the outer charge, contains the remaining quantity of gun cotton (5/6 to 2/3) under a high density (40lb. to 80lb.) The object of the interior or core charge is to generate the propelling gas during the motion of the projectile through the barrel of the gun, and to supply the gas at a rate corresponding to the accelerated motion of the projectile. The resisting medium which separates the outer and inner charge may be a cylindrical tube of considerable strength, and it has been found that the relative quantity and density of both charges—outer and inner—and the dimensions of the cylindrical tube, its inner diameter, length, and thickness, are quantities so intimately connected that the omission of or inattention to one of them wholly impairs the effect, uniformity, or powers of the gun cotton cartridge. Without going into actual figures it may be stated that the initial velocity of the Enfield rifle projectile, with the use of such gun cotton cartridges, already exceeds the initial velocity of the service gunpowder charge. This has been tested by means of trajectories due to gun cotton and gunpowder charges, each projectile recording its path of flight or trajectory. The maximum incurvation of the trajectory of the service gunpowder charge of the Enfield rifle, within a hundred yards of the muzzle of the gun, being on the average 3in.—that of a series of gun cotton cartridges made on the above principle has been, on the average, 3in.; the gun cotton trajectory being therefore flatter by 1in. in the first hundred yards. The path of the projectile was recorded by means of screens, every 50ft. apart. These velocities have been obtained with a service Enfield rifle, out of which about two thousand gun cotton rounds have been fired, without any signs of distress upon the gun, as officially reported by the inspector of small arms at Woolwich.

The trials of gun cotton cartridges for rifles and ordnance being in course of progress, it is for the present preferred not to give definite quantities respecting the construction of such cartridges. When the gun cotton charges shall have been finally settled by the Government committee, a full account of the trials will doubtless be given. The cartridges will give still better results when made with machinery better adapted to ensure uniformity of construction. The actual dimensions and quantities of gun cotton cartridges for fowling or sporting guns may be given, from which a general idea may be gained as to the construction of gun cotton cartridges. Breech-loading sporting gun, gauge No. 16, charges made up in cases, gun cotton charge: exterior, 4/8 grains gun cotton muslin; interior, 18 grains of solid 6-fold braid of fine yarn; density of core charge, 67 33lb. per C. F. Dimensions of cylindrical tube containing core charge: lengths of tube, 94in.; inner diameter, 35in.; outer diameter, 5in. First wad, next the gun cotton cartridge, boiled in wax; second wad, soft, as usual, 1oz. of shot, ignition of core charge both ends. The shooting of this cartridge is superior to sporting gunpowder in every respect. One little incident from the sporting field is not without significance. The boy carrying the game bag made the following homely remark:—"This cotton business is likely to be a bad thing for the birds," as he found his wallet filling much more rapidly by the gun which was fired with the gun cotton than that charged with gunpowder. Such a remark would not excite surprise with any person who had seen the greater penetration, and the more equable distribution of the shot, as shown by the state of the targets after a competitive trial with each explosive.

LAUNCH OF THE "LADY DERBY."

SOME time since Messrs. Maudslay and Co. purchased the extensive building-yard at Greenwich which formerly belonged to the National Boatbuilding Company, with the view of adding shipbuilding on a large scale to their former business. The keel of the first vessel built in the yard was laid last May, and the launch took

place last Saturday. The ship, which was named the "Lady Derby," is a screw steam vessel built for the General Iron Screw Collier Company. She is a fine specimen of naval architecture, and was designed on Henwood's patent dynamical principle. Her dimensions are as follow:—Length over all, 182ft. 6in.; between perpendiculars, 176ft. 6in.; breadth moulded, 27ft. 6in.; depth moulded, 18ft.; tonnage, 639 55-94, builders' measurement; gross register tonnage, 580. She is classed A B at Lloyd's, but in several points she is stronger than is required by their rules for vessels of this size. The engines are of 90-horse power, but will work up to 500 or 600. They are on the most approved principle for vessels of this sort, taking up but a small space, and leaving a spacious hold capable of containing 700 tons of coal or other dead weight, or 800 of measurement cargo. This launch at East Greenwich is an occasion of some note, as it marks the commencement of large works in connection with one of the first engineering firms in the country. Like other eminent engineers, Messrs. Maudslay had until lately been in the practice of handing over the construction of ships for which they contracted to builders whom they supplied with engines. They have now entered on the extended branch of operations for themselves, and have fitted up a spacious yard with workshops of great size, whither it is probable that their Lambeth factories may in time be transferred. The launch was conducted in an unusually quiet manner and the flags were flying half-mast high. This night, so at variance with the occasion, was accounted for by the lamented death of Mr. Fitzpatrick, one of the oldest and most valued servants of the firm, and latterly a partner. He died almost within a day of the time named for the launch, having been busily engaged in the preparations up to a very few hours before his death. Had a postponement of the launch been practicable, it would have been the course adopted by the other members of the firm, but circumstances rendered this impossible, and the launch was duly carried out.

PNEUMATIC DESPATCH RAILWAY.

THE works of the above line between Holborn and Euston Station are now completed, and the line ready for opening. To test the working of the Company's tube on Tuesday last, a small goods train was driven through from the Central Station in Holborn, passing beneath Holborn, New Oxford-street, Tottenham-court-road, Hampstead-road, and Drummond-street on to the Euston Station, a distance of about two miles, having some sharp curves on approaching the North-Western Station. The tube is 4ft. 6in. high, and about the same width, the rails being fixed in it for the carriage-wheels to run upon. At the Central Station in Holborn two tubes are carried beneath the footway and ground floor of the building; one connecting Euston Station with the Central Station, and the other being intended to connect the latter with the Post-office in St. Martin's-le-Grand. This tube has only been carried to Holborn-hill. In the Holborn Station the back portion of the building is occupied by three boilers, each of which can be worked up to a pressure of 30lb. per square inch. As a rule only one boiler will be worked at a time, though all three can be used if necessary. Between the boiler-room and the arrival and departure platform is the engine-room, fitted with two 24-horse power engines, which work the shaft of the circular disc or fan, 22ft. in diameter. This, revolving rapidly upon its axis, having enclosed air chambers, can be used either for propelling the laden trains forward by atmospheric pressure behind them, or for drawing them back through the tube by forming a partial vacuum before them. The trucks of goods, accompanied by one of the attendants, were blown through the tube to Euston in about five minutes, showing the ease with which a portion of the goods and parcels traffic of the metropolis will shortly be conducted. Wheatstone's telegraphic apparatus is used at the stations, and is found to act well. In the station there are two main lines of rails and three sidings, the distance between the rails being 3ft. 8 1/2in. There are also two traversing platforms for shifting the trucks from one part of the station to another. The Duke of Buckingham, the chairman, and some of the directors of the company, were blown from the Holborn Station, under the supervision of Mr. Rammell, the engineer, through the tube to Euston, the distance being accomplished in five minutes.

* Read before the British Association.

ELECTRO-MAGNET LOCOMOTIVE.

We have recently referred to the above locomotive, which is the invention of MM. Bellet and De Rouvre, of No. 27, Rue Mademoiselle, Versailles, and we now illustrate and fully describe the same. The invention consists in the application of electricity for the construction of a locomotive to run on railways for the transmission of letters, the carrying of passengers and merchandise from one place to another. The locomotive is especially adapted for the service of the post office for carrying letters and similar parcels. In large towns, by a proper system of underground railways uniting together the main post-office stations, this invention will render the greatest services. Figs. 1, 2, and 3 of the engraving represent a locomotive as an application of this invention. Fig. 1 is a part lateral elevation of the apparatus; fig. 2 is the plan, and fig. 3 section of the wheel. The locomotive is composed of two fore wheels of small dimension, and of two hind wheels R of a larger diameter. These last wheels are in reality the force and the motive power. These two sets of wheels are united together by a frame c. Each motive wheel R is composed, firstly, of an iron boss M, in which are made twenty holes, serving for the setting of a similar number of very short brass rods D; secondly, of twenty electro-magnets E, having one of their extremities supported by the shoulders of the radii, and the opposite extremities being on the level of the external part of the felly. The disposition of the electro-magnets is so arranged that their bobbins rest internally on the felly, whilst their polar surfaces cross through the felly externally, and are level with it. The motive wheels are keyed on the axletree for the purpose of crossing between them their radii, and therefore the electro-magnets which compose them. Such position of the wheels on the axletree produces on the rail an attraction for each fortieth part of the circumference run over.

The axletree by which the two motive wheels are connected carries the distributor o, consisting of a commutator similar to those employed in apparatus for natural philosophy. It is composed of two hardened caoutchouc discs, on the circumference of which are alternately set twenty ivory and twenty platina plates. On each of these latter is placed a rod, on which is fixed one of the wires of the electro-magnets, and corresponds to it in the wheel between the two circles; another entirely of platina, having a smaller diameter, is placed and carries on its sides forty brass rods, each of them corresponding to an electro-magnetic wire. This distributor keyed on the axletree is completely isolated by the adjunction of the caoutchouc hereinbefore described. Underneath the circles a division plate F supported by two cross pieces T is placed, and carries the spring hammers V of the commutator. This division plate consists of an ivory plate having two slide bars, through which pass the stems of the hammers. By this means and with adjusting screws their length is regulated. These two hammers are composed of steel springs having their extremity provided with a brass prism, the stopper of which is in permanent contact with the circumference of the distributor circles. A brass plate connects these hammers

together, and the electric current can thereby pass from one to the other; they are in communication by a bolt and a movable rod with a grooved roller G, serving to bring them the current. Another roller is in direct communication with a spring bearing on the brass circle of the distributor. In the centre of the two rails forming the line are two metallic wires H, similar to telegraphic wires, and on which run the brass rollers hereinbefore referred to. These wires are in direct communication with a battery placed at one extremity of the line. By such arrangements the patentees avoid, firstly, the inconveniences of having a battery close to the passage of letters and parcels; secondly, the difficulties of properly handling a large number of voltaic apparatus, and the expenses attending the transport of considerable dead weight. It will be therefore required to fit at fixed stations a battery, as is done for the telegraphic lines, and which battery by means of the conductors will supply with electric current the apparatus during their transit.

By the arrangements hereinbefore described the current produced by the battery runs through one of the conductor wires, passes on its grooved roller G, with which it is in contact, crosses the division plate F to reach the hammer V in juxtaposition with one of the distributor platina plates. The current then follows the wire conducting to an electro-magnet E, and, egressing through the second electrode of that magnet, passes the platina disk Q through the spring in contact with it, and returns to the battery by following the second roller and the conductor wire opposite to the one it had started from. The force instantaneously produced in the electro-magnets causes on each attraction a displacement of the wheel, and consequently a corresponding motion of the distributor circles. On account of this movement the hammer in contact with a platina plate is moved on an ivory plate. The current being now stopped on that side passes through the opposite hammer, which in consequence of the crossing of the radii, as hereinbefore described,

is in contact with a metallic plate. The electric current travels alternately from one motive wheel to the other, and each of these wheels is behind the other at a distance of one-fortieth part of their circumference. To stop one of these apparatus when travelling it suffices to break by any means whatever the electric current giving the impulse to the engine. The electro-magnets will cease to work, and the locomotive will be soon stopped.

ON SUGAR-MAKING MACHINERY.

BY PERRY F. NURSEY.

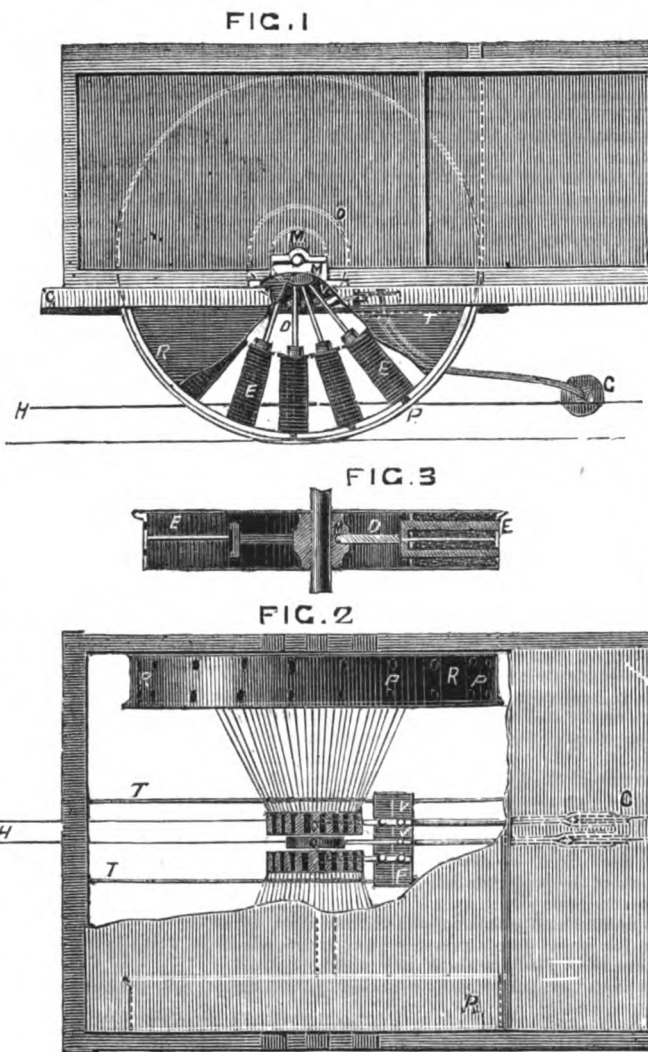
(Concluded from p. 213.)

ARTICLE III.—PURIFICATION AND CONCENTRATION OF THE SYRUP.

THE juice, on being delivered from the mill, is full of impurities, the removal of which may be divided into two processes—defecation and clarification. In defecating the syrup lime is the agent most frequently employed; but there are wide differences of opinion as to the best method of its application. The lime should be thoroughly burned, and quickly slaked with hot water, enough water being added to give the consistence of cream. This should then be filtered through a fine wire sieve, in order to remove silicious particles and fragments of unslaked lime or unburned limestone. The following process is adopted by some manufacturers:—When the syrup in the clarifiers has attained the temperature of 130 deg. Fah., successive portions of the cream of lime are added until the acids in the syrup—acetic and lactic—have been completely and exactly neutralised, which is shown by litmus paper. The mixture of syrup and lime is thoroughly incorporated, and left to digest for about a minute. The cream of lime added to effect neutrality should not contain more than about four ounces of solid lime per gallon. The product so obtained is run off, through a stop-cock in the clarifier, to the bag or charcoal filters to be noticed presently. In the more common process of defecation, after neutralisation by cream of lime, as above described, the heat is urged until a temperature just below the boiling point of the syrup is reached. A thick scum is then formed upon the surface of the syrup, and the clarification is judged complete when this scum breaks, and a white froth appears in its interstices. In all cases an excess of lime is to be guarded against, mainly on account of the destructive action of caustic earths on sugar. Various other substances have been employed for the defecation of cane juice, the principal of which are—bullocks' blood, nut galls, sulphate of zinc, alum, sulphate of alumina, sulphuric acid and lime, and subacetate of lead.

In one process of clarification the juice, as it is expressed from the cane, is run into the clarifiers and a battery of pans. The clarifiers are copper pans with arched bottoms, into which the juice from the cane is conveyed. From these pans it is run into the battery. These pans or teaches are also of copper. As the juice becomes concentrated, each pan is filled up from the one next behind it, until the striking teach is full of granulated sugar, which is then ladled into shallow wooden vessels and conveyed to the curing house. An improvement upon the old system of lading is now much used. It consists of a copper pan or dipper, fitting the inside of the striking teach, and having at the bottom a large valve, opening upwards and worked by a lever. The dipper is attached to a crane which commands the striking teach, and a gutter to the coolers. This implement enables the striking teach to be emptied and refilled in much less time than by the ladle. The pans are set in brick-work, with a furnace under the striking teach, and a flue through which the heat passes under the range and under the clarifiers to the chimney. The megass from the cane mill is dried and used as fuel for the battery, being much better suited for that purpose than any other convenient fuel, as far as heat goes, a quick fire being required. By placing the boiler of the cane mill at the end of the battery, so that the products of combustion may pass from the latter to the former, a saving of fuel is effected.

In another and improved method of clarification the necessary heat is obtained by steam. This is a great improvement, and by its adoption the process of manufacture is facilitated, and the colour and quality of the grain are improved. It is more economical in the working, and admits of more perfect regulation of temperature. Fig. 1 shows a transverse section of



a boiling-house fitted up with the latest improvements, and worked by steam heat. A is a wrought-iron tank to receive the cane juice forced up from the mill by the pump; B is a copper trough fitted with outlet plugs of wood, through which the juice is supplied from the tank to the clarifiers; C is a copper clarifier, 5 ft. in diameter, fixed in a cast-iron steam case which is fitted with steam valve, two-way cock and plug, condense box, &c.; D is a copper trough fitted with plugs for supply of clarified juice to the bag filters. D' is another copper trough for carrying off scum, &c., from the clarifiers through the large opening of the two-way cock. E are condense boxes to the clarifiers with pipe to feed-water supply for boilers. F are bag filters, each of which is provided with a stopcock opening into a copper main to wrought-iron tank H, from which the juice is supplied to the evaporator through the pipe H'. The wrought-iron evaporator J is fitted with a steam valve, range of copper pipes, expansion box, and condense box. There is a copper pipe for discharging the liquor from the evaporator to a wrought-iron tank, where it is stored for supply to the *monte-jus* through a copper main. The wrought-iron *monte-jus* or juice elevator is fitted with a steam valve, and is made of sufficient strength to sustain a pressure of 50 lb. per square inch. A copper pipe O, which is fitted with a stopcock, dips down to near the bottom of the *monte-jus*, and through this pipe the liquor is forced by steam pressure from the *monte-jus* to the wrought-iron tank P, from which it is run off into the trough Q, to supply the charcoal filters R, which are sometimes made of cast and sometimes of wrought iron, or even of copper, if preferred. A stopcock is fitted to each filter, which opens into a copper main, through which the filtered juice passes into another tank, from which it is drawn through the measure into the vacuum pan for granulation. U shows the system of steam pipes from the boilers to the clarifiers, evaporator, *monte-jus*, &c. The boilers are of Cornish construction, and measure 30 ft. long by 6 ft. diameter, having 3 ft. flues. There are also several wrought-iron tanks for water, fitted with supply pipe, cocks, &c. The foregoing will be found a very suitable arrangement, but circumstances may and do arise where different arrangements are adopted.

Having considered the general arrangements of the boiling-house it will be as well to proceed in order with the detail description of the various apparatus therein. The steam clarifier, which is shown in section at fig. 2, is 5 ft. diameter, and consists of a hemispherical copper pan A, which is hammered out of one piece of copper, and fixed by a flange laid off to an outer cast-iron pan B; a space is allowed between the two pans for the passage of steam. A copper light course C is fixed on the top, and a wrought-iron ring D is laid on the flanges, the whole being bolted through with $\frac{1}{2}$ in. bolts 4 in. centres. At the side a steam valve E is attached, by which the supply of steam is regulated. A gun-metal two-way cock F is fitted at the bottom; the smaller branch is used for drawing off the clarified juice, and the larger one for the scum. A gun-metal plug G, with copper rod and handle, is ground into the top of the cock; this plug is withdrawn when the scum and heavier matter are to be let out. At the bottom of the cast-iron pan a small wrought-iron pipe H is inserted, by which the water is carried off to the condense box. The juice in the clarifier is raised to a temperature of 176 deg., and sufficient milk of lime is added to neutralise the acid in the juice. The heat is then continued till a scum, consisting of impurities present in the juice, has risen to the surface, and appears about to crack. The time occupied in this should be about ten or twelve minutes from the commencement of the operation. The steam is then shut off, and the liquor allowed to subside for fifteen or twenty minutes, when the scum will be found to remain at the top, some heavy matter will have fallen to the bottom, and between them will be the clarified cane juice, clear, and of a pale straw colour. The clarification being complete the two-way cock is first turned on to the smaller aperture, until the top scum begins to appear; the cock is then turned to the large way, and the plug taken out. The heavy matter at the bottom and the top scum are conveyed to a cistern, from whence it is placed in bags, and any juice remaining in it is squeezed out, leaving only a small portion of solid matter behind.

The steam evaporator consists of a rectangular wrought-iron vessel or tank, at the bottom of

which is placed a range of copper pipes, connected by gun-metal bends brazed to the pipes and carried on wrought-iron supports. The tank is fitted at the side with a steam valve at one end of the steam range, and at the other side is a cast-iron box fitted with a wrought-iron pipe for exit of condense water to condense box. This form of evaporator presents a large amount of heating surface, with facility for cleaning. By passing the ends of the steam range through stuffing-boxes the pipes can be turned up, and all parts of the evaporator readily cleaned. This is a point of great importance in the manufacture. Fig. 3 shows a section of the self-acting condense-water box, through which the water arising from the condensation of steam in the various vessels passes on its way to the boiler feed-water cistern, and consists of a cast-iron box A fitted with a cover and a copper float B with a pin at the top, which slides vertically in a groove in the condense-box cover. The float is connected at bottom with a simple valve arrangement C, which it opens when a sufficient quantity of water has accumulated in the box to raise it. The condense water is thus allowed to flow away without permitting the steam to escape.

The clarified juice or liquor after leaving the clarifiers is passed through mechanical filters. The kind commonly used are bag filters, which consist of a wrought-iron case, provided with openings, and made with an internal flange at top to carry a cast-iron box, having holes at the bottom, into which are sored gun-metal bells, to which the cotton filter bags are attached. Each filter is fitted with a stopcock at bottom to the copper main. A steam cock is attached to the side of the wrought-iron case for cleansing the filter by the admission of steam. The bags which are attached to the bells are made of twilled cotton cloth, and are about 6 ft. in circumference and 6 ft. long, woven without a seam. They are enclosed in a strong open webbing about 18 in. in circumference, thus giving a large surface of filtering medium in a small space.

The charcoal filters are large slightly conical vessels, generally of wrought iron, with a perforated false bottom about $\frac{1}{2}$ in. from the bottom. A blanket is spread over the false bottom, to prevent the charcoal from being carried through with the liquor; some, however, always accompanies the liquor at first, which runs into a separate receiver to be filtered over again. In filling these vessels the first few inches of charcoal should be pressed compactly down, after which it is packed lightly, but evenly, nearly to the top, where space is left to receive the liquors. The object to be attained in these filters is to remove all the vegetable colouring matter from the liquor, and any excess of lime that may have been added during the clarification, as well as some of the mineral salts, such as sulphate of lime, originally existing in the cane juice.

ARTICLE IV.—GRANULATION, OR CRYSTALLISATION.

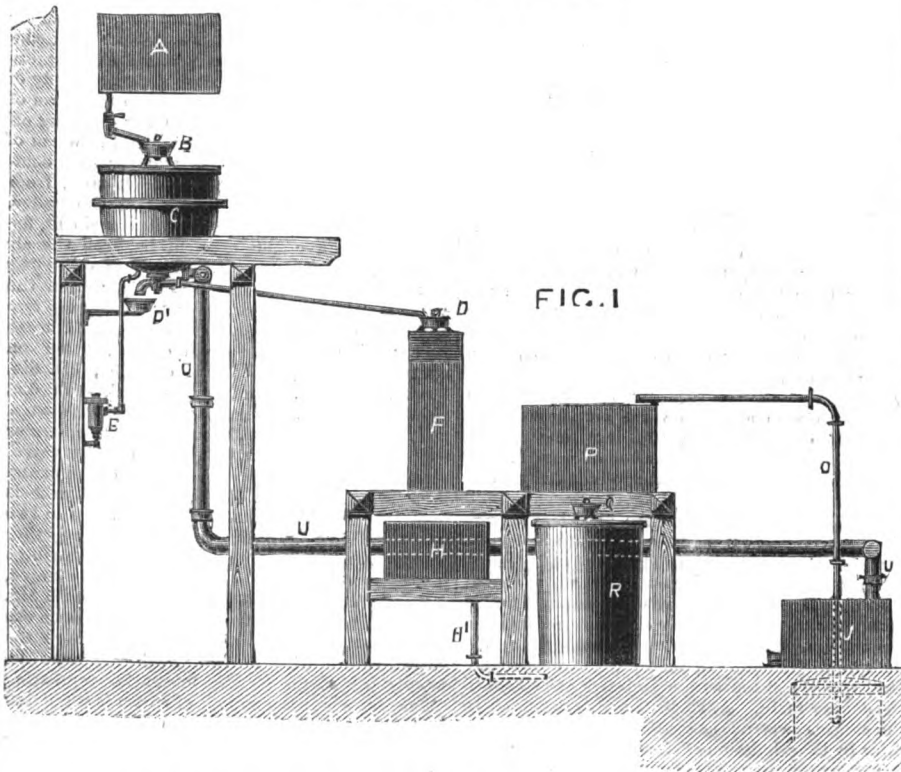
The granulating is performed *in vacuo*, so that next in order for consideration comes the vacuum pan, which depends for its action upon the principle that liquids boil at greatly reduced temperatures when relieved from the pressure of the atmosphere. The vacuum pan, originally patented by Howard in 1812, has been of great value in the chemical arts, not only in the preparation of sugar, but also of medicinal extracts and other substances. It has, however, gone through a variety of improvements since the date of its introduction. The vacuum pan apparatus, which is shown in elevation at fig. 4 and in plan at fig. 5, consists of a vacuum pan A, which is mounted on a cast-iron framing, carried by eight cast-iron columns. The top compartments of the framing are fitted in with deal boarding or iron plates, which form a staging round the vacuum pan. The pan is fitted with thermometer, vacuum gauge, eight glasses, proof-stick for extracting samples of sugar, slide for discharging sugar from pan and for steaming, &c., steaming cock, in connection with a steam pipe, to admit the steam to clean out the pan. There is also an arm pipe and a receiver B to catch any sugar that may boil over. The receiver is fitted with a delivery cock and air cock for destroying the vacuum when necessary. The condenser C is fitted with a perforated pipe and a stopcock, with a lever, and an index plate to regulate the supply of water for condensing the vapour from the vacuum pan. There is a measure D for regulating the supply of sugar to the vacuum pan. The measure is fitted with a stopcock and inlet pipe from the filtered juice

tank, a glass gauge to indicate the quantity of syrup in the measure, outlet pipe, with a stopcock opening into the vacuum pan, and an air pipe having a cock communicating with the vacuum pan for forming a vacuum in the measure. A valve E is attached for the supply of steam from the expansion vessel to the worm of the vacuum pan; and a pipe O for carrying off condensed water from the steam coil or worm of the vacuum pan to a condense box, which communicates by a pipe with a brick tank, from which the feed water is supplied to the boiler. An air valve F is mounted on an air main F', for regulating the communication between the air pump and the vacuum pan. There is a dividing box for distributing the flow of air from the vacuum pan to the air pumps. There are two 16 in. air pumps 1 ft. 9 in. stroke, and a 10-horse power high pressure beam engine, fitted on diagonal frames, with 11 in. cylinder, 3 ft. 6 in. stroke, and 12 ft. diameter fly-wheel, with 6 in. elliptic rim; 4 in. plunger feed pump, with stopcock, clock box, copper air vessel, and feed-water supply pipe to boiler, fitted with safety valve, weighted for regulating pressure on pipe and stop valve to boiler. The Cornish boiler J is 36 ft. long and 6 ft. diameter, and is made in two parts for facility of exportation; it is put together with wrought-iron rings, and is fitted with gauge cocks, mercurial pressure gauge, safety valve, whistle valve, and steam chest, mounted with 5 in. steam valve to pipes for supply of steam to the engine, and to the vacuum pan through the expansion vessel. A sluice cock regulates the supply of steam to the mercurial regulating valve, by which the supply of steam is regulated to the expansion vessel, which is fitted with a whistle valve and safety valve to prevent excess of pressure in the worm of the vacuum pan; the steam passes from the expansion vessel through a pipe to the steam valve K, which regulates its admission to the vacuum pan.

The details of a vacuum pan 7 ft. in diameter, that being the size suitable for the rest of the machinery, are shown in fig. 6:—The copper pan A is fitted in a cast-iron steam case B, with steam space left between the two; the pan is surmounted by a copper dome A'. The copper and iron pans and the dome are accurately fitted and bolted together through their flanges with a wrought-iron ring and bolts, as in the case of the clarifier, so as to be perfectly airtight and steam tight throughout. A manhole D, with a ground gun-metal cover, is attached to the top of the dome, from which proceeds the arm-pipe E, opening into the receiver; a steam valve F is attached, which opens into the copper steam worm G. This worm gradually diminishes in diameter from the entrance point at the steam valve to the exit at the bottom of the pan. A wrought-iron pipe is fitted into the cast-iron pan, to carry off the water to the condense box. A slide valve H is provided at the bottom of the pan for discharging the sugar; the dome of the pan is mounted with a vacuum gauge, thermometer, sight-glass, and proof-stick, for testing the concentration of the liquor without destroying the vacuum in the pan. This proof-stick is simply a brass rod, which is driven from the upper part of the side of the vacuum pan down an aperture made of the same size as the rod. When it reaches the bottom the rod is twisted half round by the cross handle, and opens a communication with the end of the rod and the syrup. In the end of the rod is a groove into which the sugar enters; the rod is half turned again and drawn out, and the entrance is closed as before.

In situations where there is not sufficient water to admit of condensation by injection being used, surface condensation is employed to maintain a vacuum in the pan. For this purpose Messrs. Pontifex and Wood use condensers, which consist of one or more series of iron or copper pipes fixed to boxes at each end, with partitions to direct the current of the vapour. Above each series of pipes is fixed a trough, always kept full of water, and so constructed that the water trickles in a gentle shower uniformly spread over the pipes, so as to keep them well covered with a thin film of water. The lowest pipe is connected with a small pump, worked by the engine, which draws the condensed vapour, and any air that may have collected, from the pan. An improvement introduced by Messrs. Pontifex consists in doing away with solder joints at the junction of the pipes with the case, the solder being liable to crack from the unequal expansion of the pipes (owing to the lower pipes being cooler than the upper ones), and the substitution of an elastic

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joint, which allows for the irregularity of the expansions without injuring the vacuum; they are also easily replaced, not requiring any mechanical skill, and take up less space for shipment. The superior economy of water in these condensers is owing to the condensing water being evaporated, and carrying away not merely sensible but latent heat. The ordinary method of condensation is similar to that employed in the condensers of steam engines when the steam is led into a vessel where it is brought into contact with a stream of cold water. In this case, as the condensing water must not be allowed to become vapourised, all the heat it absorbs must be in the form of sensible heat, and it is said practically to require about thirty times the quantity of condensing water. But in these surface condensers the vapour which passes off from the surface of the pipes not only carries off the sensible heat, but it also renders latent a great amount of heat in its conversion into vapour, the quantity of water passing off from the surface being equal, or nearly so, to the quantity condensed inside the pipes. The water which falls into the trough under the condenser is used over again, the heat of it not materially affecting the action of the condensers.

The mercurial steam regulating valve of Messrs. Pontifex and Wood consists of a cylindrical casting, having an internal cylinder, passages, and a 3in. flange branch, cast in one piece; it is fitted with cover and fastenings. The internal cylinder is 4in. diameter, and is bored out for the reception of the gun-metal cylinder, which must be accurately fitted in place, having passages cast in it corresponding with those in the cast-iron cylinder for the admission of high-pressure steam. A gun-metal cylindrical slide is turned and fitted to the gun-metal cylinder, and is attached to a float by means of a crosshead. A wrought-iron mercury tube is fitted with a cast-iron box. The apparatus is provided with a flange for connection to the 4in. pipe, to conduct the reduced steam to the expansion vessel. The reduced pressure steam (18lb.) required in the vacuum pan, clarifiers, &c., is obtained from the ordinary boiler steam (40lb.) by its action on the mercury. According to the rise or fall of the mercury in the cylinder and tube, so does the float rise or fall, and thus opens or shuts the passages, according to the pressure of steam on the larger surface of mercury, which pressure is regulated by the height of the column of mercury in the tube. The duty of the box is to receive any mercury that may be forced out of the tube by the steam pressure in the cylinder, and it is returned through the aperture in the tube.

It will be observed that copper enters very largely into the composition of sugar machinery.

Such being the case, and considering the character of the metal, it may be useful to give the weights and thicknesses generally adopted in the various portions of the apparatus. These are as follow:—Thickness of dome of vacuum pan, $\frac{1}{2}$ in. in rim and $\frac{1}{4}$ in. at centre; the same thicknesses apply to the bottom of the pan; each weighs about 8 cwt. 2qr. 14lb. The metal in the worm of the vacuum pan is $\frac{1}{2}$ in. thick, that in the arm pipe 3-16in. thick, and that in the measure 3-32in. thick. The clarifiers are $\frac{1}{2}$ in. thick on the rim, and $\frac{1}{4}$ in. at centre, and each weighs about 6 cwt. The light course of the clarifiers is $\frac{1}{2}$ in. thick; the open clarifiers and battery of pans or teaches are $\frac{1}{2}$ in. thick at bottom, and $\frac{1}{4}$ in. at top. The copper troughs are 1-16in. thick; copper main to the bag filters, $\frac{1}{2}$ in.; copper pipes in the evaporator, $\frac{1}{2}$ in. thick; copper pipes in monte-jus, 3-16in.; copper main to charcoal filters, 3-16in. thick; the air vessel to the pumps, 1-16in.; and the float for the condense-water box, 1-32in. thick.

The following is an estimate for a set of apparatus as usually supplied to work with a 16-horse power sugar mill, and is sufficient to take the full produce of juice from that sized mill when working at its best. The prices are for the goods packed and delivered at the works:—

ESTIMATE.

	£	s.	d.
1 16-horse power cane mill, pump for raising liquor, 3 spur pinions to connect rolls, intermediate gearing, 1 high-pressure 16-horse power horizontal engine and fly-wheel, 1 Cornish boiler, 20ft. long, 8ft. diameter, and 3ft. flue, fitted and mounted complete; the whole, including all necessary bolts, &c., complete for fixing	1,450	0	0
1 7ft. inside diameter strong and highly finished copper vacuum pan, with large copper worm, steam branch direct into jacket, gun metal steam and air valves, copper measure, copper safety receiver with arm pipe, cast-iron condenser, with gun metal dial cock and copper injection pipes, two condense-water boxes, glass gauges, barometer, thermometer, proof-stick, &c., complete	1,913	0	0
1 cast-iron staging, supported on columns, to receive the vacuum pan, with flooring plates, hand rail and stairs, and with air pumps, engines, &c.	825	0	0
6 strong copper steam clarifiers 5ft. diameter, with cast-iron steam jackets, gun metal, steam valves and two-way cocks, two copper channels, and copper pipes from discharge cocks	380	0	0
4 wrought-iron bag filters of 60 bags each, with gun metal draw-off cocks, steam cocks, copper main, &c., and one set of bags to each	85	0	0
1 wrought-iron evaporating or clear liquor heating cistern, with copper steam coils, gun metal valve, discharge cock, &c.	30	0	0
1 wrought-iron monte-jus, with gun metal cocks, copper pipes, &c.	410	0	0
8 wrought-iron charcoal filters, stopcocks, &c., copper mains, cocks, &c.			

10 wrought-iron store water tanks, pipes, cocks, &c., steam pipes to all vessels, and sundries	470	0	0
2 30ft. Cornish boilers, mounted, complete	500	0	0
2 open copper clarifiers of 600 imperial gallons each, with discharge cocks, &c., and four open copper pans or teaches of 200, 300, 400, and 600 gallons contents respectively	598	0	0
Total cost	£6,761	0	0

The above estimate may be taken in round figures at £7,000. As will be seen, this does not include Messrs. Pontifex's surface condensers, which if employed add about £600 to the above sum.

Machinery and apparatus such as have been described, and fitted with all the modern improvements, are, it is true, costly in erection; but they very soon pay for themselves, in the superior quality of the article produced, and the greater return for the same quantity of canes. By employing the strong mills and powerful engines as now manufactured, the canes yield a much larger percentage of juice than previously; and the megass leaving the mill being much drier, is in a better condition to be used as fuel. By applying steam heat and boiling *in vacuo* at low temperatures, the colour is improved, and less of the sugar is converted into molasses; so that estates which were formerly worked at a loss may, by the introduction of improved machinery and utensils, be made to yield a profitable return.

ARTICLE V.—IMPROVEMENTS.

A long account might be given of the numerous interesting and curious attempts at improvement in all the various processes of sugar manufacture; but there are two reasons why no detailed statement will be here made of the alterations—otherwise called improvements—which have been proposed from time to time. The first is, that an outline description of them would occupy an evening, and would be out of place in a paper; and the second is, that no practical purpose would be served thereby. It will, therefore, be sufficient to refer to such improvements as have come under the author's notice, and justify a reference by their practical character. In the arrangement of the mill-gearing, Mr. N. P. Burgh, the author of a very practical work on sugar machinery, makes a girder-like frame, or in section as the letter U inverted, the engine used being horizontal. The first motion shaft is on a line with the crank shaft, and the second motion shaft is supported by two plunger blocks, one of which is secured to the engine bed-plate, and the other on the main framing. He argues that a greater stability is obtained by surrounding the gearing with a framing than by any other means. The disconnecting gear is somewhat novel; instead of the square coupling or the disc coupling, a socket is preferred, the shafts of both spur wheels and top roll being fitted with four keys, the socket being made to slide on these keys; corrugations are cast and turned on the surface of the sockets, and by a small spur pinion working into these corrugations, a rotary motion being given to the pinion, the socket slides forward or backward as required.

An improvement on the adjustment of the cane returner is attained by double wedges at each end of the returner, the smaller end of each wedge being screwed; adjustment is produced by turning a nut on each wedge. With reference to vacuum pans it is to be observed that, in most cases, the stop valve of the condenser is secured on the outside in a separate case. Mr. Burgh, however, inserts the valve in the connecting pipe, at the bottom of the condenser. Motion is imparted to the valve by a lever outside the condenser, the connecting rod being inside. By this arrangement simplicity and direct action are attained; also when the valve is closed the water in the condenser assists to render it tight. When the valve is open the water can pass direct from the condenser, while in the ordinary mode the exit must be made at right angles, thus increasing the friction, and reducing the vacuum. For creating a vacuum double-acting horizontal pumps are preferred to the single-acting vertical type, which have to be entirely disarranged for inspecting the foot valves. As the steam cylinder is between the pump and the fly-wheel, and as each set of valves can be inspected by separate doors, simplicity and economy result, and a better vacuum can be maintained.

The use of steam in sugar houses, whether for colonial or home produce, has now become general, and its economical use is a matter of the first importance. Steam at a given pressure occupies a certain space and creates a given

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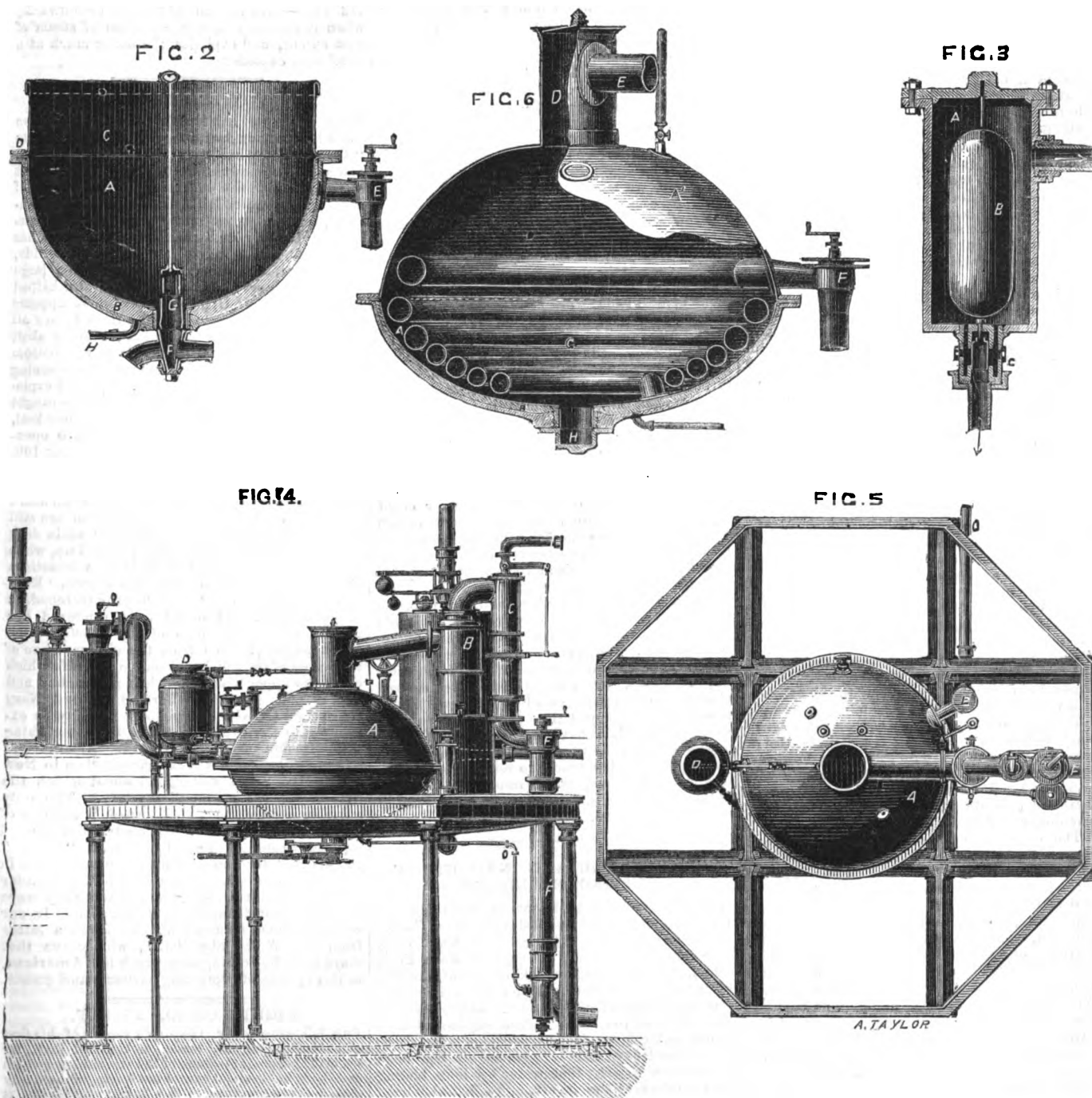


FIG. 4.

FIG. 5.

temperature; hence, in all modern sugar factories the use of the expansion valve is considered imperative. These valves are of various kinds; lever action and spring and weight balances are the most general. Stuffing-boxes create friction, and in the case of the expansion valve the action of the steam causes the reduction of pressure. Now, if the spindle of the valve and the valve itself be acted on by the stuffing-box and the steam a great inequality of action will be the result; valves so arranged require the most critical adjustment. In order to mitigate these evils Mr. Burgh has effected an arrangement whereby stuffing-boxes are dispensed with, and the action of the steam on the valves is rendered nearly neutral. The form of valve used is of the double-beat type; a piston is connected to the valve by rods, and on the steam entering the casing, it passes through and around the valve, and, before its exit, operates on the piston, the latter being regulated by a spiral spring at the back. Hence rods, valves, and piston are within the casing, and the only friction imposed is beyond the steam, and is due to the metallic rings in the piston.

The next improvement will be the "Bour evaporating pan," so named after the inventor, Mr. Bour. While observing the working of the Wetzels pans he found that larger grains of sugar were produced at the ends than in the middle, where the breaking up motions of

the tubes disturbed the formation of the crystals. He then concluded that to dispense with the tubes and make a series of discs over the whole length of the pan would give better grains of sugar all over, and also have a greater amount of heating surface. These pans are now getting well into use in sugar-growing countries, as a very good sugar can be made in them by the ordinary attendants on the estate. The patent has become the property of Messrs. D. Cook and Co., of Glasgow, who appear to be successfully working it. The Bour pan consists of ten hollow discs of copper, mounted on an axis of a form which allows the steam to communicate freely with all the discs, and, at the same time, collects the water resulting from the condensation, and carries it off at one end. In the inside of each disc are two spoons, running from the extreme diameter of disc, and terminating in the axis into which the water is delivered. On the outside of these discs are a number of small buckets, which lift the liquor as the discs move round, and which, being open at the sides, admits of spreading itself as a thin film over the surface, not immersed, which is remarkably favourable for rapid evaporation. Where the Bour pan is used the number of pans in the battery may be reduced, in some cases only three pans being used, and the finishing completed in the Bour pan without any risk of carbonising the sugar, from the ease with which the steam can be regu-

lated to the heat wanted. The speed of the revolver may be from ten to twenty revolutions per minute. Where steam is plentiful equally good sugar is produced by the quick speed, and nearly double the work performed in the same time. In an estate in Penang one of these pans has cooked 12 cwt. of sugar per hour, from 20 deg. Beaumé, as taken from the battery, the temperature never exceeding 170 deg. Fah. The pan may be driven by a small engine, the exhaust steam of which is carried through the pan, or by any convenient arrangement from any other source of power. The exhaust steam from an engine is that generally employed, but direct steam from the boiler through a small pipe may be used, with a regulating cock attached. A safety valve is fixed on the top of the column where the steam enters, which blows off at 2 lb. per square inch; this prevents bursting from over pressure.

We now pass on to notice the valuable invention of Mr. Alfred Fryer, of Manchester (of the firm of Fryer, Benson, and Forster). It is called the concretor, and its object is the more rapid condensation of the syrup. The machine consists of three principal parts—a tray, a cylinder, and a drum. The tray is placed as close as possible to the sugar mill, and receives the juice direct from the rollers. It is of cast iron, 3 ft. long by 6 ft. wide, and 6 in. deep. It is crossed by ribs or ledges, which run from one side nearly

to the other, the vacant spaces being on alternate sides of the tray. It is cast in several lengths, which fit into each other, and should any length be injured it may easily be removed and replaced by a new one. This tray is set up at a gentle slope, so that the juice received at its upper end flows in a continuous stream, not more than about $\frac{1}{2}$ in. deep, backwards and forwards, from side to side to the lower end; the whole length of the passage in the machine itself is 140 yards. Underneath the tray is the furnace, the flame of which spreads evenly along the bottom in a broad sheet, the draught being perfectly clear and uninterrupted. The time occupied in the passage of the juice through the tray is about five minutes, in which short period eleven-sixteenths of the water are driven off, and the juice has already become what is termed "aling."

On leaving the tray the liquor is passed at once into the second part of the machine, called the cylinder. This is of copper, 20ft. long and 3ft. 6in. in diameter, and it is kept slowly turning about six revolutions per minute by a small engine attached for the purpose. The cylinder is partially open at the end, only a narrow ledge being left, retaining a shallow quantity of the liquor in the lowest part, from which the constant revolution of the cylinder carries up a thin pellicle or film of syrup. The outside of the cylinder is heated by waste heat from the tray or its furnace, or both. Through the inside of the cylinder a blast of strongly heated air is driven; however hot this air may be made, it is impossible by its means to burn the syrup, the heat being instantly absorbed by the particles of water, as they are carried off by the blast. By an ingenious arrangement the liquor is continually passed into and removed from the interior of the cylinder. When it is remembered that its inner surface exposes to the drying action of the hot blast a surface of syrup of more than 192 square feet, it is no matter for wonder that the desiccation proceeds very rapidly. On the removal of the liquor after a stay in the cylinder of a very few minutes all possibility of fermentation is at an end, and the concentrated syrup might in this state be safely stored in bottles or casks for shipment. To do this would, however, be to carry with the sugar a small quantity of water, and to incur the risk of leakage. It is, therefore, passed to the third and last part of the machine, called the drum.

The drum is a large cylinder of iron and copper, 4ft. long and 4ft. diameter, heated within by waste steam from the small engine, and the syrup is distributed along its surface. The drum is driven slowly at the rate of two revolutions per minute, and its surface is swept over by a hot blast, which removes from the syrup the last particles of water, thus finishing the formation of the concrete. This is taken off as fast as it is formed by a scraper attached for the purpose. While warm it is plastic, and may be cast into blocks of any convenient shape and size, but it hardens as it cools. In this state it may safely be packed for shipment in bags or matting; it shows no tendency to deliquesce, and of course cannot drain. (A sample of sugar and molasses prepared under the ordinary process, and a sample of concrete from the same juice prepared by Fryer's process, were exhibited.) No lime or other chemical is used, and, as will be observed, no molasses are made. Whatever crystallised sugar is in the cane-juice is also present in the concrete. The colour of the concrete is so good as to be certainly preferred by the refiner to good Muscovado sugar, and its make does away with hogsheads, puncheons, molasses, rum, and curing-houses, while the increase in value and the saving of drainage appear to equal more than £4 sterling per hogshead. The concretor, the cost of which is about £1,000, does its work at the rate of 10 cwt. per hour.

Artificial refrigeration is evidently destined to receive most important industrial applications. Already, in the paraffin oil manufacture, and in the ingenious process by which M. Balard and M. Merle obtain chloride of potassium from sea water, it renders most valuable service, and now, according to a recent statement in the *Mechanics' Magazine*, M. Alvaro Reynoso, of Havana, is applying it to the concentration of syrups. In face of the well-known fact that water, in freezing, becomes completely separated from whatever it may have previously held in solution, and of the successful working of the process by which Carré and others produce any desired degree of cold by mechanical means at a scarcely appreciable cost, one wonders that no one should have thought before of applying

artificial cold to the extraction of sugar from syrups, especially when it is remembered how injurious the action of heat is apt to be. However, M. Reynoso has conceived the idea at last, and is devoting himself energetically to its realisation. He is in England just now, testing the respective merits of the various cold-producing appliances in use here. He has found that a syrup marking only 6 deg. of Beaumé's saccharometer becomes converted by congelation into ice and a syrup of 30 deg. Should it be found that the cold does not injure the syrup, we may look to see great changes in the processes of sugar manufacture.

A few words upon Chinese sugar. It appears that much extra ground has been set apart at Swatow this year for the cultivation of sugar, in consequence of the demand in the north of China for this product. The Chinese method of pressing sugar is most rude. The cane is passed between two perpendicular granite cylinders—one, being turned by oxen, gives a motion to the others by means of cogs cut in the granite, and shod with hard wood; the juice is thus expelled, and runs through a channel cut for that purpose into a large wooden tub, from which it is removed to the boiling hut closely adjoining. These cylinders are not at all firmly fixed, depending altogether upon their weight to keep them in position. A company of Europeans working a modern sugar mill might make a large profit, if the Chinese would consent to sell their crops when ready for cutting. An improved cane mill was imported by an English firm, but the natives refused to purchase or even try it—a fact not to be wondered at when we find people taking a pride in defying all change.

In concluding this section, and, in fact, the paper, the author would observe that he could wish it had been more comparative in its character than it is. But, as an excuse, he pleads the difficulty of obtaining information of practical improvements, by which alone the desired character of the paper could be attained. It is, however, to be hoped that the discussion may elicit facts which have not come within the author's reach. It was originally intended that the paper should embrace the refining processes; this was, however, found impossible, but the author hopes the object may be compassed at some future period.

NORTH OF ENGLAND INSTITUTE OF MINING ENGINEERS.

At the last meeting of the members of this institute, a paper, by Mr. Doubleday, "On the Causes of certain Boiler Explosions," was read. The boiler explosions referred to were those which take place on the rekindling of the fire after breakfast or dinner hours when the water has been at rest for some time. It has been remarked that the most violent explosions take place under these circumstances, and for these Mr. Doubleday thus accounts:—It has been proved, he asserts, that water by long boiling may be deprived of its air, and it has also been proved that water so deprived is a more rapid conductor of heat than ordinary water, which contains a great deal of interspersed air. It has also been proved by Professor Tyndall, amongst others, that this airless water is much more strongly cohesive than ordinary water, and will not boil, or become steam, until heated to a point far above the ordinary boiling point of air-containing water. Water so circumstanced may be heated to more than 100 deg. above the boiling point, 212 deg.; after which, in Professor Tyndall's phrase, "it has an enormous mass of heat stored up. The looked atoms finally part company, but they do so with the violence of a spring which suddenly breaks under strong tension, and the ebullition is converted into explosion." Mr. Doubleday argues that, from the unequal way in which heat is applied to the bottom of a large boiler, some portions of the water within may be deprived of their air, while the mass is not. As long as the boiler is kept in action these airless portions will float about without producing steam; because at 212 deg. they cohere too strongly to become steam. When the fire is drawn, however, these airless portions of the boiler-water, being of a greater specific gravity, fall to the bottom and form a layer, or substratum, of airless water, quite homogeneous, and conducting heat more rapidly than the air-interspersed water above. When the fire is again applied, consequently, this layer becomes heated, as has been shown by M. Donné, and by

Faraday as well as Tyndall, to a point far beyond 212 deg.—probably to 312 deg. or upwards, when it suddenly becomes a mass of steam of vast extent, and explodes the boiler much as a bombshell explodes.

TORPEDO TRIALS.

SINCE the experiments with torpedoes which we recorded in our last, the old wooden frigate "Terpsichore" has been docked at Chatham, and an examination made to ascertain the extent of the injuries she sustained. The work of docking was attended with considerable difficulty, in consequence of the vessel barely floating. A number of barrels were placed on her main deck, and these, on the rising of the tide, helped to increase her buoyancy. Two large mooring lighters at stem and stern also helped her into dock. Upon examination it appears that the injuries effected by the torpedo are all on the starboard side of the hull, slightly abaft of the fore chains, the port side of the bottom showing no injury whatever, except the loosening of a few of the sheets of copper. The full explosive force of the torpedo appears to have caught the frigate about 8ft. upwards from her keel, blowing in her timbers and planking, the opening thus effected being somewhere about 10ft. square. A close examination shows that few of the timbers are broken off, the separation being at their points of junction. Proceeding on board the frigate, the effects of the explosion are still more apparent, the planking of the main deck for a length of above 20ft. being ripped up, while the deck beams are broken in various directions and forced upwards to the upper deck. Even had the explosion not sunk her the tremendous shock she sustained would have rendered her useless, while some idea of the effects of the shock may be formed from the circumstance of the whole of the iron knees on the port side which carry the upper deck beams being wrenched and broken off. The *New York Army and Navy Journal* says that the torpedo Mr. McKay is exhibiting to the British Lords is the same thing which Unshing used to blow up the "Albemarle," and the same which was experimented on in New York harbour last winter, and about which the reporters made so much mystery. The only valuable feature about this torpedo is the use of an air vessel, which was first contrived and used for the mammoth torpedoes called "devils" constructed for blowing up the obstructions in Charleston Harbour. The report of Commander Stevens, who tested one, showed that they were tremendous instruments of destruction. In our correspondence columns will be found a letter from Mr. Willoughby Smith, who states that there is really nothing new, much less American, in this system of protecting harbours and coasts.

NIGHT BALLOON ASCENT.

THE following is Mr. Glaisher's report of his first night balloon ascent, made on the 2nd inst., for scientific purposes:—Some of the experiments which have been made about sunset not having shown any change of temperature to the height of 2,000ft., it seemed probable that the laws holding good by day might be very different, and even reversed, at night. At the recent meeting of the British Association at Birmingham, the Balloon Committee was re-appointed, and was charged with, if possible, to carry out night experiments up to moderate elevations. The balloon at present at my command for these experiments is that belonging to Mr. R. Orton, of Blackwall, and it was with this balloon, under his management, that this ascent was made. The instruments were read by means of a well-constructed Davy miners' lamp, made by Mr. Watson, of New-castle-on-Tyne, with which careful experiments had previously been made to satisfy the committee of its safe use in a balloon.

On Monday, the 2nd of October, when the sun had set for nearly three-fourths of an hour, and night had fairly closed in, the moon shining, and the wind passing from the E.S.E., we left Woolwich Arsenal about 6.20 p.m. Within three or four minutes a height of 900ft. was reached, and here the scene which suddenly burst on me, having been previously occupied in adjusting the instruments, far exceeds description; almost immediately under was Woolwich, north was Blackwall, the Commercial-road, south, Greenwich and Deptford; and west, as far and farther than the eye could reach, was London; the whole forming a starry spectacle of such brilliancy as far to exceed anything I ever saw. When I have been at this elevation in the evening at a distance from London, it has had the appearance of a vast conflagration; but, now, the air was so clear and free from mist, that each and every light was distinct, and apparently all but touching each other.

The whole of Woolwich, Blackwall, Deptford, and Greenwich could be traced as a perfect model by the boundary lines of lights of their streets, squares, &c. In nine minutes we were crossing Blackwall Reach and opposite Brunswick-pier, then passed across the Isle of Dogs, Greenwich Reach, thence up the river Thames. As we advanced towards London the mass of illumination increased in intensity; at 6.42 the South-Eastern Railway Terminus at London Bridge was directly under us; looking southward at this time we saw the Borough stretching far away, the many streets shooting from it, particularly Southwark-street with its graceful curve of lamps. In one minute afterwards we were over Southwark Bridge; passed Blackfriars Bridge at 6.45, Charing Cross at 6.47. On leaving Charing Cross I looked east over London. The whole of London could be seen and traced. Its squares were distinguished by their lights; the river, which looked dark and dull, by the double row of curved lights on every bridge, spanning it. Looking round, two of the illuminated dials of the Westminster clock were like two dull moons. Again, looking eastward, the whole line of Commercial and Whitechapel-roads, with their continuation through Holborn to Oxford-street, were visible, and were most brilliant and remarkable. We were at such a distance that they appeared like lines of brilliant fire, assuming a more imposing appearance when the line separated into two about Holborn, and most imposing just under us in Oxford-street. Here the two thickly-studded rows of brilliant lights were seen on either side of the street with a dark space between them, but which dark space was bounded, as it were, on both sides by a bright fringe of frosted silver. I at first could not account for this appearance, but presently at one point more brilliant than the rest persons were seen passing to and fro with their shadows on the pavement, and at once it was evident this rich effect was caused by the bright illumination of the shoplights on the pavements. All the principal streets assumed this appearance.

I feel it impossible to convey any adequate idea of the brilliant effect of London, viewed at an elevation of 1,000ft. on a clear night, with the air free from mist. It seems to me to realise a wish I have often felt when looking through a telescope directed to the Milky Way, when the whole field of view appeared covered with gold dust, to be possessed of the power to see these many spots of light, as brilliant stars, for certainly the intense brilliancy of London this night would have rivalled the brilliancy of such a telescopic view of brilliant clusters of stars. We were over the Marble Arch at 6.51, about eleven miles in a straight line from Woolwich, which distance had been passed in half an hour. We therefore were travelling at more than twenty miles per hour. On passing onwards, we left the Edgware-road on our right and the Great Western Railway on our left, and passed nearly down the Harrow-road. In six or seven minutes, we left the suburbs of London, passing over Middlesex in the direction of Uxbridge. Here the contrast was great, indeed; not a single object could anywhere be seen, not a sound reached the ear, the roar of London was lost. The moon was shining, but seemed to give no light, and the earth seemed a black obscurity; after a time the moon seemed to shine with increased brightness, the fields gradually came into view, then the shadow of the balloon was seen distinctly pointing out our path, in reference to the polestar and the moon. After this occasional masses of lights appeared as we passed over or near towns and villages, from all of which cries came up urging us to come down. At 7.18, while passing a town, we came down to inquire where we were, but our voices were drowned by the beating of drums. Then we passed out of Middlesex, over parts of Buckinghamshire and Berkshire to High Moor, in Oxfordshire, where we descended to the farm of Mr. Reeves at 8.20, a place distant about forty-five miles from Woolwich; the horizontal movement of the air at Greenwich in the same time was registered as 16 miles.

The temperature of the air at Woolwich, as determined by Mr. Howe and myself, was 61.2 deg. at half-past 5, and 56 deg. at 6.20; it immediately increased on leaving, and had passed above 57 deg. when about 900ft. high. The difficulty I experienced in reading the instruments was so great that several minutes were lost in vain attempts to do so. At the height of 1,100ft. the temperature was 58.2 deg., and it increased with increase of elevation, till at 2,000ft. it was as high as 60 deg., or about 4 deg. higher than when the earth was left. On descending the temperature declined to 57 deg. at 600ft. high; after this spaces of 500ft. to 600ft. were repeatedly passed, and the highest temperature was met with at the highest points.

At the Royal Observatory, Greenwich, Mr. Nash superintended a series of experiments; the temperature here at 6.20 was 59.9 deg., and at 8.30 was 53.2 deg. From this it would seem that at 6.20 the air at Woolwich was 3.9 deg. colder than at Greenwich; and if the readings at Greenwich be compared with those in the balloon, the amount of increase with elevation is lessened. The self-registering minimum thermometers were tied down, the one with its bulb resting on a bed of cotton wool, fully exposed to the sky, and the other with its bulb pro-

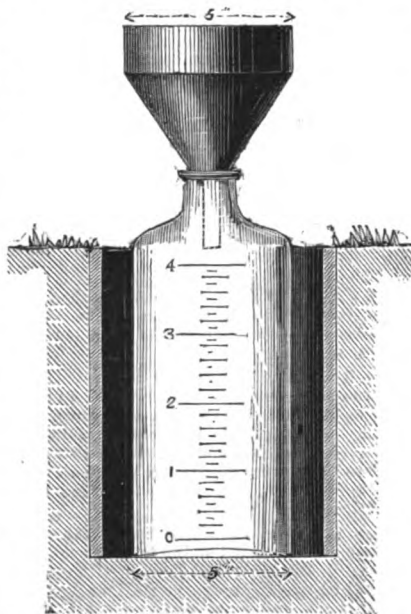
jecting beyond the supporting frame, their indexes were at the end of the spirit column, or at 56 deg. At every examination of each of these instruments, a space was found between its index (which remained unmoved) and the end of the column of spirit, which indicated a temperature closely approximating to that of the temperature of the air. Finding this I removed and replaced the silver caps placed over the dry and wet bulb thermometers, but found their presence or absence exercised no influence on their readings. At the Royal Observatory, Greenwich, the thermometer for radiation read from 6 deg. to 7 deg. below that for the temperature of the air during the whole time the balloon was in the air. The temperature at which dew was deposited at about the height of 1,000ft. in the early part of the ascent was from 1 deg. to 2 deg. below that of the air, and at about the same elevation was from 3 deg. to 4 deg. at the late part of the ascent. At Greenwich the depression below that of the air at 6.30 was 2.4 deg., and at 8.30 was less than half a degree. The degree of humidity of the air—considering air completely saturated represented by 100—at the beginning of the ascent in the balloon was 95; at Greenwich was 84; towards the end of the ascent was, in the balloon, 85; and at Greenwich, 97. The state of things was completely reversed, and would indicate that the water in the air had descended; its amount at the beginning of the ascent was 5.4 grains in a cubic foot of air, and at the same elevation, towards the end, was 4.4 grains. No ozone was shown at Greenwich, but in the balloon paper tests were coloured to 4, on a scale of greatest intensity being considered 10. The readings of the instruments were taken very slowly owing to the smallness of the car; the difficulty of directing the light on the instruments; the painfully constrained position necessary to read them at all. I failed entirely in my attempts at magnetical experiments—indeed, in all, excepting those relating to the temperature and humidity of the air.

Correspondence.

RAIN GAUGES.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—I beg to enclose a sketch of a rain gauge bottle, which I think if adapted with a Howard's 5-inch funnel, would save a great amount of trouble, and be more accurate, than Mr. Symonds' present plan, of measuring the water by a separate glass.



I propose a bottle capable of holding say one month's rainfall, and it would be better if the internal diameter of the bottle corresponded with the diameter of the funnel; the side of the bottle should be marked off in inches and tenths, so that a person has merely to take up the bottle and read off each day or week the amount of rain fallen. I am not sure if this plan has been already adopted, but I think it would be preferable to the present plan of measuring by a separate glass.

Yours obediently,
E. H. CLARK.

Great Grimsby Docks, Lincolnshire,
October 7.

[The gauge used by the Manchester, Sheffield, and Lincolnshire Railway Company, on the Peak Forest and Macclesfield Canals, is similar to the above, but the bottle is not graduated, the water having to be poured into a graduated vessel for measurement. The above is therefore an improvement.—Ed. M. M.]

WATERING CATTLE WAGGONS.

SIR,—I observe a letter in your issue of the 6th inst., signed "A. J.," on the necessity of watering live stock while on a journey by rail. The method he suggests for effecting this is good so far as it goes, only I fear such an arrangement would fail to answer the purpose in anything like as efficient a manner as troughs attached to trucks. In the first place, twenty trucks are considered a special train, covering over 400ft. of rail. What an unwieldy machine, then, a trough of 400ft. long would be! To water on "A. J.'s" plan, two such troughs would be required, and at each side of the train thirty pillars, or davits, would be wanted for their support, besides as many pulleys, blocks, and tackles, with about ten men on each side, to raise and lower this complicated and ponderous machine. The present trucks would require to be altered to allow the cattle to get their heads at the water, and the ends of the trucks would be altogether unrepresented by troughs. There is also the additional expense of a separate water tank and hose at every watering station, whereas troughs can be attached to trucks, at a mere nominal expense, and can be supplied with water by the present hose, from the tank that supplies the engine, by running the train slowly past. By the pressure of the hand of the party directing the hose into the troughs, the loss of time, so much dreaded by "A. J.," in passing the doors and couplings of the waggons, is obviated. Thus no stop is really necessary for a long train, as the quantity of water each truck requires is very small. The troughs are so constructed that when attached to the waggon, the water flows all round from door to door, and allows the cattle to drink with ease at both sides and ends. The troughs may be afterwards used for feeding, which plan could not be adopted with stationary troughs. The great expense of erecting and maintaining stationary troughs is sufficient to prevent their adoption, whilst from the complication of the whole affair, it would always be getting out of order. In frosty weather the ropes would not work, and one end of the machine might be pulled up before the other, thus upsetting all the water, and drenching those about it. Troughs attached to trucks are the only reasonable means by which cattle can be watered and fed when on a journey by rail. The general construction of trucks may be very much improved. Trucks with a centre division could have a trough on each side, each end being divided into stalls, the heads of the cattle being towards the centre; the doors would require to be placed at the ends. Cattle must be fed, as well as watered, when the journey exceeds twenty-four hours. When the line of rail is open from Thurston to London, the journey will occupy four days, and no live stock could live and thrive afterwards, if kept without water and food all that time.

I am, yours, &c.,

October 7.

W. R.

TORPEDOES.

SIR,—If I understand correctly the experiments made by Mr. Beardslee with torpedoes in Gillingham Reach on the 4th inst. (particulars of which are given in the last number of your Magazine), he simply attached cases containing large quantities of gunpowder beneath the "Terpsichore," and at a given signal exploded the same by means of electricity. The result of course was the destruction of the ship, and we are informed that "the experiment fully demonstrated the great destructive power of the American torpedoes." Now, Sir, there is really nothing new, much less American, in this system of protecting harbours, &c., against a hostile fleet. As far back as 1851, when the Gutta-percha Company first called attention to their newly discovered fuse, with which gunpowder could be exploded at any distance under water, a series of experiments were made at their works in the presence of several scientific gentlemen. In one of the experiments a charge of gunpowder attached to the end of an insulated wire, no less than forty miles long, submerged in the Regent's Canal, was exploded by the fuse in connection with a voltaic battery.

The result of these experiments was recorded at the time in the "Army and Navy Register," with the following observations appended:—"The discovery is also applicable to naval purposes, as it explodes powder under water at any depth, and would be admirably adapted to the protection of harbours, as cases of powder, sufficiently large to blow up the largest ships of war, might be sunk sufficient for concealment, and fired at the time they would be sure to have effect." Unless Mr. Beardslee possess the means by which he could attach torpedoes to hostile ships, I contend that there is nothing new in his system, and it ought not to be entertained as such by our Government.

I am, Sir, your obedient servant,
Gutta-percha Works, WILLOUGHBY SMITH.
October 10.

By order of the King of Sweden, experiments with submarine infernal machines are about to be tried on the old ship of the line "Charles XIII."

Greeting for the Week.

Mon.—Society of Engineers.—Discussion on Mr. Nurey's paper on "Sugar Machinery," &c.

TO CORRESPONDENTS.

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

Advertisements are inserted in the *MECHANICS' MAGAZINE* at the rate of 6d. per line, or 5d. per line for 5 insertions, 4d. per line for 12 insertions, 4d. for 16 insertions; and 4d. a line for 32 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.—J. N.—Messrs. M. and Co.—W. R.—T. W.—J. H. E.—J. S. and Co.—J. N.—W. R.—E. H. O.—J. E.—J. N.—E. A. O.—J. P.—F. O. R.—T. W.

Miscellaneous.

The directors of the Atlantic Telegraph Company feeling themselves strengthened by the results of the late expedition, have issued proposals for a further amount of capital. Very favourable arrangements have been entered into with the Telegraph Construction and Maintenance Company for the manufacture and laying of a new cable next year. In the event of success the company will be in possession of two efficient cables for a less amount than if the last cable had been successfully laid and another had been purchased separately. Subscriptions are therefore invited for £200,000, in 120,000 shares of £5 each. Existing shareholders will have a priority in the allotment to the extent of 60,000 shares if they apply before the 26th inst.; the remaining 60,000 shares are offered to the general public. This new issue of shares will be entitled to a first preferential dividend of 12 per cent. per annum over all the other capital of the company.

According to an American telegram, Captain Hall has written from the Arctic regions, under the date of December, 1864, announcing that he had received information from the natives, by which he was induced to believe that there may yet be three survivors of Franklin's expedition, including Capt. Crozier, who succeeded to the command on Sir John's death.

As at present arranged Mr. Winans' cigar ship will be launched from the premises of her builders, Messrs. Hepworth, Millwall, on the 19th inst. This novel addition to our naval architecture is, we understand, to be succeeded by another experimental vessel on an entirely new principle, and which is about to be laid down by an eminent shipbuilding firm or the projectors, who have patented the invention. It is described as the light draught roller ship, or water chariot. The principle consists in supporting a car or vessel above the water level on axles or shafts passing through rotary hollow drums or cylinders, which are made to revolve by steam or other motive power. This car or vessel, constructed to carry passengers and freight, is supported by the buoyancy of the drums, and kept suspended above the water level. The advantages of the invention are said to consist in increased speed at a much less expenditure of motive power and fuel, and from the light draught of water greater safety from shoals, rocks, &c. Should the theory prove successful on its practical application it will be highly useful for the navigation of creeks and rivers, where vessels requiring any considerable depth of water cannot be used.

It is stated that the search for coal at Thirkley, near Thirsk, has proved successful, and that measures are about to be taken for bringing the mineral into working. Should the working prove profitable a remarkable change will come over that part of the North Riding.

An American exchange states that a new mineral of lead has been discovered in Chili, containing 10 per cent. of iodine. Iodine has lately become very valuable, on account of its extensive use in photography, and of the discovery, by Dr. Hofmann, of a new dye, having this element among its constituents. It is said that one cargo of the new mineral will represent a fortune. As a further illustration of the progress that mining adventure is making in South America, a mine of bismuth ore has recently been opened in Bolivia, about two-thirds up the highest of all the peaks of the Andes—the Ijampa Mountain. Bismuth, also, has lately increased in value; and 15,000ft. above the level of the ocean, only slightly beneath the line of perpetual snow, men are setting to work to obtain it.

A German named Bonn has discovered a means of making air additionally useful to the world. The humus, or upper mould, is well known to be the cream of the earth, and the product of the atmosphere acting on animal and vegetable matter for centuries. Deep ploughing, however, being expensive, is not much resorted to, hence, the really valuable soil is but in proportion to the earth as cream is to milk. According to the *Warrington Guardian* it is proposed to introduce air into the earth by means of pipes, with narrow apertures, laid from 8ft. to 8ft. deep, all leading to one huge hearth, upon which a fire will constantly burn, and consequently draw the atmosphere through the pipes, dispersing oxygen about the roots of everything growing above. To make the idea complete we would suggest that a fire be kindled at each end of the pipes, so that in cold wet seasons the air may be turned on hot and dry, to take the place of sunshine. Of course the pipes must taper, or both fires would pull alike. Perhaps underground watering may yet be performed by the same means.

M. Payen has just made a communication to the Academy of Sciences on iodide of potassium, in which he showed that the starch granules swollen under the influence of the neutral iodine are coloured an intense violet by a slight excess of iodine. Under the influence of this agent, the granules seem to contract, separate as flocculi, and fall to the bottom of the vessel. A curious fact pointed out by the author is, that, on crystallising a solution of iodide of potassium containing a slight excess of iodine, the whole of the latter is taken out by the crystals, the mother-liquor containing none.

We understand that the flying machine which has been in process of construction in Jersey City, and which has been incorrectly called the Government flying machine, as the Government had nothing to do with it, has been completed and tried. The result, however, was complete failure, as it could not be persuaded to leave the ground.

An ingenious piece of parlour magic has lately been introduced into Paris. According to the *Chemical News*, a pastille is placed on a plate, a light is applied, and in a moment the pastille swells up and seems to uncoil itself, and something very much resembling a snake appears on the plate. The preparation made use of is sulphocyanide of mercury (mercurous sulphocyanide), which swells up when heated, and gives a very bulky laminated mass. Some nitrate of potash is mixed with the sulphocyanide, so that the heat may be applied within the mass, and the snake-like appearance of the residue is caused by the form in which the mixture is made up. Since vapour of mercury is given off in the combustion, it will not be advisable to repeat this experiment many times in one evening in a small room.

It appears that the trial of the two vessels—the "Winoski" for the Navy Department, and the "Algonquin" for Mr. E. N. Dickerson—has not yet begun in earnest. There have been some preliminary experiments. On the 26-hour trial the conditions are, that each vessel, having the same sized wheel and draught of water, shall receive 1,600lb. of coal per hour, and make fifteen revolutions per minute. Of course the engine that can make this speed with the least fuel will be the victor. This point being decided, the vessels will proceed to Sand's Point, and run from thence three times around Fisher's Island, a distance of about 750 miles; then the contest will be ended and the result made public.

The Academy of Sciences is inundated by documents signed by medical authorities from all parts of the empire as to the cholera. Dr. Burg, who has so long advocated the influence of metals on the nervous system, has gone to Toulon to see what powdered copper taken internally, and discs of that metal applied externally, can do towards mitigating the violence of the malady.

There are at present 150 lifeboats on the coasts of the United Kingdom belonging to the Royal National Lifeboat Institution, and 35 to local boards. The mortar and rocket apparatus stations now number 243, and are under the management of the coast guard and the Board of Trade. During the year 1864 and the first eight months of 1865, 627 lives (besides 28 vessels) were saved by the lifeboats of the National Institution alone, and 895 by shore boats and other means, for which it granted rewards. A sum of £2,297 was expended by the Institution in the same period in rewards; and £34,128 on its various establishments round the coasts of the British Isles. In the presence of facts like these, the Lifeboat Institution need have no misgiving in respect to pecuniary support, whilst it pursues vigorously and successfully the great and national objects for the promotion of which it was established more than forty years ago.

Professor Church has found an answer to the question, have we any ready method of selecting corn for seed, so as to enable us to get a larger and better crop? He recommends the use of the densest grains for seed. The following is the process by which the Professor separated the grains according to their density. The wheat was first wetted

with a solution of mercuric chloride to remove the adherent air. They were then partially dried with a cloth. The seed was then placed in a capacious cylinder, and several gallons of a solution of chloride of calcium, sp. gr. 1.247 poured upon it. The liquid was gently stirred for a few minutes, the seed allowed time for subsidence, and the floating grains finally removed in a perforated ladle. The denser seed was then separated, washed, and dried.

Mr. Mayall's life-size photograph of the poet laureate, which has been exhibited at Dublin and has been freely spoken of as an illustration of a new phase in the interesting art of photography—viz., the power of obtaining any sized picture up to the life size from a very small negative, has won for the artist the distinction of a medal from the jurors of the Fine Arts Section of the Dublin Exhibition. The medal is awarded for that and for "skilful manipulation."

On Friday afternoon last the largest iron screw-steamer ever built in Hartlepool was launched from the yard of Messrs. Richardson, Denton, Duck, and Co. The launch was a most successful one, notwithstanding that one of the check chains snapped and the vessel was brought up by one chain alone. The dimensions of the steamer, which is named the "King of the Greeks" are—length over all, 238ft.; breadth, 33ft. 9in.; depth, 25ft. 3in.; and the tonnage is 1,684 tons, and burthen 3,500. She will be fitted up with engines of 300-horse power by Messrs. Richardson and Sons, of Middleton, and she has received the highest class at Lloyd's.

A ministerial order has been issued in France that only utensils tinned with pure tin should be used in the military hospitals, and M. Jeannel gives the following process for detecting small quantities of lead in tin. He treats five decigrammes of the metal filed off with an excess of nitric acid diluted with three times its weight of water, boils the mixture, filters, and then drops into the solution a crystal of iodide of potassium. If only one ten-thousandth of lead is present, a yellow precipitate is formed, which does not disappear on adding an excess of ammonia.

A few months since we noticed the circumstance of pigs being fed on coal. It now appears as if humanity was destined to thrive upon the same kind of food. Dr. Dyes, chief physician to the Regiment of Hussars of the Royal Guard of Hanover, having observed that sea-coal given to pigs made them grow fat, conceived the idea that its therapeutic effects on man might be equally advantageous. He therefore administered some to such of his patients as complained of abdominal affections, and is said to have obtained excellent and speedy results from this treatment. The sort of coal he prescribes, is the Piesberge anthracite, which is found in large quantities near Osnabruck.

To facilitate the tedious operation of shelling beans and peas, the *Scientific American* tells us that a Mr. Price has invented a machine. The details are simple enough, being merely a pair of rollers covered with india-rubber, similar to those used in wringing machines, and mounted in a wooden frame, in the same general way. These rollers are connected by gearing with a shaft and crank, so that when the same is turned the rollers will revolve also. In the bottom of the compartment, in which the rollers work, there are holes. These holes let the peas and beans fall into the drawer below. By turning the rollers, the pods are drawn in, and the compression causes them to burst open and deliver the peas on the other side in good order.

Within the last two years M. Dubouché Soleil has applied with great success one of the most complicated laws of light—viz., polarised light—to the commercial estimation of the various qualities of sugars. By this process the sugar refiner, or any other person interested in that product, is enabled to ascertain in half an hour exactly the amount of crystallised sugar there is in a given sample, as compared with the quantity of non-crystallisable, or what is commonly called treacle. M. Dubouché Soleil's apparatus is considered so accurate that the French Government has adopted it to determine the value of raw sugars imported into the country, and the customs duties are levied upon the results given by this instrument. This apparatus, called "Polarising Saccharometer," is based on the peculiar property which light has when polarised, or when its rays are received at an angle of 33 deg. 25 min. on a plate of tourmaline or a mirror. M. Dubouché Soleil's apparatus enables him to work with polarised light, which presents the various colours of the spectrum in such a way as to enable him thereby to determine the amount of crystallisable sugar in any given quantity of the article sufficiently accurately for all commercial purposes.

It is expected that the alteration to the "Bellero-phon" will occupy at least six weeks, when she will leave Chatham for Sheerness to make a second trial trip, in order that the effect of the change made in her may be ascertained. She will be tried with two blades to the screw-propeller, instead of with four as on the first trial.

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.—724, 734, 767, 778
ORCHESTRY AND PHOTOGRAPHY.—727, 729, 732, 765, 788, 797
CULTIVATION OF THE SOIL. including agricultural implements and machines.—739, 742

ELECTRICAL APPARATUS.—749, 775

FIBROUS FABRICS, including machinery for treating fibres, pulp, paper, &c.,—780, 785, 789, 792, 793, 798, 774
FOOD AND BEVERAGES, including apparatus for preparing food for men and animals.—760, 770, 792, 793

FURNITURE AND APPAREL, including household utensils, time-keepers, jewellery, musical instruments, &c.—725, 726, 728, 733, 741, 746, 747, 752, 758, 764, 768, 769, 773, 776, 784, 786

GENERAL MACHINERY.—737, 744, 754, 757, 761, 781, 782, 785, 789, 792, 794, 795, 796

HEATING, AND VENTILATING.—753, 755

METALS, including apparatus for their manufacture.—736, 777, 779

MISCELLANEOUS.—730

ROADS AND VEHICLES, including railway plant and carriages, saddlery, and harness, &c.—738, 740, 745, 780

SHIPS AND BOATS, including their fittings.—787

STEAM ENGINES, &c.—731, 743, 748, 751, 771

WARFARE.—772, 783, 790

734 T. KENNEDY. *Improvements in apparatus for smoke vents or chimneys.* Dated March 15, 1865.

This invention consists in fitting smoke vents or chimneys with apparatus of a permanent character. For this purpose a spindle with a pulley loose upon it is fixed in the top of the smoke vent, and an endless chain is passed round the pulley long enough to reach the bottom, where, when not in use, it can be brought upon a hook. When required for sweeping or cleaning the chimney, a broom can be fixed to the chain and worked up and down. *Patent abandoned.*

735 H. OWEN. *Improvements in the manufacture of stockings and other articles of hosiery.* Dated March 15, 1865.

This invention refers to a former patent dated 24th January, 1859 (No. 223), and consists in the insertion at each edge, course or seam in or at the time of making of articles of hosiery of two or more draw threads of any strong material, and which can be withdrawn therefrom without disturbing the remainder of the article, the worn parts being thereby separated. *Patent completed.*

736 H. CHREVOS. *Improvements in keyless watches.* Dated March 15, 1865.

This invention consists, essentially, in actuating the winding square by means of the handle or bow of the watch. *Patent completed.*

737 W. E. NEWTON. *Improvements in distilling oils and other liquids from coal and other substances.* (A communication.) Dated March 15, 1865.

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

738 E. LOTHEI. *Improvements in the construction of safes or receptacles for securing and protecting valuable property.* Dated March 15, 1865.

This invention consists in protecting the entrance to the safe with a movable steel wall, which, when released from the bolts which retain it in its place, may be moved laterally so as to uncover the opening or entrance. *Patent abandoned.*

739 A. F. FAIR. *Improvements in obtaining sulphurous acid.* Dated March 15, 1865.

The patentee claims obtaining sulphurous acid from mixed gases, and the separation and utilization of the same by effecting the absorption or solution of sulphurous acid in water, or in a solution of sulphites, or in water holding in suspension sulphites capable of absorbing the sulphurous acid gas, and of disengaging the same when the temperature of the solution is elevated, or when subjected to the action of a vacuum, either at the ordinary or at elevated temperatures. *Patent completed.*

740 J. F. BIRNIE. *Improvements in apparatus for cooling animal and other charcoal.* Dated March 15, 1865.

This invention consists, by one arrangement, of a spiral or volute conduit of any convenient sectional form and number of convolutions, which is attached to the discharging end of a revolving retort, and communicates with the interior of such retort by an opening or first coil of the volute. As the retort revolves, the charcoal is discharged into the mouth of the first coil of the volute, and by the continuous revolution of the retort and volute it is caused to travel the entire length of such volute, and is finally discharged at the outer end of the last coil thereof (which may or may not be provided with a door as required) in a sufficiently cool state, so as to be injuriously affected by contact with the atmosphere. *Patent completed.*

741 H. BIRNIE. *Improvements in gas engines.* Dated March 15, 1865.

Here the inventor fires the charges by vapour, which burns spontaneously in coming in contact with the air. We cannot give the details here. *Patent abandoned.*

742 C. MORRIS. *Improvements in treating and purifying oils and fats.* Dated March 15, 1865.

According to this invention the oil or fat is placed in an open pan or vessel, and is subjected to the action of streams of free steam and of lime in the state of powder, or mixed with water (milk of lime) till the viscous matters are seen to separate, and then the oil or fat is strained. *Patent abandoned.*

743 G. T. BOUSFIELD. *Improvements in mail and despatch bags, and bags for other similar uses.* (A communication.) Dated March 15, 1865.

The principal feature of this invention is in forming a "false mouth" (as the inventor terms it) in the interior of mail bags, &c., made of waterproof material, so that it can be rolled up tightly and secured by straps, &c., from rain and wet. *Patent abandoned.*

734 S. B. BOULTON. *Improvements in the means and apparatus employed for treating timber with antiseptic or preservative fluids, also applicable to other purposes.* Dated March 15, 1865.

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

736 J. RAMSBOTTOM. *Improvements in machinery for rolling and shaping metals.* Dated March 15, 1865.

This invention refers to a previous patent dated 13th April, 1863 (No. 934), and consists under one modification in the application of a reciprocating frame or truck mounted upon rails, or otherwise, to the back of the segmental rolls described in the specification of the above-named patent, the object of which is to receive the article that has passed between the rolls, and to return it within the aid of manual labour when the direction of the rolls is reversed. For this purpose the truck or frame is weighted to hold it near to the rolls, except when, pushed back by the article under operation. *Patent completed.*

737 J. FAIRER and E. BOOTH. *Improvements in machinery and apparatus for mining or working coal and other minerals.* Dated March 15, 1865.

This invention consists in the application of steam, compressed air, or other elastic fluid, for the purpose of working a slotting tool or cutter to and fro, so as to produce a steady and constant action thereof upon the face of the coal or other minerals. This to-and-fro motion of the reciprocating tool or cutter produces horizontal or longitudinal grooves or narrow outtings to any desired extent, and at any desired level in the face or end of the coal or other substance to be acted upon, and thus facilitates its removal from the roof and floor of the mine. *Patent completed.*

738 W. LORDER. *Improvements in the permanent way of railways.* (A communication.) Dated March 15, 1865.

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

739 J. SHAMAM. *Improvements in harrows, drags, cultivators, and other similar implements to be used in the cultivation of the soil.* Dated March 15, 1865.

Here the inventor makes the beams of implements above named of two bars placed edgewise side by side, and held together by a square or other shaped ferrule through which the bars are passed. Between these bars and through holes made for that purpose in the ferrule is drawn the tooth, tine, or shank of the wearing part of the implement, according as it is intended to be used as a harrow, drag, or cultivator, thus securing the parts together. This peculiar mode of combining together the bars, ferrule, and tooth, or tine involves the principle of a trussed beam in the formation of the slings and straight beamed harrows, and constitutes the main feature of the invention. *Patent completed.*

740 R. BELL. *Improvements in working railway signals, and in the machinery or apparatus connected therewith.* Dated March 15, 1865.

This invention consists in a method of arranging the lever handles for working points, and station and distant signals, in one frame, and so connecting them as to prevent contrary signals being given at points of junction, or safety signals when the points are not right for a train passing the junction. *Patent completed.*

741 W. BROOKES. *Improvements in musical instruments.* (A communication.) Dated March 15, 1865.

This invention relates to a new system of pistons which the inventor calls equitonic, giving the perfection of justness in instruments with four pistons, as the basses or euphoniums. It is well known that with the ordinary system of pistons the following notes F, E, Eb, D, and Db, in the lower octave of those instruments are always bad, and almost impossible to be obtained, because the slides of the three pistons were not in the right proportion to the extra length given to the instrument when the fourth piston is put in motion. The present invention obviates this inconvenience. The equitonic pistons are provided with two passages of air and two sets of slides. When playing in the medium and upper notes of the instruments it is only necessary to use the three pistons, as in all the regular brass instruments, and the air coming from the mouthpiece tube passes in its regular way, but when playing in the low notes of the instruments, and when using the fourth piston, the air passes in the two columns of air and the two sets of slides, and by that means the notes above mentioned have in the instrument their proper length, and, consequently, may be obtained perfect in tune. *Patent completed.*

742 J. MARSHALL. *Improvements in combined apparatus for threshing, dressing, and grinding grain and other agricultural produce.* Dated March 15, 1865.

This invention consists in the construction in one machine of grinding apparatus such as or similar to that described in the specification of a patent granted to J. Ross, dated 29th of April, 1862 (No. 1,253), with ordinary apparatus for threshing and dressing grain and other agricultural produce. The object of this invention is to combine the said apparatus in one machine in such a manner as to provide a communication between the threshing and dressing apparatus and the grinding apparatus, which may be either opened for the purpose of passing the material under operation from the threshing and dressing apparatus to the grinding apparatus, or closed so as to allow such part of the machine to be worked independently of the other. For this purpose the ordinary threshing and dressing apparatus, and the grinding apparatus, are combined in one machine, the revolving separating screen of the first-named apparatus being fixed over the grinding apparatus, and the hopper of the latter being so placed as to be capable of receiving the material intended to be ground where the grinding apparatus is used separately. The means of communication between the two sets of apparatus for the purpose referred to consist of two valves, the pivots of which are fixed between apertures leading from the threshing and dressing apparatus out of the machine, and other apertures leading into the grinding apparatus, so that, by one simultaneous movement of the two valves on their pivots, they are caused to open the apertures leading to the grinding apparatus and close the exit apertures of the threshing and dressing apparatus, and by a simultaneous movement of the valves in another direction the apertures leading to the grinding apparatus are or may be closed and the exit apertures of the threshing and dressing apparatus opened. *Patent abandoned.*

743 A. V. NEWTON. *Improvements in the construction of steam generators and evaporators.* (A communication.) Dated March 15, 1865.

This invention consists, first, in a peculiar construction and arrangement of the boiler, whereby, in lieu of a large amount of water being exposed at one and the same time to the action of the heat from the furnace, as has heretofore been the case, only a small or comparatively small portion is exposed to the same, thus causing steam to be more quickly and expeditiously generated; second, in forming the fire-grate of the furnace of a coil or coils of pipes into which water is passed through any suitable connecting pipe, and by the heat of the furnace converted into steam, and as fast as formed conveyed into the steam chamber of the boiler. *Patent completed.*

744 J. STANDFIELD. *Improvements in differential wheel gearing.* Dated March 15, 1865.

This invention consists in certain novel arrangements and combinations of wheels, and of parts connected therewith (which we cannot here fully describe), forming a differential gear apparatus, which is applicable generally for transmitting motion and for imparting either increased or diminished power or speed to the machinery, apparatus, or parts actuated by it. *Patent abandoned.*

745 H. A. BOWSERVILLE. *Improvements in railway brakes.* (A communication.) Dated March 15, 1865.

This invention consists in the application of compressed air as a means of stopping railway trains by combining pneumatic (air) pumps with a reservoir placed upon a small one-axled truck, which is fixed in front of the locomotive, or forms part of the same. *Patent completed.*

746 O. A. WHEELER. *An improved apparatus combining a pencil shield and india-rubber.* Dated March 15, 1865.

This apparatus consists of a split tube open at one end for inserting the point of the pencil, and closed at the other, so that when the pencil is pushed home, the point shall come in contact with the closed end, and thereby prevent its being broken by projecting beyond. When the pencil is required for use, it is withdrawn from the sheath and the unclosed end inserted therein. A band of india-rubber is also placed round the closed end at or near the top, as may be found most convenient, so as to be at hand when required. *Patent abandoned.*

747 H. WETHERED. *Heating preparatory to and for the purpose of hardening or tempering of knives, files, tools, and all other descriptions of cutlery or hardware usually subject to the process of hardening or tempering.* Dated March 15, 1865.

This invention consists in inserting and placing steel or iron bars, files, knives, tools, and all and every other description of cutlery or hardware usually subjected to the process of hardening, tempering, or heating, for the purposes of manufacture, in or upon tubes, trunks, pipes, or ovens (whether fixed, movable, or otherwise), of iron, or any other suitable metal or substance, and placing the said tubes, trunks, pipes, or ovens immediately over or in connection with a furnace or furnaces, and so that the same tubes, trunks, pipes, or ovens coming immediately over or upon the fire impart to the said steel or iron bars, files, knives, tools, or other cutlery inserted or placed therein or thereupon, a strong and uniform heat, avoiding thereby contact of the same with coal, coke, fuel, or other deleterious matter, and rendering them cleaner and fitter for the purpose of hardening, tempering, or heating for manufacture than any other method now in use. *Patent abandoned.*

748 B. LAWRENCE. *Improvements in increasing the mechanical value of steam as a motive agent.* (A communication.) Dated March 15, 1865.

This invention relates to condensing engines and consists, instead of passing steam after its action on a piston into a condenser combined as usual with the steam cylinder, in passing it into another cylinder open at the top, or at one end, so that the atmosphere may press down its piston as the condensation of the steam beneath it takes place. By thus separately evolving the contracting force, a greater amount of it is obtained. *Patent completed.*

749 G. DISLEY and F. BRADY. *Improvements in posts or supports for telegraph wires, also applicable to posts or supports employed for other purposes.* Dated March 15, 1865.

The patentees claim, first, constructing posts or supports of a number of iron bars or bands, angle, tee, or other iron fixed or secured at certain distances apart round a series of rings or hoops of a circular, square, or other suitable form, to the bottom ring or hoop of which is fixed or fitted a base plate of any suitable known form, substantially as described with reference to the drawings; second, forming posts or supports constructed as above described of two or more separate lengths so proportioned that the upper length or lengths may be placed inside the lower length or lengths for facility of transportation, substantially as described; third, constructing the base plates to posts or supports in manner described with reference to the drawings. *Patent completed.*

750 J. BULLOUGH. *Improvements in looms for weaving.* Dated March 15, 1865.

The patentee claims, first, the employment and arrangement of movable, forks, movable pins, and stationary pins for holding back the weft in a line parallel or nearly parallel with the reed for enabling the weft feelers to descend upon the weft or detect its absence immediately after the shuttle has been thrown across the race of the sley, and also for assisting the temple and making better cloth; secondly, the system of employing compressed air for blowing back the weft towards the reed, for enabling the feelers to detect its presence or absence without loss of time; thirdly, the improved back rail for obtaining easy access to the under working parts of the loom. *Patent completed.*

751 J. GOODFELLOW. *Improved combinations of direct acting steam engines with single or double acting pumps for pumping water, air, or gases.* Dated March 15, 1865.

This invention consists in the employment of direct-acting steam engines working horizontally, vertically, or diagonally, and connecting them direct to single or double-acting pumps, thereby dispensing with the ordinary crank shafts, cranks, connecting rods, and eccentrics; and these improved arrangements are applicable to pumps for fire-engines, for feeding boilers, bilge pumps, blowers, and all other purposes where pumps are required. *Patent abandoned.*

752 W. M. WILLIAMS. *An improved method of treating, cleaning, or preparing painted or other canvases, tarpaulins, and dirty cotton waste so as to render the same suitable to be used for household and other purposes for which they may be applicable.* Dated March 15, 1865.

In performing this invention the inventor takes the pieces of old or waste canvas or tarpaulins, or other painted fabric, and places them in large tanks partly filled with boiling water, to which is added from twenty to thirty pounds of an alkaline solution composed of the following in-

redients mixed in about the proportions named below:—Half a ton of soda ash or other equivalent alkali, half a ton of lime, a quarter of a ton of borax, a quarter of a ton of chloride of sodium, mixed in about five hundred gallons of water. The pieces of canvas or fabric to be operated upon are placed in iron cages half the size of the tanks, and the cages are kept in constant motion in the hot solution for about three hours, during which time the solution is to be kept boiling. When the paint or other coating has been detached from the fibres, the canvas is removed from the tank and thoroughly washed in clean water in order to remove the free alkali, and any dirt that may adhere to the fibres, and when thoroughly cleaned the canvas may be bleached and dried, and then cut up into pieces of suitable size for sale. *Patent abandoned.*

753 A. V. NEWTON. *Improvements in the construction of bracket, pillar, and suspended lamps and lanterns.* (A communication.) Dated March 17, 1865.

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

754 W. ROBERTS. *Improvements in cocks or valves.* Dated March 17, 1865.

This invention has for its object improvements in cocks or valves, and is applicable to cocks or valves such as are described in the specification of a patent granted to the present inventor and T. Greenacre the 22nd May, 1862 (No. 1581), and to other cocks or valves in which a number of complete rotations of a lever or handle is required to open the valve. In using such cocks or valves difficulty is frequently experienced in ascertaining to what extent the water-way or passage is open. To obviate this inconvenience the inventor combines with the cock or valve an index mounted on an axis, and this axis he gears with the spindle of the valve in such manner that the index axis makes somewhat less than a complete revolution whilst the lever or handle by means of which the valve is turned is turned the number of times required to move the valve from end to end of its course. The arc over which the index travels is marked at each end at the points where the index stands when the passage is shut, and where it stands when it is full open; the arc may also be further graduated if desired. The gearing he prefers to employ is a bevelled wheel on the spindle actuating a bevelled wheel on an intermediate axis, on which a worm is formed, and this gears with a toothed wheel on the axis of the index. *Patent abandoned.*

755 J. COOKSON and P. BILLINGTON. *Improvements in apparatus for blowing smiths' and other fires.* Dated March 18, 1865.

This invention consists in driving the fans for blowing smiths' and other fires by means of a lever acting on a friction pulley with an escapement motion, the said pulley being connected to the fan by a train of wheels and pinions, or other equivalents. The friction pulley is keyed on the driving shaft between two weighted levers, which are loose on the shaft; these levers are connected by the fulcrum stud of the driving lever, the boss of which forms a cam to press on the friction pulley, when the lever is moved in one direction, and to escape from the pulley when moved in the other direction; consequently the vibrations of the lever give a rotary motion at a great speed to the fan. The smiths' or other hearth is placed above the wrought-iron or other framing supporting the fan and gearing, and the casing around the fan is in communication with the fire by a pipe or tube. *Patent abandoned.*

756 T. OGDEN. *Certain improvements in lap machines employed in preparing cotton and other fibrous substances.* Dated March 18, 1865.

This invention consists in the employment and use of a vertical rod or bar which is hooked on to and suspended from each horizontal spindle or shaft upon which the lams are formed that supply the machine; the lower ends of these rods pass through holes formed in one end of a long balance lever or beam, the opposite end of which is in connection with the strap fork. Upon each of the aforesaid suspended rods are adjustable weights, the position of which, when a full lap is placed upon the supply lattice, are at their greatest distance above the balance lever, so that, as the "lap" diminishes in diameter, the suspended rod passing through the hole in the balance lever gradually lowers the weight into closer proximity to such lever, until the "lap" is finally spent, at which time the weight in connection with the rod of such spent lap bears upon and depresses the balance lever, thus causing its opposite end to rise, which, being in connection with the strap fork, forces the strap on to the loose pulley, and thereby stops the machine. *Patent abandoned.*

757 J. McOWELL. *Certain improvements in platform weighing machines.* Dated March 18, 1865.

This invention relates to those weighing machines wherein the body to be weighed is placed on a table or platform which is connected to one end of a lever, commonly called a "steelyard," along which a weight is moved until the body on the platform is balanced. These improvements are designed to render the travelling weights on the lever self-adjusting by the presence of a body or material on the platform, so as to form a self-acting weighing machine, and also to indicate the weight, and, if required, to imprint or impress it on a ticket. *Patent completed.*

758 G. RALSTON. *Improvements in the mode of forming and making clothing.* (A communication.) Dated March 18, 1865.

This invention consists in the manufacturing of trousers and waistcoats in combination in such a manner with elastic bands that they are easily put on and comfortably worn, and as easily put off, in part or in whole, as convenience or necessity may require. *Patent completed.*

759 E. PILLING and J. HARRIS. *Improvements in self stop motions for looms.* Dated March 18, 1865.

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

760 J. H. WATERW. *A new or improved machine for peeling or skinning almonds.* Dated March 18, 1865.

Upon uprights on the bed of the machine two horizontal rollers are situated, the axes of the said rollers working in bearings on the said uprights. The said rollers are situated side by side, and parallel to one another, the distance between them being adjusted by screws. The bodies of the rollers are made of iron or other hard metal, the said bodies being coated or covered with a covering of vulcanized india-rubber. Above the rollers is a hopper in which the almonds to be peeled or skinned are placed, and below the rollers is an inclined platform upon which the peeled or skinned almonds fall on leaving the machine. The two horizontal rollers are geared together by toothed wheels, the toothed

wheel on one roller having a diameter double that of the wheel on the other roller, so that one roller rotates with double the velocity of the other. Motion is given to the rollers by a winch on the axis of that one carrying the smaller toothed wheel. On giving motion to the rollers by the said winch and toothed gearing, and permitting the almonds to descend from the hopper and pass between the rotating rollers, the peel or skin is removed from the said almonds by the pressure of the said rollers, and the different velocities at which they rotate, the almonds being uninjured by the rollers while passing between them by the yielding of the india-rubber covering thereon. The peeled or skinned almonds on passing from the rollers fall on to the inclined platform, and thence pass to a receptacle placed to receive them. *Patent abandoned.*

761 J. WALLS. *Improved arrangements and apparatus for drawing off liquors or liquids from casks and other vessels without the aid of pumps.* Dated March 18, 1865.

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

762 T. KENTON, jun. *Improvements in preparing, ficing, and mordanting cloths and yarns.* Dated March 18, 1865.

In performing this invention the patentee combines prussiates, phosphates, and all kinds of animal matter with alumina, stannate, tin solution, or other suitable matter dissolved in alkalies or acids; or he uses the animal matter or matters separately if found desirable. The proportions he prefers are about 15 per cent. of prussiates, phosphates, and animal matter, to about 25 per cent. of the alumina, stannates, tin solution, or other suitable metals. *Patent completed.*

763 F. WISE. *Improvements in mechanism for attaching buttons to fabrics.* (A communication.) Dated March 18, 1865.

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

764 J. VERO. *Improvements in brushes or brooms.* Dated March 18, 1865.

This invention consists in certain modes of connecting the handles to the backs of brooms, so that, when one end of the broom has become worn, the broom may be turned end for end, so as to expose a fresh end of the broom to wear, and yet that the handle shall be at the requisite angle to the broom in both positions. This may be accomplished in the following ways:—The inventor bores a hole vertically into the centre of the back of the brush, into which he inserts or screws a metal socket. The upper end of the socket, which has a hole in it to receive the end of the wooden handle, is at an angle to the part which enters the back of the brush, so that the handle is brought to the requisite angle to the brush. When one end of the broom has become worn, the socket is turned half round in the hole in the back of the brush, and the socket is then prevented from turning by a pin or otherwise; a fresh end of the broom is thus brought into the position where it will be most exposed to wear. *Patent abandoned.*

765 J. O. STEVENSON. *Improvements in the preparation of hypophosphite of lime.* Dated March 18, 1865.

The late Dr. Julien obtained a patent in 1861 (No. 330) dated 9th of February, 1861, for a process in which a solution of hypophosphite of lime was produced from the yellow liquor obtained by the oxidation of soda waste. The soda waste was exposed in a thin layer to the action of air and moisture, and was repeatedly turned over, and the yellow liquid was then obtained from it by lixiviation. This liquid was saturated by sulphurous acid gas, and so sulphur was precipitated, and a solution of hypophosphite of lime was produced. These improvements relate to the treatment of the solution of hypophosphite of lime thus or otherwise obtained, in order to obtain the salt in a dry form, suitable for the market. If the solution is evaporated by heat in the open air it decomposes. According to this invention the patentee evaporates it in a vacuum pan made of iron, and similar in construction to that used in the manufacture of sugar. The vacuum maintained within the pan should be such that a mercurial barometer in the pan will mark only from half an inch to one inch pressure. The solution is boiled at a temperature of 110 deg. Fahrenheit until it reaches the specific gravity of 1.480, which is ascertained by drawing samples from time to time, when it is run out, settled, and allowed to crystallise. The crystals obtained are not sufficiently pure, and are re-dissolved in a waterbath at a temperature of 110 deg. Fahrenheit; the quantity of water employed to dissolve them is such that the solution may be of a specific gravity of 1.480; and this is then crystallised a second time. Or the salt may be re-dissolved in cold water, and then again concentrated to the crystallising strength above-mentioned in the vacuum pan, but the dissolving the crystals in the waterbath is simpler, and the patentee therefore prefers it. *Patent completed.*

766 O. ROBINSON. *Improvements in sewing machines.* Dated March 18, 1865.

This invention relates to improvements in that class of sewing machines known as shuttle or lock stitch machines, and consists, firstly, in placing the wheel feed of a cylinder machine so as to work on the right hand side of the needle, in lieu of on the left hand side, as heretofore, whereby the inventor is enabled to perform the operation known in the trade as gooseling the uppers of boots and shoes more easily and expeditiously. Secondly, in a peculiar combination of mechanism for driving or actuating the feed wheel, whether such feed wheel be applied to a cylinder or arm machine, or to a platform machine. Thirdly, in placing a wheel-feed of any suitable or well-known construction with its axis transverse to or at right angles with the longitudinal axis of the arm or cylinder in that class of sewing machines, so that the material may be fed in the direction of the cylinder. Fourthly, in an arrangement for lifting the presser foot after each stitch in those sewing machines wherein the wheel feed is employed, in order to facilitate the turning of the work. Fifthly, in a peculiar combination of mechanism for actuating the shuttle driver of lock stitch machines. *Patent abandoned.*

767 O. W. SPARK, T. S. CROSS, and W. ADKINS. *Improvements in portable or fixed machines for the manufacture of bricks and tiles, whether plain or for ornamental purposes.* Dated March 18, 1865.

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

768 J. H. KIDD and J. O. MATHER. *Improvements in floorcloth and in machinery for the manufacture of floorcloth.* Dated March 18, 1865.

This invention refers to a former patent dated 23rd September, 1864 (No. 2,340), the object of which was the manufacture of an improved floorcloth at reduced cost, resem-

bling that known by the name of Kamptulcon. The composition described in the specification of the said letters patent is formed by taking the linseed oil of commerce, or any other suitable drying oil, and in boiling it with resin until it has attained the consistency of cement. The present improvements (by which the composition is rendered more elastic) consist in taking the boiled linseed oil of commerce, or any other suitable drying oil, and boiling it alone until it has attained the consistency of cement, when it is mixed with ground cork, sawdust, or other like materials, and when properly combined it is applied to the surface of the fabric, as described in the specification before referred to. These improvements in floorcloth also consist in taking a composition similar to that above described, or that described in the specification of the aforesaid patent, or a composition formed partly as described and partly of suitable seeds of drying oil ground fine, and applying it to the back of a woven fabric by a rolling mill, coating the face side of such fabric with any suitable and well-known water-proofing material by a spreading or rolling machine, then pumice stoning and printing and ornamenting it if required. The improvements in machinery consist in making the rolls which come in contact with the fabric of the most convenient diameter, and in adding one or more rollers to work against each roller in contact with the fabric, so as to sustain the pressure coming thereon. All the rollers may be geared together, and those in contact with the fabric may be made hollow and heated by steam, or other suitable means; the rollers are also provided with suitable doctors or scrapers to remove any adhering matter. *Patent completed.*

769 S. S. GRAY. *Improved machinery for manufacturing paper and cloth lined paper collars for gentlemen and ladies.* Dated March 20, 1865.

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

770 T. OLIVER and J. W. MUSTO. *Improved toy or mouthpiece for cigars and cheroots.* Dated March 20, 1865.

This invention consists in attaching to the top or end of the cigar or cheroot a mouthpiece, the same to be made in any ornamental shape or design, and to be made with and form part of the cigar or cheroot, being attached thereto by gum or cement. The said mouthpiece may be made of wood, bone, ivory, metal, amber, or any other equivalent suitable material. To permit the end of the cigar to fit the said mouthpiece, it is formed blunt, whereby an economy is effected in the manufacture of the cigar. *Patent abandoned.*

771 J. T. ROMMINGER. *Improvements in apparatus for generating steam.* (A communication.) Dated March 20, 1865.

The peculiarity of this steam generator consists in the form and combination of a series of pipes in order to obtain the greatest possible steam generating surface in a given space. For this purpose the patentee arranges a system of pipes which, by their peculiar shape, do not require the interposition of any heat-absorbing material, the smoke flue from the fire grate to the chimney being produced by the form or transverse section given to the pipes. These pipes are made of cast iron, and have a transverse section of a cross-like form. In some cases, however, the passage through these pipes is formed with a lining of wrought metal, which is introduced into a mould so as to have cast metal run thereon. The ends of these pipes are connected in such a manner as to cause the water which is forced into the entrance pipe to pass in succession through the whole of the pipes constituting a series. Further, he arranges the proportions of the series of pipes in a manner to produce an even pressure throughout by giving the entrance a smaller size than the outlet. He introduces metal rods into the pipes in cases where the water produces sediment, so as to cause by thus narrowing the passage a greater friction in the passage of the steam, by which means the pipes are kept clear of sediment, which is carried away by the steam. A hand pump is used when starting the engine, and another pump is driven by the engine when at work, so that for each stroke of the engine jets of feed water are introduced into the entrance pipe of the system, and this water traversing to and fro through the whole series of pipes issues as steam of high pressure from the outlet at the opposite end of the series, and is then passed to the steam cylinder. *Patent completed.*

772 J. T. COOK and J. T. COOK, jun. *Improvements in breech-loading firearms.* Dated March 20, 1865.

The patentees claim, firstly, the general arrangement or combination of the parts described and represented in the drawings for fastening down and releasing the hinged blocks or closers. Secondly, a cartridge case extractor consisting of a bar or rod, or bars or rods, and working freely in the side or sides of the breech block or closer, one end of the bars or rods carrying a stud or hook which, by the raising of the block or closer, is made to advance in a slot in the side of the barrel, and start or extract the exploded case, essentially in the manner described and illustrated in the drawings. Thirdly, the application of the said cartridge case extractor to breech-loading firearms in which the barrels turn upon a hinge or joint, as described. *Patent completed.*

773 M. ELEY. *The more economical wear and more speedy fastening of gentlemen's scarfs.* Dated March 20, 1865.

This invention consists of an endless revolving knot or barrel revolving round the body of the scarf, the said body also being movable through the knot or barrel to any part of it, so that, when one part is soiled, either the knot or the body can be moved to any part of the other, and thereby making every part of the scarf wearable; by this arrangement the knot can be worn any size. The said scarf is fastened by two or more rings or links sewn on or inserted in the back of the band near the end, a hook being fixed at the other end to hook into any one of the rings, so that the fastening cannot by any possibility be seen when the scarf is being worn. *Patent abandoned.*

774 I. PHILIPPSALL. *Improvements in the manufacture of yarn so as to render same applicable as a substitute for woolen yarn for manufacturing into shawls and other textile fabrics.* Dated March 20, 1865.

This invention consists in utilizing the waste hemp and flax known in the trade as tow by cutting the same into pieces and then mixing the same with wool in the proportion of about two parts of the tow to one part of wool, which may afterwards be spun into yarn by ordinary spinning machinery, and then woven into shawls, neckerchiefs, and other articles of dress in ordinary looms. *Patent completed.*

775 A. G. BROWNING. *An improved socket for joining and telegraph posts.* Dated March 20, 1865.

This invention is applicable, principally, to cast-iron sockets for wrought-iron fencing posts, straining pillars, for fencing and telegraph posts, but it may also be applied to the sockets of any kind of iron posts or pillars which are intended to be sunk in the ground. The invention consists in casting such sockets in one piece with a spear head point or spike having two or more flanges, so that the sockets can be driven into the ground, and will form a good hold for the post or pillar. The internal form of the socket will correspond with the section of the post or pillar, whether circular, flat, square, triangular, L, T, or other shape. *Patent completed.*

776 A. V. NEWTON. *Improvements in sewing machinery.* (A communication.) Dated March 20, 1865.
This invention is not described apart from the drawings. *Patent completed.*

777 R. T. CRAWSHAY and I. A. LEWIS. *Improvements in the manufacture of puddled iron bars and every description of malleable iron.* Dated March 20, 1865.
This invention consists essentially in mixing with iron while in a molten state sulphate of iron, together with oxide of lead in certain proportions. *Patent completed.*

778 S. CHATWOOD. *Improvements in locks for safes, strong rooms, and other purposes.* Dated March 20, 1865.
This invention consists, first, in lining the keyhole passage of locks with platinum or platinum alloy, and in coating or forming such parts of the lock as are accessible from the keyhole passage with platinum or platinum alloy. And, second, in closing the keyhole passage by a screw or other plug, itself secured by means of a self-contained lock or catch, that is a lock or catch carried in the plug, or by means of a platinum lock, or lock of platinum alloy. *Patent completed.*

779 W. MENELAUS. *Improvements in machinery for working puddled balls or blooms of iron and steel.* Dated March 20, 1865.

This machinery is mainly intended for working balls, or blooms, or ingots of iron and steel as they come from the puddling furnace, balling furnace, or ingot mould, to prepare the iron or steel for being further operated upon. The machinery is composed of three cylindrical rolls made to revolve in the same direction; the two bottom rolls are so placed that the third shall revolve above and in a line between them, and shall have an up-and-down motion imparted to it by steam or hydraulic power. Though the patentee prefers up-and-down motion to be imparted to the top roll, yet either of them may be moved from and towards the others. *Patent completed.*

780 A. R. MACKENZIE. *Improvements in locomotive engines and carriages for common roads and tramways, and also for agricultural and other purposes.* Dated March 20, 1865.

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

781 C. H. PENNYCOOK. *Improvements in constructing gasometers, tanks, casks, and similar vessels.* Dated March 21, 1865.

In constructing a gasometer, for example, according to this invention, instead of attaching to each other the metallic sheets or plates forming the shell by riveting the same continually round their adjacent edges, such sheets are connected together by narrow intervening seam strips formed with grooves on each side, into which grooves the edges of the sheets are entered. At the meeting corners overlapping pieces are riveted to the adjacent sheets to bind them to each other, whilst the grooves are made tight by paint, cement, or solder. At the bottom edge the frame-ring may be formed with a groove to receive the bottom edges of the lowest line of sheets, whilst at the angle between the sides and the roof the frame-ring may be formed with grooves in suitable positions for the side sheets below and the roof sheets above; or a narrow grooved seam strip may be used at the angle, and a frame-ring in addition. In making gasometer and other tanks, the same general construction may be adopted, but in the place of some of the vertical seam strips, frame pillars will be required to give strength, such pillars being formed with grooves to receive the edges of the adjacent sheets or plates. A ring grooved on its under side and fitted upon the pillars and sheets at the top edge of the tank will bind the whole together. Casks and similar smaller vessels may be rapidly and economically put together in a similar way. *Patent abandoned.*

782 J. W. MIDDLEY. *Improved means or apparatus for lubricating vertical or diagonal spindles and shafts.* Dated March 21, 1865.

This invention has a two-fold object, viz., to lubricate spindles or shafts (vertical or diagonal) more effectually, and also more economically, than is now the case, and has special reference to spinning and preparing machinery. For this purpose, adducing as instance the ordinary throstle frame used in spinning worsted yarns, the inventor elongates the "neck" (usually made of brass and secured to the frame rail), making the elongated part of smaller external diameter than the remainder of the neck. Upon the spindle he affixes by any convenient method a species of cup, within which the elongated part of the neck enters. The spindle or shaft (as the case may be) being lubricated, the lubricating substance naturally works down into the cup, and the latter revolving with the spindle or shaft, necessarily throws particles of the lubricating substance upon that portion of the spindle within the neck, and gives the results named. *Patent abandoned.*

783 W. V. GERRIE. *Improvements in vessels of war and in ordnance.* Dated March 21, 1865.
Provisional protection has not been allowed for this invention.

784 D. GOURLEY. *Improvements in the manufacture of boots and shoes.* Dated March 21, 1865.

This invention consists, firstly, in a peculiar method of fastening the boot or shoe, whereby the use of laces and other kinds of fastenings over the arch of the foot are superseded, and the action of the arch of the foot left free; and also the side springs now in use, which, by permitting the foot to slip forward to the toe of the boot, throw much of the weight of the body on the toes, and thereby cause serious injury to them. The same fastening forms a very material support to the annular ligament at the ankle-joint. The said fastening consists in a band of leather or any other suitable material, passing over the annular ligament, and fastened by a buckle or other suitable fastening. Secondly, the sole of the foot is protected from injurious contact with hard roads and flagstones, which prematurely impair the elastic tissue of the sole of the foot by an elastic material placed between the soles of the boots or shoes. *Patent abandoned.*

785 C. FARMER and T. TURNER. *Certain improvements in machinery and appliances for the manufacture of nails, pins, and rivets.* Dated March 21, 1865.
We cannot here give space to the details of this invention. *Patent completed.*

786 J. H. JOHNSON. *Improvements in the manufacture of looking-glasses or mirrors, and in apparatus employed therein.* (A communication.) Dated March 21, 1865.

This invention relates to improvements in the manufacture of looking-glasses or mirrors, whereby such articles are rendered more durable, and are produced more economically than those manufactured by the ordinary existing methods, and consists of certain peculiar processes or modes of treating platinum which is substituted for the ordinary amalgams or silvering, whereby it is caused to adhere in a perfectly secure and permanent manner to the surface of the glass employed. *Patent completed.*

787 W. ARTHUR. *Improvements in compasses or apparatus for registering the course steered by a vessel during any given period.* Dated March 21, 1865.

The object of this invention is to make a compass register the courses steered by a vessel during any given period. For this purpose the patentee suspends a framing in which a cylinder is supported vertically on an axis at the lower end while the upper end is formed with a step to receive a socket and a shaft which passes through the framing; on this shaft a guide plate is fitted which is guided by two pins carried by a lower plate forming part of the socket, which is free to be raised and lowered on the shaft for the purpose hereafter mentioned. The shaft is formed with two flanges above the guide plate, between which rollers work; the framing carries at its upper part a compass card or magnetic needle. The rollers just mentioned are carried on one end of a lever pivoted near its centre to a bracket on the framing; the other end of the lever carries a roller which rides in a cam groove in a block carried on the upper end of a vertical threaded rod. This rod passes through the framing which contains the cylinder and carries a pencil or marker which is kept in contact with a sheet of paper wrapped round the cylinder. The pencil is held in a frame fitted over the threaded rod and is caused to descend thereon by means of a rotary motion imparted to the rod by clockwork. The paper which is secured to the cylinder is marked with thirty-two perpendicular divisional lines at equal distances apart, each line representing a point of the compass. The paper is also marked with horizontal lines representing the distance the pencil descends in one hour or other stated time. In the descent of the magnetic needle its position is transmitted to the cylinder by a roller on the shaft riding on one of the inclines of a double inclined cam fixed on the under part of the compass card. *Patent completed.*

788 E. A. BROOMAN. *Improvements in the preparation of hydrated oxide of chromium.* (A communication.) Dated March 21, 1865.

This invention consists in the production of hydrated oxide of chromium by means either of boric acid or other acids, or salts with an acid reaction, possessing analogous properties of chromo-oxide, hydrate or acid. *Patent completed.*

789 W. OLARK. *Improvements in apparatus for cutting pasteboard and other like boards.* (A communication.) Dated March 21, 1865.

The first part of this invention relates to certain new and useful improvements in the mode of attaching the outer holders and stocks to the cutter beam of pasteboard cutting machines. The second part relates to new modes of adjusting the cutters for the cutting of pasteboard to different widths. The third part of the invention relates to the mode of arranging or adjusting the position of the feed rollers of the machine with regard to each other. The fourth part consists in the use of a zigzag-shaped cutter or cutters for the cutting of zigzag edges, which are necessary to be given to the ends of a pasteboard box made in the shape of a cylinder, so as to turn the same under the bottom; also in the use of a serpentine-shaped cutter or other desired shapes according to the cuts to be given to the pasteboard. The fifth part relates to certain new and useful improvements in machines for the cutting of pasteboards by which both the scoring and through cut may be effected at one operation; and also to constructing and combining the parts of the machine that the same may be worked in a great measure automatically. *Patent completed.*

790 R. J. GATLING. *Improvements in firearms, termed a battery gun.* Dated March 21, 1865.

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

791 J. SMITH and S. A. CHEASE. *An improved arrangement of valves and other appliances for a new description of hydraulic engine for raising water and other fluids above their common level, the fluids so raised to be used as a motive power.* Dated March 21, 1865.

This invention of an improved arrangement of valves and other appliances for the patentee's hydraulic engine for raising water and other fluids above their common level, for which they obtained letters patent dated the 9th July, 1863 (No. 1,706), consists in constructing a reservoir having two compartments, called the upper and lower compartments. The upper compartment has a lift pump for raising the water or other fluid from the lower compartment, producing two different levels of the fluid in the one reservoir. Into the lower level of the fluid they insert a portion of a tank or tanks, allowing the fluid in the reservoir to have free play around them. Inside and on the bottom of the tank or tanks they fix a box or boxes, each box having two sets of valves composed of gun metal, one set opening to the fluid contained in the reservoir. These valves they so arrange that, when the pair or set of valves in communication with the fluid in the tank are open, the other pair or set are closed and shut off the communication with the reservoir, and vice versa. On the upper side of the box or boxes is a circular aperture, round which is fitted a cup leather valve. This valve fits the lower part of an airtight cylinder or float, which is inserted in the circular aperture, and by means of connecting rods the cylinder or float they attach to the end of a lever or beam. The other end of the beam is united by two connecting rods to the crank of the engine, and the piston rod of the lift pump. On the shaft is fixed an eccentric to work the gear, which actuates the tank valves. On the head of the tank they fix a feed-pipe, which passes downwards into the upper compartment of the reservoir, having a valve attached to it which is always kept beneath the high level of the fluid in the upper compartment of the reservoir, and thus acts as a syphon. They then fill the tank and feed-pipe with water or some other fluid, and raise the fluid in the lower

compartment of the reservoir which contains the lift-pump to within a few inches of the lid of the tank or tanks when the engine is ready for use. *Patent completed.*

792 W. BERRY. *An apparatus for cutting bread or bread and butter.* Dated March 21, 1865.

This invention has for its objects facilitating the cutting the loaves of bread into slices of any requisite thickness, and spreading butter by mechanical means on the bread to be so cut, and the invention consists, firstly, of a box open at its upper end, and having a movable bottom or platform working freely within it. The loaf to be cut is supported by this platform, which is raised by means of a spring, or a rack and pinion, or other suitable means, to such a height as to cause the portion of the loaf which it is wished to cut off to project above the sides of the box. Secondly, of a butter-box having a perforated bottom, through the perforations in which any required quality of butter is forced on to each slice of the bread to be cut, the forcing of the butter through the said perforations being effected by a plunger pressed upon by or affixed to a screw or lever. *Patent completed.*

793 E. J. WEBBER. *Improvements in machinery for threshing and rubbing barley and other grain.* Dated March 21, 1865.

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

794 H. S. JACOBS. *Machine for dressing and rounding the inner surfaces of filloes.* Dated March 22, 1865.

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

795 G. FARMER. *Improvements in machinery for cutting, punching, raising, shaping, or drawing through sheet metal by means of tools and dies.* Dated March 22, 1865.

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

796 W. M. WILLIAMS. *Improvements in apparatus for the distillation of coal and peat, and such other substances as are or may be used for the manufacture of solid and liquid volatile hydrocarbons, or for the manufacture of the said hydrocarbons and coke.* Dated March 22, 1865.

The patentee claims the arrangement or combination of the parts described for adjusting the thickness of the layer of coal or material to be distilled to the variable heat of the different parts of the retort, or to the quality of the coal or material, the coal or material being arranged in contact with the top and bottom of the retort in layers of the required variable thickness by means of adjustable shelves or trays, or by means of a lining having upper and lower adjustable shelves or compartments. *Patent completed.*

797 H. POTTER. *Improvements in treating the waste liquors obtained in bleaching certain vegetable substances.* Dated March 22, 1865.

This invention consists in boiling the waste liquor obtained in bleaching jute and the waste of flax, commonly called shew or shew, with lime or magnesia, or their carbonates, or with a metallic oxide, in order to recover the soda which is used in the process of bleaching the before-mentioned vegetable substances. *Patent completed.*

PROVISIONAL PROTECTIONS.

Dated June 1, 1865.

1809 T. E. Wright, Birmingham, general manufacturer. Certain improvements on "Bourdon's" steam pressure gauge.

Dated July 5, 1865.

1775 J. Longbottom, Camp-road, Leeds, engineer, and A. Longbottom, The Terrace, Hammersmith, civil engineer. An improved combination of materials for the manufacture of carpets, floorcloths, felt, wall paper, fireproof flexible roofing, ship and boat building, and for other similar purposes.

Dated August 23, 1865.

2169 D. Macpherson, South Thistle-lane, Edinburgh, stereotype founder. Improvements in sewing machines.

Dated September 1, 1865.

2258 R. Davies, Green Neath, Glamorgan-shire, engineer. Improvements in propellers for ships and boats.

Dated September 7, 1865.

2296 J. Dawson, Greenock, engineer and sugar refiner. Improvements in supplying charcoal to sugar decolorizing vessels, and in apparatus therefor.

2300 W. L. Wise, Chandos Chambers, Adelphi. Improvements in machinery or apparatus for hulling and winnowing grain. (A communication.)

2302 W. Cory, Coal Exchange, City, and J. H. Adams, O.E., Campbell-road, Bow-road. Improvements in floating vessels and apparatus used for unloading vessels containing coals, corn, or grain.

Dated September 8, 1865.

2304 J. and W. Weems, Johnstone, Renfrewshire. Improvements in the construction of hydrostatic presses.

Dated September 9, 1865.

2308 A. Mackie, newspaper proprietor, and J. Paterson, engineer, Warrington, Lancashire. Certain improvements in the method of lighting gas, and in apparatus connected therewith.

2310 J. Brigham and R. Bickerton, Barwick-upon-Tweed, implement makers. Improvements in reaping and mowing machines.

2312 W. E. Newton, Chancery-lane, civil engineer. Improvements in machinery for making lace. (A communication.)

2316 R. P. Roberts, Kennington Park-road. Improvements in cleansing and coating the bottoms of ships and other submerged surfaces to prevent oxidation and the adhesion of marine animals and plants, also in compositions to be employed for these purposes.

2318 A. E. Nordenskiöld and J. W. Smith, Stockholm. Improvements in apparatus connected with safes for protecting valuables from fire.

Dated September 11, 1865.

2320 S. Davis, Strand, saddler. An improved stirrup latch bar.

2321 W. and S. Tyne and R. Clayton, Bradford, engineers. An improved mode of removing and preventing the incrustation of steam boilers.

2324 C. T. Burgess, Newgate-street, City. Improvements in reaping machines.

2326 S. Inkpen, Bartholomew-terrace, Cambridge-road, Mile End. Improvements in covering submarine telegraph cables and in the machinery and means employed for paying out or hauling in the same.

2327 J. Lightfoot, Acorington, Lancashire, chemist.

Improvements in dyeing and printing fabrics and yarns and animal or mixed animal and vegetable substances.

2328 C. Huntley, Hackney Wick, cricket ball manufacturer. Improvements in cricket, racket, tennis, and foot balls.

Dated September 12, 1865.

2332 J. Macintosh, North Bank, Regent's Park. Improvements in constructing and insulating telegraphic conductors and in apparatus connected therewith.

2334 J. Welch, Redditch, Worcestershire, watch maker. Improvements in the manufacture of swivels.

2338 R. A. Boyd, Duke-street, Southwark. Improvements in cooling bacon-curing rooms or chambers.

Dated September 13, 1865.

2339 J. Dunbar, Westminster Chambers, Victoria-street, Westminster, civil engineer. Improvements in the construction of boots and shoes.

2342 J. Dodd, Oldham, Lancashire, mechanical engineer. Improvements in mules for spinning and doubling.

2346 S. Soutar, Turnham Green. Improved apparatus for cleaning the tubes of steam boilers. (A communication.)

Dated September 14, 1865.

2352 I. Beamish, Leadenhall-street, engineer. Improvements in lubricating apparatus.

2354 W. B. E. Ellis, Brandon Villa, Cheltenham, Capt. Royal Artillery. An improved form of rifling for fire-arms and ordnance.

Dated September 15, 1865.

2358 J. Whitehouse, Tipton, Staffordshire, ironfounder. Improvements in the manufacture of box-irons.

2360 R. A. Brooman, Fleet-street, patent agent. Improvements in locks for trunks, bags, dressing-cases, and other like articles. (A communication.)

2362 S. Myers, Liverpool. Improvements in smoking pipes and cigar holders, and an improved tobacco cartridge to be used with the same. (A communication.)

2364 H. Law, Essex-street, Strand, civil engineer. Improvements in caissons for closing the entrances of docks and canals.

Dated September 18, 1865.

2376 F. Daina, Bergamo, Italy, civil engineer. A new method of and apparatus for condensing the steam of steam engines.

2378 H. Venables, Newcastle-under-Lyne, potter. An improved method of ornamenting the surfaces of tiles.

Dated September 19, 1865.

2385 J. Fletcher, Betts-street, St. George's-in-the-East, engineer. Improvements in the machinery or apparatus and in the processes for the treatment and manufacture of sugar.

2386 G. Smith and O. Ritchie, Upper Thames-street. Improvements in brooms or brushes for sweeping and dusting.

2390 I. S. M'Dougall, Manchester, manufacturing chemist. Improvements in the manufacture of insoluble oils and greases.

Dated September 20, 1865.

2398 W. Porter, Manor Park, Lee, Kent, engineer. Improvements in machinery used in the manufacture of bricks and tiles.

Dated September 21, 1865.

2403 J. B. Hulme, Manchester, surveyor. Improvements in machinery for excavating earth.

2405 W. Watkin, St. George's-road, Southwark, traveller. Improvements in and applicable to furnaces for the consumption of smoke.

2407 E. W. Collier, Bishopsgate Railway Station, clerk. An improved mode of, and apparatus for, securing the labels of trucks and invoices of goods conveyed on railways.

2409 W. Clark, Chancery-lane, engineer. Improvements in the manufacture of materials for decoloring sugar and other saccharine and liquid matters. (A communication.)

2411 B. Chaffer, Burnley, stone merchant, and J. and C. Thomson, engineers, Padiham, Lancashire. Improvements in machinery for grinding, dressing, smoothing, or polishing flags and stones without the use of the ordinary cutting tools.

2413 R. A. Brooman, Fleet-street, patent agent. Improvements in blast furnaces and in charging the same. (A communication.)

2415 A. Bird, Birmingham, experimental and pharmaceutical chemist. Improvements in purifying water.

Dated September 22, 1865.

2423 M. Cartwright, Tavistock-street, Covent Garden. Improvements in the adaptation of elastic material to articles requiring a bellows arrangement, or a partially rigid and partially expandable arrangements.

2427 P. Spence, Newton Heath, Manchester, manufacturing chemist. Improvements in the manufacture of white lead.

Dated September 23, 1865.

2433 G. Davies, Serle-street, Lincoln's Inn-fields, civil engineer. Improvements in the manufacture of horseshoes, and in the machinery used for such manufacture. (A communication.)

2435 J. H. Johnson, Lincoln's Inn-fields. Improvements in generating illuminating gas, and in the machinery or apparatus employed therein. (A communication.)

2439 A. V. Newton, Chancery-lane, mechanical draftsman. Improved apparatus for generating illuminating gas. (A communication.)

2441 J. Parkins, St. John's Wood. An improved apparatus for bordering paper and envelopes.

2443 M. Schaffner, director, Aussig, Bohemia. Improvements in treating soda waste to obtain sulphur therefrom.

Dated September 25, 1865.

2449 J. W. Coburn, New Haven, Conn., U.S., india-rubber worker. An improvement in the manufacture of waterproof soles for boots and shoes.

2451 E. Brooke, jun., Huddersfield, manufacturer. An improved arrangement of apparatus and materials to be employed for effecting the decoloring of the noxious gases arising from sewers and drains, and for the more effectual ventilation and inspection of such sewers and drains.

Dated September 26, 1865.

2457 C. Parigot and A. Grivel, jun., Davies-street, Berkeley-square. Improvements in the construction of safes, strong rooms, and other similar depositories, and in the locks thereof.

2463 O. M. Kernot, M.D., Gloucester House, West Cowes, and N. Symons, Albert Foundry, Princess-street, Lambeth. Improvements in the construction of railway plant to ensure the safety of passengers' lives in the event of accident or collision.

2467 J. Hilliar, Great Cambridge-street, manufacturer. Improvements in apparatus for ventilating and for preventing draught in flues.

2469 G. T. Bousfield, Loughborough-park, Brixton. Improvements in machinery for tempering and preparing peat for fuel. (A communication.)

Dated September 27, 1865.

2471 J. Taylor, Chancery-lane, engineer. Improvements in the construction of washing machines and churns.

2473 L. B. Gillet, Rue St. Appoline, Paris, merchant. Improvements in the construction of vessels for preserving food and liquids.

2475 J. Broun, Ardgowan-square, Greenock, barrister-at-law. Improvements in cartridges.

2477 W. Morgans, Brendon Hills, Somersetshire, engineer. Improvements in coke and charcoal ovens, and in the manufacture of coke, parts of which are applicable to bread, biscuit, and pastry ovens.

2479 J. R. Arnoldi, Hunter-street, engineer. Improvements in steam engines.

2481 J. J. M'Comb, Liverpool. An improved construction of paddlewheel. (A communication.)

PATENTS APPLIED FOR WITH COMPLETE SPECIFICATIONS.

Dated September 28, 1865.

2488 W. E. Metford, Flook House, Taunton. Improvements in rifling firearms, and in missiles or projectiles used in such, and in the machinery for the production of these improvements.

Dated September 30, 1865.

2509 J. A. Mee, Falls-woth, near Manchester, wire drawer. Certain improvements in telegraphic cables.

LIST OF SEALED PATENTS.

Sealed October 6, 1865.

1005 W. Weatherley	1020 W. Brooks
1011 A. G. Hunter	1025 W. Clark
1012 S. Moore	1026 D. Payne
1013 T. Turton	1044 G. A. Montanet
1018 R. A. Brooman	1070 M. Smith

Sealed October 10, 1865.

910 H. A. Bonneville	1075 E. and G. H. Morgan
1042 H. Sikes and G. Jarman	1077 A. W. Hale
1045 J. M. Hart	1085 J. Gardner, R. Lee, G. H. Wain, and S. C., and S. Hargrove
1046 T. J. Mayall	1109 F. Wise
1047 F. Bapty and E. B. Sayers	1111 D. S. Buchanan
1061 C. Turner and T. Room	1125 E. Lord
1063 T. Bennett	1175 J. W. Lowther
1065 J. M'Dowall	1223 J. H. Johnson
	1679 J. Gale, jun.

NOTICES OF INTENTION TO PROCEED WITH PATENTS.

From the London Gazette, October 10, 1865.

1469 P. Young. Furnaces.
1470 H. Son. Keyless watches.
1471 E. Myers and J. Stodart. Downward draught in chimneys.
1472 W. Johnson. Vices.
1475 W. T. Hamilton. Circular saws.
1480 J. Hibell. Annealing pots.
1481 J. Jopling. Steering vessels.
1482 W. Martin. Brooms.
1483 M. Meisel. Spinning machinery. (A communication.)
1492 R. Howarth. Safety of railway passengers.
1497 F. N. Gisborne. Indicating the pressure of steam.
1503 W. J. Burgess. Mowing machines.
1505 H. Allman. Metallic vessels.
1506 H. Allman. Iron.
1508 T. Brinsmead. Exercising chair.
1510 F. Knight. Economic boiler.
1515 H. Allman. Ignition of matter.
1516 J. Nuttall. Valves.
1518 R. A. Brooman. Electro-magnetic clocks. (A communication.)
1519 W. Gadd and J. Moore. Pile fabrics.
1522 F. J. Bolton and H. Matheson. Printing surfaces.
1525 A. Lancaster. Breaching firearms.
1527 C. Taylor. Tube cutters.
1530 W. Townsend. Twisting yarns.
1534 T. Gentle and J. Allmark. Turbines.
1535 P. Coombes. Separating whey from curds.
1538 J. Robertson. Actuating slide valves.
1540 R. A. Brooman. Soap. (A communication.)
1550 R. A. Brooman. Combing wool. (A communication.)
1565 S. Stell, T. Broughton, and F. Hall. Spinning wool.
1574 J. de Hemptinne. Spinning cotton.
1582 R. A. Brooman. Kilns. (A communication.)
1610 W. Edson. Condition of the atmosphere.
1617 J. F. Dubois. Bit for horses.
1632 C. A. la Mont. Dedicating eggs.
1707 W. E. Newton. Hats. (A communication.)
1711 R. A. Brooman. Burning liquid hydrocarbons. (A communication.)
1734 W. E. Newton. Incrustation of steam boilers. (A communication.)
1884 G. Nimmo. Pots.
1919 J. M'G. Croft. Rudders.
1942 W. E. Newton. Planing metals. (A communication.)
1949 W. E. Newton. Bolt screwing machines. (A communication.)
2006 H. Allman. Burglar proof safes.
2008 J. W. Perkins. Hydrocarbon oils.
2071 M. H. Blanchard. Terra cotta.
2111 J. Billings. Ventilators.
2163 J. G. Avery. New composition for paint. (A communication.)
2214 R. T. Holmes. Disengaging runaway horses.
2245 O. Bennett. Steam blower. (A communication.)
2302 W. Cory and J. H. Adams. Floating vessels.
2332 J. Macintosh. Insulating telegraphic conductors.
2363 A. V. Newton. Cutting stone. (A communication.)
2469 G. T. Bousfield. Preparing peat. (A communication.)

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

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

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

2671 R. Broadbent	2726 J. H. Johnson
2700 S. F. Cox	2784 J. B. G. M. F. Piret
2710 H. D. P. Cunningham	2818 J. Tangey

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

2207 A. Bessemer	2230 D. Naylor
2212 G. Hamilton and W. H. Nash	2387 B. Goodfellow
	2787 J. Jobson

LIST OF SPECIFICATIONS PUBLISHED

For the Week ending October 7, 1865.

No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.
s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
2841 0	8 2860 0	4 2879 0	10 2897 0	4 2915 0	4 2933 0	10 2933 0	10 2933 0	10 2933 0	10 2933 0	10 2933 0	10 2933 0
2842 0	4 2861 0	4 2880 0	4 2898 0	4 2916 0	4 2934 0	4 2934 0	4 2934 0	4 2934 0	4 2934 0	4 2934 0	4 2934 0
2843 0	8 2862 0	8 2881 0	4 2899 0	4 2917 0	4 2935 0	4 2935 0	4 2935 0	4 2935 0	4 2935 0	4 2935 0	4 2935 0
2844 0	4 2863 1	2 2882 0	10 2900 0	4 2918 0	10 2936 0	4 2936 0	4 2936 0	4 2936 0	4 2936 0	4 2936 0	4 2936 0
2845 0	4 2864 0	4 2883 0	4 2901 0	8 2919 0	4 2937 0	10 2937 0	10 2937 0	10 2937 0	10 2937 0	10 2937 0	10 2937 0
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2847 0	8 2866 0	4 2885 0	8 2903 0	4 2921 0	10 2939 0	4 2939 0	4 2939 0	4 2939 0	4 2939 0	4 2939 0	4 2939 0
2848 2	6 2867 0	4 2886 0	4 2904 0	4 2922 0	10 2940 1	2 2940 1	2 2940 1	2 2940 1	2 2940 1	2 2940 1	2 2940 1
2849 0	4 2868 0	4 2887 1	10 2905 0	10 2923 0	6 2941 1	2 2941 2	2 2941 2	2 2941 2	2 2941 2	2 2941 2	2 2941 2
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2854 0	4 2873 0	6 2892 0	8 2910 0	8 2928 0	4 2946 0	4 2946 0	4 2946 0	4 2946 0	4 2946 0	4 2946 0	4 2946 0
2855 1	10 2874 1	10 2893 0	4 2911 0	8 2929 1	8 2947 0	4 2947 0	4 2947 0	4 2947 0	4 2947 0	4 2947 0	4 2947 0
2856 0	4 2875 0	10 2894 0	4 2912 0	10 2930 0	8 2948 0	4 2948 0	4 2948 0	4 2948 0	4 2948 0	4 2948 0	4 2948 0
2857 0	4 2876 0	4 2895 0	4 2913 0	6 2931 0	4 2949 0	4 2949 0	4 2949 0	4 2949 0	4 2949 0	4 2949 0	4 2949 0
2858 0	4 2877 0	4 2896 1	2 2914 0	10 2932 0	10 2950 0	4 2950 0	4 2950 0	4 2950 0	4 2950 0	4 2950 0	4 2950 0
2859 1	8 2878 0	4 2897 0									

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

LATEST PRICES OF MATERIALS USED IN CONSTRUCTION.

Timber, duty 1s. per load, drawback 1s.	Archangel, yellow	£13 10	£14 10
Teak - load £11 0	4 15 St. Petersburg, do.	11 0	13 0
Quebec, red pine - 3 5	4 15 Finland -	8 0	10 10
Yellow pine - 2 15	0 0 Mosel -	10 0	15 0
St. John, N.B., yellow 0 0	5 6 Gothenburg, yellow 10 0	11 0	11 0
Quebec oak, white - 5 5	0 0 white 9 0	9 10	11 0
" birch - 3 10	4 0 Goffe, yellow -	10 10	11 0
" elm - 3 10	0 0 Soderhamn -	9 10	11 0
Dantale oak - 3 0	0 0		
" birch - 2 10	3 10		
Memel fir - 3 10	3 10		
Riga - 3 5	3 0		
Swedish - 2 9	2 10		
Masts, Quebec pine 6 10	8 10		
Yellow pine 5 0	6 0		
Lathwood, Danzig 7 10	8 0		
St. Petersburg 8 10	9 10		
Deals, per C, 12 ft. by 3			
by 9 in., duty 2s. per			
load, drawback 2s.			
Quebec, white spruce 13 0	17 0		
St. John, " 12 0	14 0		
Yellow pine, per reduced C.			
Canada, 1st quality - 16 10	19 0		
" 2nd " - 12 0	14 0		
Cottonseed -			

METALS.	IRON.	£ s. d.	£ s. d. per
Welsh Bars, in London -	per ton	7 15 0	to 8 0 0
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
Staffordshire Bars -	do	8 10 0	9 10 0
Bars, in Wales -	do	7 0 0	7 5 0
Rails -	do	7 0 0	7 5 0
Foundry Pig, at Glasg. No 1	do	2 18 0	3 7 0
Swedish Bars -	do	11 15 0	12 0 0

		STEEL:—						
Swedish Keg, hammered	-	do	15	0	0	0	0	0
Swedish Fagot	-	do	16	0	0	0	0	0
		COPPER:—						
Sheet & Sheathing, 8 Bolts	-	per ton	91	0	0	93	0	0
Hammered Bottoms	-	do	101	0	0	0	0	0
Flat Bottoms, not Hamdr	-	do	96	0	0	0	0	0
Cake and Tough Ingot	-	do	85	0	0	86	0	0
Best Selected	-	do	87	0	0	0	0	0
Fine Foreign Copper	-	do	92	0	0	0	0	0
Yel. Metal Sheathing & Rods	-	per lb.	0	0	7 1/2	0	0	7
		TIN :—						
English Block	-	- per ton	92	0	0	94	0	2 1/2
do Bar	-	- do	93	0	0	95	0	0
do Refined	-	- do	95	0	0	96	0	0
Bansa	-	- do	92	0	0	0	0	net
Straite	-	- do	85	10	0	0	0	-net
		LEAD:—						
Pig, English	-	- per ton	20	10	0	0	0	0 2 1/2
Spanish Soft	-	- do	15	15	0	0	0	0
Shot, Patent	-	- do	22	10	0	0	0	0 2 1/2
Sheet	-	- do	20	0	0	20	0	0 2 1/2
White	-	- do	26	10	0	0	0	0

THE
MECHANICS' MAGAZINE.

LONDON: FRIDAY, OCTOBER 20, 1865.

BOILED IRON.

AMONG the numerous improved processes which have of late years been introduced in the manufacture of iron, few are more interesting or important than that of "boiling" the metal. To this system, which has been somewhat recently introduced, the ordinary process of decarbonisation in the refinery and the puddling furnace appears to be fast yielding. Pig iron produced in the smelting furnace by coke or coal is converted into malleable iron either by decarbonisation in the refinery or oxidising hearth, and subsequent puddling; or it is converted at once in the puddling furnace by the process of boiling, which is equally effective and is now more generally practised. Shortly after the employment of the puddling process, it was found that considerable advantage was gained by mixing some of the crude iron with the refined plate metal. By this means a saving of the expense of refining upon the iron used in the crude condition was effected. Trusting to the decarbonising effects of the puddling furnace, it was found that if crude iron, containing a proportion of oxygen and very little carbon, was used, the refining process might be entirely dispensed with. This operation is popularly known as the "boiling" process, and it has acquired its name from the following circumstances which are attendant upon its working. As, in this single process, all the carbon has to be got rid of in the puddling-furnace, a violent evolution of gas ensues, so that, during the period of its disengagement, the fluid iron boils and bubbles most energetically, and thus furnishes an appropriate name for the system. When melted in this operation the pig iron is more fluid by reason of its containing a greater proportion of carbon than the metal from the refinery. A greater amount of labour, too, is required in stirring it about and submitting it to the action of the current of air. There is likewise a greater waste of iron attached to this process than occurs in puddling either plate, or crude iron and plate mixed. The loss, however, is less than in the two operations of refining and puddling. Another unpalatable fact which results from the boiling process is that the superior fluidity of the iron has a more injurious action on the furnace. But, in spite of these objections, the plan of boiling without the intermediate refining process is gradually gaining ground, and for the past ten years there has been a general tendency to adopt this decidedly superior method; in fact, in several places the use of the refinery has been superseded by boiling. Taking this in conjunction with other collateral circumstances, it may fairly be inferred that the time is not far distant when the refining process will be universally abandoned.

Mr. Fairbairn tells us that in the boiling process as carried on at the works of Messrs. Rushton and Eckersley, at Bolton, a small proportion of Cumberland hematite ore or peroxide of iron is mixed with the pig iron to be converted. It is found to assist in the process of boiling by supplying oxygen in the molten mass, and in other respects facilitating the process, increasing the yield, and improving the quality of the metal. As regards the first introduction of the boiling process in the iron manufacture, it appears that the credit of it is due to Mr. Hall, of the firm of Barrows and Hall, of the Bloomfield Ironworks, Tipton. Mr. Hall instituted a long-continued series of experiments in re-melting and extracting from the scrap and slag of puddling furnaces a quantity of ductile iron. According to that gentleman these experiments led to the introduction of pig iron and the boiling system in the puddling furnace. This is said to have

taken place more than thirty years ago, so that we may consider Mr. Hall as the first to introduce the system of boiling, which ultimately dispensed with the refinery, and established the more expeditious process of puddling direct from the pig. Considerable attention has been given to the decarbonisation of the crude iron, and many unsuccessful attempts have been made to secure a more scientific and perfect process. The nearest approach to perfection, however, appears to exist in an improvement patented by Mr. James Nasmyth in 1854. This patent has been worked for some years at the Bolton Ironworks, where its constant employment in the puddling furnaces has afforded proof of its utility. As its advantages become known its adoption increases, and it is gradually extending itself among the large manufacturers. The principle of the invention consists in the introduction of a small quantity of low pressure steam into the molten metal as soon as it is fused; 5lb. steam is generally used. As at that high temperature the oxygen of the steam has a greater affinity for carbon than for the hydrogen with which it is combined, or for the iron, the carbon is rapidly oxidised off. The hydrogen which is liberated has no affinity for the iron, but unites with sulphur, phosphorus, arsenic, and other substances which are very prejudicial to the quality of the iron. However minute may be the quantities in which they are present this is always the case, and they are frequently found both in the ores and in the fuel. Besides the chemical part the steam plays with respect to the iron, it also has a mechanical action on it. It is introduced at the bottom of the furnace, and being thence diffused upwards it violently agitates the iron, thereby causing fresh surfaces to become exposed to the oxygen passing through the furnace.

In carrying Mr. Nasmyth's plan into operation steam is conveyed from the boiler to a vertical pipe fixed near the furnace door. At the lower end of this pipe is a small tap or syphon to let off the condensed steam and prevent its being blown into the furnace. To the flange of the vertical pipe are fastened a cock with several jointed pieces of pipe, forming in effect jointed bracket pipes, which allow of free motion in every direction; the steam tube or "rabble" being bent at the end so as to inject the steam on the liquid metal. As soon as the iron in the furnace is melted, the puddler introduces this apparatus, which he moves slowly about in the molten iron, while the steam pours upon it through the bent end of the tube. In about five or eight minutes the mass begins to thicken, when the puddler withdraws the steam-pipe and the operation is finished in the usual way with the common iron rabble. It is found upon an average that from ten to fifteen minutes are saved by this process in every operation or "heat," and that during the hottest and most laborious part of the operation. By the adoption of this simple apparatus the highly carburised pig iron, which is the most free from impurities, is rendered malleable in one furnace operation, without the deteriorating adjuncts of the ordinary refining and puddling process. In this arrangement no deleterious substance can enter into combination with the iron, whilst the mixture of fuel and metal, as in the refinery process, is liable to deteriorate the metal with sulphur, silicium, &c. In short, the new process has a beneficial effect in purifying the iron with greater economy than any known process.

Whilst upon this subject we may refer to the Silesian gas puddling-furnaces, which are rather extensively employed in the iron manufacture upon the continent. These take the place of our reverberatory air-furnaces, upon which they are said to be a very great improvement. They not only entirely prevent smoke and greatly economise fuel, but they so far simplify the wrought iron manufacture that the furnaces are managed by a less skilled class of workmen. The Silesian furnace somewhat resembles, in character, a reverberatory

furnace in which the fireplace is superseded by an oblong chamber called the gas generator, which measures 6ft. by 4ft. This chamber has an opening at the bottom through which air is admitted from a fan, for the purpose of driving the gases from the chamber into the furnace amongst the iron. The same fan also supplies air to the furnace through a series of tuyeres which deliver the air at the point where the gases enter the furnace. The entire action of the furnace is placed under the control of the attendant by means of regulating valves which are attached to the pipes supplying the air and the gas. The quantity may therefore be very nicely regulated, so as to suit the intensity of the flame to the nature of the work, and to effect complete combustion. These furnaces date from about twenty-four years since, and are extensively used in the Silesian district, with highly favourable results. They do not emit any smoke, and, as the whole of the gaseous products are made available, a saving of upwards of 30 per cent. in fuel is effected. In working, the furnace is very simple, and so perfect as to have led those who have witnessed its action to describe it as being as precise as a machine. The iron being preserved from contact with the ash and impurities of the fuel, constitutes another important feature of the apparatus.

These furnaces are at work at the Government Ironworks in Upper Silesia, where they were inspected by Mr. F. A. Abel, who states the process of refining to be carried out as follows:—When the charge of iron on the hearth is ascertained to be thoroughly fused a small quantity of crushed limestone is thrown over its surface. Two tuyeres are then introduced into the furnace at an angle of 25 deg. through an opening on each side of the hearth near the bridge. The air rushing in from these two points impinges upon the iron, and the two currents meeting impart an eddying motion to the fused metal. This motion soon increases, the supernatant slag is blown aside by the blast, and the surface of iron thus exposed undergoes refinement, while it changes continually, the action of the air raising the temperature of the whole mass to a full white heat. In order to insure a proper change in the action of the metal exposed to the blast, the iron is occasionally stirred. A small quantity of limestone is thrown in at intervals, the total supply amounting to about 1 per cent. of the iron acted on. With a charge of 40 cwt. the time of treatment of the metal after fusion varies from two and a half to five hours. In withdrawing the charge the side tuyere nearest the tap-hole is removed, and the metal is thus forced towards the hole by the blast from the opposite side. The iron leaves the furnace at a white heat and is perfectly limpid, but it soon chills and solidifies. The efficiency of this system should certainly recommend it to the attentive consideration of our own ironmasters, to whom the least improvement in manufacture is daily becoming of increased importance.

THE MOTION OF ADVANCE OF A SHOT
DOWN THE BORE OF A GUN.

THERE is hardly any question in gunnery more material than that of the advance of the shot down the bore of a gun under the force of powder explosion. Until its method is thoroughly ascertained and understood, all the theory in the matter which, properly supported and based, is so productive of result and economy must remain empirical and untrustworthy. The sudden and violent explosion of a powder charge in the confined chamber of a gun presents much difficulty to investigation on account of the great force and rapidity of the action. It seems almost impossible to judge of it except empirically and by its result; nevertheless of late years the great and intimate attention which has been given to this subject has gradually supplied a theory and laws of action, which, although almost always following on facts instead of leading them, and generally matter of very doubtful speculation until

confirmed by long trial, put into form the reasons for observed action, and enable them to be tested to certainty, and secured as principles for guidance.

The motion of advance of a shot down the bore is a very-complicated matter, involving consideration of the method of combustion of the charge of gunpowder, its expansive force, the friction of gases against metal at very high pressures, and the escape of gas by means of the windage or the vent, all questions concerning which but little certain experimental data exists. The motion of the shot at any epoch will be in proportion to the amount of gas pressure on its base, deducting the obstructive effects of atmospheric resistance, friction, and in rifled guns the resistance due to groove pressure. The friction of gas escaping round the shot by the windage will also no doubt have some accelerating effect, for, that gases at high pressures have very considerable frictional effect is shown in the Maackay gun, where rotation of the projectile is altogether enforced by gas friction. The mode of combustion of the gunpowder charge in a gun is not at present sufficiently understood to enable anything but a rough and conjectural approximation to be made in its assertion. The rate at which the powder will be converted into gas, under the circumstances of compressed combustion which obtain in the bore, has not been ascertained with any pretension to exactness, though the rate of combustion of powder unconfined is easily ascertained. The difficulty of securing such data is so considerable that we are forced to trust more to direct experiments on the force exerted at different portions of the bore, such as those of Captain Rodman, U.S., than to any theory so empirically founded. Perhaps, however, further experiments might enable an approximation to be made to knowledge of these elements sufficient to afford further information by comparison with theories founded on other bases. There are two principal considerations affecting the explosion of a charge of gunpowder,—the rate of transmission of the flame, and the rate of burning of the powder. The amount of gas evolved in decomposition, if at an ordinary temperature, is stated at about 317 times the original bulk of the powder, and with correction made for heat is generally stated at about 2,000 times the original bulk. This gives a pressure of 2,000 atmospheres for the gas when first developed from the powder, and when considered as only occupying the same space as it. So enormous a pressure ensures very great rapidity of movement in the inflamed gas. Supposing a very small quantity of powder ignited on the firing of the gun in the immediate vicinity of the vent, then the innate pressure of the resulting gas has, as forces opposed to its motion—the inertia due to its weight, the atmospheric pressure, and the friction against material with which it comes in contact; but since the first force of the gas on ignition is so great, 2,000 atmospheres, the flame would probably be passed with such rapidity from grain to grain if they are near one another, continually developing with fresh combustion the initial pressure, that the time of transmission of flame in comparison with the time of combustion might be considered almost immaterial; the effect, however, attributed to air space of increasing the rapidity of combustion seems to indicate that transmission is not sufficiently instantaneous to prevent time for motion of grains, remote from the origin of combustion, which causes them to cake together and thus to diminish the rapidity of inflammation.

Whether the rate of burning of an inflamed grain of powder is the same in the bore of a gun as in an unconfined space, is also matter of uncertainty. The exact amount of gas developed at any period of the combustion must then, in the absence of acquaintance with the above considerations, remain only a matter of doubtful speculation; and we can only attempt to make some rough approximation to statement of the force at any time in action on the shot. Assuming as sufficiently correct the law known as Mariotte's, that the elastic

pressure of gas varies as its density, the gas pressure at any time existing in the bore in rear of the shot will be proportionate to the amount of gas developed, and will also depend on the space it occupies, to which it will be inversely proportionate. The principal forces which resist expansion are the shot's inertia, frictional, groove, and atmospheric resistance, also the inertia of the gas, and the friction of the moving column of gas against the bore. Deductions may also be made for escape of gas by windage and by the vent. This escape is probably a most important element in modifying the force first impressed on the shot on ignition of the charge. For if there were no escape and the powder were supposed to fill completely the bore in rear of the shot, at first ignition the full initial expansive force of the powder (assumed above at 2,000 atmospheres) would be exerted on the shot, a force which would give it a velocity of some 200ft. per second, if acting through only lin. of the shot's advance. The motive force acting on the shot at any time is proportionate to the area of its greatest transverse section expressed in square inches, multiplied by the gas pressure per square inch. If the force acting on the shot were supposed to be constant, its amount could be determined by the formula—

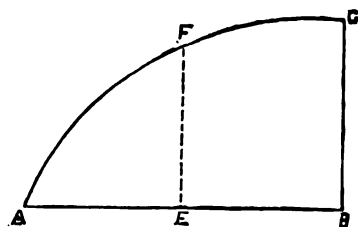
$$P = \frac{W V^2}{2 g S};$$
 where W = weight of shot; V its initial velocity; S the length of the bore through which the force acts, and g is equal to 32.

$P S = \frac{W V^2}{2 g}$, will, whether the force is or is not constant, be equal to the total amount of force expended in effecting the motion. But since the transmission of inflammation to different parts of the charge may perhaps be considered instantaneous compared to the whole time of combustion, the development of gas will be continually diminishing in amount, as the grains of powder consume more rapidly at first, when they expose a larger surface for flame. But to keep up a constant pressure the development should be far greater towards the latter part of the passage of the shot down the bore, as the shot is then moving with greater velocity, and developing proportionately more space in its rear to be filled by gas. A considerable portion of the gas, too, perhaps 20 or 30 per cent., may have escaped by windage when the shot arrives at the muzzle. The force expended in giving motion to the column of gas may also be proportionately greater when the gas occupies a larger portion of the bore, and when there is consequently a greater surface for pressure productive of friction, though this effect will be modified by the diminution of the pressure per square inch. For the above reasons it seems quite improbable that a constant force could be impressed on the shot without using a cartridge contrived of different materials, to burn much more rapidly towards the end of combustion, and so in a manner contrary to that of the ordinary powder charge. Probably a great deal depends on the force first impressed on the shot. The amount of windage and of the space between the powder and the base of the shot will most materially affect this. If the shot be retained in the bore until the powder is more developed into gas, greater effect may be obtained with the same charge of powder. This is exemplified in a case mentioned in an "official report" of the performances of two 32-pounder guns of the same calibre, &c., fired with the same charge and weight of shot, but one rifled, the other smooth. The initial velocity of the shunt-rifled gun was 1,224ft., that of the gun fired with a smooth cylinder was 1,201ft. This would seem to show that the ultimate velocity of the rifled projectile was actually increased by the resistance in the bore due to rifling, which retained it perhaps more advantageously in the bore for the action of the powder. If the shot be at first and almost instantaneously endued with great velocity, it will evidently arrive sooner at some point in

the length of the bore than if the first impressed velocity had been less; and, consequently, when it has reached such a point, less time will have elapsed for conversion of powder into gas in one case than the other, and there will be proportionately less pressure on the shot which has traversed the distance most speedily. It would seem, then, that by allowing sufficient windage, or perhaps by shaping the shot so as to allow of more space between it and the powder, or by using other means, so that the shot be not endued with too great velocity at first starting, the powder gas may be so utilised towards the muzzle that the same or greater initial velocity may be obtained than would be the case when the first force impressed on the shot was much greater; and when consequently also the strain on the gun near the seat of the shot is similarly greater; but it must be remembered that in relieving this part of the gun of strain additional pressure and strain is thrown on the gun near the muzzle, to obtain the same result.

If we consider the combustion in the bore as similar to that which would occur with grains of powder inflamed in an unconfined space, we find that a charge of powder will occupy about 1-14th of a second in complete combustion, that being the time in which, as is ascertained by experiment, one grain of the ordinary powder will be consumed. In fig. 1,

FIG. 1



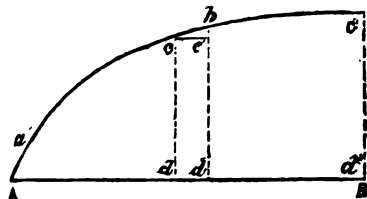
if AB represent the time of this combustion, ordinates EF denote the amount of powder converted into gas after a time of burning AE . It will be seen that gas is very slowly developed towards the end of the period, and that, in fact, more than three-fourths of the gas is formed during the first half of the time; so that it might be advantageous to use a powder burning so slowly that not more than perhaps half the time required for complete consumption should be occupied by the passage of the shot down the bore, as then, on the shot arriving near the muzzle and attaining its greatest velocity, the development of gas would be still sufficiently rapid to keep up the necessary supply of gas, and to utilise, for impressing force, the portion of the gun near the muzzle.

The proportionate motive effect of the gas at different portions of the gun's length may be considered by examining the probable effect that will follow on the combustion of successive small portions of the charge, observing the amount of gas developed, the space which is allowed for its occupation by the motion of the shot, the probable escape by windage, &c., and the consequent pressure and motion. The results of such inquiry are of course only empirical, and nearly useless till confirmed by experiment. The escape by windage, when there is any, will be greatest at first, and will considerably modify the first force. The expansive force of the gas causes its motion and escape round the shot, the opposing forces being the inertia of the gas, the friction due to its pressure against the bore and shot, &c. At first the gas is more compressed and has also consequently more expansive force, so that at first ignition a certain weight or actual quantity of it will be discharged through the orifice of the windage in a less time than when the gas is more expanded, and has less pressure acting on it.

Experiments with a 24-pounder have shown that with ordinary charges, increase of length of the gun beyond about eighteen calibres is ineffective to produce increase of range; and

some experiments made by Dr. Hutton with a gun throwing a 1lb. shot, show that with such a gun the effective limit would be reached at between about fifty and sixty calibres. This seems to indicate that with guns of large calibre the effective limit measured in calibres is soon reached; and the effective length for different guns counted in calibres, judging from these experiments, would seem to vary in about the inverse ratio of the length of calibres; and it will be seen that, estimating from this, a length of 9ft. for every gun would appear to give the greatest effective length. This appears to be about the length generally adopted for the bore of the gun in front of the charge. It may be argued from this that at the muzzle the motive force acting on shot fired from guns of ordinary length is nearly counterbalanced by the force opposing motion. From a consideration of the initial velocities obtained by Dr. Hutton, with similar guns of from fifteen to forty calibres length, it would appear that the velocities of the shot at various lengths of the bore were very much as shown in fig. 2, where A B represents the length of the bore of the gun, and the ordinates $c d$ represent the velocities of the shot at points a and d . The velocity added during the passage of the shot through some portion of the bore $d d'$, being the difference between the lengths $d' c'$ and $d c$. The initial velocity at the muzzle is shown by $d' c'$. From this figure the velocities

FIG. 2



added in different portions of the bore may be observed; and if we suppose the motive force constant through any short distance of the

bore, the formula $PS = \frac{WV^2}{2g}$ will give the

force in action through such distance by substituting for V and S values for the velocity added during the short distance denoted by S . There will, however, be considerable doubt about the form of the curve near A a , and about the angle which it makes with the line A B. The increment of velocity added to the shot during its passage some short distance $d d'$ will be represented by the amount of difference between the two ordinates $c d$, $a d$, and may consequently be represented proportionally by the tangent of the angle, which a line tangential to the curve at the point under consideration makes with the line

A B; $\frac{A c}{c c'}$ represents the proportion of increment, and is equal to the tangent of the angle made by a line such as just referred to. The angle $A c c'$ may perhaps be taken as about 55 deg. at A, 35 deg. at about 1-5th the length of the bore, and 10 deg. at about 1-4th its length. By comparison of the proportionate amount of force which may hence be deduced to exist at different points in the length of the bore, with the amount of constant force which, acting through the length of the bore, could perform the same quantity of work,

$PS = \frac{WV^2}{2g}$, values may be obtained for the

actual amount of the variable force existing at different points. It must be remembered that the above consideration is merely a matter of speculation, and, although it possibly shows with tolerable exactness the method of impressment of force on the shot at some distance down the bore, it may be much astray concerning the first strain on the gun and pressure on the shot within the first few inches of its motion. It seems, however, to agree with the result obtained by investigation of the effect produced by successive development of

small quantities of gas during the explosion as before suggested.

The idea which formerly prevailed of the impossibility of understanding the nature of combustion and explosion, and which led most theorists in gunnery to consider the charge as instantaneously inflamed and decomposed, has now given place to a more scientific comprehension, and perhaps further experiment and theory may enable the initial force and subsequent development of the gas to be ascertained with all the exactness necessary to economy and proper method in the manufacture of ordnance.

REVIVIFYING ANIMAL CHARCOAL.

IN the manufacture of sugar two principal processes of filtration are employed. The first has for its object the removal of the mechanical impurities remaining in the syrup after it has left the clarifiers. To effect this, the liquor is passed through bag filters, which consist each of a cast-iron tray fitted on a wrought-iron box. The bottom of the tray is full of perforations, under each of which a cotton bag about two feet long and a foot in diameter when extended is fixed. Each bag is enclosed in an outer one of canvas about 4in. in diameter, in order to prevent the swelling out of the interior cotton filter. The duty of this filter is to detain the suspended scum and other mechanical impurities. But beyond these the juice of the sugar cane contains impurities of a chemical nature—various colouring matters—which are not removed by the antecedent processes. It is true, they can be removed during the process of defacation by the successive employment of subacetate of lead and phosphate of lime. Subacetate of lead has the power of throwing down the whole of the colouring matter and other organic foreign substances present in the syrup. But the subsequent separation of the lead which is in solution, by phosphate of lime, is either not perfect in the presence of sugar, or requires more delicate manipulation and greater care than can be usually looked for in sugar manufactories. Hence, the employment of lead as a defacating agent has been discouraged, and probably abandoned, the action of repeated, though very minute, doses of lead on the system being exceedingly deleterious. Dr. Scoffern found that he could remove the whole of the lead by precipitating it by sulphurous acid, and his process is perfectly capable of being done well. But still the dangers attending the use of lead are so great that it is highly improbable the plan will ever be adopted in practice. It therefore becomes necessary to employ some other and less objectionable method of effecting the decoloration of the juice. To this end the second process of filtration through charcoal is resorted to, animal charcoal being the agent employed. The vessels used are usually made of wrought-iron, circular in form and slightly conical from the upper rim downwards. They have a perforated false bottom, upon which a blanket is placed, and whereon is piled the charcoal through which the juice is passed. Animal charcoal possesses pre-eminently the power of removing many organic substances from solution when brought into prolonged contact with the liquids which contain them. Thus, strychnine when in solution is removed by agitation with animal charcoal, and the decolorisation of sugar depends upon the same power of the coal.

Animal charcoal or bone-black undergoes no profound change in removing colouring matter from syrup. It appears to act by a species of superficial affinity, that is, as far as the process can be followed, an affinity pervading the surface of every one of the minute pores of the charcoal, rendering the actual superficies something enormous. But, although no change takes place in the charcoal, its power is limited. When it has withdrawn a certain amount of colouring matter from the syrup, the pores become charged, and the surface coated with it, so that the liquid has

no longer a charcoal surface to act upon. Hence arises the necessity for its revivification, for the same bone-black may be employed any number of times provided the substances it has withdrawn from the syrup be removed. This is sometimes done, by allowing them to ferment as in Peyron's filter, but the general practice is simply to rekindle the coal. In Peyron's filter, after the syrup ceases to flow freely, hot water is used to displace that portion absorbed by the bone-black, and as soon as the density of the escaping liquid becomes feeble it is no longer collected. The hot water is then allowed to flow through the filters until they are washed perfectly. The dilute syrup and nitrogenous impurities absorbed by the bone-black cause a rapid fermentation, which proceeds for twenty-four hours, when it is considered complete, and the impurities taken up by the bone-black destroyed. Half an hour's exposure to the passage of a jet of high-pressure steam, and a subsequent washing with hot water, prepare Peyron's filter for resuming work. But the more simple process of rekindling is the general method adopted, and perhaps no point is of more importance in the manufacture of sugar than the burning of the charcoal or bone-black. This material is generally used in small pieces, about the size of a half pea. Formerly it was preferred to have the charcoal as fine as dust, but the objections to this are that the liquor does not run so rapidly through the filter, it is not mixed with so much facility or convenience, and it is not so easily revivified. The dust is therefore now no longer used, and even very fine charcoal is often objected to. When the charcoal ceases to act upon the syrup, the usual course is to wash it with hot water, and afterwards to return it in closed furnaces of various construction. One form of kiln in rather extensive use is that made by Mr. Chantrell, of Liverpool. It is constructed of firebrick, and has an upper floor, heated by the flux which comes from the furnace on its way to the chimney, and on which the charcoal is dried before it is strongly heated. The kiln contains twelve chambers for the charcoal, each 2ft. long and 3in. broad. These chambers or slits receive the charcoal at the top after drying, and, being filled up with it and heated to redness, all the organic matter in the charcoal is destroyed. This is done in about forty minutes, when the slide at the bottom is removed and the charcoal falls into coolers, which are iron vessels, somewhat narrower than the red-hot chambers. Each chamber divides into two coolers, which are exposed externally to the air and allow the charcoal to become black, removing all fear of burning or uniting with oxygen when it arrives at the measuring-box at the bottom. This kiln is said to require much less coal than the iron retorts, a saving of as much as 70 per cent. being effected according to some accounts. This appears very considerable, but we know that iron possesses a far greater conducting power of heat; for this reason it is used for cooling, whilst bricks are used for containing the heat.

Various improvements have been effected from time to time in apparatus for re-burning animal charcoal; the first one of any note, however, was made by Mr. J. W. Bowman in 1846. He introduced revolving retorts, whereby the charcoal, by being constantly agitated and turned over during the process of re-burning, is more readily and uniformly operated on, and a saving of both time and fuel are effected. Six years later Mr. George Torr introduced improvements in the construction and setting of revolving retorts. By his plan one end, as well as the sides of the retort, was contained within the combustion chamber, and was consequently heated. The first arrangement whereby the re-burning process was rendered absolutely continuous was patented by Messrs. Brinjes and Collins, in 1858. According to their system the retorts were charged at one end and emptied at the opposite end continuously by the aid of an

Archimedean screw or other equivalent mechanism inside the retort. The motion of a continuous process was followed up by Mr. Drummond, of Montreal, whose plan, patented in 1862, in the name of James Paterson, consists in placing two or more inclined revolving or reciprocating retorts at reverse angles, one above another. This is to enable the charcoal to descend by its own gravity from the upper to the lower retort and be finally discharged into a closed receiver. Mr. Drummond appears to have been the first to propose the use of two or more retorts placed one above the other. In the same year that Mr. Drummond patented his retort, Mr. Torr took out another patent for carrying on the process of re-burning continuously in lieu of intermittently as in his first arrangement. In 1864, Mr. J. F. Brinjes obtained a patent for an arrangement of horizontal cylindrical retorts having a circular reciprocating in lieu of a continuous rotary motion on their axes. But, although this arrangement is very effective, it is still inferior to Mr. Brinjes' more recent plan, in which the means employed for traversing the charcoal along the retorts are greatly simplified. Encased in a brick setting are two horizontal retorts, each of which receives a circular reciprocating or alternating motion of nearly one entire revolution on its longitudinal axis. The upper retort, which acts as a drying chamber, is contained in a separate brick setting over the roof of the furnace, and is acted on by the flames before they finally pass off into the chimney. The two retorts are provided with a series of internal flanges at intervals of six inches or so, and ledges are formed between the flanges for carrying up the charcoal as the retorts reciprocate. An opening is made through each flange, all the openings being disposed in a line with each other. An angled projection is cast inside the cylinder in each of the spaces between the flanges and in the centre line of their openings. By this means the charcoal is caused to travel continuously along the retorts. The upper retort is driven direct by a mangle wheel and pinion arrangement, and this motion is transmitted to the lower retort by an endless chain. A feeding hopper communicates with the retort by a sliding door, by which the feed can be nicely adjusted. The upper retort discharges its contents into a conduit, through which they pass to the lower retort, after traversing which they are discharged into a closed receiver. They pass thence through the cooler, which consists of a number of long narrow passages placed side by side, and having air spaces between them. By the time the charcoal has traversed these coolers it may be exposed to the atmosphere, and is, therefore, discharged into a small waggon. The advantages of this apparatus appear to be greater regularity and certainty of action, and less labour and attention when in operation. The action of the apparatus is very gradual, and the charcoal is first dried in the upper cylinder, so that the charcoal is re-carbonised in a very efficient manner. There is also an economy of space, as the entire apparatus only occupies a space of about 12ft. by 5ft. in plan, and is about 12ft. in height from the stoking floor. The work done with each apparatus of two cylinders over one furnace is said to be about ninety tons of charcoal per week, with a consumption of about ten tons of coal, or at the rate of nine tons of charcoal for one of fuel.

But although these arrangements are very perfect and restore to a considerable extent the decolorising powers of the charcoal, we shall find on looking a little closer into the matter that at each successive reburning the coal loses some of its properties. In course of time it ceases altogether to act as a decoloriser, unless mixed after each burning with a proportion of new charcoal. Experiments have established the fact that the decolorising power of charcoal used in sugar refining is correlative to its power of absorbing lime; that is, the more the pores of the bone become choked with lime the less is its power

of decolorising. Mr. Edward Beanes has been occupied for some years past in contriving how he can best remove the obnoxious lime without attacking the structure of the bone itself. The result of his labours is that he has recently patented a process of restoring to charcoal its primitive properties of decolorising syrups. In his experiments Mr. Beanes found that dry hydrochloric gas was absorbed by charcoal with the greatest avidity and in enormous quantities when the coal was perfectly dry and hot. A soluble chloride of calcium is formed by the combination of the gas with the lime. The charcoal, after having been treated with gas, is mixed with some of the untreated charcoal; the combined gas remaining in the pores of the former is taken up by the latter, and the whole becomes neutral. A few hours' washing removes the chloride of calcium from the charcoal, which afterwards undergoes the usual process of burning. By the adoption of the preliminary chemical process it is found that the decolorising power of the charcoal is augmented as much as 100 per cent. We thus see that by Mr. Beanes's process the whole of the lime and carbonate of lime can be removed from the pores without attacking the phosphate, whilst the decolorising powers of the coal are greatly increased. The process is inexpensive as far as apparatus is concerned, and in itself is almost costless, two saleable products being obtained nearly equal in value to the materials employed. Mr. Gerken in our own columns has recently called attention to the loss resulting to sugar refiners through having the charcoal simply returned without any previous treatment. The method adopted by him in revivifying animal charcoal consists of three processes: first, the fermentation of the charcoal by which the colouring matters are destroyed; secondly, the addition of muriatic acid to dissolve the lime, which is subsequently washed out; and thirdly, the reburning of the coal in open cylinders. He states that charcoal thus treated enables the refiner to obtain from 20 to 30 per cent. better liquor. There are, however, practical objections in this method as compared with Mr. Beanes's process, which, followed by burning on the principles laid down by Mr. Brinjes, will, if adopted, confer considerable benefit upon those engaged in the sugar manufacture.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

Is Nitrogen an Element?—New Method of Employing Sunshine as a Source of Mechanical Power—A White Inoxidable Alloy for Taps—Cheaper Production of Pyrogallie Acid—New Method of Reducing Zirconium—Nature of the Invisible Photographic Image.

CHEMISTRY and astronomy unquestionably stand out from among the sisterhood of the sciences as being the two which of late years have made by far the greatest progress, and are still advancing with the most rapid strides. Scarcely an hour has passed during the current century, and certainly not an hour passes now, without adding some new fact to the vast stores of knowledge which it is the province, on the one hand of the chemist, and on the other of the astronomer, to study and increase. And it is curious to note how the two sciences help each other. There exists, indeed,—so, at least, it seems to us,—such a perfect "correspondence," to use that word in the sense in which Swedenborg employs it, between the laws which govern the great orbs of which it is the object of the astronomer to learn all he can and those which rule the minute atoms into whose properties the chemist inquires, as must necessarily ensure, when it shall be fully recognised, that any step forward taken by the student of the former shall be a step forward for the student of the latter also, and *vice versa*. We have not yet got to that point, but already it has begun to be not unfrequently the case that observations made from the

astronomer's watchtower confirm and support those made in the chemist's laboratory. The latest instance of this has reference to the constitution of nitrogen, and is afforded by Mr. Huggins's observations of the spectra of some of the nebulae, taken in connection with certain observations of the nitrogen spectrum which have recently been made in the laboratory of M. Waltenhofen. It consists simply in the fact that Mr. Huggins and M. Waltenhofen have both been led to the suspicion that nitrogen is not an elementary substance, but a compound of more simple forms of matter,—the former by observing in the spectra of some of the nebulae *some, but not all*, of the lines of the nitrogen spectrum, just as though nitrogen were a compound body, and those nebulae contained, among the materials of which they are composed, one of its constituents and not the other, and the latter by the discovery that in a highly rarified nitrogen atmosphere the violet rays disappear before the blue and green rays.

M. Babinet has communicated to the Academy of Sciences an account of some experiments by M. Mouchot, Professor of Mathematics at Alençon, on the mechanical effects producible by confined air heated by the rays of the sun. In these experiments M. Mouchot employed a cylindrical vessel of thin silver, blackened on the outside, and enclosed within two cylinders of glass, placed one inside the other. The office of the glass cylinders, of course, was to prevent the heat which might pass through them to the blackened silver cylinder being radiated back again,—glass, while affording a free passage to the direct rays of the sun, being practically opaque to radiant heat. The silver cylinder was half filled with water, and an airtight cover was then fitted on it, a tube, fitted with a stopcock, passing vertically through this cover to very nearly the bottom of the vessel. Thus arranged, the apparatus was placed in the sun, whereupon the air in the upper part of the vessel speedily became heated sufficiently to cause it to exert so much pressure on the water under it, that the latter, on the stopcock in the tube passing through the cover of the vessel being opened, escaped in a jet more than ten metres high. This very remarkable result led M. Mouchot to construct an apparatus on the same plan which yielded a continuous jet of water as long as the sun was shining on it. M. Babinet is of opinion that machines on this principle might be found useful for raising water on the great scale in tropical countries.

M. Vigouroux, of Nîmes, has devoted much attention to the production of a white alloy suitable for taps for wine and beer barrels, etc., etc., and he has found that alloys of tin, antimony, and nickel answer the purpose best. For the body of the tap he prefers an alloy consisting, per thousand parts, of 785 parts tin, 195 antimony, and 20 nickel, and for the key an alloy of either 807 parts tin, 175 parts antimony, and 18 parts nickel, or of 715 parts tin, 215 parts antimony, and 70 parts nickel. These alloys are quite inoxidable under any ordinary circumstances, and, although containing antimony, are otherwise quite harmless, not being acted upon in the least by any of the elements of ordinary beverages.

Pyrogallie acid has of late years become very extensively used in some of the arts, and especially in that of photography. It is obtained by the decomposition of gallic acid, which compound, when heated to from 210 deg. to 215 deg. Centigrade, splits up into pyrogallie acid and carbonic anhydride. The formula of gallic acid is $C^7H^6O^8$, and its equivalent is thus 170, the formula of pyrogallie acid being $C^6H^5O^3$ (or $C^7H^6O^4$, less CO^2 , or carbonic anhydride), and its equivalent 146. One hundred parts of gallic acid ought therefore to yield 74.1 parts of pyrogallie acid, but hitherto, in practice, manufacturers have not succeeded in obtaining more than 25 parts of pyrogallie acid from each 100 parts of gallic acid employed. By using, however, a closed vessel in which to

effect the decomposition,—a kind of Papin's digester, made of bronze,—MM. Victor de Laynes and G. Esperandieu have just succeeded in obtaining from a given quantity of gallic acid the full amount of pyrogallio acid which it ought to yield according to theory. If their method should answer on the great scale, it will cheapen this valuable agent more than sixty per cent.

We mentioned some little time back that M. Trost had obtained zirconium in crystalline laminae by heating, in a crucible made of gas retort carbon, to the temperature at which wrought iron melts, one part of the double fluoride of zirconium and potassium with one and a half parts of metallic aluminium, and afterwards separating the reduced zirconium from the excess of aluminium by dissolving the latter in dilute hydrochloric acid. Dr. T. L. Phipson has since obtained zirconium by reduction from its oxide, the earth zirconia, by means of metallic magnesium. Like carbon, boron, and silicon, zirconium is capable of existing in three distinct forms, the crystalline, the graphitic, and the amorphous, and by Dr. Phipson's method it is obtained in the amorphous state, as "a velvety black powder." The reduction takes place at the moment the magnesium begins to melt. The magnesia, which is formed by the combination of the oxygen of the zirconia with the magnesium, may be dissolved away by dilute hydrochloric acid, which has not the least action on the reduced zirconium. Dr. Phipson was led to try this method of obtaining zirconium by his having previously found that magnesium will reduce carbon, boron, and silicon from the acids which those bodies respectively form with oxygen. He concludes that carbon, boron, silicon, zirconium, and titanium all belong to the same group of elements. In most of their properties these five bodies certainly resemble each other very closely, but in their relations to hydrogen there is some difference between them. Carbon, silicon, and titanium form, very readily, gaseous compounds with hydrogen, and carbon forms also various liquid compounds therewith; but neither boron nor zirconium has yet been made to combine with hydrogen at all.

Dr. Vogel, as the readers of these "Notes" will remember, some months ago published some researches going to show that iodide of silver is not sensitive to the action of light except when there is present with it some body capable of combining with iodine, just as oxide of iron is not capable of being decomposed by heat except when there is in contact with it some substance capable of combining with oxygen. Dr. Vogel deduced from his researches the conclusion that the invisible photographic image is produced upon the sensitive plate by a *chemical* action,—that is to say, by the *reduction* of a portion of the silver haloid in the sensitive film,—and not by a merely *physical* change in the sensitive surface, as the theory more generally accepted previously supposed. Mr. Cary Lea, of Philadelphia, however, has lately completed some researches the results of which seem to prove conclusively that the physical theory is the true one, after all. Reasoning that if the iodide or bromide of silver in the film really undergoes decomposition in the camera, and, still more, if the developed image is formed at its expense, the film of iodide or bromide must necessarily be greatly consumed in the development under the dense portions of the negative which it has contributed to form, he determined to ascertain whether or not this consumption takes place. Accordingly, he developed an iodo-bromized plate in the ordinary manner, and then, instead of removing the unchanged iodide and bromide in the usual way, took measures to *remove the developed image without affecting the iodide and bromide*. This object he accomplished by means of a very dilute solution of acid permanganate of mercury. Now, if the iodide or bromide, or both, had been in any way decomposed, to form, or aid in forming, the developed negative image, when this came to be

removed there should have been left a more or less distinct *positive* image, depending upon varying thicknesses of iodide and bromide in the film, much like a fixed negative that has been completely iodized. Nothing of this sort, however, was visible. The film, on the contrary, was perfectly uniform—was just as dense where an intense sky had been as in those parts which had scarcely received any actinic impression, and looked altogether exactly as it did when it first left the camera, and before any developer had been applied to it. In a second experiment, Mr. Lea treated a plate in all respects the same as in the first experiment, except that the application of the nitrate of mercury for removing the developed image was made by yellow light. The plate, which now showed nothing but a uniform yellow film, was then carefully washed, and an iron developer, to which nitrate of silver and citric acid had been added, was applied to it. *The original image was thereby reproduced*, coming out quite clearly in all its details. As every trace of a picture, and all reduced silver, had been removed by the nitrate of mercury, this experiment would seem to absolutely demonstrate that the image is a purely physical one, and that, after having served to produce one picture, that picture may be dissolved off, and the same physical impression be made to produce a second picture by the mere application of a developing agent. The experiment succeeds just as well when a pyrogallio developer is used as with an iron developer.

NON-EXPLOSIVE GUNPOWDER.

MR. J. N. HENDER, of Plymouth, delivered a lecture on "Combustion" before the members of the Devonport Working Men's Association on the 11th inst., and, in reference to attempts to lessen the danger of explosive and combustible materials, alluded to a fallacy with regard to the prevailing idea that Gale's new patent rendered gunpowder perfectly safe, and that it was free from all objections. He took a mixture containing four parts of powdered glass (the same as that which Mr. Gale uses) and one part of gunpowder, which were thoroughly mixed together. These were thrown into a glass vessel. A portion of the mixture was put into a pistol, and the percussion cap being snapped, the mixture was blown out without producing any report. The vessel containing the mixture was then gently tapped on the table for a few seconds, when a considerable quantity of gunpowder rose to the top. A portion of this was poured off and put into the pistol, where on being fired it exploded just like ordinary gunpowder. The lecturer left the remainder of the mixture in the hands of the audience, that they might be satisfied of the correctness of the proportions employed. The experiment is a very important one, as it serves to show that the gunpowder will regain much of its explosive power by the simple shaking which it receives in carriage. The lecturer stated that even the process of rolling the mixture forwards and backwards would cause a partial separation of the two powders.

THE ACTION OF LIGHT UPON SULPHIDE OF LEAD.

By DR. D. S. PRICE.

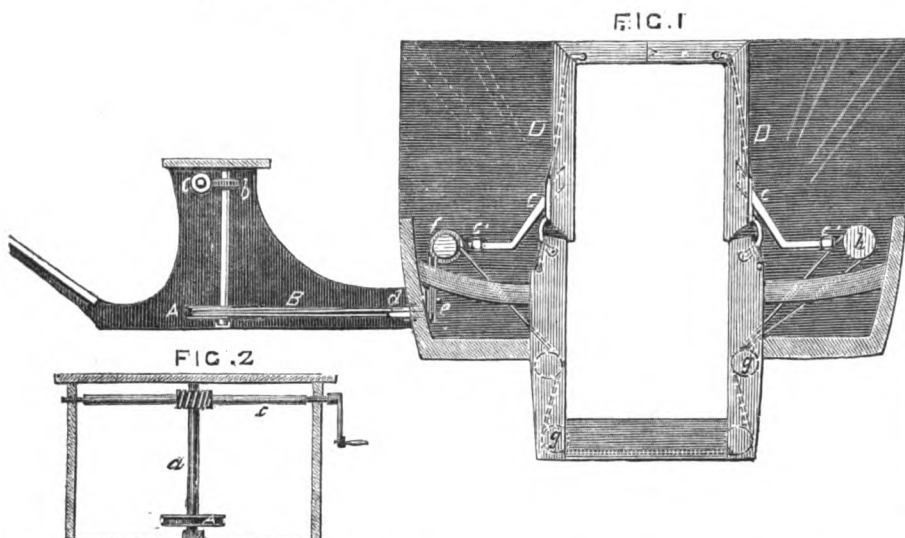
THE following paper "On the Action of Light upon Sulphide of Lead, and its bearing upon the Preservation of Paintings in Picture Galleries," was read at the meeting of the British Association. The author's attention was directed to this subject by observing that, in the cases in the South Kensington Museum which are painted with white lead, substances which emitted sulphurous vapours did not cause a darkening of the surface of the case, excepting where it was protected from the direct influence of light. A number of experiments was then tried as to the action of light upon sulphide of lead produced by the action of sulphuretted hydrogen upon lead paint. A board painted white with white lead was exposed for several hours to the action of sulphuretted hydrogen, until the surface had acquired a uniform brown colour. Plates of glass of different colours were then placed upon the painted surface, one portion being at the same time covered with an

opaque medium, and another left entirely exposed. The board was then placed facing the light. The glasses employed were red, blue, yellow (silver), violet, and smoke-colour glass. The results exhibited were after an exposure of eight days, and showed that the parts of the board directly exposed to light were bleached; those protected by an opaque medium were not acted upon; while with the glasses of different colours intermediate effects were produced, those of the violet glass being most decided. Drying oils in conjunction with light rapidly bleach sulphide of lead, and boiled oil effects the bleaching still more rapidly. When water colour is used bleaching takes place, but much more slowly than in the case of oil. After quoting authorities, stating that generally light was advantageous to the preservation of pictures, Dr. Price showed a striking illustration of this fact. He had a picture painted, and then exposed it to the action of sulphuretted hydrogen, until it became sadly discoloured, and to all appearance destroyed. Some strips of paper were laid across the picture, so as to cover some parts. The picture, thus partially covered, was exposed to light for a long time. The result, as shown at the meeting, was very curious indeed, the parts of the picture exposed being perfectly restored, while those protected by the paper remained still discoloured. From his experiments he came to the conclusion that it was advantageous to have picture galleries well-lighted, especially where, as in towns, the atmosphere was charged with sulphur compounds, and that it was quite a mistake to have curtains placed in front of pictures, with a view to their protection. In the course of his communication Dr. Price referred to the use of zinc paint for houses, and considered it likely to be acted upon, as the paint was rendered soluble by the acids contained in the atmosphere of towns.

NEW BAROMETER.

PROFESSOR HOUGH, the director of the New York Dudley Observatory, has recently invented an instrument, which is called an "Automatic Registering and Printing Barometer," and is designed for making meteorological observations. The problem the inventor set out to solve was to cause a meteorological instrument, by means of proper mechanism, effectually to record its own changes. The instrument selected was the barometer, and the agent used to note such record was electricity. The electrical contact with the fluctuating medium was effected by means of a float, outside the barometer tube, resting upon the mercury column. By this plan there is no demand for action from the battery until some change takes place in the barometer. It was found by experiment that a motion of less than 0.005 of an inch was readily shown—a quantity within the limits of a first-class standard barometer. The next step was to devise the proper mechanism for repeating the motion thus transferred, and recording it in some legible form. A finely-cut screw was considered as best adapted to measure such minute intervals of space. To this screw a forward or reverse motion was given by a double system of clockwork, each operated by an electro-magnet in connection with the float, and raising or lowering the screw by intervals corresponding with the changes in the mercury column. The permanent record of results is produced by presenting a lunar diagram or curve of atmospheric pressure, and at the same time giving a printed record of variation to any extent deemed advisable. Professor Hough illustrates the working of his apparatus by giving the curve of pressure and copy of the printed results from May 11 noon, to May 12 noon. His machine informed him that there was a violent atmospheric disturbance somewhere, yet the weather was pleasant in New York; and it informed him, moreover, that at a certain hour the disturbance was at its maximum point. Twelve hours later the telegraph announced the news that a terrible storm had swept over Boston, 200 miles distant. Professor Hough, sitting in his study, and listening to the clink of his machinery, could feel the pulsation of the air 200 miles away, and get the exact measure and force of the disturbing agent. By this method the fall of rain may be measured, and the results printed to the thousandth of an inch, any hour, and as often as is practicable. The registration of the force and direction of the wind can also be readily accomplished. Professor Hough remarks that a large number of

OPENING AND CLOSING CARRIAGE HEADS.



readings showed that by this method the personal equation was entirely eliminated; the mean of five or ten consecutive readings not differing by any appreciable quantity. The mean error for a single reading amounted to 1·001 of an inch, and the maximum error to 0·002 of an inch; showing conclusively that the chief source of error of reading a barometer lies in the adjustment of the surface of the mercury in the cistern to the zero. That important results will be obtained from the application of the method devised by Professor Hough there can be no doubt.

OPENING AND CLOSING CARRIAGE HEADS.

MR. CHARLES MARTIN, of Cheapside, London, civil engineer, has patented an invention which has for its object the simplifying of the means hitherto used for opening and closing the heads of carriages, and, from the peculiarity of the construction and arrangement of the mechanism employed, it can be adapted to every description of carriage, however varied its outline or form may be. In order to effect these improvements he uses a band or cord of metal wire rope, or of any material suitable for the purpose. An open cord or band may be used, but an endless cord or band is preferred. Upon the cord or band being pulled in one direction the carriage head is opened, and upon its being pulled in the contrary direction the head is closed. The principle upon which this invention is based is that of tension, and consequently the mechanism employed is much lighter and more simple than that which is required when the principle of compression is used, and which necessarily involves mechanical arrangements of much greater weight and complexity. The band or cord and pulleys are placed beneath the lining of the carriage, so as to be entirely unseen by its occupants.

Fig. 1 in the annexed engraving represents a landau to which this invention is applied, the apparatus being actuated from the box or driving seat. A is a wheel or pulley mounted horizontally on the lower part of the vertical bar *a*, on the upper part of which is a worm pinion *b* gearing into a worm fixed on the horizontal bar, shown in section at *c*, and by which it is actuated, a winch or handle being placed on the end of the said last-mentioned bar; B is the cord or band which is passed round and secured to the wheel or pulley A passing thence over the pulleys *d* e and *f*, and being carried by the guide pulleys *g g g g* passes round the wheel or pulley *h* at the back part of the carriage; *c c* are the before-mentioned iron arms, with the slides *c' c'* and D D are the rods before mentioned for the purpose of throwing back the door head. The arrangements are shown only as applied to one side of the carriage, but both sides of the carriage are similarly fitted. Fig. 2 represents a section of the box or driving seat, with the wheel or pulley A mounted on the vertical bar *a*, and actuated by the worm on the horizontal bar *c c*.

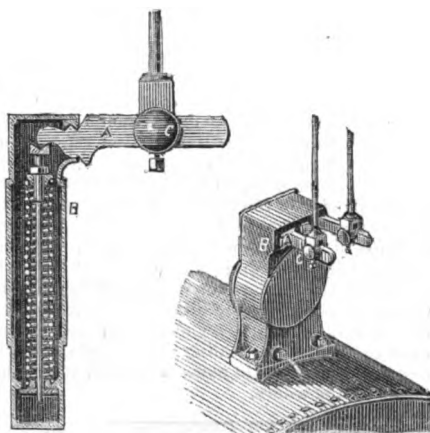
It is generally understood that the new Parliament will not meet till the third week in January, when the first business will be the election of a Speaker.

FIG. 1

FIG. 2

SAFETY-VALVE BALANCE.

This simple and durably-constructed balance was originally intended for locomotive engines, but can also, with great advantage, be used on marine engines, or any place where a dead weight is objectionable. It is well known that a dead weight on a safety-valve lever is the most desirable and safest, wherever it can be applied; but on locomotive boilers, which rest on springs, it cannot be used, as its action on the valve would be influenced by the vibrations continually occurring. On marine boilers, where weights are still in use, the rolling of the ship occasionally makes it necessary to lash the levers down until the weather moderates, thereby destroying the only virtue of the valve. Spring balances, as generally made, are more or less objectionable, on account of the springs becoming stiffer as the valve rises. Various plans have been adopted to overcome the defect by regulating the strength of the springs, thereby depending on the vigilance of the engineer to prevent the pressure from getting too great;



whereas, the balance here illustrated requires no attention whatever when in use, as an increase over the allotted pressure cannot take place.

The engraving shows an outer view and a vertical section of this valve, which we take from the *Scientific American*. It will be seen that the arms A A can rise as much as the safety valves may require, without additional pressure, which makes this balance equal in efficiency to a dead weight. An example will make the disadvantages of spring balances now in use more apparent. For instance, if a safety-valve lever is held down by a spring, the other end of which is fastened to the boiler or some other fixed point, the lever cannot rise without increase of power over and above the pressure it was calculated for; and if the proportions for length of lever are as 1 to 10, then the valve cannot be lifted one-eighth of an inch without raising the end of the lever ten times one-eighth, or 1¼ in.—which distance is, on the ordinary spring balance, equal to 28 lb.; and ten times 28, or 280 lb., on the valve. Now, if we have a valve of 2¼ in. diameter, or 4·9 square inches area,

the additional pressure would be 57 lb. per square inch to lift the said valve only one-eighth of an inch off its seat. Under such circumstances it ceases to be reliable, and requires watching and regulating to avoid over-pressure or accident.

The advantages of this improved balance are in the peculiar lever arrangement, by which the above enumerated faults are avoided. The arms of the levers A, inside of the casting B, from the fulcrum to the springs, are at an angle with the outside arms; and an upward movement of these outside arms is accompanied by a corresponding downward, and also an inward movement, of the inside arms resting on the springs; therefore, the more the springs are compressed the shorter the effective length of the inside arms will be, thereby increasing the power of the outside arms in the same proportion as the springs get stiffer from compression, thus enabling them to rise the required distance without increase of power. The rod C is fastened by a set screw to any distance from the fulcrum, according to the pressure required. Close behind this rod a small pin can be put through the arm, to prevent the engineer from increasing the pressure beyond what the boiler was intended to carry; but as much of the arms as is not in the way of anything may be allowed to protrude, for the purpose of decreasing the pressure, should any accident to the boiler make it desirable to do so. To keep up a uniform pressure of steam is considered far less injurious to a boiler than the sudden changes produced by slacking or screwing down safety-valve levers. Such changes will not take place where the improved balance is used.

The springs are made of hard brass wire, expressly drawn for these balances, and are not liable to corrosion, as is the case with steel springs; and, being compressed when working, are far less liable to break, or to lose their elasticity. These balances, which are the invention of Mr. William Camerer, of Reading, Pa., have been in use for more than a year on several leading railroads in America, where they give entire satisfaction.

ON THE DISCOVERIES IN CHEMISTRY APPLIED TO ARTS AND MANUFACTURES.

By DR. F. CRACE CALVERT, F.R.S.

THE following is the first of the Cantor lectures on some of the most important chemical discoveries made within the last two years, and which was delivered by Dr. Calvert before the Society of Arts:—In this lecture I intend to treat of chemistry applied to the arts, and more especially to some of the discoveries which have been made within the last two years. Many of these will appear to you to be incomplete, but if complete they would not be new, for seldom are discoveries perfected at once. They are generally the result of many years' study, and of the thoughtful consideration of several men. The first part of this lecture will have reference to some of the applications which the laws of light have received during the last few years; and it will, I hope, convince you of the necessity of everyone engaged in the arts making himself acquainted with all the laws connected with the phenomena of light, to enable him to appreciate the discoveries which have been made, or to assist him in improving upon those which are already known, as they are constantly receiving the most valuable applications in the arts and manufactures. Thus, for example, M. Donné has applied the properties of light to ascertain the relative values of milks by the amount of cream they contain, and this he effects by an instrument which he calls the lactoscope. Dubosch Soleil has applied with great success one of the most complicated laws of light—viz., polarised light—to the commercial estimation of the various qualities of sugars. By this process the sugar refiner, or any other person interested in that product, is enabled to ascertain in half an hour exactly the amount of crystallised sugar there is in a given sample, as compared with the quantity of non-crystallisable, or what is commonly called treacle. M. Dubosch Soleil's apparatus is considered so accurate that the French Government has adopted it to determine the value of raw sugars imported into the country, and the customs duties are levied upon the results given by this instrument. I may further add that this apparatus, called "Polarising Saccharometer," is based on the peculiar property which light has when polarised, or when its rays are received at an angle of 35 deg. 25 min. on a plate of tourmaline or a mirror. M. Dubosch Soleil's apparatus enables him to work with polarised light, which presents the various colours of the spectrum, in such a way as to enable him thereby to determine, as I have already stated, the amount of crystallisable sugar in any

given quantity of the article, sufficiently accurately for all commercial purposes.

It is impossible for me in a single lecture to attempt to give you an idea of the various improvements which have been effected, even within the last two years, in the arts of photography, Talbotype, photoincography, glyptography, or other processes which are due to the action of light on sensitive surfaces; but you will find an excellent paper on the application of photography and also of light to sensitive surfaces, as applied to the art of engraving in vol. xiii., page 131, of the "Society of Arts Journal," by Mr. S. T. Davenport, under the heading of "Engraving and other Reproductive Art Processes." Still there are two discoveries which appear to me to deserve passing notice, viz., the carbon process of Mr. Swan, and also the process discovered by M. Villème, and now carried on in London by a company, by which the operator is enabled not only to take the photograph of a person, but to produce a statuette giving a full representation of the figure itself, and a far more accurate personification than could be produced by any sculptor, and that at a cost of as many shillings as the sculptor would expect pounds. But the most important series of researches which have been made of late years in connection with photography, and to which I deem it my duty to call especial attention, are such as to acquire more and more importance as they are more developed; I therefore feel convinced that anyone who will devote his talents to the study of this particular branch of photography, will in time be amply rewarded, and of this there can be no doubt when we consider the results already obtained by the labours of only two or three gentlemen. I refer to the reproduction of the various colours of the spectrum upon sensitive surfaces. In 1838 Herschel was the first to publish a paper on the various colours which chloride of silver is susceptible of taking under the influence of certain coloured rays of light. Mr. Robert Hunt also published, in 1840, a paper referring to the subject; but the most complete series of researches on the subject of the reproduction of the colours of the spectrum, and which led to a process by which several of the colours of the spectrum could be reproduced on a sensitive surface, is due to Edmond Becquerel. The results arrived at by this gentleman were so remarkable that they drew the attention of the whole scientific world; and the following is an outline of the processes which were applied by him to obtain this interesting result. He took a daguerreotype plate or a silver-plated one, and having dipped it in a weak solution of chlorine, or, what was still better, a weak solution of hydrochloric acid, by connecting it with the poles of a battery, the brilliant silver surface acquired different tints, passing gradually from an opaque white to a black tint. He also observed that the tint best suited to obtain favourable results was when the plate had acquired a pearly pink; and, although he found that the plate so prepared, when placed in the camera obscura, assumed the colours composing the spectrum, still they were faint, but he remedied this defect of intensity of tints by heating for several hours to a temperature of 95 deg. to 100 deg. the chlorinated plate, and then submitting it to the influence of the various colours composing the spectrum. Further, in the course of his studies he made the important observation that he could replace the peculiar action of heat on his prepared daguerreotype plate by exposing it to the rays of the sun under a sheet of paper which had been steeped in an acid solution of sulphate of quinine. The effect of this was that the plate of silver assumed an intense white colour, nearly resembling that of paper; whilst, if the protective paper had not been used, the silver plate would have gradually acquired a dark tint, and would have lost the whole of its sensitive properties, the protective paper having the power of arresting completely the most refrangible rays of light, especially those which are beyond the line H of the spectrum. Notwithstanding M. Edmond Becquerel's ardent hopes to find a method which would enable him to fix on a sensitive surface the various colours of the spectrum, still he failed, for they faded immediately they were exposed to the direct rays of light, and could only be preserved in obscurity. But there is one gentleman who deserves great praise for the extraordinary perseverance he has shown in this class of investigation. I mean the nephew of the discoverer of photography, M. Niépce de Saint Victor. Although I will not enter here into the details of these valuable researches, as they can be found in the *Comptes Rendus de l'Académie des Sciences*, still I may just be allowed to state that he has not only by the following process obtained far more brilliant colours than those first produced by M. Becquerel, but has succeeded in reproducing on sensitive plates the various colours of coloured surfaces, such as are presented by fabrics, flowers, &c., and further, he has lately been so fortunate as to reproduce on his plates yellow and black tints, which had resisted all previous attempts. To give you an idea of the facts arrived at by this gentleman, I may state that he has succeeded in so fixing upon sensitive surfaces the various colours of the spectrum, or of coloured surfaces, that they will bear the action of diffused light

for several days. In fact, I have seen photographs which reproduce faithfully a small doll dressed up in various colours, and in which even the most minute ornament could be traced, and what is certainly not less interesting was the reproduction of the iridescent colours of the peacock's feather. To obtain these marvellous results, M. Niépce de Saint Victor takes a daguerreotype, or silver-coated plate, and dips it into a weak solution of hypochlorite of sodium, having a specific gravity of 1.35, until it has assumed a bright pinkish hue. The plate is then covered with a solution of dextrine, saturated with chloride of lead; it is then dried, and subsequently submitted to the action of heat, as in M. Becquerel's experiment, or under the screen of sulphate of quinine, also referred to above. The plate is then ready to be placed in the camera obscura, and to receive the colours of the spectrum, or representations of nature, such as flowers, as well as certain colours produced by man. Lastly, he succeeds in increasing the stability of the colours developed on the sensitive surface, by covering the plate with an alcoholic solution of gum benjoin, and M. Niépce gives the name of *Heliocromie* to this branch of photography.

During his lengthened researches, M. Niépce de Saint Victor has made two series of observations which I deem it my duty to lay before you, viz., that he can produce with facility, on prepared plates, the binary colours of the spectrum, viz., orange, violet, indigo, and green, if these colours are natural; but if they are artificially produced by the mixing of two of the primary colours, as red and yellow, or orange and blue, and yellow or blue, he cannot reproduce the binary colour, but only one of the two colours employed by the artisan to prepare them. Thus, for example, he can reproduce the natural green of malachite, and the beautiful colour known as Scheele's green, but he cannot do so with a mixture of Prussian blue and yellow chromate of lead, the blue only reappearing. These facts enable him to explain why, in ordinary photography, the leaves of plants always appear black, and why, when he attempts to fix on his plates the colours of leaves, they have a bluish hue, the yellow portion of the colour not being reproducible. M. Niépce has made another series of observations which deserve notice, viz., that when a plate, as prepared by his process, is dipped in an alcoholic solution of substances susceptible of imparting a colour to flame, such, for example, as strontia, which communicates a red hue to it, or baryta, which gives a yellowish-green colour, the prepared plates when exposed in the camera will assume the same colour as the salt which they have on their surface would impart to the flame of alcohol; and if a salt of copper be used, which has the property of communicating a variety of tints to the flame of alcohol, the plate also will assume a variety of tints when exposed to the action of light; and during a certain period of his lengthy researches M. Niépce availed himself of this curious phenomenon to obtain coloured plates in the camera. They are not only interesting as reproductions of art, and as a feat of extraordinary skill in the progress of photography, but they are especially so because in time they will lead to methods which will enable us to communicate to our little children perfect and correct views of our time, and other interesting facts connected with the period in which we live.

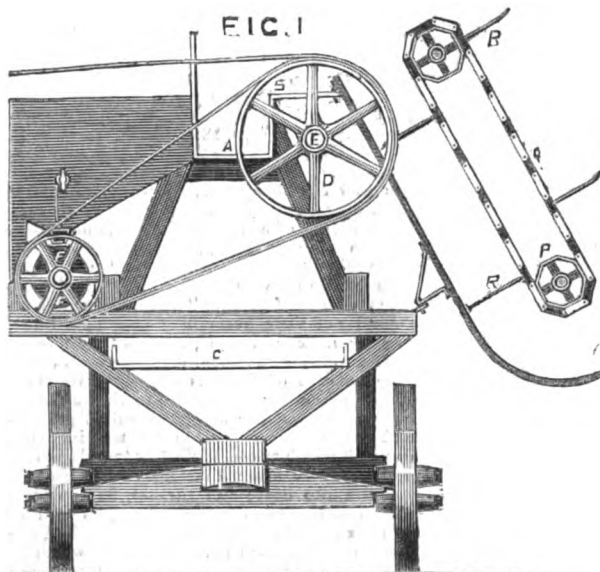
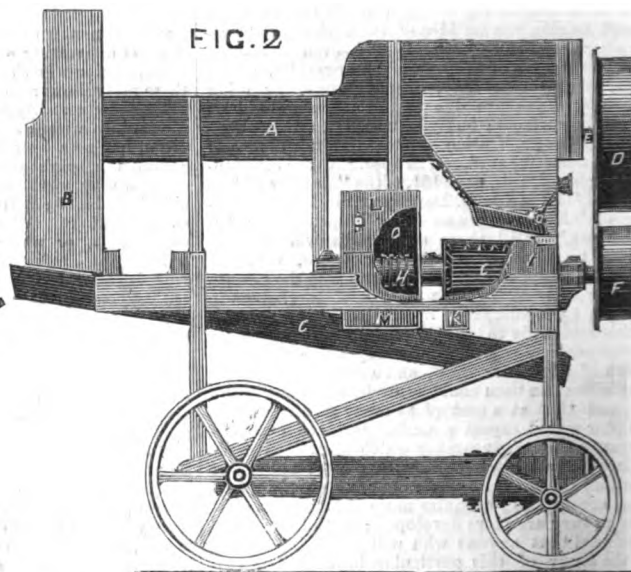
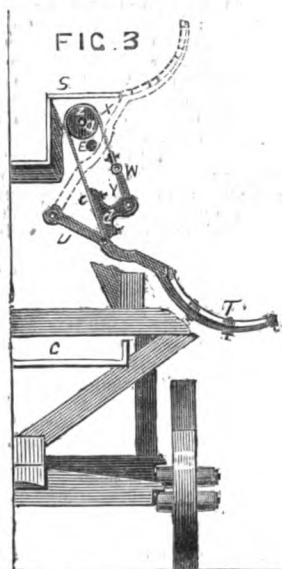
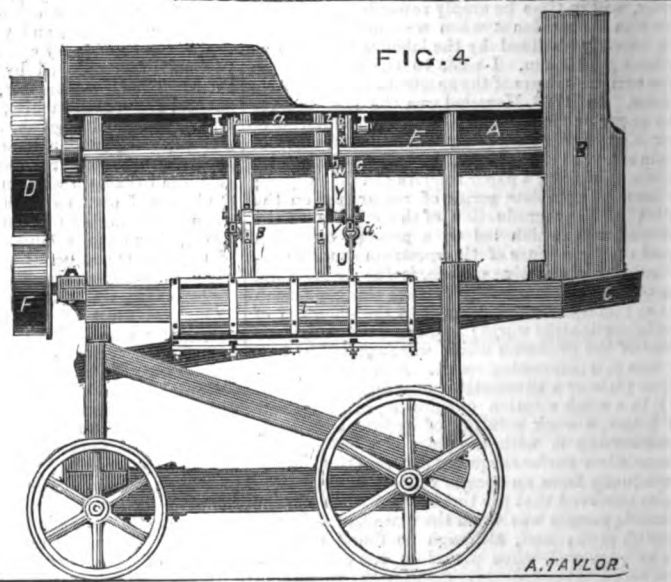
I shall now have the pleasure of calling your attention to a most important series of researches published by Professors Bunsen and Roscoe; but, to enable you to appreciate their value, it is necessary that I should make the following remarks:—It is now well known that the solar spectrum is composed of three primary colours—blue, yellow, and red; and also of four complementary or binary colours, viz.—orange, green, indigo, and violet. It is also known that those colours represent different properties or qualities of that universal fluid called ether, which, I may say, was generalised by Sir Isaac Newton under the name of gravitation, on which the whole of the planetary system is based, and which gives to the universe its harmony and stability. This fluid is susceptible, under certain influences, as those generated by the sun, of being set in vibration, and thus are generated heat, light, and chemical rays; and further, as there is no chemical action without a corresponding production of electricity; it follows that electricity, as well as magnetism, may be considered as a mere modification in the vibrations of the same fluid. Therefore, we may truly say that all the impalpable fluids called Light, Electricity, Heat, Magnetism, and Force, have all the same origin, namely, the fluid called ether, and which, according to the nature of the vibrations, develops or renders palpable to our senses one of those fluids. In fact, I feel convinced that this unique fluid is not converted into those diverse fluids by special modifications of its own vibrations, but that they only become manifest to our senses when it has imparted its own or special vibration to the particles of matter, and that it is the peculiar vibration which it imparts to the molecules of matter that develops in the molecules themselves such a mode of vibration as gives birth to what we call light, electricity, magnetism, heat,

and force. In fact, there is no doubt, from the researches of Dr. J. P. Joule, Professors William Thomson, Mayers, and others, that heat and force are the same fluid, for Dr. Joule has given us the exact measurement of that force. H. has demonstrated that the amount of heat necessary to raise one pound of water one degree in temperature, would, if applied mechanically, be competent to raise one pound weight 772 ft. high, or it would raise 772 lb. 1 ft. high. The term "foot pound" has been introduced to express in a convenient or systematic way the lifting of 772 lb. to the height of 1 ft. Thus the quantity of heat necessary to raise the temperature of a pound of water, one degree being taken as a standard, 772 foot pounds statute, is what is called the mechanical equivalent of heat. Dr. Tyndall, in his valuable work on "Heat Considered as a Mode of Motion," gives many interesting examples of the conversion of heat into force, and vice versa. For example, he cites the following theory of Professor Thomson, who assumes that an immense amount of force is converted into heat when meteoric matter is attracted to the surface of the sun by the molecular attraction called gravitation; that the force generated by the immense velocity with which meteoric matters travel towards the sun becomes converted instantly by its contact with the sun into heat; and further, he considers that the showering of meteoric matter, as well as that of the zodiacal lights on the sun's surface, are sufficient to account for the immense heat which he supposes the sun's surface to possess. I must say that I do not believe that the sun possesses much heat or light; I believe that it is only an immense mass, which, by its size as compared with the rest of the planetary system, becomes the centre of gravitation; and that there exists between it and the planetary bodies a constant state of attraction; that the fluid called ether, which represents the force called gravitation, is in a constant state of activity throughout the universe, and brings about that Godly and admirable harmony which pervades it; and although the ether filling space can be considered in a constant state of action or vibration, and convertible into the fluids which we call heat, light, electricity, and magnetism, still these fluids only become manifest to our senses when they put into vibration the particles of matter, or produce, according to their peculiar vibration, the phenomena of light, electricity, magnetism, heat, and force; for if heat is convertible into force, as asserted by the researches of the eminent savants above stated, why should not the production of other fluids be due also to similar phenomena? If it be true, as Joule, Thomson, and others contend, that force and heat are due to the vibration of the molecules of matter, and that according to the rapidity of the vibrations of such atoms (imparted to them by the vibrations of ether) one or other of these forces is engendered, why should not the manifestations of other fluids be traced to similar causes? In fact, no doubt can exist in my opinion with respect to electricity and magnetism, for if their manifestations to our senses were owing to the vibration of a universal force, it would affect all bodies in the same way and in the same degree. Now this is not the case; for there are good and bad conductors. Therefore it follows that the atoms composing matter, or more so, their nature, have an influence on its degree of manifestation. The same with magnetism; for we find oxygen to be magnetic, and nitrogen non-magnetic or diamagnetic. Thus it appears to me from these facts, which might be multiplied if time permitted, that the manifestations of heat, force, electricity, and magnetism are not peculiar and distinctive fluids, but are due to the modification in the mode of vibration of the universal fluid called ether, which imparts to matter its peculiar undulations, and that these forces are only made manifest to us when the vibrations come into contact with solid matters such as compose the atmosphere or the earth. Therefore, I am of opinion that there is no light, heat, electricity, or magnetism beyond the limits of the atmosphere which surround the earth; but that when the ether, which is in a state of vibration, comes in contact with the particles of matter composing our atmosphere it then communicates one of its own peculiar vibrations to these particles; then they, by their vibrations, become luminous. If this theory is correct, it follows that the production of the phenomena of light is due to the vibrations of solid matter, and not to the vibrations of the ether, as is assumed by the philosophers of the day. I very well know that these views of mine are completely in contradiction with those entertained by most of the philosophers of the day; but still I hope to be able to publish a sufficient number of scientific researches, as well as to draw attention to such a number of physical, chemical, and astronomical facts as may, even if not proving the truth of my views, at all events, I hope, deserve some attention.

(To be continued.)

The total production of the collieries of Prussia in 1864, was estimated at 42,394,500 tons.

CUTTING AGRICULTURAL PRODUCE.



CUTTING AGRICULTURAL PRODUCE.

This invention relates to improvements upon an invention for which letters patent were granted to Mr. Robert Maynard, of Whittlesford, Cambridge, on the 3rd March, 1866, for improvements in machinery for cutting and separating agricultural produce, and consists, first, in combining with such machines as are described in that patent as portable chaff engines, and as are fitted with a riddle for separating the chaff from the cavings or short straws, apparatus for grinding or crushing agricultural produce, so that the operations of cutting and sifting and of grinding or crushing may be carried on simultaneously in the same machine. And, second, in combining in such machines apparatus for elevating the straw or other substance to be operated upon to a convenient height, for the purpose of being fed to the cutting, grinding, or crushing apparatus. In the engraving fig. 1 represents an end view of a portable chaff engine fitted with a riddle and with the parts suitable for the accomplishment of the purpose set forth in the foregoing statement; fig. 2 is a side view of the same, A being the trough wherein straw, hay, or other material to be cut into chaff is laid, which is drawn forward by rollers, and out by the knives which revolve in the case B, whence the chaff descends into the riddle C, which separates the perfectly from the imperfectly cut chaff or cavings. D is a rigger keyed on the end of the shaft E, which carries the knives; and F is a rigger keyed on the end of a shaft carrying a tapered grooved roller G and a toothed roller H. The roller G revolves within a conical spirally grooved case I, and corn or grain being supplied to the same by the spout J, it is ground to meal in its passage through, and is delivered by the spout K. The hopper L contains a plate O with notches in the lower end of it, which fit between the teeth of the roller H, and oilcake being supplied to the hopper, it is acted upon by the teeth

and the roller, and broken or ground to any desirable size, passing out at the spout M. The riggers D and F are connected by a band, over which a band from the driving power is passed, thereby communicating motion to the several parts described; or the band from the driving power may be passed over either of these riggers separately when all the operations are not required to be carried on at the same time. N represents the end view of a curved board; P P are drums, over and under which is passed the endless chain Q, carrying the spikes R. Motion is communicated to the drums by suitable gearing leading from the shaft E, and straw or other material requiring to be elevated is laid on the lower part of the incline, and carried by the spikes R to the platform S, ready to be operated upon by the machinery already described; or, instead of the board and endless chain, the apparatus shown in figs. 3 and 4 is used, fig. 3 being an end view, and fig. 4 a side view of the same. T is a cradle carried by the radial arms U U, working on the rocking spindle V; Y is a crank caused to revolve by suitable gearing connecting its spindle with the shaft E; it carries the thimble W, to which is attached one end of the strap X, the other end of which strap is passed round and made fast to the rigger Z, which rigger is keyed on the spindle (a). On the spindle (a) are also keyed two other riggers b b, each having one end of a strap c c attached to it, the other end of each of these straps being attached by the loops d d to the arms of the cradle U U. Straw or other material being placed on the cradle it is obvious that the crank Y revolving the strap X causes the rigger Z and b b to revolve till it arrives at its lowest dead point, and the straps c c coiling round their riggers b b, the cradle ascends till it arrives in the position shown by the dotted lines delivering the material on to the platform. The crank continuing to revolve, the cradle descends to its former position again.

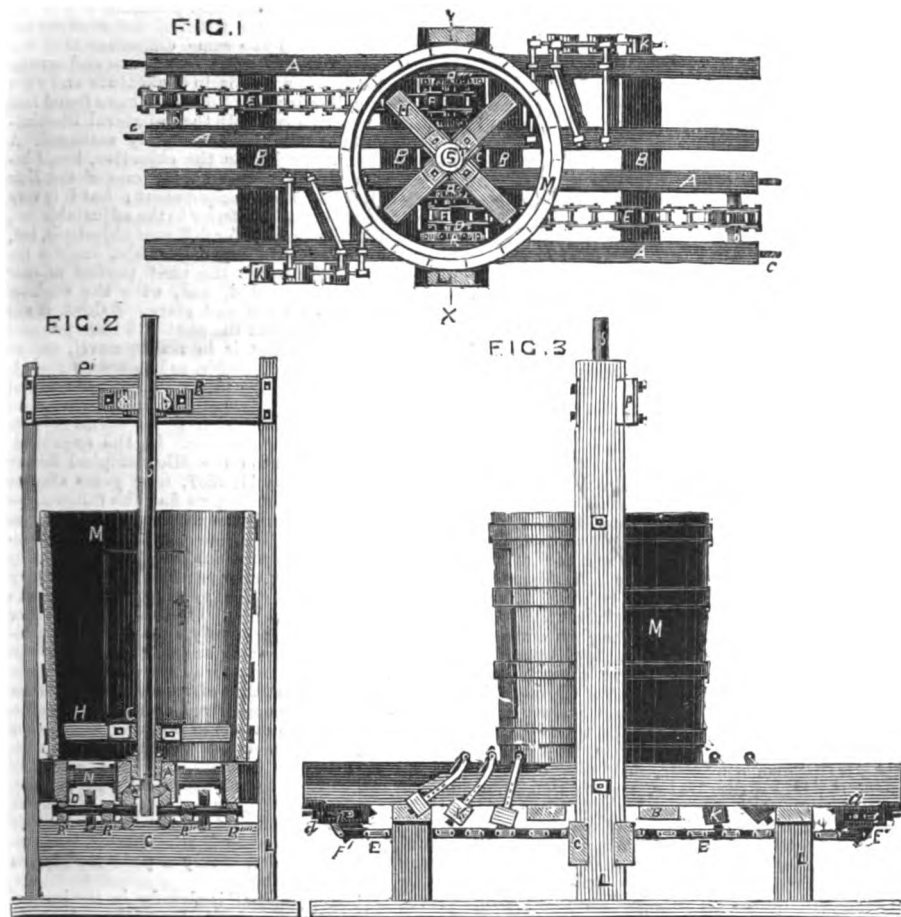
PREPARING YARNS FOR SAILCLOTH.

MR. HARRINGTON, of Leadenhall-street, and Messrs. H. and F. Hewetson, of Old Fish-street, London, have patented an invention, the object of which is to prevent sailcloths from rotting, and also to increase their durability. The invention consists in applying to the threads and yarns used in the manufacture of sailcloth, whether by steeping or otherwise, and prior to their being woven, a mixture of the following ingredients, and in or about the proportions stated:—112lb. of catechu, 112lb. of ochre, 40lb. of oil or fat, 2 gallons of tar, boiled in 400 gallons of water, and the whole thoroughly mixed. These form the best ingredients for the preparation, but other similar tanning mixtures are sometimes employed.

BRICK-MAKING MACHINERY.

MR. GEORGE AXTON, of Shepherd's-Bush, and Mr. John Leach, of Hounslow, have patented an invention for improved apparatus and machinery for making bricks, which invention consists in so adapting an ordinary pug mill that the clay may be forced into moulds passing through or under the pug mill, the moulds being propelled along two channels, one on each side of the centre of the mill by endless chains or other suitable appliances, whereby the moulds are caused to travel continuously on loose slides with rises to form the hollow of the brick to the end of the channel formed for them, where the bricks are then shifted by hand or raised out of the moulds or pushed through them by an apparatus worked by the foot, or by levers worked by hand; the moulds and loose slides are then sanded and returned in the opposite direction. To accomplish this, the lower end of the pug mill shaft is formed without a "step" or "toe," as is usually the case, but working in a bearing in the main framing under the bottom of the pug mill, having a bevel wheel

BRICK-MAKING MACHINERY.



keyed on its extremity, the said bevel wheel working into two other bevel wheels or pinions secured to the extremities of two transverse spindles working in bearings in the main framing for propelling the moulds on slides in opposite directions, the moulds themselves being placed upon the slides and endless chains or other suitable apparatus, and secured in position by being slid into grooves or by studs; the aforementioned endless chains being made to pass over chain wheels fixed on spindles working in bearings in the main framing at such a distance from the pug mill that the moulds will clear the outside of the pug mill, in order that the bricks may be removed. The moulds are formed of cast or wrought iron, brass, wood, or other suitable material. The bricks on arriving at the end of the main frame are shifted by hand or pressed out of the moulds by levers or forcing blocks actuated by a lifting apparatus working with a treadle or levers for forcing the bricks up out of the moulds or pressing them through; in this case having shifting stocks or pallet boards.

In the engraving fig. 1 represents a plan of the machine for making bricks; fig. 2, a vertical section of the same on the line *xy*; and fig. 3, a side elevation. A A represents the main frames, which may be made of wood or iron or other suitable material, and are firmly secured together by the cross beams B B, which form legs or supports, as shown at L L in figs. 2 and 3. The centre legs L L are prolonged upwards above the top of the pug mill M, and are united by a cross beam P, which supports the upper end of the pug mill shaft S in the plunger block R. H H, in figs. 1 and 2, are the lower pugging blades, which are bolted in the form of a cross, as shown, to a socket G, which is made to slide down the pug mill shaft S, and is keyed in position. The lower pugging blades are bolted to the socket G angularly, in order the more effectually to press the clay into the moulds N N, fig. 2, which travel beneath the pug mill. O O are two cross beams, which support the plunger blocks R¹ R² R³ R⁴ in which revolve the spindles D D¹ D² D³ D⁴, which carry the chain wheels F F, the form of which is shown in fig. 3; W is a bevel wheel keyed on the lower extremity of the pug mill shaft. Two similar bevel wheels W¹ W² are keyed on the extremities of the spindles D D¹, and all three are made to work freely and gear into each other. The pug mill shaft S is supported in a bearing T at its lower end by a collar,

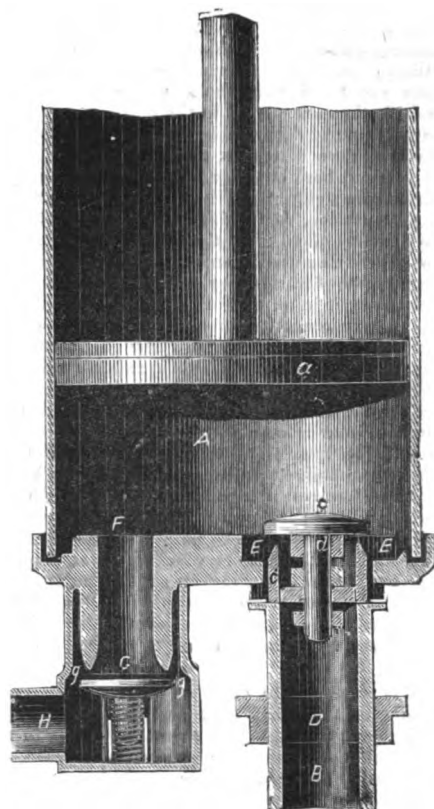
as shown in fig. 2. E E are the chains which carry the moulds N N; these chains are made of links, so that they work in the teeth of the wheels F F, and the similar wheels F¹ F², at the extremities of the frames A A, &c.; these wheels being supported on spindles O O, as seen more clearly in fig. 3. Should the chains E E get slack through wear, and so prevent the moulds from travelling correctly between the frames, they are tightened by the apparatus a a shown at the end of the frames in fig. 3, in which O O represent the spindles on which the chain wheels revolve, being fixed in sliding blocks b b. The sliding blocks can be drawn farther out, and so gather up the slack, or if too tight brought nearer to each other by turning the nut d on the bolt c. I I I are scrapers of steel or iron, which are made so as to scrape the top of the moulds as they pass under them, and so remove any superfluous clay, and give the brick its proper shape. They are counterpoised by the weights K K, so that in the event of coming in contact with a stone, they are raised up and pass over it.

The action of the apparatus is as follows:—When the pug mill shaft S is turned, which may be done by steam power, or otherwise, the bevel wheel W revolves, and so causes the two wheels W¹ W² to rotate in opposite directions; the teeth on the periphery of the chain wheels F F dragging the chains round, and so causing the moulds which are placed in grooves, as shown in fig. 2, to travel with them. The bottoms of the moulds are furnished with rises or kicks to form the hollow of the bricks. As they pass under the bottom of the pug mill the clay is forced into them through the bottom of the mill, which is left open for that purpose by the action of the lower pugging blades H H, &c., and the top of the brick is struck off or scraped by the scrapers I I, &c. On arriving at the end of the grooves on the one side of the machine, the bricks are removed by hand, the moulds are sanded and placed in the grooves on the opposite side of the machine, and are in the same manner caused to travel under the pug mill to the other end of the machine, where the same process is repeated.

Mr. W. C. Burder, the well-known meteorologist, died on Wednesday last, at his residence at Clifton, at the comparatively early age of forty-three. The deceased gentleman was the discoverer of the small but beautiful comet of March and April, 1864, and also of the large comet of June and July, 1861.

BEER PUMPS.

MESSRS. WILLIAM JACKSON, JOHN GLAHOLM, and WILLIAM GLAHOLM, of Bishopwearmouth, have



obtained letters patent for an invention which consists of certain improvements in the construction of pumps for drawing or raising beer from the barrels or receptacles in which it is contained, and whereby that beverage is delivered in a fresher and brisker condition than by the pumps and engines hitherto employed for the like purpose. The pump consists of a cylinder mounted in and fixed to a suitable frame, in which cylinder works a solid plunger, connected with and actuated by a lever in the ordinary way. At the bottom of the cylinder is placed an outlet pipe communicating with the tap for the delivery of the beer, the same being fitted with a suitable valve. At the bottom of the cylinder is also placed the suction valve, by which, upon the rising of the plunger, the beer is admitted from the suction pipe into the cylinder. The valve seats are so tapered as to present only a thin edge to the faces of the valves, the object of this mode of construction being to prevent the valves being clogged by the resting of any extraneous matters upon the faces thereof, and which might impede or interfere with the proper operation of the pump. Upon the plunger being raised the beer is drawn through the suction pipe into the cylinder, from which it is expelled through the delivery valve by the downward motion of the plunger, the cylinder being thus filled and completely emptied by each elevation and depression of the plunger. In the engraving which represents the apparatus A is the cylinder, and a the plunger; B is the suction pipe; C is the suction valve, c c being the valve seat, which, as well as the seat of the delivery valve, is made taper; D is a nut on the part connected with the suction pipe, and by which the cylinder is fastened to its frame; d d are nuts on the suction valve, one to fasten leather on to the surface thereof, and the other to prevent the valve from rising out of its seat; E E is a recess in the cylinder end to facilitate the falling off of any extraneous matters from the face of the valve; F is an opening at the bottom of the cylinder for the outlet; G is the delivery valve, having a spiral or other spring to keep it up to the valve seat g g; H is the outlet where the tap is affixed.

At the last meeting of the Literary and Philosophical Society, Mr. Dyer, referring to the breaking of the Atlantic Cable, expressed his surprise that no apparatus had been provided to seize and secure the end of the cable when the rupture took place, as contrivances for a similar purpose were in use in almost every cotton mill.

TANNING.

LETTERS PATENT have been granted to M. François Panhauser, of Winsley-street, London, for the invention of an improved process of tanning. The preliminary preparation of the hides, whether fresh, dry, or salted, to render them suitable for immersion in the tanpit is precisely the same as hitherto practised. When the calf skins or ox hides are freed from hair, well cleaned and washed, they are placed in the tanpit or vat, the best manner of doing so being to suspend them. The substance which in the improved process replaces oak bark or other tannin is obtained by transforming sulphate of iron by means of a chemical operation, furnishing a solution possessing the property of tanning the stoutest hides in a few days. The transformation of the nature of the sulphate of iron is very simple, and is effected by burning it in an oven on a cast-iron platform heated from beneath until red hot, and the substance being constantly moved about becomes transformed into a powder of a reddish colour, when it is removed and the operation repeated for a fresh supply. The liquid is obtained by pouring water into an earthenware vase or other suitable receptacle, then adding a part of the substance obtained as above described, which rapidly dissolves if continually stirred with a stick or ladle; the liquid is then allowed to rest and deposit until perfectly limpid, when it is run off. This liquid being very strong serves to prepare the liquid in the tanpits or vats, according to the degree of strength which it is desired to give it, using for this purpose Beaumé's hydrometer or any hydrometer which the tanner may prefer.

It is advisable to commence the operation of tanning by immersing the hides, firstly, in a very weak solution, and to pass them by degrees to a stronger, as, for example:—The first day give to the solution but half a degree Beaumé, and when the hides have remained therein during twenty-four hours remove them, wash them well in pure water, and pass them into a solution of one degree Beaumé; the third day into a solution of one degree and a half; the fourth day into a solution of two degrees; the fifth day into a solution of two degrees and a half; the sixth day into a solution of three degrees; the seventh day into a solution of four degrees; the eighth day into a solution of five degrees; and if on the ninth day the hides are not yet well tanned and fit for removal leave them for another day or two in a solution of the same strength, taking care to add to the solution as much strength as the hides have absorbed, unless to accelerate the operation it be preferred to increase the strength to six degrees, which could not be hurtful. When the hides are perfectly tanned throw them into water, and having well washed them with brushes and pressed out as much of the tannin as possible, leave them for twenty-four hours in pure water, and after another washing and pressing immerse them in a slight solution of soft soap during half a day, often moving them about; then well wash them again in this same bath, and suspend them for drying.

IMPROVED STEAM ENGINE.

AMONG the machines exhibited at the meeting of the British Association at Birmingham was a portable engine by Mr. R. W. Thompson, of Edinburgh, on the rotary principle. The boiler is vertical, having a cylinder of 3ft. in diameter by 6ft. in height, the internal fire surface consisting of a hemispherical bottom, with the heat spreading all over it by leading to a circle of vertical fire-tubes, passing through the water. To one side of this boiler is attached the engine, which shows externally as a horizontal cylinder, about 12in. in diameter by 2ft. in length, within which the pistons revolve, the entrance and exit of the steam being provided for by the action of external elliptical tooth wheels fixed on the revolving shafts, which, causing alternate faster or slower movement of the pistons past each other, opens and closes the passages. A drum-wheel on the axis of the cylinder carries a strap, which will put in motion any required machinery. The whole is supported on one pair of wheels, with a pair of shafts attached, and can be moved by one horse. The machine as shown was stated to be the equivalent of an ordinary eight-horse portable engine, and that the relative weights were, 30 cwt. the rotary engine against 55 cwt. on the

ordinary plan, while the cost price of the former to the latter was in the same proportion. No flywheel is needed to keep up the movement, and there is an absence of all the vibrating motion induced by the reciprocation of ordinary engines. The principle is equally applicable to portable purposes or to boats or locomotive engines. The actual consumption of fuel for work done was not given.

ILLUMINATOR FOR OPAQUE MICROSCOPIC OBJECTS.*

By H. L. SMITH, OF KENYON COLLEGE.

In attempting to study the structure of the diatomaceous frustule, I found it impossible to view it with high powers as an opaque object, by any means hitherto devised. In a valuable paper on the scales of the Podura, Mr. Richard Beck has stated that there is no difficulty in viewing them as an opaque object with the 1-8th in. objective and condensers rightly placed. Any illumination of diatoms thus obtained is almost useless from the great obliquity of the light, and with powers higher than the 1-8th in. is quite impossible. Mr. Ross's ingenious arrangement, suggested by Mr. Brooke, of a plain reflector, flush with the front surface of the objective, and receiving light from a truncated ellipsoidal reflector below, is so exceedingly difficult to use, and only with a special mounting of the object, that it has never been generally adopted. Mr. Wenham's method is entirely inapplicable to diatoms, inasmuch as it depends upon the total reflection of the light from the under surface of the glass cover of a mounted object, and in such case the diatoms, from their transparency, and the near coincidence of refractive index of silex with that of the mounting fluid, throw back but a feeble light and are nearly invisible. The use of the well known collimating eye-piece suggested to me the idea of making the objective its own condenser, and upon communicating this idea to Mr. Wales, already well known for the excellence of his objectives, he at once sent me a trial instrument. This first illuminator proved so far successful that I was induced to persevere, and with his assistance an "Illuminator" has been constructed which gives entire satisfaction, and answers admirably with all objectives from a 4-10th to a 1-50th.

It must be borne in mind that there are certain difficulties to be overcome in this mode of illumination, the chief of which is the reflection of the light from the posterior surface of the back combination of the objective. All the difficulties are now surmounted, and there is no trouble in viewing diatoms, or other objects, mounted dry, and uncovered, with the highest powers of the microscope, and with abundant illumination; and this without any trouble in mounting the object on little discs or pins, but using the ordinary 3in. by 1in. slide. As I do not here intend describing the instrument in detail, I will only say that it consists essentially of a rectangular brass box, having the "Society screw" at the top, to attach it to any microscope tube, and at the bottom, to receive any objective; and so constructed that it can be placed in any position with regard to the light. A brass draw, moved by screw and milled head, slides into the box, and carries a reflector of silver, also movable on its own axis by means of small milled heads; the forward edge of the reflector is curved, and it is concave, having a focus of about 6in. By means of the screw, the curved edge of the reflector can, when adjusted at an angle near 45 deg., be pushed more or less over the opening at the back of the objective. Opposite to the reflector, and attached to one side of the box, is a revolving circle of diaphragms, of great use in regulating the light, so as to exclude all fog or glare; the apertures vary from 3-20ths to 1-20th of an inch.

I had supposed that the idea of making the objective its own illuminator was original, until very recently, when I found that Dr. Riddell had proposed to place Shadbolt's annular ring behind one of the lenses of the objective, and to reflect light, received up by the side of the lens, back down through it. I need not say that this method is entirely impracticable; it would require a very peculiar mounting of the objective, and also of the object, to allow the rays to pass up into the ring in order to be again transmitted down through the objective. Moreover, parallel rays would scarcely answer, as the working distance of the objective is not exactly the distance at which it would condense parallel rays reflected through it. This, however, might be remedied. It is hardly desirable to receive the illumination from all sides. A unilateral light reveals the structure much more clearly. I attempted, at first, to employ as the reflector a disc of the thin glass, or two or three of them, used as covers of microscopic objects. A very good illumination, without sensible interference with definition, when the glasses are clean and well selected, may thus be obtained; and the reflection, from the

posterior surface of the objective lens, may be entirely removed by a Nichol's prism over the eye-piece; but by an illumination produced in this way the field has a peculiar flatness, no shadows are perceived; there is the same difference that one experiences in viewing the mountains and cavities in the moon when she is in quadrature and when she is fully illuminated. Indeed, I have found that nothing can compare with the unilateral illumination from the silver reflector rightly managed. A fixed reflector attached to the objective, has, I believe, been recently proposed by one of the New York opticians as an improvement; but it is very obvious that this is far inferior to the adjustable one, which not only answers for different objectives, but, from the very fact of being movable, enables the light to be condensed in the most perfect manner just where it is wanted, and, with the slightest touch, removes all fog and glare. I think it will sufficiently appear that the method I have proposed and carried into effect is in reality novel, and no modification of Dr. Riddell's, as has been stated. It would be strange if the idea of a reflector behind the objective had not occurred to this ingenious and veteran microscopist; but if so he seems never to have carried it out in practice. In the annual address of the president of the Microscopical Society of London, February 11, 1857, four years after he proposed the annular ring, we find the following:—"This is a problem," the illumination of opaque objects under the highest powers of the microscope, "the solution of which has been attempted by numerous adepts in manipulation with only very partial success." He then speaks of Mr. Wenham's method as by far the best. If, then, Dr. Riddell, or anyone else, had previously succeeded in accomplishing so desirable an object, why has it been kept secret? It is not the one who may have had vague ideas as to the possibility of accomplishing certain results who is to be considered as the real benefactor; rather he who puts it in tangible shape before the world, and, surmounting the difficulties of practice, makes the idea a reality. I make these latter remarks because I have heard, with some surprise, that it has been stated, by an optician of deserved celebrity, in a meeting of the Microscopical Society of New York, that the "Illuminator" as constructed by Mr. Wales, is only a poor modification of Dr. Riddell's method.

As the "Illuminator" is already in the hands of many, I append a few simple directions as to its use. The objective must be adjusted for an uncovered object, though I find few are rightly marked. An ordinary paper-covered slide, with bits of gold leaf on it, answers admirably as an object to adjust the light. The "Illuminator" being screwed on to the tube, and the circle of diaphragms placed facing the light (I find the ordinary coal-oil lamp with flat flame to answer admirably, the flat side being toward the reflector), turn the reflector at an angle of about 45 deg., and allow the light to enter the largest aperture of the diaphragm. By means of the screw, push the reflector forward nearly as far as it will go. Turn the reflector on the axis of the tube, and on its own axis, until the light, which may be placed 10in. or 12in. to the left of the microscope, and directly opposite the circle of diaphragms, is reflected down on the paper-covered slide, the tube of the microscope being racked up to about the position it will occupy when the objective is screwed on and in focus. The light thus reflected down should appear just at the curved edge of the reflector, in the axis of the tube, when looking through the tube, the eye-piece being removed. Now screw on the objective, and before replacing the eye-piece bring it into focus. The field will appear brilliantly illuminated, as in using a lens with a Lieberkuhn; if not, a slight movement of the reflector, or diaphragm, or light, will quickly accomplish this. Put in the eye-piece and adjust for focus; if the field is not clearly illuminated, say with 1-5th in. objective, a little fingering of the reflector, or diaphragm, will suffice to effect this. The screw which moves the draw and reflector may now be withdrawn, uncovering all but about a quarter or one half of one side of the posterior lens of the objective; and, if care has been taken to properly adjust the diaphragm and reflector, a most brilliantly illuminated field, free from all fog and glare, will reveal objects with a beauty and clearness inconceivable by those who have never used high powers of the microscope upon opaque objects. The most common objects appear with new and hitherto unsuspected beauty, brilliant not only with their own proper colours, but reflecting iridescent tints from the thin membranes. The diatoms are especially beautiful, and no one can view, without a sense of profound reverence and unspeakable emotion, the elegant structure of *Arachnoidiscus* and *Heliopelta*; of *Surirella* or *Pinnularia*. In thus accomplishing the illumination of opaque objects under the highest powers of the microscope, a powerful aid to investigation is furnished, which, I doubt not, will be rightly appreciated. An inexperienced microscopist may find some difficulty at first, but a few trials will ensure success, and when properly used, there is no want of light with the 1-12th or 1-16th even with the B or C eye-piece.

* From the "American Journal of Science and Arts."

Correspondence.

THE FRENCH GUN OF THE FUTURE.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—Absence from London has hitherto prevented my replying to an article on the above subject which appeared in your last issue, nor have I now sufficient time to remark at length thereon. I propose, however, to send you a full account of what I have done during the course of next week. I shall for the present confine myself to stating that Mr. Parsons never proposed lining a cast-iron gun with a tube of coiled wrought iron, and further that, if such a tube be employed, it matters not whether the tube be mechanically fitted to the casing, or whether it be forced in, shrunk in, or the casing cast round it. You are mistaken in supposing that "casting a gun over a wrought-iron tube involves such mechanical difficulties and objections that it has not been practised even by me beyond my models of 1854." I consider it to be the cheapest and most efficient method of constructing a gun, and have inserted the coiled tubes into cast-iron guns only because I found them ready made. The last gun that I have constructed by casting round a tube was a 3-inch 12-pounder, weighing 8 cwt. I had it made at Norwich, at my own expense. The report of the Ordnance Select Committee, dated March 3rd, 1865, says:—"The test of your 3-inch compound gun has been completed, and the gun remains apparently unaltered. It has fired ten rounds, charge 1½lb., cylinders 2½lb. weight; ten rounds, same charge, and 48lb. cylinders; ten rounds, 72lb. cylinders; and twenty rounds, with 96lb. cylinders." The gun was subsequently cut open, as was another similar one previously made by me, and the cast iron found to be perfectly sound and lying close round the tubes. I am at the present time constructing a 9-inch rifled gun of 12½ tons weight in the same manner, at my own risk. Should the gun pass proof successfully with 55lb. charges it will be purchased by Government. My second gun has not burst, the inner tube was composed of steel; it was not my invention, and had it succeeded I should have received no credit for it. The steel tube split the first round. It has since been cut out and replaced with a coiled tube like my other gun, and rifled. The B or outer tube was found quite uninjured. My last gun was rifled, and has fired eight hundred rounds; twenty with 12lb. charges; forty with 20lb., and seven hundred and forty with 16lb. charges, and shells of 100lb. weight. The report of the Ordnance Select Committee, dated March 10th, 1865, says:—"At the seven hundred and fiftieth round a crack was observed passing from the bottom of the bore in the direction of the muzzle 33in. long. Fifty more rounds were then fired without causing much apparent change in the character of the crack, completing in all eight hundred rounds. Looking at the danger attending the loading of a gun with so large a fissure the Committee have thought it expedient to discontinue the test, but they are by no means certain that the gun in its present condition would not stand the two hundred rounds that remain of the test originally proposed for it. They are of opinion that the result of the trial is more favourable to the system than if the gun had fired a larger number of rounds and then burst with violence without giving warning. No rifled gun has as yet fired so many rounds with such large charges, and the accident which has led to the suspension of the experiment might, to all appearance, as well occur to the inner tube of any wrought-iron gun. It is probable that the split was first caused by the groove becoming guttered, and that this guttering was accelerated by the use of round-bottomed shells, a form which would favour the entry of the gas into the grooves before the shells had sensibly moved."

These shells were old condemned stores, which were used up in this manner for the sake of economy. The inner tube was split quite through for the last fifty rounds. Since the report was written it has been extracted, and the B or outer tube found to be quite uninjured. The object of employing two thin coiled tubes instead of one thick one was to break the continuity of fracture in the event of the inner tube splitting. This gun has likewise been fitted with a new inner tube, and it, as well as

the gun, stated by Mr. Parsons to have burst, will be proved in the course of a few days with 27lb. charges and shells of 115lb. Both will then be tested by continuous firing with 23lb. charges and 115lb. shells. With regard to the statement, that I have found it necessary to rifle these guns in calibres of 7in. instead of 8in., their original bore, I would point out that the first of my four guns—I have had only four old condemned guns in all—was lined in a calibre of 9in., and completed the "test to destruction" without bursting. The object of lining them in a calibre of 7in. is that the weight of the guns will not admit of larger rifled calibres; in fact, the charges with which they are to be fired are much heavier than the weight of the guns, 5½ tons, would admit of on service, and are the same as those of the 7-inch wrought-iron rifled guns of 7½ tons weight.

I am, Sir, yours, &c.,
Army and Navy Club, WILLIAM PALLISER.
Oct. 19, 1865.

THE GUN QUESTION.

SIR,—Having been for a considerable time under the influence of the "Great Gun" mania, I should be glad if any of your readers could inform me if experiments have ever been tried, of lining old-fashioned brass fieldpieces with steel tubes, for firing rifle shot. A brass field gun stands a deal more hammering than an iron coil built one; a single shot striking an Armstrong is very likely to disable it, but a brass gun will stand three or four shots and still be serviceable; gun metal has also other advantages over "coil built." Perhaps Major Palliser could answer the question.

Yours, &c.,
Barracks, Belfast, A. B. T.
October 12.

NEGATIVE SLIP.

SIR,—Would you allow me to suggest what appears the most reasonable solution of that apparent anomaly, the negative slip of the screw propeller? The water in the wake of a vessel is always moving forwards with the vessel, or, in other words, following it. This progressive motion of the water at the stern diminishes the more the after part of the vessel is tapered, and vice versa. It is merely the water closing in to fill up the space occupied by the advancing body. The screw working in this advancing mass of water necessarily has increased effect, showing that no better place could be chosen for a propeller.

How this negative slip can injure the engines is difficult to imagine or explain, although such appears to be the general opinion among engineers. A writer some years ago on "The Steam Engine, by the Artisan Club," says, in reference to this apparent anomaly, "the water in closing in upon the wake of a vessel having a motor given to it, the screw impinges not upon still, but upon moving water, whereby an increased reaction is obtained." If this explanation be correct, any propeller would have more effect at the stern than elsewhere.

I am, yours, &c.,
Weston-super-Mare, J. ELWIN, Jun.
October 12.

RAIN GAUGES.

SIR,—I believe the form of rain gauge suggested by Mr. Clark in the last number of the *MECHANICS' MAGAZINE* to be a very good one, and I wish to add a few words to his description. It is impossible to secure the accuracy of the inside diameter of a glass bottle, and therefore the funnel should be of a diameter which will make the circle some definite number of square inches in area. The bottle should be divided by pouring into it as many cubic inches of water as there are square inches in the area of the funnel, and marking the level of this quantity of water on the bottle; this mark will represent one inch of rain. The other principal divisions may be marked in a similar manner, and all may be subdivided to any extent required. But all the divisions and subdivisions should be marked by actual measurement in the way I have described for the first division. A broad streak of white paint down one side of the bottle will take divisions in pencil, and, if varnished, these marks will last a very long time. There should be a wire gauge (movable) diaphragm at the bottom of the funnel, and the funnel should communicate with the bottle by a very small pipe, which should be trapped to prevent evaporation.

Yours, &c.,
October 18. J. F. E.

TO CORRESPONDENTS.

The *MECHANICS' MAGAZINE* is sent post-free to subscribers of £1 ls. 8d. yearly, or 10s. 10d. half-yearly, payable in advance. Post-office orders made payable to Mr. R. A. Brooman, of 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.

ENQUIRER (Birmingham).—The standard gallon is 10lb of distilled water at 60 deg. Fah. A cubic foot of pure water at 60 deg. Fah. is 62.32lb; therefore, there are 6.232 gallons in a cubic foot of water.

A. UJ. (Edinburgh).—Your letter departs entirely from the original question of mechanical arrangements.

RECEIVED.—F. A. P.—J. H. E.—W. W.—J. H. P.—J. H. E.—J. F. E.—J. H. E.—A. J.—W. H. T.—R. B. C.—J. S.—A. B. T.—F. S. R.—J. Y.—A. E. S.

Miscellaneous.

Mr. Francois S. Beatty, of Dublin, telegraph engineer, has forwarded us particulars of an electro-mechanical submarine telegraph safety ring, which he has invented. The object is the preservation of telegraph cables in cases of fracture or imperfect insulation. He proposes a ring made to close and open by electricity, and which is to be attached to a wire rope having two insulated copper wires enclosed therein. The cable is to be passed through the ring, which is then lowered into deep sea, the wire rope being attached to the paying-out vessel and connected with the battery. Mr. Beatty argues that in the late disaster, had this apparatus been in use, the moment the cable parted, battery contact would have closed the ring upon the cable, and by winding in the wire rope, the broken end would have been secured.

In our last number the patent of Mr. Roberts for protecting ships' bottoms, dated March 10 last, is stated to be abandoned. Such, indeed, is the fact, but Mr. Roberts wishes us to state that he renewed protection of the invention with improvements prior to the patent lapsing.

The "Pallas" armour-plated screw ram corvette is to have the following armament:—For the mid-ship battery, four 300-pounders and two 100-pounder Armstrong guns. On the upper deck four 40-pounder Armstrong guns, and on the weather deck two pivot guns fore and aft. She is also ordered to have four of Captain Rodgers's patent indented small-palmed anchors, a number of which have recently been subjected to every description of test with entire success.

An American gentleman, Mr. W. B. Robins, has patented a new apparatus for extinguishing fire; it is called the Kathhydron, or Ready Fire Engine. The chief defect of all other portable fire-engines is the delay which is caused by connecting them with a supply of water. Mr. Robins has directed his attention to this point, and has attached a force pump to a vulcanised india-rubber bag, into which the pump slides, and which holds besides about eight gallons of water. Once charged, the engine is always ready, and may be hung on a peg until required. In case of fire the water in the bag serves as a supply until a bucket of water can be brought, and, indeed, will frequently prove sufficient to extinguish the flames without further feeding. The pump throws 12 gallons per minute to a distance of 40ft., and as the working can be done with the most perfect ease, this invention seems to afford every security that can be expected.

We have received a letter from Mr. J. A. Morris, of Westminster, who, referring to our recent article on "The French Gun of the Future," claims to have invented the system of lining guns with steel or iron tubes previously to either Major Palliser or Mr. Parsons. He bases his claim on a specification for utilising old cast-iron guns upon the above principle, and which, he states, he submitted to the Admiralty in March, 1860. We believe, however, that Major Palliser was working on this principle in 1854.

Towards the latter end of last week the Esk came down in partial flood, and the banks near Musselburgh were afterwards strewn with dead trouts, eels, flounders, &c.; in short, life seems to have been extinguished in everything of the fish kind. This wholesale destruction is supposed to have arisen from the accumulation of deleterious matter at the manufactories during the long drought.

A new material for paper making has just been discovered in France. With the root of *Lucerne* M. Caminade has succeeded in making a pulp which can be employed jointly with rags in the manufacturing of paper, and even separately.

The Committee of the Anglo-French Exhibition have succeeded in raising the necessary funds to cover the expenses, and to throw the exhibition open to the public visiting the Crystal Palace, without any extra charge. The result has been a considerable increase in the number of visitors.

The "Bellerophon" has had her four-bladed screw taken out preparatory to being fitted with a two-bladed Griffith propeller, now being manufactured for her, with which she will again be tried at the measured mile, Maplin Sands.

A gigantic steam road locomotive has been taken to Belfast from Fleetwood to work in connection with the quarries at Newcastle, county Down. The works are massive and elaborate, and the machine is calculated to carry 80 tons with ease.

Last week, while the River Tyne Commissioners' dredger, No. 4, was at work above Messrs. Leslie's iron shipbuilding yard, Hebburn, the buckets met with an obstruction, and upon an examination being made, it proved to be the wreck of an old-clinker built vessel, which appeared to have been embedded a considerable depth in the water for a number of years. Upon portions of the wreck being brought up, there was discovered among it an old wrought-iron breech-loading gun, of about 6ft. in length, and having a 2in. bore of a conical form. A portion of the breech was, upon examination, found to have been broken off.

At the last meeting of the Metropolitan Board of Works, a proposition was carried for the increase of the engineers' salaries. Mr. Bazalgette's salary was raised from £1,500 to £2,000 a year, with £200 a year for incidental expenses; and the salaries of the three assistant engineers were raised from £500 to £800 a year, with £200 for incidental expenses. This is nothing more than reasonable, considering that these gentlemen are debarred from private practice.

Few people are aware of the vast number of passengers carried by the 664 omnibuses belonging to the Paris General Company. They amount to 93,270,719 annually. The 44 omnibuses which run from the church of the Madeleine to the Bastille take 8,938,543 passengers. The 38 omnibuses which run from the Bastille to the Odéon convey 4,936,012. The omnibus of the Ternes takes 4,080,288; that from Menilmontant to Montparnasse, 4,027,208. Next in importance comes the omnibus from the barrière Charenton to St. Philippe de Roule, which takes 3,727,664. The two which take the fewest passengers are that from the barrière de Charenton to the barrière de Fontainebleau, 1,640,706, and that from the Petite Villette to the Cours la Reine, 1,551,668.

The newly-projected line of railway from Staffordshire to London, which has been proposed with a view to remedy the excessive freight and terminal charges on the conveyance of manufactured iron, has been well received by the trade, and it is said that the matter will shortly come before the public in a tangible shape.

The following is said to be a good method of blackening zinc statues, &c. Make a solution of six parts chloride of antimony in one part of alcohol and four parts hydrochloric acid, and apply it to the object with a brush. Wipe the figure over with a wet cloth, and then apply the solution a second time. Dry the object as quickly as possible in a warm place, and when perfectly dry rub it all over with oil.

The manufacture of railway signals, with their machinery, has now become an extensive business, employing hundreds of skilled workmen. The signals on a railway 40 or 50 miles long cost as much as £3,000, and the complicated ones at a chief station on a great railway will cost £2,000. These signals are of the semaphore kind. Immense levers move railway points and signals at the same time. One of the principal railway signal manufacturers, who employs 400 hands, was formerly a common carpenter on a railway.

In a recent action at Hull to recover damages for injury to some cloth by reason of impure oil having been supplied to the plaintiff, it was admitted by the defendant that the oil in question was a compound, and that cotton-seed oil was used in its manufacture. He further stated that large quantities of so-called olive oil were merely mixtures of which inferior oils formed a portion. He also admitted that he had supplied hundreds of tons of cotton-seed oil to Italy, from which place pure olive oil is supposed to be exported, naively adding that as soap was not manufactured there, they could infer for what purpose the oil was used.

A cylinder of 100in. in diameter—the largest ever cast at the navy yard in Washington—was successfully cast recently. The amount of metal used was 53,000lb.; time of running into the mould, three minutes and a quarter.

A trial trip has recently been made by Richards and James's patent highway locomotive engine, manufactured at the Victoria Ironworks, West Croydon. This engine is nominal 32-horse power, having two 13in. cylinders, 12-inch stroke, fixed upon the bedplate or frame, upon which also rests the boiler. The boiler working pressure is 100lb. per square inch, proved 250lb.; the steering apparatus is attached to the front wheels, and the driver is the engineer and steersman, being able, by the arrangement adopted, to handle his engine from his position as the steering-wheel, one stoker and driver being only necessary to man the engine. The driving gear is divided into three speeds, changed at will of the steersman, viz., two, five, and eight miles per hour. The machinery is entirely hidden from view by a very neat framing. The distance from the ground to ashpan is 2ft. 2in. She carries a tender, with donkey pump attached, for pumping water from the sides of the road, steam being taken through a flexible tube from a large engine boiler; this pump throws 10,000 gallons of water per hour, filling the tender, capacitated to carry 1,000 gallons—enough water for twenty miles. The boiler is fitted with waste steam pipe, which is conducted into the ashpan for damping the fire when the engine is at rest, or standing on the roads. The engine-wheels are constructed upon quite a new principle, having chains to the driving wheels to prevent slipping in ascending steep inclines, or in travelling over rough roads, and side teeth in the front wheels, which may be protruded at pleasure, to act as a flange of a railway wheel, to prevent the engine striking from one side the line to be pursued, or when it turns sharp curves, or stands upon side-lining roads, these teeth are of considerable value. This engine passed through town and district, and main thoroughfares of Croydon during the fair time without emitting any steam or smoke, and without making any noise, or meeting with any mishap, with a train of eight vans attached, the length of train from front of engine to end of last van being 160ft.

According to the last census of France recently published, it appears that the proportion of persons employed in the textile manufactures (1,770 in 10,000) as well as in metals (124 in 10,000) was lower in 1861 than what it was in 1856 (1,794 and 128 in 10,000 respectively); on the other hand, the proportion of persons employed in building has increased to 1,927, being higher by 71 than it was in 1856. The proportion of persons employed in ministering to the food of the people has increased from 1,393 to 1,513 in 10,000, while that of those employed in making clothing has fallen from 1,868 to 1,755.

In the mining districts of Melbourne water is scarcely inferior in value to gold. Wherever water is plentiful the reports of the workings seem satisfactory; wherever water is deficient, the working mines suffer. In the deep-sinking operations there is generally more water than is wanted, and occasionally in such works steam-engines must be kept going, to prevent the miners from being swamped out altogether.

An enlarged photograph of the moon 21in. in diameter was taken by Mr. L. M. Rutherford, of New York, on the 6th March last. It is pronounced to be the best lunar photograph yet seen, and decidedly superior to any yet produced in this country.

A vessel which has just arrived at Liverpool is said to afford a remarkable instance of the value of steel as a material for shipbuilding. This vessel rode out the cyclone at Calcutta last year. She was run into twenty times, and her plates twisted in every direction, but not one was cracked.

From the West Indies we learn that the engineers sent out by the company established in London for the construction of a railroad from Carthagena to Magdalena appear to have been satisfied with the quality of the soil and topography of the country they had explored. The distance already surveyed is considerable, and in a short time they expect to forward their report, which promises to be favourable. The distance to be traversed is stated to be about sixty miles.

A clockmaker at Horsforth has designed and made a miniature steam engine and boiler which he placed in the Wakefield Exhibition. It is described as the "smallest steam engine in the world." It stands scarcely 2in. in height, and is covered with a glass shade. The fly-wheel is made of gold, with steel arms, and makes 7,000 revolutions per minute. The whole engine and boiler is fastened together with thirty-eight screws and bolts, the whole weighing 14 grains, or under 1oz. The manufacturer says of it that the evaporation of six drops of water will drive the engine eight minutes. This is much larger than the steam pump, consisting of a steam and water cylinder, made by Charles Fichtel, of Philadelphia, in 1860. This pump was auxiliary to a model of a steam fire-engine. According to the *Scientific American*, the steam cylinder was one eighth of an inch in diameter, and the whole affair would go into a common thimble.

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.—862
BUILDINGS AND BUILDING MATERIALS.—805, 822, 836, 840
CHEMISTRY AND PHOTOGRAPHY.—804
CULTIVATION OF THE SOIL, including agricultural implements and machines.—None.
ELECTRICAL APPARATUS.—825
FIBROUS FABRICS, including machinery for treating fibres, pulp, paper, &c.—801, 806, 810, 815, 820, 821, 824, 845, 850, 851, 870
FOOD AND BEVERAGES, including apparatus for preparing food for men and animals.—799, 811, 842, 867
FURNITURE AND APPAREL, including household utensils, time-keepers, jewellery, musical instruments, &c.—803, 816, 819, 830, 835, 836, 848, 852, 853
GENERAL MACHINERY.—809, 812, 835, 837, 840, 841, 844, 865
LIGHTING, HEATING, AND VENTILATING.—813, 817, 856
METALS, including apparatus for their manufacture.—806, 807, 856, 861
MISCELLANEOUS.—823, 831, 834, 843, 859, 864, 867, 868, 869
ROADS AND VEHICLES, including railway plant and carriages, saddlery, and harness, &c.—798, 833, 838, 844, 847, 858, 866
SHIPS AND BOATS, including their fittings.—828, 829, 871
STEAM ENGINES, &c.—802, 818, 827, 854, 860, 863
WARFARE.—806, 814, 838

798 W. LANE. Improved mechanism or apparatus for propelling carriages and other road vehicles by hand power. Dated March 22, 1865.

In the fore part of the carriage or other road vehicle, the inventor has a double-flanged drum, which may be of wood, iron, or other suitable material, the body of which works freely through the bottom of the carriage or other vehicle. On the upper flange he has a frame securely attached thereto, carrying an axle on which is secured a toothed wheel. The said axle is fitted with a crank for the purpose of turning the wheel. The aforesaid drum is slotted down in the direction of its length, and in the said slot is fitted on a revolving axle another toothed wheel which gears into the one before mentioned. To the under flange of the drum is attached the framing which carries the springs that support the fore part of the carriage, and in which framing also is fitted the axle on which are the road wheels. To this axle is secured a toothed wheel gearing into one on an independent axle which works into the teeth of the wheel aforesaid, so that all four work freely and gear into each other, and when the upper one is turned by the crank, the road wheels are caused to rotate by reason of the toothed wheels secured on their axle, and those fixed in the slot of the drum and on the independent intermediate axle. The springs are not in any way attached to the carriage, but press against it under side and operate by reason of the carriage or vehicle rising and falling upon the body of the drum. The carriage or vehicle may be directed along the road and turned in any direction by turning the drum by means of a lever attached thereto, so as to be easily accessible by the person working the machinery or any other attendant, and it may be secured at any angle by a catch working in slots cut in the upper flange, or by any other suitable appliances, if required. *Patent abandoned.*

799 W. J. COLEMAN. An improved composition for clarifying and fining beer and other fermented liquors. Dated March 22, 1865.

This invention has reference to the manufacture and employment of an improved composition (which the patentee terms the tasteless beer fining for clarifying beer and other fermented liquors) and consists in dissolving sulphuric acid in sulphuric acid and water, and subsequently removing the acid by constantly agitating the mixture for about three days, thereby leaving, when strained and a small proportion of concentrated solution of hops added, a transparent tasteless liquid solution fit for use. *Patent completed.*

800 A. P. TROCHON. Improvements in the construction of firearms. Dated March 22, 1865.

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

801 W. CLARK. Improvements in the manufacture of fabrics in lace machinery. Dated March 22, 1865.

This invention relates, first, to the manufacture in twist lace machinery of plain or ornamental fabrics having paired edges obtained from warp threads, or warp threads combined with bobbin threads. Second, to the formation of spot or other fabric simultaneously with, but for a time separate from, the body fabric. In carrying out the first part of this invention the plain or ornamental figures or parts of the fabric are formed longitudinally by the aid of extra warp threads, sometimes combined with the body fabric threads, which are traversed by other extra warp threads, and these other extra warp threads thereby become warp weft threads, and they also form the puris. Intermediate weft threads are obtained from bobbin threads, which are, when desired, also caused to twist with the warp weft threads to produce combined twisted puris held or laced generally by draw threads in the usual way. In carrying out the second part of these improvements the patentee forms simultaneously with the production of lace or other fabric, spot or other fabric by the aid of extra warp threads acting with certain of the bobbin threads, such extra warp and bobbin threads acting together for a time on one side of, but separate from, the ordinary or body fabric, and then being drawn into the position required on the body fabric, and there tied in by the working of other threads. *Patent completed.*

802 V. BAKER. *Improvements in obtaining motive power.* Dated March 22, 1865.

This invention relates, firstly, to an improved system or mode of supplying water to hydraulic motive power engines worked by a head pressure, and consists in bringing the water from lakes, reservoirs, streams, or rivers in elevated localities by means of syphon pipes of increasing strength in proportion to the depth of fall, and causing such water to operate upon suitable hydraulic motive power engines situated at a lower level. According to one form of engine, which constitutes another portion of the invention, two cylinders are combined together, each being furnished with a single acting reciprocating piston, which pistons work in opposite directions, and are alternately subjected to the head pressure of the water by means of two-way valves or cocks provided for that purpose. These valves or cocks may be worked either by the water pressure which supplies the engine, or by weights or springs acted upon by any convenient moving part of the engine itself. The motion of the pistons may be transmitted in any well-known manner to machinery of all kinds for the purpose of driving the same. The valves or cocks are so arranged that, when the one opens to allow of the water pressure acting upon one piston, the other is simultaneously closed to the water pressure, but opened to an escape pipe which allows the water which has previously done its work and been out off to escape from the cylinder, and allow of the back or return stroke of the piston, which is produced by the stroke of the other piston and *vice versa*. *Patent abandoned.*

803 J. J. CARTER. *Improvements in the manufacture of jewellery cases and other similar cases.* Dated March 22, 1865.

This invention consists in manufacturing cases for jewellery, and for other purposes for which such cases are required, by means of moulding them by pressure in iron or other moulds. In order to carry out such manufacture the inventor takes either bag, cap, or milled board, or other suitable material, and having reduced it to a state of pulp by soaking it in gum water, or water containing glue, size, or any substance which will cause pulp to adhere or cohere together, he takes moulds of the form required for the case or cases to be manufactured, and having filled the same with the pulp he subjects the moulds to pressure in a screw, hydraulic, or other press. After the removal of the moulds from the press he dries them either by heat or by a current of air directed upon them. The iron or other moulds have holes drilled in them at suitable distances apart for the purpose of facilitating the drying operation. *Patent abandoned.*

804 A. PARAF. *Improvements in dyeing and printing.* Dated March 22, 1865.

The patentee claims producing an aniline black upon fabric, or yarns by the action of chloric acid and free chlorine upon aniline or its homologues, or any mixture of the same, as described, or any modification thereof. *Patent completed.*

805 J. WRIGHT. *Improvements in the process of preparing kaolin and China clay and other clays for potters' use, and for expelling water from other earthy deposits.* (A communication.) Dated March 22, 1865.

The patentee claims preparing clays for potters' use, or for the market, by subjecting the clays in proper quantities to the action of centrifugal force in a whirling vessel, as described, whereby the clay, by reason of its adhesiveness and greater specific gravity, is condensed and separated from the water to the desired extent without recourse to straining, and adheres to the sides of the vessel, from which it may be removed in a plastic state for potters' use, or to be prepared in the usual manner for the market or potters' clay. *Patent completed.*

806 M. MORGANS. *Improvements in the manufacture and refining of iron and steel.* Dated March 22, 1865.

This invention consists in an improved mode of purifying or refining iron and steel, and of converting crude iron into wrought iron or steel by dividing it into minute particles, and causing them to be brought under the influence of water, steam, air, or any other gases or fluids, mixed or otherwise, to effect refinement or conversion as the case may be. *Patent abandoned.*

807 R. A. BROOMAN. *Improvements in engraving on metal.* (A communication.) Dated March 22, 1865.

This invention consists of new processes of engraving in intaglio and in relief on metal plates and rollers by photography, lithography, and by biting in an electric bath, or by aquaforts for printing on stuffs, paper, leather, and other substances. We cannot here quote the details of the invention. *Patent abandoned.*

808 G. E. DOWSTHORPE. *Improvements in apparatus for washing wool, hair, and other fibres.* Dated March 22, 1865.

According to this invention the patentee places a partition across the bath near the end from which the wool or fibre is to be taken, and the dirty suds as they are pressed out from the wool or fibre by the rollers, are caused to flow back into the portion of the bath which is shut off by the partition, and do not fall as before on to the wool or fibre which is about to be taken out to be passed between the rollers. At the bottom of the bath a communication is formed between the small space which is shut off by the partition and the rest of the bath, and this communication is by preference formed before the perforated false bottom, which, as usual, is placed at the bottom of the bath. The dirty suds thus only enter the bath below its perforated false bottom, so that the dirt contained in the suds may be allowed to settle out from them and remain below the false bottom. *Patent completed.*

809 W. M. BAKER. *Improvements in argand gas burners.* Dated March 22, 1865.

This invention consists in applying a movable valve or regulator to an argand gas burner below its upper surface where the gas is ignited, so that the supply of air through the argand burner to the interior of the flame may be regulated from time to time according to the quantity of gas which is allowed to pass, and is being burned by the burner. *Patent completed.*

810 J. MACDULAY and R. WATSON. *Improvements in weaving ornamental fabrics.* Dated March 23, 1865.

This invention relates to the weaving of ornamental fabrics in an improved and simplified manner, so as to present a distinct and complete pattern on both faces, and it is more particularly suitable for the production of shawl and similar designs. There are two classes of these double faced or reversible shawl fabrics, in weaving one of which two sets of warps are used, one for each face, or twice as many warps as are used for a single faced shawl fabric, while still

weaving goods of the other class a single set of warps is used, or not more than is required for a single faced shawl fabric. The present invention comprises improved modes of weaving shawl fabrics of the latter class, that is, single warp double-faced goods, and in carrying it out, according to one modification, a double-legged Jacquard harness is used, with two lift boards, whilst a single warp thread is passed through each mail. The warps are entered through four heddle leaves in front of the harness, the action of two of the leaves affecting the upper face of the cloth, and that of the other two the under face, and supplementing the action of the pattern harness in such a way as to produce the requisite plain cloth texture on both sides of the fabric. Each harness cord or tall lifts two mails, but the heddle action keeps down one of the two warp threads thereby raised at one shed and the other at the next shed. *Patent abandoned.*

811 J. BURLEY and L. GLOVER. *An improved method in the manufacture of toast racks.* Dated March 23, 1865.

This invention consists in making toast racks with one entire piece of wire, either plain or ornamental, of silver or other metal or alloyed wire. *Patent abandoned.*

812 E. FIELD and F. WISE. *Improvements in machinery or apparatus for feeding paper to printing machines, and for taking off or removing and piling the same after printing.* Dated March 23, 1865.

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

813 T. H. SAUNDERS. *Perforated tubular cornices and centres for ventilation.* Dated March 23, 1865.

The patentee claims the application of perforated tubular or hollow cornices, for the purposes of ventilation, the same to be in communication with the outer air by means of an opening or openings through the external wall; also the application of a single tube or channel enclosed in or by the ceiling, terminating at one end in an opening in the external wall, the other in an opening in or about the centre of ceiling or panel, the said opening to be screened from view in the interior of the room by a perforated centre piece larger than the opening itself, and to be fixed so as to project slightly from the surface of the ceiling, having a space between the two for the ingress or egress of air to and through the said tube or channel. *Patent completed.*

814 C. H. OSWOW. *Improvements in stoppers for bottles, jars, and other vessels, the same being applicable to firearms and ordnance.* Dated March 23, 1865.

A stopper made according to this invention suitable for being used as a substitute for an ordinary cork for stopping the mouth or neck of a wine or other bottle is constructed as follows:—The stopper consists of a cylindrical plug, which may be made of wood, metal, or other suitable material (but by preference of wood), and of a size capable when ready for use of passing easily into the neck of the bottle it is intended to close. This cylindrical plug is slit up or divided longitudinally into two, three, or more parts (four being a convenient number), combined or fitted together, and formed with a conical or wedge shaped hollow at the lower end, into which a corresponding conical plug fits, having a stem or rod which passes out at the upper end of the cylindrical plug, the upper end of the stem or rod having a screw thread cut thereon to receive a screw nut which is prevented from coming off the end of the screw by means of a collar or otherwise. The lower part of the cylindrical plug is covered with a capsule of india-rubber, or other suitable elastic or compressible material, so that when the plug or stopper is inserted into the neck of a bottle, and the screw nut is screwed down against the end of the neck or mouth, the internal cone will be drawn upwards into the hollow conical chamber at the lower end of the plug, causing the parts to be expanded outwards, so as to compress the capsule against the inner surface of the neck of the bottle, and thus effectually close the same. *Patent abandoned.*

815 D. MACKENZIE. *Improvements in machinery and apparatus for indicating, selecting, and reading in such cords of designs or patterns as are transferred and perforated on cards, papers, or their substitutes, and for reproducing and repeating duplicates of such operations on such materials for jacquard machines.* Dated March 23, 1865.

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

816 L. A. LEINS. *Improved apparatus for securing the frame carrying the fittings in travelling bags.* Dated March 23, 1865.

The patentee forms the frame with four legs, two at each end, extending outwards from the centre; he prefers that the legs terminate in square feet, but they may be of other shape. To each foot he fits a spring loop or stirrup. To the bottom of the bag he fits a plate or foundation to receive the feet, one plate for each pair of feet; and in each plate he fits a pair of spring bolts or catches with the outer ends sloped. *Patent completed.*

817 R. A. BROOMAN. *Improvements in treating fat and fatty matters for the manufacture of candles.* (A communication.) Dated March 23, 1865.

This invention consists in treating fatty matters as hereafter described. The inventor first prepares a bath by evaporating caustic lye to 15 deg. Beaumé, made of a mixture of potash and soda; the evaporation is continued until the mixture of caustic alkalies reaches a temperature of about 570 deg. Fahr. (300 deg. Centigrade); he then pours into this bath gradually the fatty body to be treated, and raises and lowers therein a perforated plate or agitator until solidification of the fatty matter. The mass is raised in perforated scoops, and placed in a vessel heated by a naked fire or by steam, and containing already alkaline lye at 15 deg. Beaumé. The mass and lye are well stirred, and allowed to settle for about eighteen hours to allow the soapy mass to separate from the lye. This latter is then run off. The soapy mass will be still charged with caustic and carbonated alkalies, and to free it from them the vessel is filled with weak lye and water, and the whole well stirred and heated to boiling point, and then allowed to settle for about 18 hours. The soap will then only contain the necessary quantity of alkali; it is removed to be decomposed by an acid. This decomposition is effected by sulphuric acid in a vessel lined with lead. It is charged with sulphuric acid diluted to 35 deg. Beaumé, it is heated, and the soap is added gradually and stirred in; in about 12 to 15 hours the decomposition will be complete; 15 hours are allowed for settlement, when the solidified fatty matter is removed, care being taken not to take off with it black scum and matter produced by the operation, and on the surface of the acid water. These black matters are afterwards treated separately by acid water

under heat to separate the last trace of fatty acid therefrom. The solid fatty acids obtained from the acid decomposition possess the necessary hardness for the manufacture of candles, but they are coloured. To make them white he boils them several hours in water, which is renewed, and then distils them with a great excess of superheated steam in such apparatuses as are now used for the distillation of fatty matters acidified by sulphuric acid. Having to distil a matter intended for being run into candles without further preparation, the temperature should be moderate, and the steam in greater quantity than for ordinary working. *Patent abandoned.*

818 A. B. BARON VON RATHEN. *An elementary power engine or a new or improved compressed air engine for imparting power and motion to all kinds of machinery.* Dated March 23, 1865.

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

819 R. W. MORRELL. *Improvements in machinery for sewing and stitching.* Dated March 23, 1865.

This invention relates more especially to the construction and arrangement of a machine for sewing and stitching, having series of needles on one needle slide in combination with a series of "duck bill" crochet hooks working on one reciprocating shaft, each needle having its own hook, and each hook its respective needle (in the series), for the purpose of sewing lines of single thread stitches at the same time. Or the same arrangement of needles may be each supplied with a shuttle race and shuttle for the purpose of sewing stitches with two threads. The series of shuttles in their respective races is to be acted on by one shuttle bar, on to which the patentee affixes a shuttle driver for each shuttle, so as to have their motions at one and the same time. The machine is so arranged that the fabric to be sewn can be fed up to the needles on a table with a feed movement, so as to sew straight parallel lines, but when straight lines are to be departed from the table has a transverse movement carrying the whole feed motion with it, so that by the combination of the movement of the table carrying the cloth transversely in one direction, and the direct longitudinal movement of the feed at the same time in another direction, a series of "geometrical wave lines" or zigzag lines parallel to each other, is produced by this compound movement of the feed and table, the same being useful in quilting or sewing of fabrics together. *Patent completed.*

820 H. CAKES. *Improvements in worsted carding and preparing machinery.* Dated March 23, 1865.

This invention has special reference to carding machinery used in the preparation of wool for worsted yarns, and refers to the "doffing" or delivering end of such machinery, the object being to deliver the wool from the cards in such a manner as to dispense with several intermediate machines now used after the wool leaves the cards, and before it arrives at the finishing machinery, as well as to diminish the quantity of waste. To effect these results, in place of the "doffing knife" now used to strip the doffer cylinder, the patentee substitutes a cylinder clothed with cards of any desired width at intervals from each other. These cards strip the wool from those portions of the "doffer" cylinder opposite to them on the condenser principle, the remaining portions being stripped by a similar cylinder placed underneath the previous one. The wool is thus delivered in any desired number of strips or alivers on to rubbing rollers, and conveyed by the ordinary mouths or funnels rotating (if desired) to the usual baling apparatus, the number of balls being varied at pleasure according to the number of strips or alivers thrown together. *Patent completed.*

821 J. LEES and M. MELLOR. *Improvements in machinery or apparatus employed in the manufacture of cloth and other fabrics.* Dated March 23, 1865.

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

822 J. TALL. *Improvements in the construction of walls, houses, and other buildings.* Dated March 23, 1865.

This invention has for its object to effect an economy in building dwellings, houses, cottages, garden walls, and other erections by forming such structures in concrete combined with brick rubbish, or other hard durable substance, in place of employing costly brickwork or masonry, as is now the case. *Patent completed.*

823 T. ROBERTS and L. LUC. *Automatic twin scales for weighing grain, flour, and other ponderables, and registering the number of draughts.* Dated March 23, 1865.

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

824 G. H. and J. A. CASTREE. *Improvements in looms for weaving.* Dated March 23, 1865.

The patentees claim, in double power looms for weaving the under and over central picking stick, or moving a picker faced at both ends and working in connection with two end picking sticks and pickers for enabling two pieces of fabric to be woven at the same time, and on the same level, for the purpose of effecting great economy of labour, time, space, and material, as all such improvements are described and illustrated in the drawings. *Patent completed.*

825 R. TIDMAN. *Improvements in machinery or apparatus for paying out and for raising electric telegraph cables in deep waters.* Dated March 23, 1865.

This invention consists in employing a raft or floating platform constructed with divisions or wells on the under surface in order to give great buoyancy in the water. To this raft or floating platform the inventor attaches lee boards to steady it, which lee boards also act as a helm to steady the raft. He also constructs and connects to the floating platform by chains or other means a lighter raft, or a series of lighter rafts or sea cradles, coupled by chains or otherwise, to which are attached lee boards, and furnished with horizontal rollers, over which the cable passes on its way to the sea, and also with rack pulleys to keep the cable central. These lighter rafts or sea cradles are used only for paying-out cables, being unnecessary when cables have to be raised. *Patent abandoned.*

826 J. O. MORGAN. *Improvements in stoves or fireplaces, ashpans, and fenders.* Dated March 23, 1865.

This invention consists in combining certain new arrangements for the escape of smoke or other gaseous products of the fuel into the flue or chimney, together with the means of obtaining a more perfect control over the draught or draughts than has hitherto been secured, affording varied outlets to suit the peculiarities of different chimneys or shafts; also in constructing different parts so that a better radiating surface can be obtained with a better concealment of the ashes and other products, and making certain other parts that can be made at pleasure into a guard or dress protector. *Patent completed.*

827 M. P. W. BOUTLON. *Improvements in obtaining motive power from aeriform fluids and from liquids.* Dated March 23, 1865.

This invention has more particularly for its object to enable the heat produced by combustion to be utilised in the production of motive power through a greater range of temperature and of pressure than is now done, in order that a larger proportion of the heat may be converted into mechanical effect. When valves are used in passages through which highly heated aeriform fluid passes the following construction may be employed:—The valve works in a chamber containing liquid. When the passage is open, the level of this liquid stands lower than the orifice which is opened and closed by the valve, and the aeriform fluid can pass without passing through the liquid. When the passage is closed, or when it is about to be closed by the valve, a plunger worked by the engine descends into the liquid and raises its level, so that it stands higher than the orifice closed by the valve, and encompasses the valve or its exterior. To supply loss by evaporation liquid is injected into the chamber by a pump or forcing apparatus. This method is applicable to valves of various constructions, such as the slide valve, the piston valve, the plug valve, and the double beat valve. *Patent completed.*

828 W. SIMONS and A. BROWN. *Improvements in dredgers.* Dated March 24, 1865.
We cannot here give space to the details of this invention. *Patent completed.*

829 O. BEVAN. *Improvements in cabin furniture for ships and other vessels.* Dated March 24, 1865.

This invention consists in so constructing tables and seats for cabins of ships and other vessels that they are capable at all times of being brought to a horizontal position, though the vessel may be sailing on its side. *Patent abandoned.*

830 A. BAILLOT. *Improvements in sewing machines.* Dated March 24, 1865.

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

831 T. FARMER and F. LEWIS. *Improvements in ornamenting the surfaces of japanned goods and papier maché goods and other varnished surfaces.* Dated March 24, 1865.

The patentees claim ornamenting the surfaces of japanned goods and papier maché goods and other varnished surfaces by applying thereto positive photographic pictures, substantially in the manner described. *Patent completed.*

832 W. LOEDER. *Improvements in the manufacture or construction of rails for railways.* (A communication.) Dated March 24, 1865.

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

833 E. LUSINSKI. *Improvements in umbrella and parasol tip fasteners.* Dated March 24, 1865.

The object of this invention is by a novel arrangement to allow the silk or alpaca, or other material of which the umbrella may be made, to dry without the necessity of being left open. This invention consists in the use of one piece of metal tube about two inches long, or thereabouts, of other suitable size and shape; the piece of tube is fastened to one end of a metal shield or plate where the elastic passes through, and to the other end is firmly fastened a piece of elastic or other suitable material, which elastic passes up and down the tube, the object being to let in as much elastic as will be found necessary to stretch round the tips of the umbrella. In some cases the patentee uses a small coiled tube into which the elastic or other material may be inserted. The box, or coiled tube, or other substance used, is inserted in the stick of the umbrella, or may be fixed outside the stick, the top being ornamented as may be desired. *Patent completed.*

834 J. B. BROWN. *Improvements in casks or vessels for storing petroleum and hydrocarbons.* Dated March 24, 1865.

For this purpose a compound cask or vessel is constructed, consisting of an interior cask or vessel of lead, and an exterior vessel or cask of wood. It is preferred that the interior vessel or cask should be of a cylindrical, or nearly cylindrical form, for facility of manufacture. At each end of the cylinder or vessel of lead, a head or end of lead is fixed by soldering or otherwise, so as to be perfectly fluid and vapour tight. In one end or head there is formed a tubular opening to receive a screw-plug or cap which will close the opening fluid or vapour tight. This vessel or cask of lead is placed within or protected by an exterior vessel or cask of wood, made in like manner to ordinary wood casks, but it is preferred to have as little bilge as may be, more particularly when the lead cask or vessel is made without bilge, or with very little bilge. *Patent abandoned.*

835 J. GREEN. *Improvements in machinery or apparatus for cutting or chasing the threads of screws or worms.* Dated March 24, 1865.

This invention consists in mounting a carriage or slide upon a lathe-bed or gantry of the ordinary kind, upon which are placed the fast and loose headstocks of the lathe, which may be either cast upon or fastened to it. The spindle of the fast headstock is connected at its extreme end by means of suitable gearing to the driving pulley, and upon this spindle are cut worms or threads in one lateral direction, or towards the right hand, and the other part having them in the contrary direction, or towards the left hand. *Patent completed.*

836 W. E. NEWTON. *Improvements in the manufacture of ink.* (A communication.) Dated March 24, 1865.

This invention consists in combining with an aqueous extract or infusion of braised Aleppo galls a proper proportion of sulphate of iron, gum arabic, and cloves, and submitting the liquid mixture drop by drop to the action of the air. *Patent completed.*

837 J. A. SWANEY. *An improved machine for washing, wringing, and mangling.* Dated March 24, 1865.

In a tub or vessel of suitable form is mounted a cylinder or drum composed of two circular ends connected together by turned rails. On two opposite sides of the cylinder are reversible boards which serve as doors to the same, through which the clothes are introduced into the cylinder. These boards are either provided with bristles so as to act as brushes, or furnished with rods or rails like the other parts of the cylinder. The cylinder is mounted on a central axle so that it can be readily removed from the tub or vessel and replaced. A continuous rotary motion is given to the cylinder by means of a flywheel and handle connected to

the cylinder axle by means of spur wheels, which are capable of being thrown in or out of gear when required. At one side of the tub or vessel is a pair of wringing or mangling rollers mounted in slots in suitable cast-iron standards, which are connected together by a top piece, the centre of which is furnished with a boss through which passes a screw. This screw acts upon a spring which bears upon a crossbar, the ends of which press on the axle of the top wringing or mangling roller, and so give a parallel and uniform pressure to the roller. *Patent abandoned.*

838 D. ARNOLD. *Improvements in gun locks.* Dated March 24, 1865.

This invention has for its object to fix the hammer either when down on the nipple, at halfcock, or it may be in other position, in such manner that it cannot be moved without first applying pressure to the trigger or otherwise to release it. For this purpose the patentee either forms an angular joint on the tumbler which takes into a notch in the sear, so that it holds the tumbler, and, consequently, the hammer fixed, and so that the hammer cannot be raised or lowered without first detaching the sear from the tumbler; or the position of the holding parts may be reversed; that is to say, the point may be found on the sear, and the notch or holding part on the tumbler; it may be further so arranged that the tumbler and hammer will become fixed either in the down position or in the elevated position, or at both. By this arrangement there is no liability to accidental discharge of the gun if the lock be kept at either of the fixed positions indicated. *Patent completed.*

839 J. O. BROVIN. *Improvements in the means of communicating signals from passengers in railway trains to the guards and engine drivers.* Dated March 24, 1865.

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

840 V. BAKER. *Improvements in obtaining motive power, parts of which improvements are applicable to the compressing of air and gases.* Dated March 24, 1865.

This invention relates, partly, to an improved system or mode of supplying water to hydraulic motive power engines worked by a head pressure, and consists in bringing the water from lakes, reservoirs, streams, or rivers in elevated localities by means of syphon pipes of increasing strength in proportion to the depth of fall, and causing such water to operate upon suitable hydraulic motive power engines situate at a lower level. *Patent abandoned.*

841 G. F. MARCHEISO. *Improvements in apparatus for obtaining light.* Dated March 24, 1865.

This invention relates to a mode of obtaining light without danger of explosion by the use of air which has been rendered inflammable by admixture with the vapours of petroleum and other hydrocarbons. In all apparatus employed in this system of lighting it is necessary to use liquids of a brightly volatile nature, which are liable to explode spontaneously with the smallest excess of heat. The peculiar apparatus which constitutes the essential feature of this invention is intended to obviate the danger and inconvenience above referred to. It consists of a circular chamber, in the interior of which rotates a drum, which receives its rotary motion from any convenient arrangement of mechanism outside the chamber. This chamber is half filled with water at its normal temperature, and upon this water is poured petroleum in a specially refined state, naphtha, or other hydrocarbon, so that the water and hydrocarbon together will fill about two-thirds of the capacity of the chamber. Whilst the drum is at rest, there is no danger of explosion, as the hydrocarbon will always be at the same temperature as the water, and when the apparatus is set in motion, the external air enters the chamber by an opening for that purpose, and passes into the interior of the drum, which is made hollow and provided with openings at the sides. This air is carried through the hydrocarbon by the rotation of the drum and becomes impregnated with inflammable vapour, and by the same rotation of the drum it is discharged through other openings therein, and enters the supply pipe of the burners. The hydrocarbon being constantly agitated and mixed with the water by the movement of the drum, all danger of explosion is obviated, as any undue elevation of the temperature is rendered impossible. *Patent completed.*

842 J. H. JOHNSON. *Improvements in the treatment of rice.* (A communication.) Dated March 24, 1865.

This invention relates to the treatment of rice which may have become discoloured, or which may have acquired an offensive odour owing to the cargo having been either heated or wetted, or from other causes, and it consists in exposing such discoloured or damaged rice to the action of sulphurous acid, and, subsequently, to exposure to atmospheric air, and, if necessary, to the action of light. *Patent abandoned.*

843 E. WOLVERSON. *Improvements in the manufacture of ornamental metallic chains.* Dated March 25, 1865.

This invention consists in the manufacture of ornamental chains from sheet metal without the use of solder, the said improvements being specially applicable to the manufacture of guard chains, Albert chains, and chains for other articles of jewellery. *Patent completed.*

844 H. O. HURRY. *Improvements in railway points and switches.* Dated March 25, 1865.

The patentee claims converting the rail or a portion of the rail of which the points or switches of railways are constructed into a spring, so as to act in substitution of all other description of heel hitherto applied to point or switch rails. Secondly, the cutting of the rails, as described, for the purpose of regulating the place at which the plates shall bend and yield. Thirdly, the general construction, arrangement, and working of the same, as described. *Patent completed.*

845 J. MILTON. *Improvements in looms for weaving.* Dated March 25, 1865.

This invention comprises certain improved automatic mechanism to be applied to looms for weaving in connection with the take up, and in connection with the weft fork stopper details, by which a loom is stopped when a weft thread breaks. *Patent abandoned.*

846 W. MILLER. *Improvements in presses for cotton and wool.* Dated March 25, 1865.

This invention consists of an improved arrangement or construction of press for cotton and wool with which a given power is made to effect the required compression with a considerably diminished hydrostatic pressure, that is to say, the aggregate pressure required is produced with a considerably less pressure per square inch, thus avoiding the great strain on and rapid wear of the cap leather packings and pump details accompanying the excessive pressure necessitated by the arrangements hitherto in use. *Patent abandoned.*

847 A. I. L. GORDON. *Improved means of communication between the passengers, guard, and engine driver of a railway train, part of which said improvements is also applicable for the prevention or detection of burglary.* Dated March 25, 1865.

In the first place the inventor proposes to furnish each carriage, on any convenient part of the roof, with a small electric machine provided with a burner enclosed in a strong blue or other coloured glass frame. This burner may be either a charcoal point, or any other combustible substance which can be ignited by electricity. Inside each compartment of each carriage is a button or other contrivance, which, by acting as a contractor so as to complete or interrupt the electric circuit by a simple pressure, will enable any passenger to strike an instantaneous and brilliant light at will in the blue or other coloured glass lantern on the top of the carriage. In connection with this same button or contractor is a wire running along the roof of the carriage, each wire being sufficiently long to be connected to the corresponding wire of the adjoining carriage, the connection being made (when the carriages are coupled together to form the train) by any simple contrivance which will ensure electrical contact between the two wires. These wires communicate with an electrical bell apparatus in the guard's van, so that upon any passenger removing the button or other contractor in the carriage, the bell will be struck, so as to call the guard's attention, and at the same time a brilliant (say blue) light will be exhibited on the roof of the particular carriage where assistance is required. *Patent abandoned.*

848 E. H. SMITH. *Improvements in sewing machines, which improvements also involve or comprise a new mode of manipulating the threads of the needle and shuttle in forming the "lock stitch."* Dated March 25, 1865.

For the purpose of reciprocating the needle, the inventor makes use of a crank or eccentric, and to actuate the shuttle, which is also reciprocating, he employs a crank and vibrating lever in combination. He has the actuating mechanism of the needle and shuttle arranged in such a manner that the reciprocations of the parts of each shall be the reverse of those of the other, thereby neutralising the tendency to vibration. He also has the said mechanism so arranged that at each upward draught upon the needle thread the shuttle thread shall be slackened, by the return motion of the shuttle or otherwise, sufficiently to allow a loop of the needle thread to be drawn above the cloth, each loop being afterwards drawn down and into the cloth by the movement of the said shuttle. *Patent abandoned.*

849 R. W. BARNES. *Improved apparatus for ascertaining the state of sewers, tunnels, drifts, or other subterranean work, part of which apparatus is applicable to levelling purposes.* Dated March 25, 1865.

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

850 J. DODD. *Improvements in mules for spinning and doubling.* Dated March 25, 1865.

The patentee claims the use of a winding-on screw of variable pitch worked by the ordinary faller staple and endless band arrangement, as described. *Patent completed.*

851 W. RICHARDSON. *Improvements in cotton gins.* Dated March 25, 1865.

This invention refers to those gins which are constructed on the Macarty principle. In these improved arrangements the patentee employs two of those rollers which are usually termed "leather rollers," and in conjunction therewith one revolving knife-roller. The leather rollers he places on each side of the knife-roller, below which he places a grid. One of the fixed knives he adapts to the upper side of its leather roller, and the other to the under side of the second leather roller. *Patent completed.*

852 J. H. JOHNSON. *Improvements in spittoons.* (A communication.) Dated March 25, 1865.

This invention relates to a peculiar construction and arrangement of spittoon, and consists in providing such article with a hinged lid or cover, capable either of being opened and closed as required by the foot or hand, and of being held permanently open if desired. Also in fitting castors to spittoons for facilitating their removal from place to place. *Patent abandoned.*

853 W. BETTS. *Improvements in protective labels for bottles, jars, and other similar vessels.* Dated March 25, 1865.

The patentee claims the application and use of protective labels, which are a magnified or enlarged fac simile or copy of the head of the capsule, and the device or design thereon covering the bottle, jar, or other similar vessel to which such label is to be applied, with a view to the prevention of fraud, as described. *Patent completed.*

854 D. E. BLACK. *Improvements in means and apparatus for utilising the heat of steam.* Dated March 25, 1865.

This invention relates to an apparatus which consists of a vessel in the form of a cylinder, or otherwise, to suit the form and position of the engine to which it is to be attached, into which the inventor introduces tubes of any requisite size and number, making them fast in the ends of the vessel in such a way that the interior of the vessel will be steamtight. The tubes are open at the ends for the purpose of allowing the steam and water that are blown into them to pass through. The said vessel is supplied with water from the boiler or boilers to which the engine is attached, and, if necessary, from the source whence the feed water is obtained; but either of these sources of supply may be used separately. To the said tubular vessel he attaches a pipe leading to the boiler, or to the engine, for the purpose of allowing steam free egress or ingress. He places the said tubular vessel in such a position with respect to the engine that the steam, after passing through the engine, will, before it is allowed to entirely escape, pass into the tubes, the object being to communicate to the contents of the tubular vessel aforesaid the heat of the steam, which otherwise might be blown into the atmosphere or condensed by water, and by this means to effect a saving in fuel, the steam being used over again for the purpose of heating. *Patent abandoned.*

855 W. OLARK. *Improvements in the manufacture or preparation of materials for, and in their application to, lighting and heating purposes, also in apparatus used for the same.* (A communication.) Dated March 25, 1865.

This invention relates to a means of supplying a combustible gas to consumers for lighting and heating purposes, which may be contained in very light receptacles relatively to the quantity of gas contained, and thus suitable for conveyance the longest distance at much less cost. The invention consists in the manufacture of gaseous pro-

ducts extracted by the ordinary methods from mineral, vegetable, and animal matters, either separately or combined, in various proportions, and also in the condensation of the said gaseous products by the aid of pressure, so as to liquefy the one part and dissolve the others with those liquids in which the gases may be held in solution, so as to form an entirely new combustible matter, which the inventor terms liquid gas. *Patent abandoned.*

854 J. TODD. *Improvements in machinery for planing and shaping metals.* Dated March 27, 1865.

This invention consists of machines constructed in the manner hereinafter described to plane in one direction singly, or in opposite directions alternately, at pleasure. The patentee makes the said improved machines with an extra pair or two pairs of uprights or standards fixed to or upon the bed of the machine at any required or convenient distance apart; to each pair of standards and between the same, he fits a cross slide, which can be raised and lowered as pleasure in the usual way. Upon each of these cross slides he mounts one or more slide saddles and tool holders; the slide saddles move laterally upon the cross slides, the points of the cutting tools being towards each other. The travelling table is made to move backwards and forwards by gearing constructed and adapted therefor, connected with and giving motion to a rack screw or other mechanical arrangement suitable for producing the slow cutting and quick return motions for the single cut in one direction, or the uniform backward and forward motions for the double cut in opposite directions, so that the said improved machines by simply raising one of the cross slides can be made to answer the purpose of an ordinary single action machine, and, if the double cut is required, by setting both cross slides to the required height, and at the same time giving the table the uniform backward and forward motions, the same machine becomes a double-action machine, the metal on the table as it passes backwards and forwards being acted upon by each tool or tools in opposite directions alternately, thereby becoming thoroughly planed. *Patent completed.*

857 O. BURNETT. *An improved domestic implement for paring potatoes, apples, and other like vegetables and fruits.* Dated March 27, 1865.

This invention consists in forming the paring implement as follows:—In a suitable holder about seven inches long, the inventor adjusts a piece of tempered steel, the edges whereof are bevelled so as to form cutting edges; this piece of steel he fixes at an angle of about 30 deg. by grooves or slots to the holder, taking care to leave space between the said holder and the cutting edge. One end of the holder is formed as a handle, and the other end has a short pointed blade of thin steel fixed thereto. To use this implement the operator holds the potato or apple in one hand, and with the cutting implement in the other proceeds to remove the peel, using it similar to an ordinary knife, with this advantage that, whereas by the use of a common knife great waste occurs by cutting away too great a thickness of the peel. *Patent abandoned.*

858 H. J. WALDUCK. *An improved mode of, and apparatus for, communicating or signalling between the guards, passengers, and drivers of railway trains.* Dated March 27, 1865.

This invention consists in the use of a mirror or mirrors of plate glass, or other suitable material, affixed to the railway engine or tender, and so made and placed at such an angle that it or they will reflect the sides of the train, so that the engine driver and fireman may without turning observe any signal made either by the passengers in the carriages or from the guards in their vans. *Patent abandoned.*

859 J. BUCKINGHAM. *Improvements in oil feeders or cans.* (A communication.) Dated March 27, 1865.

This invention consists in making oil-feeders or cans of a hemispherical form, or nearly so, and with or without a small flat or hollowed part on which they may stand. This hemispherical capacity is covered by a flat or slightly raised top, from the middle of which the spout or oil channel is raised. The inventor strikes or stamps up the hemispherical bottom out of tinued iron, and prefers hard springy brass for the top; a brass bush is soldered in the centre of this brass disc top, into which the spout screws, and at which part the can is filled when the spout is removed; a small disc or flange piece is fixed on the spout on which the fingers are pressed while discharging the oil by the duct; the thumb at the same time being placed at the bottom; the spring and partial collapse produced by the pressure on the top causes the discharge of the oil at the spout or duct, in the like manner to that which is now adopted by pressing on the spring bottom of oil cans. In cans so made it is of no consequence in what way they may be thrown down, as they always take up the proper position and stand with the spout erect. *Patent completed.*

860 J. ROOKE. *Improvements in double cylinder steam engines.* Dated March 27, 1865.

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

861 C. J. L. LEVYER. *Improvements in casting ingots of steel and malleable iron.* Dated March 27, 1865.

The patentee claims arranging moulding apparatus for casting ingots in the manner described, whereby a series of inclined moulds are brought into communication with a central mould, and the molten metal poured into the central mould is caused to fill those moulds simultaneously. *Patent completed.*

862 C. MATTHEWS and J. FREDAY. *Improvements in the construction of furnaces for the consumption of smoke.* Dated March 27, 1865.

This invention consists in constructing furnaces for steam boilers, and for other purposes, with a bridge-flue and a series of traversing flues partly open and partly closed; in the closed flues the smoke is retained until burnt by the flame, which traverses the open flues. *Patent abandoned.*

863 J. BRUCE-SHAW and W. S. UNDERHILL. *Improvements in traction engines.* Dated March 27, 1865.

This invention consists, firstly, in dispensing with all crabs or projections usually formed upon the peripheries of the travelling wheels of traction engines, for the purpose of enabling them to travel over soft lands. Secondly, in an improved contrivance for steering such traction engines. With regard to the wheels the patentees make the felloes or peripheries of the travelling wheels in a zigzag or serpentine form laterally, or in the line of the axle, keeping the running surfaces of such peripheries flat and in a line concentric with the axle, so that the bearing of the wheels upon soft land is gained by the impact of the sides of the zigzag or serpentine peripheries against the earth, whilst there are no projections whatever upon the rolling face of the wheels

to impede progress or jar the engine when running upon hard land or roads. The steering apparatus is formed by a connecting rod attached by a joint or swivel to the axle of the locking wheels, as far as practicable from the locking centre, the connecting rod being bent so as to allow the nearest locking wheel to lock. The other end of the connecting rod is formed into a rack, into which works a pinion fixed upon a shaft, upon which is hung a hand or steering wheel. This shaft is supported in suitable bearings near the foot plate, so that the steersman standing on the foot plate, or in any other convenient position at the rear of the engine, by turning the steering wheel, works the pinion, and thus actuates the rack upon the connecting rod backwards and forwards, thus causing the axle of the locking wheels to make a partial rotation upon its locking centre. *Patent completed.*

864 F. LE ROY. *Certain improvements in nonconducting composition for preventing the radiation or transmission of heat or cold.* Dated March 27, 1865.

The patentee prepares this non-conducting composition by mixing and combining slimy glutinous earth known as brick clay with sand, coal ashes, charcoal in powder, wood, sawdust, cow hair, wheaten flour, fire clay, water and oil, or any other similar fatty matter. *Patent completed.*

865 G. BISHOP. *Improvements in apparatus for stamping and marking.* (A communication.) Dated March 27, 1865.

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

866 J. C. THOMPSON and J. J. M. GREEN. *Improvements in the construction of railway carriages to facilitate the passage of the guard or other person from end to end of the train whilst it is travelling.* Dated March 27, 1865.

For this purpose a gangway is formed from end to end of each carriage on one side of it, and on the same level as the floor or platform of the carriage. This gangway is just the width of the ordinary doors of the carriage, so that it is completely enclosed by the side and roof of the carriage. It is separated, however, from the compartments of the carriages by a partition fitted with sliding doors, by which any of the compartments may be entered from the gangway. At each end of the carriage the gangway is continued to meet the gangway of the next carriage, and this continuation is made by means of a slide forming a prolongation of the floor of the gangway, and these may, if desired, be coupled together by a pin dropped into eyes on the slides, but the coupling must be so effected as not to interfere with the carriages inclining more or less the one to the other in passing round curves. The sliding portions of the partitions are enclosed at the sides and top by means of canvas or suitable flexible material stretched on frames to keep it in form. *Patent completed.*

867 W. WEST. *Improvements in preparing lubricating compounds.* Dated March 27, 1865.

This invention consists in the employment of kaolin (China clay) or mica, or mixtures of these substances, in combination with tallow or other fatty or oily matters; coal or other tar is also usually employed with or without other ingredients, according to the effect desired to be obtained. *Patent abandoned.*

868 J. WILLIAMS. *An improvement or improvements in ornamenting articles made of glass.* Dated March 28, 1865.

The patentee claims ornamenting articles made of glass by applying thereto ornamental rims, the said rims being either plain or indented at their edges, as described. *Patent completed.*

869 J. NORRIS, jun. *An apparatus for grooming horses.* Dated March 28, 1865.

In carrying out this invention the patentee employs as the motive power an iron wheel with a deep groove to receive an endless elastic band; the wheel is supported on a frame capable of swivelling either to the right hand or to the left, so as to prevent the elastic band from slipping out of the groove, and the foot which supports the said frame may be either fixed or movable, the said foot in the latter case being sufficiently large for the person turning the wheel to stand on it and keep it steady. This wheel and elastic band are for the purpose of driving a circular brush for brushing or grooming horses. The brush is made circular with two handles (one at each side) at right angles to it or in a line therewith; the handles are made of wood with iron ends bored to admit a spindle to run through them with a small grooved wheel at one end outside the handle for the elastic band to drive the brush. The grooved wheel is fixed to the spindle, which is to have a square shoulder to fit into the brush so as to carry it round. The handle on the opposite end of the spindle is secured by means of a nut, by unscrewing which the handle and the brush can be removed from the spindle and a fresh brush substituted. *Patent completed.*

870 J. MILLAR and J. LAINS. *Improvements relating to apparatus for printing ornamental fabrics.* Dated March 28, 1865.

This invention relates to the printing of ornamental fabrics by two or more continuous pattern rollers, but in such a way as to leave blank spaces to be subsequently filled up by borders or other different patterns. Blank spaces, such as are before referred to, have hitherto been obtained according to one plan, by fixing pieces of paper on the respective parts of the fabric before beaming it for the printing machine, a process involving considerable labour, besides the waste of the paper which keeps the fabric blank by receiving the printed colours. By the present invention pieces of sheet zinc or other suitable material are used, being introduced as the printing goes on, and being set to marks previously put on the fabric. This process presents no difficulty in printing with a single roller, and in that application there is no novelty, but in printing with two or more rollers the plate or sheet tends to bend away from the fabric immediately on leaving the first roller, and to fall away entirely if it is not wider than the space between the nips of the two rollers. By this invention this is prevented by applying guides between every two printing rollers, such guides keeping the plates or sheets, however narrow they may be, in contact with the fabric on the large central cylinder during its passage from one printing roller to the other. *Patent completed.*

871 J. C. O. HALKETT. *An improvement in paints or compositions used for coating iron or wooden vessels and other structures exposed to the action of sea water.* Dated March 28, 1865.

The patentee claims employing a salt of baryta in compositions used as vehicles for antirouling and anticorrosive compounds. *Patent completed.*

PROVISIONAL PROTECTIONS.

Dated June 21, 1865.

1864 J. Busfield, spinner, and S. B. Walsley, machine maker, Bradford. *Improvements in machinery for combing wool and other fibrous materials.*

Dated June 27, 1865.

1710 H. Shaw, printer, Lorrimer-square, Walworth. *Improvements in the means of and apparatus for retarding the velocity of the wheels of railway and other carriages when in motion.*

Dated June 30, 1865.

1736 P. D. Finnigan, Camberwell-road. *Improvements in the means applied for arresting and stopping the motion of locomotive engines, trains, carriages, and other rolling stock of railways.*

Dated July 22, 1865.

1916 S. Boyd, City. *An improved cotton press.*
Dated August 7, 1865.

2046 W. and G. Crosher, Ann-street, Wilmot-square. *An improved manufacture of scarfs, cravats, and ties.*
Dated August 10, 1865.

2074 C. O. Crosby, New Haven, Conn., U.S. *Improvements in machinery or apparatus for the manufacture of needles.*

Dated August 19, 1865.

2142 I. Bernhard, Rue de l'Echiquier, Paris, manufacturer. *Improvements in the manufacture of artificial saltpetre.* (A communication.)

2148 J. E. Marsh, Birmingham, manufacturer. *Improvements in punkabs.*
Dated September 1, 1865.

2256 W. Clark, Chancery-lane, engineer. *Improvements in the permanent way of railways.* (A communication.)
Dated September 6, 1865.

2266 W. Clark, Chancery-lane, engineer. *Certain improvements in steam engines and valves.* (A communication.)

2280 T. O. Gibson, Stamford, Lincolnshire. *Improved machinery for mixing or grinding ointment, paint, drugs and other substances.*
Dated September 7, 1865.

2294 J. M. Hart, Cheapside, lock manufacturer. *Improvements in the construction of iron safes, strong boxes, and other receptacles.*

2298 A. Duvernois, Boulevard St. Martin, Paris, merchant. *An improved fireplace with turning grate.*
Dated September 8, 1865.

2306 J. Walker, Cowper-street, City-road, engineer. *Improvements in mounting and working guns in ships, forts, and batteries.*
Dated September 11, 1865.

2330 D. Keys, Craven-street, Strand, watch manufacturer. *Improvements in watches, and in the method of, and apparatus for, winding up fuses watches and pocket chronometers, and setting the hands without a key.*
Dated September 12, 1865.

2335 J. Holliday, Huddersfield, chemist. *Improvements in preparing certain colouring matters.*
Dated September 13, 1865.

2340 J. Dunbar, Westminster Chambers, Victoria-street, Westminster, and J. W. Butler, Danmow, Essex, civil engineers. *An improved apparatus for the distribution of perfumes, disinfecting or other fluids.*

2347 D. and J. Hyam, Houndsditch, warehousemen. *An improved fastening for purses and other like articles.* (A communication.)
Dated September 14, 1865.

2350 T. and T. L. G. Bell, Pilsatow. *Improvements in apparatus used for calcining and roasting copper and other ores and substances containing sulphur.*

2353 J. Lewis, Preston, Lancashire, engineer and mechanical draftsman. *Improvements in machinery for making rivets, spikes, screw blanks, bolts, nuts, and other such like articles.* (A communication.)
Dated September 15, 1865.

2356 W. Clark, Chancery-lane, engineer. *Improvements in magnetic telegraphs.* (A communication.)

2366 W. Clark, Chancery-lane, engineer. *Improvements in saddles and harness.* (A communication.)
Dated September 18, 1865.

2374 A. J. Sedley, engineer, Conduit-street. *Improvements in paddlewheel propellers.*
Dated September 19, 1865.

2384 E. Fox, Limehouse, zinc worker. *A new or improved method of, and apparatus for, securing or fastening metal plates to beams, rafters, and other places for roofing and other purposes.*

2388 E. A. Brooman, Fleet-street, patent agent. *Improvements in engraving on metal.* (A communication.)

2392 J. Gillespie, Garnkirk, Lanarkshire, manager. *Improvements in the manufacture of bricks, blocks, fire covers, and tiles, and in the machinery and apparatus employed therefor.*
Dated September 20, 1865.

2396 H. A. Dufrené, South-street, Finsbury, civil engineer. *Improvements in screw wrenches.* (A communication.)

2409 E. Pettit, Grange-terrace, Michael's Grove, Brompton, engineer. *Improvements in the means of communication between the occupants of vehicles and the drivers or other attendants thereof.*
Dated September 21, 1865.

2402 N. B. Thoyts, Reading, captain in the army. *An improved billiard marker.*

2406 J. Goulding, Worcester, Mass., U.S. *Improvements in bobbin holders.*

2408 A. V. Newton, Chancery-lane, mechanical draftsman. *Improvements in railways and in the wheels for railways.* (A communication.)

2410 H. Hibling, boot and shoe manufacturer, Granby-street, Leicester. *Improvements in the manufacture of boots and shoes.*

2414 W. R. Lake, Southampton-buildings, Chancery-lane, consulting engineer. *Improvements in hoisting machines.* (A communication.)
Dated September 22, 1865.

2416 W. Borgett, Lindsey-row, Chelsea. *Improvements in manufacturing wire conductors for electro-telegraphic purposes.*

2420 H. Rankin, King William-street. *Improved machinery for the manufacture of bags and envelopes made of paper or other fibrous materials, or woven or textile fabrics, either separately or combined.*

2422 J. Sheldon, New Haven, Conn., U.S., lawyer. *An improvement in machines for binding grain.* (A communication.)

THE
MECHANICS' MAGAZINE.

LONDON: FRIDAY, OCTOBER 27, 1865.

THE UTILISATION OF WASTE
MINERALS.

WHEREVER mining operations are carried on it almost invariably follows that waste minerals and other substances accumulate to a greater or less extent. The chief product of a mine, and for which the works are mainly prosecuted, may be accompanied by other materials which would yield a remunerative return if they were greater in bulk, richer in character, or less costly in transport. Indeed, some of the mine ore itself, in many instances, accumulates in large quantities upon the sett, and there lies waste, owing to its pooriness rendering its sale unprofitable. It often will not pay for carriage to the smelting works, however carefully it may be prepared on the mine. Many attempts have been made to render poor ores fit for the market, and in numerous instances the introduction of improved mechanical or chemical processes has proved highly successful. But waste is not confined to mining operations; it also occurs in many of the arts and manufactures, but in every department it is almost daily becoming less, owing to the ingenious and often beautiful applications of refuse to useful purposes. The practical utilisation of substances which have been cast aside as waste is a great gain to commerce, and opens a wide field for enterprise and research. The question is one of growing interest, and we will, therefore, proceed to the consideration of some of the more important methods which have been suggested or adopted for utilising mineral substances at present either waste or of but small value. Perhaps the mineral from which the greatest quantity of waste may be said to arise is coal. At the mouth of most pits it may be observed to have accumulated in large quantities in the form of slack. The presence of iron pyrites, shale, and other foreign substances renders this slack comparatively useless, but it may be utilised in three different ways,—firstly, for some purposes it may be used as fuel; secondly, by cleaning and preparing it so that it may be made into coke; and, thirdly, by mixing it with other combustible substances and compressing it into blocks for use in lieu of ordinary coal. Used as fuel, small coal is of little value, unless very fresh, as it soon loses its gases if long exposed to the air. On being washed, however, it may be used, not only with advantage, but it appears to be specially adapted for making the best coke.

The general principle of the various plans in use for washing coal depends upon the fact that the impurities combined with the coal are of greater specific gravity than the coal itself. The process of separation, therefore, is a modification of that adopted in the case of metallic ores, and by this means the coal may be parted from its deleterious accompaniments. The coal requires either crushing or sifting, as the difference of specific gravity between it and shale is very small. In carrying out the process of separation the coal, when reduced to a uniform size, falls on a perforated plate in the upper part of a cistern, through which a stream of water is constantly flowing. By means of a species of piston which is actuated by machinery, the water is made to pulsate or rise through the plate. The light and clean coal is washed off the surface of the mass by the stream of escaping water, the shale and pyrites remaining upon the plate and being occasionally removed. A few years since Mr. E. Edwards, a mining engineer, made some experiments on this process, and arranged a modification of the machine, by which the coal was removed by self-acting scrapers. He also found that when the rise and fall of the water through the perforated plate was limited to a vibration of small ex-

tent, substances of very nearly the same specific gravity were separated, the shaking of the mass being quite sufficient. He effected this vibration by forming a part of the cistern with a leather disc protected by a plate, against which a succession of blows were delivered by cams. In some experiments made with South Yorkshire coal, Mr. Edwards found the impurities to be about $2\frac{1}{2}$ per cent., or 56 lb. per ton; about 35 lb. of which consisted of iron pyrites, which is by far the most injurious, shale being of rather a negative character.

The next step is the conversion of the small slack into coke, and in this process, when old slack is used, it is generally mixed with some good coal. In the South Staffordshire and other mining districts, there exist immense quantities of fine coal slack, which is almost, if not quite, valueless, in a commercial point of view. The fact that most of this slack, which has hitherto been considered waste, possesses all the chemical properties of the coals from which it is derived, has gradually forced itself upon the attention of those interested in its utilisation. It has stimulated their efforts to re-combine it as a fuel suitable for smelting and other purposes. The extensive use of coke in iron smelting, and the advantages accruing therefrom, show that the most obvious way of utilising this slack, viz., by converting it into coke, would also be the way of giving it the greatest possible value. But there are difficulties in the way of coking the Staffordshire slack, and they arise from the fact that, although possessing the valuable properties for which Staffordshire coal is noted, it does not possess sufficient bituminous matter to cause it to cake or bind in the process of coking. The most successful method of coking the Staffordshire slack is found to be by mixing with it a certain portion of bitumen in the shape of Welsh or other bituminous slack. The greatest difficulty at present experienced is with respect to the ovens, as in those hitherto in use the heat developed in the process of manufacture is not applied with an effect or uniformity sufficient for the thorough fusion of a thick mass of slack, and the production of good hard coke. The charges are found to be caked only in layers at top and bottom, the interior of the charge being imperfectly fused, and waste. With a view of remedying this defect in the process, an arrangement of ovens has been invented by Messrs. Hicklin and Pardoe. The principle upon which the ovens are constructed is that of causing the flame and gases from each oven, in a group, to enter a common system of flues passing over and under every oven in the series. From this there results a thorough intermixture of the gases, the development of intense heat, and the application of the same in a more uniform and effective manner than hitherto, the coking chambers being, as it were, enveloped in fire. It is found that the ovens will thoroughly fuse, and convert into best hard coke, thick charges of Staffordshire slack, with a less proportion of bitumen than is used in any other ovens, and without waste. The charges are so thoroughly fused that they are drawn *en masse*, the doors being as wide as the ovens. Any one or more of the ovens in a series can be drawn and recharged without interfering with the others, and the charge is immediately ignited by the heat of the contiguous ovens, and upper and lower flues, and in its turn contributes to the general effect. The perfect combustion of the gases (as shown by the absence of black smoke from the chimney) develops an intense heat, which, after expending itself upon a long group of ovens, is still sufficiently powerful to be applied to useful purposes, such as raising steam for working engines, and for heating or drying purposes generally.

The manufacture of artificial fuel is the third purpose to which the waste coal is applied, and to this end a variety of methods have been adopted. This class of fuel is composed of coal, pitch, and other substances

compressed by mechanical means, and afterwards either dried, baked, or used raw. For this purpose it is necessary that good coal, or washed coal, should be used. Another plan of utilising small coal has been devised by Mr. Wood; the product is termed preserved coal. The main difference between Mr. Wood's process and that above described is that the coal of which the former fuel is composed is either coked first to drive off the gas and volatile substances contained in it, or this process is effected after the component parts of the fuel have been mixed and moulded into blocks. When formed the specific gravity of these blocks is 50 per cent. greater than that of the coal. In Mr. Bessemer's method of compressing coal the small coal is placed in moulds and heated to a temperature sufficiently high to render it plastic. It is then pressed into a solid mass of a density greater than that of the natural coal. This process, however, appears to be very slow and expensive. The Aberdare Steam Fuel Company compress the coal by hydraulic pressure, through the medium of an accumulator, which process has long been successfully carried out. The advantages of compressed coal are, that besides effecting a saving of about 50 per cent. in its specific gravity, it is with facility made into blocks, which renders it more portable and facilitates packing on shipboard. From the heaps of waste coal at the pit's mouth it is an easy transition to the heaps of waste mineral matters containing ore which lie at the mouths of mines. The main condition by which the utilisation of this waste is governed is the percentage of mineral matter the ore contains. The only thing to be done is to improve the means of extracting the small quantity of valuable ore which is allowed to remain in the waste.

Considerable attention has been given to the manufacture of lubricating grease by the incorporation of metallic substances with tallow or oil. Every known substance having the least pretension to lubricating properties has been tried in turn, and some have succeeded while others failed. But there is one lubricator in particular which deserves notice here inasmuch as it involves the utilisation of a waste or comparatively worthless mineral. This lubricator is the invention of Mr. Perrott, and consists of micaceous ore in combination with oleaginous and fatty matters. Micaceous ore is a species of hematite iron ore found in various parts of the kingdom, but the specific ore employed by Mr. Perrott occurs in considerable quantities in the neighbourhood of the Ashburton mines, South Devon, where it is considered to be of no value whatever. It is soft, greasy, and friable in its nature, and forms a very good base for the lubricant, combining readily with oil or fatty matters. The micaceous ore is first freed from all extraneous or gritty substances by a process known as "puddling." The ore is placed in a vessel of water and puddled or stirred up, the particles being carried by a stream of water down an inclined plane. At the foot of the incline another vessel of water is placed, covered with a sieve of very fine mesh. The ore passes through the sieve, which intercepts all foreign matters, into the vessel beneath, from whence it is taken and dried. Three qualities of lubricator were made—thick, medium, and thin, which were adaptable for either heavy or light machinery. The degree of thickness was governed by the amount of oil introduced. The proportions are, for the strong quality, seven parts of ore and one of oil and tallow combined; for the second or medium quality, a quarter of a hundredweight of tallow, six hundredweight of ore, and three-quarters of a hundredweight of oil; and for the third, one-eighth of a hundredweight of tallow to five hundredweight of ore and seven-eighths of a hundredweight of oil. Some four years since the manufacture of this lubricant was commenced on a small scale, and some of the produce was tried in the machinery of a large engineering firm with very good results. Another batch of the grease was tried in some marine engines, but with less success, as the bearings became heated. This was

owing to incomplete mechanical arrangements at the works, in consequence of which the ore had not been prepared sufficiently clean. The manufacture does not, however, appear to have been proceeded with, which is to be regretted, inasmuch as the lubricant, properly prepared, was admirably adapted for its purpose. When the manufacture of the grease was commenced the ore was obtained for about thirty shillings per ton, but in time, the Devonshire proprietor hearing of the purpose to which it was being applied, raised the price some 300 or 400 per cent. He, however, gained nothing by his move, inasmuch as the heavy price demanded operated with other circumstances to bring the manufacture to a close.

There remain yet a few points more to be noticed in connection with the present subject; the first is the utilisation of the slag or dross formed in smelting iron or other metals. This slag is produced in immense quantities, and has been hitherto only partially used. We refer more especially to iron slag, which varies much in different localities, being in some of a black or dark colour, having no pretensions to ornament, whilst in others it has the most beautiful shades and tints. This material has been cast in moulds and carefully annealed, but the successful accomplishment of this is no easy matter, the articles made being of a weak and brittle nature, and incapable of standing changes of temperature. This slag has also been cast in blocks and used to a limited extent for building purposes. We have seen walls constructed of these blocks in the Black Country; they present a very solid appearance. One great objection to the slag for building purposes is its great specific gravity, which increases the cost of transit, and diminishes its value as a building material. Copper and lead slags have also been used in a similar manner to the iron slags, but the great difficulty in utilising any of these slags is that the bricks produced are of such little market value when made that the cost of moulding and carriage prohibits their use beyond the immediate neighbourhood of their manufacture. Another use to which iron slag is put is the adulteration of emery, which is frequently mixed with the ground black cinder to the amount of from 25 to 100 per cent., more especially in the commoner kinds of emery cloth. A few weeks since we briefly noticed an application of slag for a similar purpose. Some eighteen years ago emery was very dear, and Mr. Marcroft, of Oldham, made a polishing powder from the slag of iron furnaces. The action of this substitute was not equal to that of emery, although laid on paper it was useful in dressing wood. M. J. Aubé, of Moselle, has for years past utilised the slag of iron furnaces for many similar purposes. He also converts it into sand for cement, building, and road purposes, and obtains a ready sale at 4s. per cubic metre for all he can produce at his works. Another substance which appears capable of being made the basis of an important manufacture is the red oxide of iron, or "Gossan," as it is termed, which is the outcrop of copper and other mineral lodes. Many thousand tons of this material are lying at grass in the mining districts, and, as far as we are aware, no attempt has been made to utilise it. Struck with its apparent adaptability for the manufacture of pigments, we some years since tried the experiment and succeeded in producing an excellent oil paint. The colours, which range from an Indian red to a deep brown, were tested by time and a lengthened exposure to the fumes resulting from gas-burning, their shades remaining unchanged. Tried upon a larger scale and with appropriate plant we think a good result might follow. Of late much attention has been given to the utilisation of waste gases from the blast furnaces, which is generally effected by closing the top of the furnace and bringing the gases down to heat the blast or raise the steam. The various methods of obtaining this result have been recently detailed in our columns; it therefore suffices to say that there can be no question as

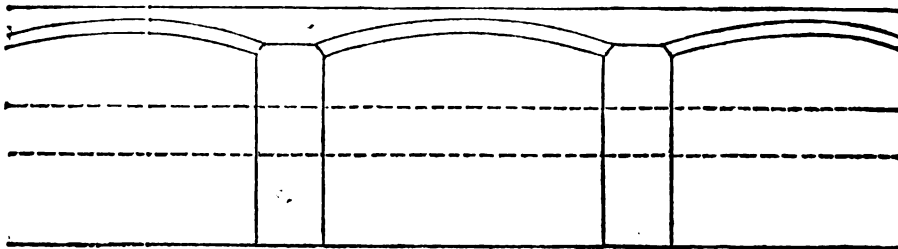
to the policy and economy of thus utilising the gases from the blast furnace. The success attending recent trials has been very complete, and the saving of fuel effected very considerable, so that most works have altered their furnaces to economise the gases. There is no doubt that the progress of science in promoting economy of working will yet lead to the further utilisation of substances for which at present no satisfactory use can be found. All matter was but so much waste before the creative faculty of man provided appliances for its utilisation. And so, human progress will further show that what is now the veriest waste will in the course of time assume a condition of value. Thus will art be made to approximate to nature in that she will know no waste.

THE EAST LONDON RAILWAY.

THE East London Railway, better known to the general public as the Thames Tunnel Railway, is designed to unite the clusters of railways meeting at Liverpool-street, on the north side of the Thames, and New Cross, on the south. At New Cross it will have junctions with the Brighton, South London, South Eastern, and North Kent Railways. These railways it will connect with the Surrey and Commercial Docks, the London Docks, and the East of London, terminating at the great central railway station in Broad-street. It will have a branch to the

The first time the Company went to Parliament it was proposed to construct the line beneath the wine stores at the London Docks, and the bill was thrown out, principally because it was objected that the vibration would interfere with the settlement of the port wine. The Docks Company, however, gave their consent to the present route. At the London Docks a very large goods station is to be made, 1,000ft. in length, and near this point the Blackwall Railway will be crossed at a considerable depth, a short length of the railway only, on the southern side of the Thames, being overground. The stations on the north side of the river will be at Commercial-road, Whitechapel-road, and Broad-street.

A special feature in connection with the new line is a plan adopted to save expense in running through London, where ground is of such high value. For more than a mile the Great Eastern and the East London Railways will run over the same ground into Broad-street Station, the former railway on a high and the latter on a low level. By this plan fully a quarter of a million will be saved by the shareholders in the purchase of land, since the same ground will do for both, and an agreement exists between the two companies, whereby each of them will pay half of the purchase money of the land. Over this length, although the East London will be 16ft. below the level of the ground, it will still be a "daylight" line, with occasional girder bridges where crossed by the streets.



Great Eastern, thereby communicating with the North London and the London and North-Western Railways, and another was projected to connect it with the Blackwall Railway, *via* the Commercial-road, but this was withdrawn in Parliament on account of strenuous opposition. At New Cross three stations are to be built in connection with existing lines: a fourth at Deptford Lower-road, and the fifth on the Surrey side of the water, at the Surrey Docks. From this point it will cross the Thames through the Thames Tunnel, which will not require any alteration but the laying of rails for the purposes of the railway, as it was originally built of surprising strength. Pieces of mortar cannot be detached without breaking off also adhering lumps of brick, and, says Mr. Burke, the engineer, Brunel once offered him a guinea for every brick they could detach from it whole and unbroken. Trials were made, but not a man of them could succeed in earning a single guinea. The only portion of the East London Railway which will be underground is this length through the Thames Tunnel and its vicinity, where for a distance of one mile and an eighth, daylight will be excluded by the tunnel and its covered way approaches. The greater part of the remainder will consist of retaining walls and embankments. Modern tunnels are built of much less strength than the old Thames Tunnel, the two arches of which are 13ft. horizontal diameter, and 2ft. 6in. to 3ft. thick, all of the best cement work. The tunnel has recently changed owners, and is now the property of the East London Railway Company, who receive the tolls from foot passengers. When the railway is opened, the Company are bound by a special clause in their Act, to carry passengers through the tunnel by train at a fare of one penny, whereby they will ride through instead of walk, so may be considered the gainers by the change. The railway will pass under one portion of the London Docks, with the assistance of iron cofferdams.

The above rough section shows the principle to be adopted in construction. The Great Eastern Railway will have four pairs of rails on the top of the viaduct, and the East London three pairs of rails below. The upper dotted line shows the summit of the curve of the arches of the lower line, and the second dotted line the level of the ground. Thus the plan adopted to enter Broad-street is unique. Practically three pairs of rails, such as will be possessed by the East London Railway Company, is nearly as good as four, because at one end of the line the trains may be started punctually, and run through quickly close at each other's heels, but when disturbing causes tell upon their punctuality of departure at the other end, two pairs of rails will be found serviceable. The branch of the North London Railway through Shoreditch, which will shortly be opened to Broad-street, has also three pairs of rails.

At Broad-street the new railway will have a fine terminus, 16ft. below the level of the ground, the other railways entering the same station at a high level. At the same time the East London Company will have a daylight station, with two carriage entrances, one on each side, the railways above having also a pair of carriage entrances, gradually curving from the street over those below. The dimensions of the lower station are 1,000ft. long by 261ft. wide, with brick roofing, supported by 150 columns. As this railway enters the station 16ft. below the level of the ground, and the others considerably above it, the height of the brick roof will be 30ft.; consequently plenty of light will be admitted at the sides, besides which a broad opening from above is made in the centre, admitting light there also.

A branch is to be made from this railway to the New Great Eastern, at Bethnal Green, thus giving direct access to the coalfields and coal traffic of the Midland district. The Great Eastern, in anticipation of a large traffic in

consequence of their recent arrangement with the Great Northern Railway Company, are constructing a coal station of unusually large size near the point of junction. The coal waggons will enter on the tops of the arches, whence they, by means of movable bottoms, will deliver their freight into the stores beneath, shoots being used to prevent the breakage of coal in its descent. "There will be in all," says the *Railway News*, "six lines of rails and about forty coal arches. The total area of these arches will be 1,500ft. long by 73ft. wide. A longitudinal wall will divide them down the centre. On one side of this wall the height from the ground to the crown of the arch will be about 18ft. 6in., on the other side it will be about 23ft. The side having the extra height will have an intermediate floor, constructed of 3in. planking for storage, supported on iron girders and cast-iron columns. This plank floor also will have hatchways for shooting the coal to the basement. The arches, which are segmental, are of about 30ft. span. The area beneath them available for the storage of coal will be 18,250 yards, minus the space occupied by the piers; this area including the double floor for half the space. There will be a roadway of 30ft. wide along one side, and one of 33ft. on the other. On one side there will be ranges of coal merchants' offices in two blocks, each 90ft. long by 25ft. wide." The total cost will be about £50,000. The East London line, where it enters this yard, will have a height of 18ft. on transverse wrought-iron girders, each about 2ft. 3in. deep, with 5ft. between centres. The engineers to the company are Mr. John Hawkshaw, C.E., Mr. George R. Stephenson, C.E., and Mr. J. S. Burke, C.E. The contractors are Messrs. Brassey, Lucas, and Wythes. A somewhat similar scheme was also submitted to Parliament at the same time, but thrown out.

The East London Railway will probably be finished within two years, and from its route has great security from competition. As it will connect numerous trunk railways on both sides of the Thames, its traffic in goods and passengers must necessarily be heavy, besides which it will prove a great accommodation to those crowded neighbourhoods through which it will pass—New Cross, Deptford, Rotherhithe, Wapping, St. George's in the East, Limehouse, Stepney, Whitechapel, Bethnal Green, and Bishopsgate. It is because it passes through some of these poorer neighbourhoods that so much of the line will be open, with retaining walls, as it will be cheaper to buy and pull down the houses altogether than to tunnel beneath them. The total capital of the company is £1,400,000.

THE PARIS EXHIBITION OF 1867.

WHATEVER amount of success attended our own International Exhibition of 1862, it certainly was in no way attributable to the timely notification of arrangements and issue of regulations. We may rather say that whatever of confusion and misrule prevailed, not only before and at the opening, but for long afterwards, was very clearly referable to the limited time allowed for every purpose and at every stage of the undertaking. Immaturely and hastily designed, even the structure itself was in danger of a collapse before it was nearly completed. At this juncture, however, Mr. R. M. Ordish was called in and saved the hopes of the nation by a piece of engineering which will be remembered whenever the constructive story of the building is told. The nerves of the Commissioners were re-strung, and the building restored to a condition of safety by the introduction of a judicious system of diagonal bracing into the latter. As with the building, so with the general arrangements, more especially affecting exhibitors. The decisions of the Royal Commissioners on points relating to the Exhibition were not published until February, 1862, and the Exhibition was to open on the 1st of May following! Everyone knows the result; hurry, drive, and bustle, con-

stant losses and accidents, the officials, taxed to their utmost, endeavouring to please everybody, and of course pleasing nobody, and getting roundly rated from all quarters into the bargain. And all for what? Just for the want of a reasonable amount of time in which to effect the multitudinous arrangements attendant upon such an undertaking. Accepting the warnings conveyed by these and similar results which have accrued elsewhere, the Imperial Commission of the Paris Universal Exhibition of 1867 have already promulgated the general regulations for the conduct of the affairs of their enterprise. These regulations are of considerable importance to those of our own countrymen who may purpose exhibiting, and as they form no small section of the community we shall notice such conditions as are specially applicable to British and Colonial exhibitors.

The objects of the Exhibition in no way differ from those of the many by which it has been preceded. The building in which it is proposed to be held will be of a temporary character, constructed in the Champ de Mars. We have already noticed the design and general features of the building, and need, therefore, only now add that it will be surrounded by a park for the reception of cattle and other live animals, and plants, as well as for those constructions and objects which cannot be exhibited in the main buildings. The opening day is fixed for the 1st of April, 1867, and the Exhibition will close on the 31st of October following. The commissions appointed by the various foreign governments will be in direct communication with the Imperial Commission, so that products sent by a foreign exhibitor will only be admitted through the medium of the commission which represents him. All communications are to be made through the same medium. We may observe that the Committee of Council on Education, Science and Art Department, at South Kensington, is acting for our own Government in this respect. All arrangements for the forwarding of goods for exhibition, and the return of the same to their owners, will be made by the foreign commissioners, who are to place themselves as soon as possible in relation with the Imperial Commission, through a representative. The duty of the representative will be to arrange questions which refer to foreign exhibitors, particularly those relative to the allotment of the whole space among the various countries, also to the detail arrangement of each foreign section. The representatives will be provided by the Imperial Commission with a plan showing the detail arrangement of the French section. They will thus be enabled to furnish the commission with an analogous plan of arrangement, showing the manner in which the portions of the building allotted to each foreign country will be subdivided. This plan is to be transmitted to the Imperial Commission by the end of the present month. Detail plans are also to be sent in by each foreign commission, with the list of exhibitors, by the end of January, 1866. These plans are to show the place allotted to each exhibitor.

The arrangement which secures a park outside the building is a special and interesting feature, and it is rendered still more so by the fact that each foreign country may claim the portion of the Champ de Mars adjoining the space allotted to it in the Exhibition building for the formation of a special park. The plan of the paths and earthworks will be settled with the General Commissioner by the representative, and the works will be executed at the cost and under the direction of the Imperial Commission. Doubtless the General Commissioner will have some difficulty in dealing with the various designs according to which the several countries may desire to have their allotments laid out. There will most probably be a characteristic variety submitted, but there is scarcely room to fear that the whole will not be made to harmonise in a country where taste so pre-eminently abounds. To facilitate arrangements, the Imperial Com-

mission will place at the disposal of the representatives the plans adopted by French exhibitors for arranging the animals, plants, model cottages, and other objects. In the literary department, the prominent feature will of course be the official catalogue, which is to contain two alphabetical lists, one of the exhibitors, and the other that of the products exhibited. The information necessary for the preparation of this catalogue is to be forwarded by foreign commissioners by the end of next January. In each section assigned to the exhibitors of the same country, the objects will be divided into ten groups and ninety-five classes. The objects which are included in these groups are given in detail in a system of classification which is annexed to the regulations. With regard to the copying of works of art, it is decreed that no object of this description, or, in fact, any exhibited article, may be drawn or reproduced in any other way without the authority of the exhibitor who is the author of it. The right to authorise the taking of general views of the Exhibition is reserved by the Imperial Commission, whose special authority, also, is required for the removal of any exhibited object before the close of the Exhibition. No rent will be charged for space, but, as is customary, all costs incurred for fittings and decorations in the building and the park will have to be borne by the exhibitors, who, by the act of becoming exhibitors, are assumed to bind themselves to adhere to the regulations laid down by the Imperial Commission.

Special arrangements have been made relative to works of art. Works by French and foreign artists, executed since the 1st of January, 1855, will be received for exhibition. The exclusions are, first, copies, including those which reproduce a work in a manner different to that of the original; second, oil paintings, miniatures, water-colour drawings, pastels, designs and cartoons for stained glass, and frescoes without frames; and third, sculpture in unbaked clay. The number and nature of the rewards to be given in respect of this section, and the constitution of the international jury who will act as judges, have not yet been decided. With respect to the products of agriculture and industry, special arrangements have also been made which relate in the first place to their admission and classification. The exceptions and limitations are:—Detonating, explosive, and other substances of a dangerous nature. Spirits and alcohols, oils, essences, corrosive and other substances, likely to injure other products, will be admitted only in very small quantities and in strong vessels specially adapted for the purpose. Percussion caps, lucifer matches, and the like may be exhibited if made in imitation and deprived of all inflammable ingredients. Exhibitors of products of an unwholesome and disagreeable nature will have to conform at all times to such measures of safety as may be prescribed. Further, the Commission reserves to itself the right of removing any products which from any cause are incompatible with the objects of the Exhibition. The time fixed for the reception of French and foreign goods is from the 15th January, 1867, to the 10th of March following, and exhibitors must see to the transmission and reception of their packages and verify their contents. Should this point be neglected the carrier must remove the goods immediately; all costs of package and carriage to and fro have to be met by the exhibitors. As the Exhibition is constituted a bonded warehouse, foreign goods for exhibition will be admitted into France, at certain ports, under bond, up to the 5th of March, 1867.

In the Machinery Department special instructions are yet to be issued relative to the period when the materials for the buildings, as objects for exhibition, the separate parts of machines and apparatus, heavy and cumbersome articles, and those which require masonry or special foundations, are to be brought into the precincts of the Exhibition. Plans of such works are to be submitted to the Commission for approval, and the works are to be performed

by the exhibitors at their own cost. If the contractors for the construction of the building consult their own interest they will also confer a benefit on exhibitors by undertaking the execution of foundations and fittings. Messrs. Kelk and Lucas adopted this plan in the Exhibition of 1862; they made the offer in a letter to the Commissioners, which letter was printed at the foot of the official document in which the space allotted was announced to each applicant. There will be a gratuitous supply of water, gas, steam, and motive power for machinery in motion. Except in special cases this motive power will be transmitted by a horizontal main shaft, the diameter and number of revolutions per minute of which will be made known by the end of this year. Exhibitors will have to furnish driving pulleys on the main shaft, connecting pulleys, and intermediate shafting for the purpose of regulating the proper speed of the apparatus, as well as the necessary belts. Engines worked with steam from their own boilers cannot be shown within the building, and are subject to further special directions. The construction of the various fittings must be commenced, at latest, on the 1st of December, 1866, and must be finished before the 15th January following. From the 11th to the 28th of March, 1867, the goods are to be arranged in the stalls for exhibition, a general cleaning is to take place on the two following days, and a review of the whole Exhibition on the 31st. Thus it is to be hoped that the Exhibition will present a somewhat different aspect to that of our own on the 1st of May, 1862, when an army of porters, workmen, and cleaners were only driven from their unfinished work by the entrance of the Company. Upon the whole the arrangements are so well timed and the regulations, as far as at present published, appear so efficient, that we may augur a brilliant success for the Paris Universal Exhibition of 1867.

AMERICAN MARINE ENGINE TRIALS.

WHEN recently noticing the proposition of the American naval authorities to try the engines of the "Winooski" and the "Algonquin" by making fast the two vessels to a wharf, we expressed a hope that this intention would be relinquished, and Mr. Dickerson's request for a fair sea trial acceded to. Trials at moorings are certainly useful as tests of the efficiency of engines when considered merely as pieces of mechanism working under a maximum strain, but they cannot show the suitability of their arrangement to, or the speed and economy which they would attain under, the conditions of actual service for which they have been designed. The relations between the results obtained under different conditions must vary with every difference in the relative proportions of vessels, engines, and propellers. Our hopes, however, have been disappointed. It appears by the accounts of the first part of the trial, which was for economy of fuel, that, notwithstanding the protest of Mr. Dickerson, the vessels were tested at the wharf. The competition originated from the circumstance of Mr. Isherwood, the Engineer-in-Chief of the United States Navy, having advocated and used for about four years in Government vessels engines with small cylinders, only cutting off the steam at $\frac{7}{8}$ of the stroke, and without superheaters. Mr. Isherwood gave a preference to these engines as being not only simpler and lighter, but even more economical than those of the opposite class. This system had been strongly opposed by Mr. Dickerson, who, although a barrister, had fitted engines in several merchant vessels, and advocated the opposite system, of great expansion and superheated steam. The Government had decided on trying the "Algonquin," a war steamer which was built by Mr. P. S. Forbes, and fitted with Dickerson's engines, under contract to equal in power and economy any vessel of the same class in the navy, against the "Winooski," which was constructed under the directions of Mr. Isherwood.

The Government being in the position of a competing party, the arrangements were nominally left to a board of experts; but it appears that they were in reality dictated to that body by the Naval Department, who only offered to consider any objections to the arrangements they proposed after the trials should have taken place. The engines of the "Winooski" are of ordinary construction and the best materials of workmanship. Those of the "Algonquin" are almost entirely of a novel and experimental character and designed by a barrister, so that it is not surprising that they should be described as being ill-proportioned and incapable of standing their work. It is said that, in consequence of the bad arrangement of the condenser and the small size of its cold water pump, she had a back pressure of 3lb. more than that of the "Winooski," which would of course, with her large cylinders, greatly lessen her apparent economy. The trial commenced at eight p.m. on the 22nd August. It should have been for ninety-six hours, but was brought to a close at fifty-one hours by the accident of a feed pipe breaking on board the "Algonquin." The following particulars are given in the report of the Board of Naval Engineers:—

	"Winooski."	"Algonquin."
Total time of trial.....	51 hours	51 hours
Total number of revolutions of wheels ...	45,149	44,918
Total number of lbs. of anthracite coal used.	80,400	79,239
Average number of revolutions per minute	14.7546	14.6791
Average number of lbs. of coals per hour	1576.5	1553.7
Average pressure of steam in boiler	16.8	70.79
Average point of cutting-off	0.475	0.111

The following are some further particulars of the two vessels, and which do not appear in the official report of the trial:—

	"Winooski."	"Algonquin."
Diameter of cylinder .	58in.	48in.
Stroke of cylinder.....	8ft. 9in.	10ft.
Nature of valves	{ balanced poppet }	single poppet
Grate surface of boiler	200 sq. ft.	142 sq. ft.
Flue surface of boiler .	5036	not stated
Pressure of steam.....	16.8 no super-heater	70.79 superheater
Diameter of paddle wheels	22ft. 6in.	22ft. 6in.
Length of paddles.....	9ft.	9ft.
Width of paddles	7in.	7in.
Immersion of lower edge of paddles	2ft. 3in.	2ft. 3in.

The conclusions drawn by the Board from this trial are, that the economy of the two vessels is equal, and the arrangement of the "Winooski" preferable, as being simpler, more convenient, durable, and reliable. It is urged by the advocates of Mr. Isherwood's system, that the "Winooski" would have shown equal economy had she been worked at the same pressure as her opponent. They appear, however, to forget how little power is derivable from the condensation of high pressure steam. They further urge that the "Winooski" would then have a still greater advantage in lightness, simplicity, and cheapness of machinery and in reduction of loss by friction; that the breakage of the pipe on board the "Algonquin" was caused intentionally, in order that the loss which would have resulted from blowing off might be avoided; and that whilst she will need more than a week for the execution of her repairs, the "Winooski," which continued working for the whole of the ninety-six hours, as originally intended, left off in perfectly good condition. On the other hand, the opponents of the system of the navy urge, that the "Winooski" was

not arranged on the same plan as Mr. Isherwood had so long advocated and applied in Government vessels, since her steam was not cut off at 0.7 of the stroke, but at 0.475 , which approximates to the degree usual in merchant vessels. Further, that the want of a superheater was compensated for by the water of the boiler being kept dangerously low, so as to expose the upper part of the vertical tubes to the steam; that the engines of the "Algonquin" were of too novel and untried a description, and too weak and ill-proportioned, for such a trial, especially as, through their being compelled to work in dock, and with different wheels from those which had been designed for the vessel, they were exposed to a much greater strain than could have occurred on a voyage; that her defective vacuum, which had nothing to do with the points on trial, deducted largely from the power which she should have developed; and finally that, whereas the same quantity of coals was charged to both vessels, the "Algonquin" had not actually used so much by 2,526lb., besides there being nearly enough for an hour's consumption on her stoke-hole floor. There seems to be a very general feeling in America, that the trial has not been made in good faith. It certainly seems strangely insufficient, as a means of comparing the competing systems, as to the main points in dispute, either with one another, or with those in use elsewhere.

Leaving, however, the consideration of the defects in, and objections to, the trial, we will endeavour to reduce its results to a form better suited for comparison with those obtained from other sources.

As indicator diagrams, although they seem to have been taken, have not been published, we can merely approximate to the indicated horse power, by considering that consumed in the work done by the wheels. Taking the section of the columns of water as 40 square feet, and assuming that its average velocity was 3.5 ths of that of the edge of the paddles, we get for that velocity $18\text{ft.} \times 3.1416 \times 14.679 \text{ rev.} = 13.83\text{ft. per}$

second, which corresponds to a pressure of 209lb. per square foot of its section. Then $209 \times 13.83 \times 60 \times 40 = 210\text{-horse power}$ transmitted to the water; and, assuming $1\text{-}3\text{rd}$ of the power generated to have been lost in friction, &c., we have 315-horse power as a rough approximation to that which would have been indicated; whence we get $1553.7 \div 315 = 4.93\text{lb. for the consumption of coal}$

per indicated horse power per hour.

Rough as this approximation is, it is sufficient to show the fallacy of Mr. Isherwood's views, if we consider that many engines which cut off at from $1\text{-}4\text{th}$ to $1\text{-}7\text{th}$, and require, at a cut-off of $1\text{-}6\text{th}$, but $2\text{-}5\text{lb.}$ of coal per hour per indicated horse power, have been constructed for our naval and mercantile steamers during the last few years, and have satisfactorily stood the test, not only of short trials under exceptional conditions, but of long service on their stations; facts too well established to be overthrown by trials, in which conditions are dictated by powerful boards interested in the results, or in which machinery is employed that has been designed by amateur engineers.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

The Metallurgical Value of the Differences between Ferrosium and Ferricum—The Properties of Manufactured Iron Dependent on the Respective Proportions in which it Contains the Metal in its Two Allotropic Conditions—Magnesium as the Positive Element of Voltaic Batteries—New Researches Respecting Gun Cotton—Remarkable Phenomena Presented by the Evaporation of Mixed Liquids—Industrial Preparation of Formic Acid—The Supposed Internal Heat

of the Earth as a Source of Mechanical Power—The Last New Material for Paper—Artificial Ivory—Falsification of Gold Coins by means of Iridium—Probable Existence of Iodine in some of the Ores of Devonshire and Cornwall.

UNTIL of late years, the proto-compounds of iron and what used to be called the "sesqui"-compounds of that body were regarded as containing absolutely the same base, and as owing all their differences from each other simply to their containing that base in different proportions. It was supposed, for example, that the base of the protoxide of iron was altogether the same kind of metal as the base of what was then called "sesqui-oxide" of iron, and that in each of these compounds the metallic base was in precisely the same physical condition, and had precisely the same chemical properties. This idea has no longer any adherents. What are now called the "peroxide" and "persalts" of iron are no longer supposed to be merely differently-proportioned compounds of the same substance as that which forms the base of the protoxide and proto-salts of iron, but it is seen that the body which is the base of the one class of compounds has a chemical nature wholly different from that of the body which is the base of the other class, and that the two bases are thus virtually different substances. As the two bases have as distinct chemical properties as though they were distinct metals, chemists have latterly regarded them as distinct metals, differing from any other two metals, in respect of distinctness, only in their capability of conversion into each other, and in accordance with this method of regarding them have given them distinct names, calling the metal of the proto-compounds "ferrosam" and that of the other compounds "ferricum." The difference between the chemical properties of ferrosam and ferricum extend even to a difference of atomic weight, the smallest indivisible proportion of ferrosam that can enter into a combination being 28 parts by weight, while that of ferricum is 56 parts by weight. Similarly, the atomic heat of ferrosam is 3, but that of ferricum 6. An equivalent of ferrosam is saturated by one equivalent of chlorine, but an equivalent of ferricum requires three atoms of chlorine to saturate it; and there is the same proportionate difference between the equivalency of ferrosam and that of ferricum in relation to all other elements. As for the differences of character and habitudes between the salts of ferrosam and those of ferricum, it is so great that, as Dr. Odling has well said, "had we been unacquainted with the methods of converting ferrous and ferric compounds into one another we should never have suspected them to contain the same metal, or even a similar metal." The compounds of ferrosam and ferricum differ from each other much more than the salts of ferrosam do from those of nickel or those of copper, or than the salts of ferricum do from those of aluminium or those of bismuth." Further on, in the paper from which this quotation is made, after remarking that there exists between carbon and the allotropic form of that element known as "graphon" a distinction similar to that between ferrosam and ferricum, Dr. Odling proceeds: "The only circumstance wanting to complete the parallel is that not only carbon and graphon compounds, but isolated carbon and graphon, are known to chemists, whereas, though ferrous and ferric compounds are well-known, chemists have not yet recognised any form of free iron distinct from ferrosam." We have now to record that the parallel is no longer incomplete. The number of the "Comptes Rendus" for October the 9th, contains an article by M. de Cizancourt on "The Allotropic Conditions of Iron," in which the author shows conclusively that manufactured iron sometimes consists solely of ferrosam, sometimes solely of ferricum, and sometimes of a mixture of the two, and that its quality and properties depend to a far greater extent than on any other circumstance on the degree in which it is ferrous

or ferric. Considering how strongly marked are the chemical differences between ferrosam and ferricum, it is wonderful that no one should till now have suspected them to have any influence in the metallurgy of iron. M. de Cizancourt, however, establishes that they have a most important influence therein, and his discovery will be likely to exercise no little influence upon the future of the iron manufacture. We must defer details of his discovery until next week.

M. Bultinek, of Ostend, has communicated to the Academy of Sciences a note on the use of magnesium instead of zinc as the positive element of voltaic batteries. In order to compare the electromotive force of magnesium with that of zinc, he employed two pairs of wires, one pair consisting of a wire of copper and one of zinc, and the other pair of a wire of silver and one of magnesium. On plunging the first-mentioned pair of wires into distilled water, having first connected them with a multiplying galvanometer, the needle of the galvanometer, at the moment of the immersion of the wires, moved 30 deg., and after the immersion had lasted five minutes still marked 10 deg. On similarly treating the silver and magnesium pair of wires, which were of exactly the same dimensions as the copper and zinc pair, at the moment of immersion the needle of the galvanometer deviated 90 deg., and five minutes after immersion it remained stationary at 28 deg. Having thus found the electromotive force of a silver and magnesium couple to be three times that of a copper and zinc couple, M. Bultinek became desirous to construct a large battery with magnesium as the positive element, but not being able, for the moment, to obtain magnesium in any other form than that of thin wire, he had to be content with making a "galvanic chain," of the kind associated with the name of M. Pulvermacher. Having constructed such a chain of silver and magnesium, he found that when simply moistened with pure water it would produce all the effects the production of which by an ordinary Pulvermacher's chain requires that the chain be moistened with either a saline or an acid solution. We knew previously that magnesium possesses greater electromotive force than any other known metal capable of being obtained in quantity; the new fact brought to light by M. Bultinek is that a battery in which magnesium was the positive element would not need an acid to excite it, but could be excited by water only.

A very long paper on pyroxiline, or gun cotton, which M. Blondeau has just presented to the Academy of Sciences, announces one or two new facts, besides embodying some new views respecting the constitution and character of the compound mentioned. M. Blondeau regards pyroxiline as a combination of nitric acid, not with cellulose, as is usually supposed, but with a body, isomeric with cellulose, which he calls "fulminose." The reason why it explodes at 284 deg. Fahrenheit is that at that temperature fulminose decomposes into aqueous vapour and free carbon. In the case of pyroxiline, however, no free carbon occurs among the final products of the decomposition. The carbon of the fulminose contained in that compound uniting with the oxygen of the nitric acid to form carbonic oxide, the ultimate products of the explosion being thus steam, carbonic oxide, and free nitrogen. M. Blondeau regards pyroxiline as being a pentabasic anhydrous acid, and the name he would prefer for it is "pyroxilic acid." Collodion he regards as a hydrate of this acid, and he says that a variety of pyroxalates may be obtained by means of it. The most important of the new facts which he brings forward is that pyroxiline, or, as he would say, pyroxilic acid, is capable of combining with ammonia, and thereby forming a salt which is much more powerfully explosive than ordinary gun cotton, while it has moreover the further advantage over that substance of not being in the least liable to spontaneous decomposition. One would have ex-

pected him to call this salt "pyroxalate of ammonium," but, oddly enough, he regards it as an amide, and gives it the ugly name of "pentamide cellulo-nitric." To form it, he exposes ordinary gun cotton to the action of ammoniacal vapours for about four hours, at the end of which time, he says, the gun cotton will have acquired a peculiar yellow tint, characteristic of the new compound. He adds that pyroxiline will combine, not only with ammonia, but likewise with the chloride of ammonium, forming with the latter also a compound at once much more explosive at a sufficiently high temperature, and much more stable at ordinary temperatures, than pyroxiline is by itself. The compound of pyroxiline and chloride of ammonium he calls "hydrochloride of pentamide cellulo-nitric."

In the course of some researches with respect to the phenomena presented during the evaporation of mixed liquids, Berthelot has lately observed some very remarkable facts, of a kind scarcely to have been anticipated. He has found, for example, that if a mixture of two liquids of different degrees of volatility, containing a preponderating proportion of the less volatile liquid, be exposed to the action of heat, it will by no means always happen that the more volatile of the mixed liquids will fly off first. Thus, if one part of alcohol be added to eleven parts of water, and the mixture be heated, the alcohol will not evaporate any more rapidly than the water, although it is much the more volatile liquid of the two. Stop the evaporation at any stage, and the residue will always contain exactly the same percentage of alcohol that was contained in the mixture before the evaporation commenced. In some cases it even happens that the less volatile constituent of a mixture of two liquids flies off first. If, for instance, a small quantity of alcohol be added to a much larger quantity of that exceedingly volatile compound, bisulphide of carbon, and the mixture be submitted to distillation, in the mixed vapours which first pass over there will be a far larger proportion of alcohol than in the mixed liquids as originally placed in the retort, and after a little while there will be left in the retort bisulphide of carbon only, the whole of the alcohol having distilled away, notwithstanding that alcohol by itself is less volatile than bisulphide of carbon, in even greater proportion than that in which water is less volatile than alcohol. Similarly, Mr. Carey Lea has found that when a mixture of ethylamine, diethylamine, and triethylamine is distilled, the last mentioned body, although, when by itself, by far the least volatile body of the three, passes over much more rapidly than either of the others. These facts are very curious, and may prove to have practical bearings of much importance, but in the present state of knowledge they are quite inexplicable.

Formic acid is susceptible of many valuable practical applications from which it has hitherto been debarred by its costliness. M. Lorin, however, has succeeded in so far improving Berthelot's process for obtaining this compound as to render it practicable on an industrial scale with a degree of economy never previously realised. The difference, in respect of constitution, between formic acid and oxalic acid is exactly the same as that between gallic acid and pyrogallallic acid, which we had occasion to refer to last week. Formic acid, or CH^2O^2 , is oxalic acid, or $\text{C}^2\text{H}^2\text{O}^4$, less CO^2 , or the elements of carbonic anhydride, just as pyrogallallic acid is gallic acid deprived of the same elements. When oxalic acid is subjected to the action of heat, it splits up into formic acid and carbonic anhydride, but if the oxalic acid be heated by itself very little formic acid will be actually obtained, because it will be impossible to prevent the temperature rising so high as to cause the formic acid, CH^2O^2 , to split up, in its turn, into carbonic oxide and water ($\text{CO} + \text{H}^2\text{O}$). Gerhardt tried to overcome this difficulty by mixing the oxalic acid intimately with fine sand, and Berthelot by mixing it with glycerine. Of

these two expedients, Berthelot's answers by far the best; indeed, as slightly modified by M. Lorin, it is so successful as to leave nothing to be desired. M. Lorin's modification consists simply in adding water to the mixture of glycerine and oxalic acid, the office of the water being to determine the separation of the formic acid from the union which on its first formation it enters into with the glycerine. M. Lorin heats together in a retort a mixture of ordinary oxalic acid with ordinary commercial glycerine and water. The reaction commences at 75 deg. Centigrade, and is in full activity at 90 deg., carbonic anhydride being disengaged, and aqueous formic acid, containing fifty-six per cent. of acid, distilling over. The mixture has no tendency to rise to the temperature—200 deg. Centigrade—at which formic acid is decomposed, and thus a full equivalent of formic acid is obtained for each equivalent of oxalic acid employed. When the evolution of carbonic anhydride has ceased, more oxalic acid is put into the retort, whereupon more carbonic anhydride is given off and more formic acid distills over, and so the process goes on continually, the same portion of glycerine serving over and over again, till it is too much contaminated by the impurities contained in the oxalic acid. If the oxalic acid used were pure, the same portion of glycerine would serve, unchanged, for ever, and M. Lorin has actually used the same portion for several months together, during which time the process was continued incessantly, by night as well as by day. The cost of formic acid as obtained by his method, therefore, is very little more than that of its equivalent of oxalic acid, *plus* the cost of fuel, labour, and wear and tear.

The distillate obtained in the above process contains, as has been said, 56 per cent. of formic acid, the rest being water. M. Lorin has a new method of separating the water, wholly or in part, so as to obtain the acid either anhydrous or monohydrated. The old method consists in saturating aqueous formic acid with oxide of lead, and then decomposing the resulting formate of lead by means of sulphuretted hydrogen. This process, however, is very long and difficult, will not succeed at all except in very skilful hands, and even then does not yield anything like the full quantity of formic acid. M. Lorin finds that formate of copper answers much better; it is just as easily formed as formate of lead, and is more easily crystallised, dehydrated, and decomposed than the lead salt, while it has also the advantage of yielding, when decomposed by sulphuretted hydrogen, the full theoretical proportion of acid. M. Lorin has moreover devised a method by which anhydrous formic acid may be obtained otherwise than by way of the intermediate production of a metallic formate. By using, in the process by which the formic acid is first obtained, dehydrated oxalic acid and saturated glycerine, instead of the ordinary commercial forms of those compounds, he obtains a distillate containing, not merely 56 per cent. of formic acid, but 75 per cent., and he finds that the 25 per cent. of water in this distillate may be separated by means of anhydrous oxalic acid. The objection to this process is, that to obtain, in the manner just indicated, aqueous formic acid of a strength of 75 per cent., requires a very much more careful attention to temperature than is requisite for the obtainment of the 56 per cent. acid.

At the last meeting of the Literary and Philosophical Society of Manchester, Mr. George Greaves read a paper embodying the suggestion that that "internal heat of the earth" which he supposes will render it impossible for us to raise coal from below a depth of four thousand feet should itself be employed in place of the fuel of which he thinks it will one day cut off our supply. He considers that the heat of the fiery ocean which he believes lies under our feet might supply us with all the mechanical power we want, and that one method of causing it to do this "might be by

the direct production of steam power by bringing a supply of water from the surface in contact with sufficiently heated strata, by means of artesian borings or otherwise." He has yet to explain, however, how, supposing his "sufficiently heated strata" to really exist, we could make "artesian borings" deep enough to reach them, or how, even if we could make the borings, we could utilise at the surface the force of steam generated at such a depth below it as that at which even Mr. Greaves must suppose the "sufficiently heated strata" to lie buried.

The new material for paper mentioned in our last week's "Miscellanea" is yielded by three varieties of lucern,—the *Medicago media*, the *Medicago falcata*, and the *Medicago maculata*. The pulp obtained from the roots of these plants is said to be fully equal to that produced from the best rags, and the roots at the same time yield two valuable bye-products, namely, soda, and a colouring matter which its discoverer, M. Caminade, has named "luzerine."

Both on the continent and in this country the manufacture of "artificial ivory" is conducted on a scale of some magnitude. The process by which the most successful imitation of natural ivory is obtained appears to consist in dissolving either india-rubber or gutta-percha in chloroform, passing chlorine through the solution until it has acquired a light yellow tint, next washing well with alcohol, then adding, in fine powder, either sulphate of baryta, sulphate of lime, sulphate of lead, alumina, or chalk, in quantity proportioned to the desired density and tint, kneading well, and finally subjecting to heavy pressure. A very tough product, capable of taking a very high polish, is obtainable in this way.

Gold is the heaviest of all known substances excepting three,—osmium, iridium, and platinum. The specific gravity of gold is about 19.3, that of platinum about 21.15, that of iridium about the same, and that of osmium about 21.45. Platinum, iridium, and osmium are all costly, but they are not so costly as gold,—platinum and iridium are worth about thirty shillings an ounce,—and certain American swindlers seem to have been making a considerable profit of late by splitting open gold pieces, filing away gold from the inner side of each half, replacing the gold so abstracted with iridium, and then soldering the halves together and re-milling the edges. As coins which have been treated in this way are just of the right weight and size, have the ring of pure gold, and consist of gold externally, it is exceedingly difficult to detect that they have been tampered with.

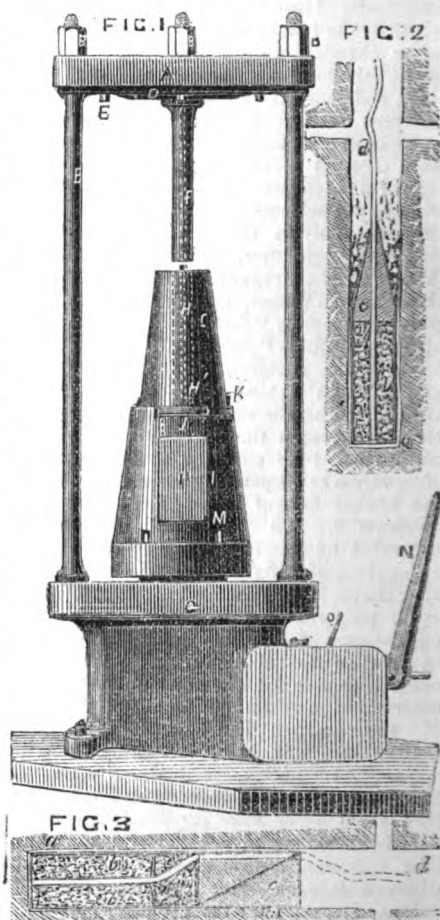
The announcement which we made some eight or nine months since of the discovery in Chili of a lead ore containing 10 per cent. of iodine is leading to careful researches in the hope of finding that valuable element among the constituents of certain British minerals. There seems tolerably fair reason for supposing that it enters into the composition,—in what quantity, however, is as yet very doubtful,—of an ore of lead, antimony, and silver which occurs somewhat abundantly in both Devonshire and Cornwall.

COMPRESSING GUNPOWDER FOR BLASTING.

THE object of this invention, which was patented by the late Mr. Douglas Symonds Sutherland, of 34, Great George-street, Westminster, civil engineer, is, first, the economical application of hydraulic power to the compression of gunpowder for blasting or other purposes; by means of the machinery employed, any desired number of charges may be compressed simultaneously. The machine consists principally of a series of hydraulic presses placed, it may be, vertically, and the stroke of whose pistons or rams are, in that case, below the fixed position of the presses. Under the pistons or rams are arranged a corresponding number of fixed holders or rests, which receive and support cylinders open at top and closed below by movable bottom pieces. These bottom pieces have cores attached for forming a hole in the compressed charge for the

reception of the fuse, or other suitable means may be adapted for its attachment. The cylinders being filled with powder are placed on their rests, the bottom pieces reposing on slides. Downward motion is then given to the pistons, which enter the cylinders and compress the powder below them. The slides sustaining the pressure of the bottom pieces are perforated with holes corresponding to the interior dimensions of the cylinders, and so arranged that, being drawn, the holes occupy a position in line with the axes of the cylinders, and the bottom pieces are then unsupported.

When the powder has been suitably compressed the motion of the ram is arrested and the slides drawn, the pressure is again applied, the motion given to the pistons, which drive the compressed charges and bottom pieces out of the cylinders into chambers prepared for them. The motion of the piston is then reversed, either by the pressure of water on an annular ring near the head of each piston, or by balances suitably arranged. The cylinders are then removed from their rests to be cleaned and oiled, the slides are re-set and other cylinders filled with powder are placed on the rests, and the operation as above described



is repeated as often as may be desired. The dies for compressing the powder may be fixed, and the cylinders containing it pressed upwards against them; or either of the above methods may be modified by being arranged horizontally, or there may be more than one die and corresponding cylinder to each ram; that is, each ram may be made to compress at each stroke one or more charges of powder.

The invention also relates to the manufacture of blasting cartridges. For this purpose the charge of mended gunpowder is enclosed in a case of paper or suitable material, together with a cone of wood or similar substance, the base of which rests on the charge, and is of such a diameter as just to enter the blast hole bored in the rock; this cone serves to convey the pressure on the explosion of the charge uniformly to the sand with which the hole is filled above the cartridge, and to prevent the gases penetrating between the grains. In cases where the blast hole is horizontal, or nearly so, there is difficulty in filling the sand properly around the top of the cartridge, and in these cases a cartridge is employed which does not require a sand tamping. In place of the cone above mentioned a cylinder is employed which is cut diagonally from end to end, so as to divide it into two wedges; these

wedges are made up into a cartridge together with the charge, by enclosing them together in a paper or other case. Gravel or similar material is also placed between the charge and the wedges, so that on the explosion, this is immediately driven into any crevices there may be between the wedges and the side of the hole; the crevices are thus stopped and the wedges rendered secure. In place of gravel an expanding wad, it may be of felt or other material, may be employed, which by fitting tightly against the sides of the hole prevents the flame and gases passing. This construction of cartridge is also applicable when using powder in grains, and also when using gun cotton.

In the accompanying engraving fig. 1 is a side view of a press, one of a series for compressing powder for blasting and other purposes; the arrangement shown is that in which the die for compressing the powder is fixed, and the cylinder containing it pressed upwards against it; this is the arrangement which is now preferred. In fig. 1 A is the upper plate of the press; B B are the standards; C the hydraulic press; D a plate of steel fastened to the upper plate of C by the screw bolts E E; F the die or plunger (one or more) of steel or other suitable metal (with a hole drilled up the centre from end to end, shown by the dotted lines, the size of ordinary fuse) and screwed to steel plate D; G the cylinder or cylinders to contain the powder made of steel or other suitable metal; H the core; H' the bottom piece to which the core is fixed. This bottom piece is fitted into the bottom of the cylinder, and made to stop in by the tightness of the fit, while the cylinder is being loaded; the core fits tightly but easily into the hole in the plunger F; I a casting of iron or other suitable metal, hollow at I' under the hole of the cylinder or cylinders in the piece of metal G; J is a slide of steel of suitable strength and thickness, which works horizontally on the screw bolt K, and is supported underneath by the casting I; L is the ram head; M M two steady pins screwed into the ram head, and fitting into corresponding holes in the casting I constantly in the same place; K k bolts, they act as steady pins for the cylinders G; N the lever, by which the press is worked; O handle of screw valve to relieve the pressure, and let the water back into the reservoir.

The operation of compressing the powder is as follows:—The core H is put into the cylinder G, and the cylinder is filled with powder. The slide J being shut, the cylinder is put in its place against the steady pins K k, the hole of the cylinder being directly under the plunger F. Power being applied to the lever N, the ram head forces the cylinder containing the powder upwards against the plunger F, and as the cylinder is pressed upwards, the core H passes into the hole drilled in the plunger F. When the powder is considered sufficiently pressed, relieve the pressure by the valve O sufficiently to allow the slide J to be turned out on its hinge K, leaving the powder in the cylinder unsupported, when by renewing the pressure the powder is forced out of the cylinder and falls into the open space I' in the casting I. Unscrew the valve O, and the ram head will sink again to the level of press, when the empty cylinder G will be taken away, the slide J again shut, and a loaded cylinder being placed in position against the steady pins K k the operation can be repeated.

Fig. 2 is a longitudinal section of a cartridge, made according to the invention, with a charge of compressed powder: a is the paper case; b the charge of compressed powder; c the cone, by preference of wood, and d the fuse; it passes down through a small hole, bored in the centre of the cone, or it may be on one side, to the charge of compressed powder below. The cartridge is placed in the blast hole bored in the rock, and the hole is filled up with sand over the cartridge. Fig. 3 is a cartridge suitable for blasting a hole, which is horizontal, or nearly so, and which cannot conveniently be filled with sand; in this case a split cylinder is employed in place of a cone. a is the case; b the charge of powder; c c the split cylinder, by preference of wood; d the fuse; e gravel placed between the charge b and the split cylinder c. An expanding wad of felt may be used in place of the gravel e; the wad should in thickness be at least equal to the diameter of the cartridge.

The "Bepulse," 91, screw frigate, which has been in frame at Woolwich Dockyard for some years, will shortly be re-constructed as an armour-plated vessel.

ON THE FRACTURE OF POLISHED GLASS SURFACES.*

BY F. H. WENHAM.

THE short communication which I submit to your notice scarcely merits consideration as a discovery; but as the microscope has in this case immediately detected the cause of a well-known phenomenon, I bring it forward as an example of the use of the instrument in practical investigations. It is a fact known to the philosophical instrument makers that if a metal wire be drawn through a glass tube, a few hours afterwards the tube will burst into fragments. The annealed glass tubes used for the water-gauges of steam-boilers are sometimes destroyed in this way, after the act of forcing a piece of cotton waste through them with a wire for the purpose of cleaning the bore. This will not happen if a piece of soft wood is employed. The late Andrew Ross informed me that on one occasion, late in the evening, he lightly pushed a piece of cotton wool through a number of barometer-tubes with a piece of cane, for the purpose of clearing out any particles of dust. The next morning he found most of the tubes broken up into small fragments, the hard siliceous coating of the cane proving as destructive as he had previously known a wire to be.

After having drawn the point of a steel burnisher over the surface of a slip of polished glass, the following appearances will be observed under the microscope, using the polarising apparatus and selenite plate, with a two-thirds object-glass. A coloured stripe is visible in the passage of the burnisher, showing that the surface of the glass has been placed in a state of tension in the direction of the line. The glass, too, seems not altogether devoid of plasticity, for the waves of colour show that it has been carried forward in ripples, resembling the mark left on a leather-bound book after the passage of a blunt point. It may be inferred from this that the mere burnishing of the surface of the glass with a substance inferior in hardness will, without any scratching, cause an irregular strain in the bore of tubes sufficient to split them, and the concussion attendant upon the fracture often reduces the tube to small fragments. If the burnished lines upon the glass slip be examined a few days afterwards, the colours will have become much less visible, showing that the strained portion of the glass partly recovers its equilibrium.

On attempting to polish out a minute scratch on the surface of a piece of glass, it sometimes appears to widen during the process, and at length resolves itself into two irregular parallel rows. Also, a clean cut made with a diamond on a piece of plate-glass, if left for a time, the surface in the vicinity of the cut will break up, forming a coarse irregular line. If the diamond be raised and struck lightly on the surface of the glass, the form of the edges of the short stroke thus made may be plainly seen, using the binocular polariscope. A conical ridge of glass appears to be left with its apex under the line of the cut, and the glass is frequently wedged up on both sides of the ridge, explaining the cause of the double line of fracture which sometimes makes its appearance in polishing out a scratch. This effect may also be exemplified by observing the marks left on a polished glass surface from the light blows of a steel centre-punch. The point of the punch drives in an atom of the glass, and the fracture extends some distance into the interior, expanding downwards in the form of a truncated cone. The polariscope shows that the conical centre is in a state of compression, and that the surrounding exterior portion of the glass is also under strain. The smooth, round edge of a glazier's diamond, when drawn over a polished glass surface, burnishes down and compresses the glass beneath the cut, and in the case of thin sheets the wedge-like force of the compressed line splits the glass nearly through; but when the glass is thick and rigid, as plate-glass, unless the sheet is bent back and broken through immediately after the cut, greater difficulty will be experienced if allowed to remain for a time, for the compressed line of glass will speedily tear up the portion on both sides, leaving a wide ragged groove in place of the original clean and scarcely visible line.

ON THE INCOMPRESSIBILITY OF WATER.

THE following remarks upon the above subject are made by a correspondent in the *Chemical*

* Read before the Microscopical Society.

News:—Some short time back Baron Segnier demonstrated the incompressibility of water by taking a glass cylinder and plunging it into water, and letting a leaden ball drop within it. I have found that a sphere does not succeed so well as an elongated spheroid, or a cylinder of brass or any other metal, with one end filed to a point, and the cylinder allowed to fall with the point first. This experiment, of course, is only a modification of Professor Faraday's, performed at the Royal Institution some few years back. In the memoirs of the Royal Academy of Sciences of Paris, tome 10th, anno 1693, page 397, will be found a theory advanced by M. de la Hire, accounting for the resistance of air and water to sudden motion, which, I think, satisfactorily accounts for the above experiments. He observes "that the resistance to motion is by so much the greater as the motion is the more sudden; and when it is so to such a degree that what resists has not the time to recede, then a body, very weak of itself, may supply the place of one that is immovable, and of an invincible obstacle. It is for this reason that air and water, struck with such velocity, and with so sudden a blow that they have not time to recede, become fixed points,—the one for the flight of birds, the other for the action of cars." This theory is at once both conclusive and reasonable, and the experiments of Faraday and Segnier only serve to prove the verity of De la Hire's theory; and, therefore, the modern theory accounting for their experiments is superfluous, and, of course, unnecessary; for when the surface of water is suddenly struck, the point of contact is, for the time being, an immovable fixed point; and when the water is enclosed in a glass cylinder, the body with which the water is struck is retained for a conceivable space of time on the surface of the water; the water then gradually rises between the sides of the striking body, which allows the body to sink; but if the body strikes with much greater force than will allow the water to have time to rise, the water seeks another direction, and consequently splits the glass. Should the body be an elongated sphere, or a cylinder with the lower end pointed, then the force required to split the glass tube is not so great, for the tapering end, acting as a wedge, passes or penetrates the water much quicker than a sphere would. Of course, the length of the wedge bears a relation to the force exerted.

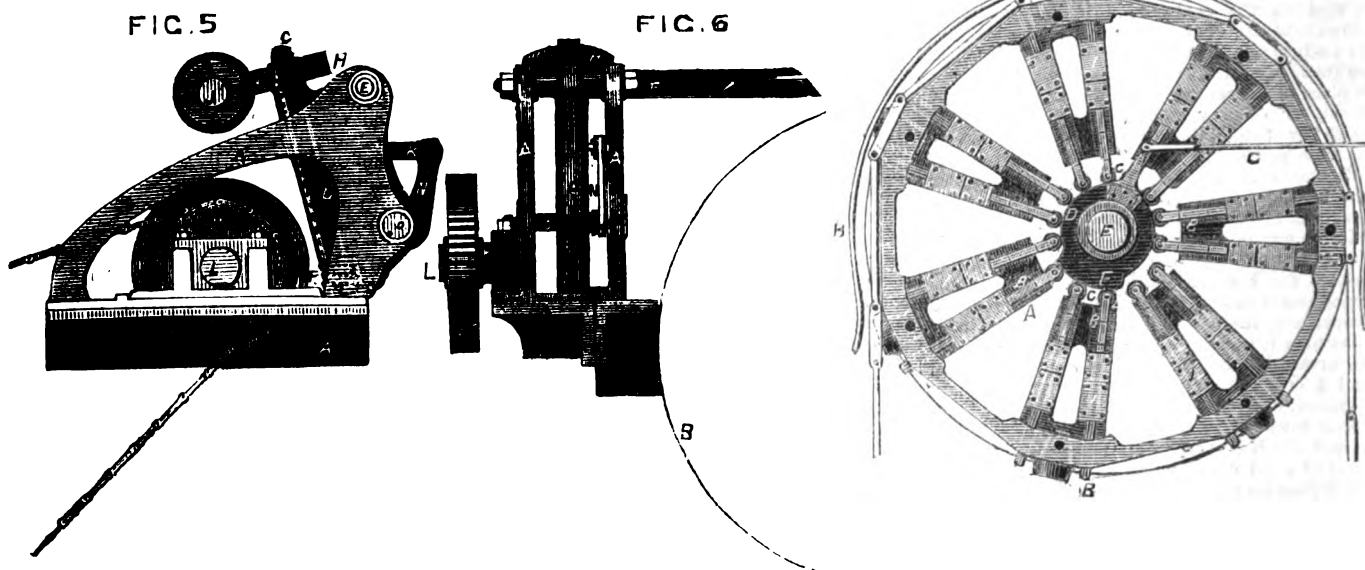
PRESSURE PISTON PACKING.

A NEW pressure piston packing has been invented by Mr. Andrew Stevens, master mechanic on the Alameda and San Leandro Railroad. Steam is admitted into the body of the piston through small valves, and by its pressure and expansive force keeps the rings steamtight against the cylinder without creating any undue friction. The valve on the steam side remains open until the pressure in the cylinder, either by expansion or exhaust, falls below that in the piston, when it closes, and the steam by its expansive force retains the rings against the cylinder to the end of the stroke, when the action is again repeated. Among the advantages claimed are—1. Absence of friction of the rings on cylinder proved by the tool marks remaining on the cylinder after six months' constant running. 2. The retention of the steam inside the piston by means of the two valves, thereby preventing waste. 3. The steam being of the same pressure inside of the piston as it is outside, the piston may overrun the counterbore without damage, and thereby prevent a ridge being formed in the ends. 4. The body of the piston fitting the inside rings keeps the piston always in the centre of the cylinder. 5. The increased ring surface, which wears much longer than narrow ones. It is not only the saving in steam and fuel which lends importance to this invention. The economy in the cost of machinery for a given amount of power must be equally great, as also the benefit to be derived from the concentration of power into small space and weight.

AGRICULTURAL MACHINERY.

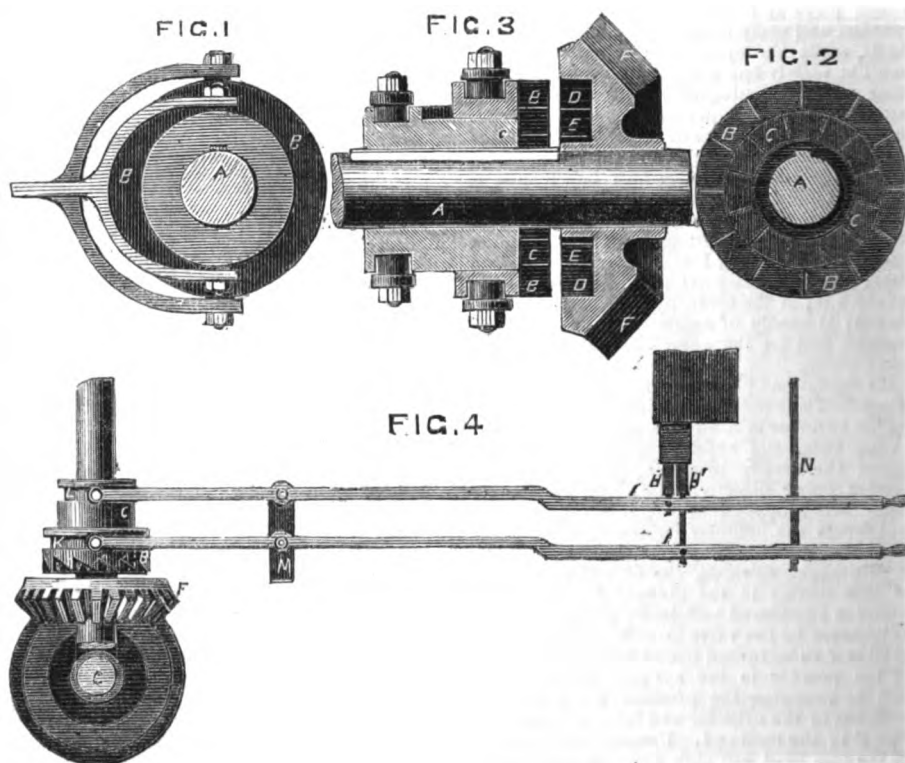
MR. COLLINSON HALL, of Navestock, in the county of Essex, agriculturist, has recently patented some improvements in engines, machinery, and implements employed in ploughing and tilling land. The first part of these improvements relates to engines for working ploughs and other implements, and consists in fitting on the crank shaft of each engine, when two engines are employed, a double clutch or two clutches, one working

AGRICULTURAL MACHINERY.



within the other, the teeth of the clutches being cut in opposite directions. These clutches act as follows:—When one of the ploughs or other implements (where two are employed) has arrived at one end of the field in work and the other at the other end of the field out of work, one engine is put in gear to draw the opposite plough into the ground, and the movement of the rope or chain is communicated to one or other of the clutches on the other engine, whereby a spring or other appliance connected to a lever gives notice to the attendant of the second engine that the first engine has commenced to work, so that he may put his engine in gear in order to assist the first engine in working the ploughs.

Figs. 1 and 2 of the accompanying engraving are elevations, fig. 3 a longitudinal section, and fig. 4 a plan, showing the clutches on the crank shaft of an engine. A is the crank shaft, B is one clutch and C the other clutch, working within the clutch B and having its teeth cut in the opposite direction; D is the counter clutch of the clutch B, and E the counter clutch of the clutch C. The counter clutches are by preference formed in a piece with the bevel pinion F, which drives the drum shaft G. H H' are two springs respectively connected to two levers I and J. The levers I and J are forked at one end to embrace the clutches B and C respectively, and carry pins which ride in grooves K L in the clutches; the levers I J are centred on a bracket M on the engine or other convenient part, and their outer ends are fitted with handles, as shown, within reach of the attendant. The levers are adjustable in a notched plate N, and are retained in the notches, in which they may be placed by the springs H H'. When one of the ploughs has arrived at one end of the field in work the attendant on the engine at the same end of the field shifts the clutches B C by means of the levers I and J, so as to throw that clutch which was in gear out of gear and *vice versa*; the plough at this end of the field then begins to return out of work, while the plough at the opposite end is drawn into work and the movement of the rope or chain is communicated to one of the clutches B C on the other engine, whereby the spring H or H' keeps the corresponding clutch B or C against the face of its counter clutch D or E, but as it runs in the wrong direction, an alarm is sounded, so that the attendant on that engine may have notice to put his engine into gear to assist the opposite engine in working the ploughs. Should the engine not have sufficient power the fixed clutch will ride upon the loose clutch and sound an alarm, thereby giving the attendant notice to put on more steam to assist in working the ploughs. The double clutch arrangement may be made to regulate the speed and power of the engines, and is also applicable when using only one implement whether double or single. The next part of this invention consists in an arrangement for moving the engine forward at each travel and action of the plough. On a shaft depending from the upper part of a projecting bracket on the engine or boiler is fitted a worm



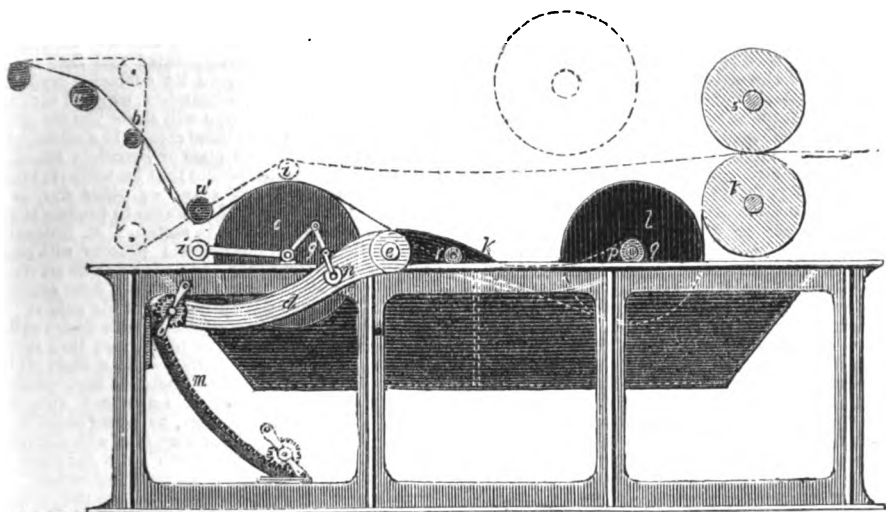
in gear with a worm wheel in the bracket; the worm is moved in and out of gear when required by a lever within reach of the attendant. The worm wheel is carried on the shaft of the small chain wheel, and when in gear with the worm the engine is moved forward. This arrangement is represented in side elevation in fig. 5, and in end elevation in fig. 6. A is a projecting bracket on the boiler B; C is a shaft in a frame D depending from the upper part of the bracket A at the point E; F is a worm on the shaft C capable of being put into gear with a worm wheel G held in the bracket A. The shaft C also carries a worm wheel H in gear with a worm I on the main shaft J, so that the shaft C is always revolving while the engine is at work. When it is required to move the engine forward the attendant, by pulling a lever K, puts the worm F into gear with the worm wheel G, and as the wheel G is carried on the spindle L of the small chain wheel M, this wheel is caused to rotate and the engine is thereby moved forward. The lever K has connected to it a short lever N on a spindle O in the bracket A; the frame D is slotted as shown in dotted lines to receive an eccentric on the spindle, by which means the lever K is caused to act on the worm F.

The third part of this invention relates to the drums over which the ropes for drawing the im-

plements pass; these drums and ropes are described in the specification of Mr. Hall's patent of March 11, 1862. The object of this part of the invention is to prevent the links of the chain becoming clogged or fouled on the tongues of the drums by earth, stones, or otherwise. Grooves are formed in the arms or spokes A (see fig. 7) of the drums, in which grooves, "dogs," or sliding plates B are moved out to push or release the links of the chain from the tongues. The inner ends of these dogs or plates carry rollers C, which ride against a cam D on the shaft E, which carries the drum, so that at each rotation of the drum the projection F of the cam bears against the rollers C and pushes out the dogs B. The dogs are forced inwards by the chain as it reaches the drum. The cam can be moved to the right or left by a lever G to enable the chain to be given off at any desired angle. The dogs are held in grooves and are prevented coming entirely out by a plate I. A metal plate or fender H is also fitted on the engine or otherwise to assist the passage of the rope or chain to or from the drum.

A line of railway is projected between Downham, Stoke Ferry, and Brandon. Mr. Harkness, the engineer consulted, estimates the cost of the line, which would be 16½ miles in length, at £8,000 per mile.

PAPER-SIZING MACHINE.



PAPER-SIZING MACHINE.

A GREAT improvement has been effected in the method of sizing paper by means of an apparatus which is the patented invention of Mr. William Weatherley, of Chatham, Kent, paper manufacturer. This invention consists in performing the operation of sizing paper partly by applying the size on one side of the paper previous to immersion in the usual sizing trough, and partly by relieving the paper when soaked with size of all strain or pull, and for these purposes a roller is used which is supplied with size, over or under which roller the paper passes before entering the usual sizing trough. The accompanying engraving shows a side view of a machine for sizing paper, constructed according to this invention. *a a'* are two rollers connected to a bar *b*, which is supported by standards on the frame. *c* is a roller, which is termed the first sizing roller; it revolves in bearings on the frame and is driven by band gearing. *d d* are arms centred at *e* to a cross bar. Each of these arms has connected to it two small rods *g g* attached to bell crank levers *h h*, the outer ends of which levers carry a roller *i* for the purpose hereafter stated. The bar *f* has other arms *k k* keyed to it, between which a second sizing roller *l* is free to revolve. On the outer ends of the arms *d d* are pinions furnished with handles to allow of their being turned. The spindles on which the pinions are mounted is weighted to counterbalance the weight of the roller *l*. The pinions gear into racks *m* fixed to the side frames. A bolt *n* passes through the arm *d* into the side frame for the purpose of securing the roller *l* in any desired position. The shaft *p* of the roller *l* rests upon supports *q* when it is in the trough. The arms *k k* also carry a roller *r*, under which the paper is made to pass as hereafter described. The band which drives the roller *l* passes round small weighted wheels; the weights are free to slide up and down a vertical bar to allow of the slack being taken up when the roller is lifted out of the size trough.

The action is as follows:—Paper when first brought from the drying cylinders is passed over the roller *a* under the central rod *b* and roller *a'*, over the roller *i*, through and between the roller *r* and transverse bar *f*, into and between the press rolls *s t*, to the reels, as represented by the dotted lines; the pinions are then raised with the arms *d d*; the action of the short rods *g g* and bell crank levers *h h* brings down the roller *i* clear of the paper, and the roller *l* is immersed in the size carrying the paper with it; the tension thus put upon the paper causes the rollers *a a'* to turn upon their central bar *b*, whereby the paper is brought down upon the roller *c* and becomes sized upon its under surface owing to the roller *c* revolving partly in the size trough; this sizing of one side of the paper moistens it, drives out the air, and renders it more fit to be submitted to the ordinary sizing by being passed under the roller *l* as represented by the full lines. The roller *c* is driven at a greater speed than the roller *l*, to relieve the soaked portion of the paper from strain or pull and to ensure a sufficient supply of size to the under surface of the paper

before entering the trough. The roller *a'* is weighted according to the thickness and quality of the paper to be sized.

CASKET PORTRAITS.

In the report of the Dublin International Exhibition jury on Section 30 (Photographs), the following description of Mr. Swan's casket portraits occurs:—One of the most curious novelties in the photographic exhibition is the production of what is called "casket portraits," specimens of which are contributed by Mr. Swan, the inventor. For such a really ingenious, original, and scientific contrivance, it seems that the author might have found a more appropriate name, designating more properly the principles upon which it is based, and the manner of its construction. It is, in fact, neither more nor less than a real stereoscope, in a different form from that well-known instrument. Without being conscious of it the observer has before his eyes, as in the ordinary stereoscope, a picture composed of two different photographs superposed, each one separately visible to one eye and invisible to the other. These two pictures, placed at right angles on the two sides of two rectangular prisms, with their hypotenuses in contact forming a quadrangular block of glass, are covered to the eye, one from the back surface by refraction, and the other from its hypotenuse by reflexion, after having been refracted upon it by the other prism. By the optical law of the angle of incidence and reflection, the reflected image is seen only by one eye, the axis of which coincides with the reflected ray, and is invisible to the other eye; and by the law of refraction the other image is seen only by the eye the axis of which coincides with the refracted ray, and is invisible to the other. So that when the observer is placed exactly in the position from which each eye has the exclusive perception of the image, whose perspective belongs thereto, the two images coalesce on the two retinæ, and the stereoscopic perception is brought out in all its beauty and force. The only defect of the apparatus is, that the observer is obliged to find the exact position from which the phenomenon takes place exclusively, and if he loses that position, by the slightest movement of the head, he sees only one or the other image, and there is no illusion of relief, the picture having the flatness of the single photograph which represents it. Notwithstanding that imperfection, Mr. Swan has succeeded in contriving a most ingenious instrument, which elegantly illustrates a very extraordinary phenomenon of optics.

A BREAKWATER IN MOUNTS BAY.

We understand that a company is in course of formation at Penzance with the purpose of carrying out works at Newlyn, on the north-west side of Mounts Bay, for the construction of a deep water harbour. The works will consist in running out a breakwater to the extent of 1,750 ft. from Cairn Gwavas Point, so as to protect the harbour from the south-eastern gales; it will be naturally protected from all other winds. A long sea wall will also be built from the point as

far as Newlyn Green, on which it is proposed to build wharves. The greatest depth of water at low water spring tide will be about 40 ft., so that it will accommodate the largest of vessels, and as it is confidently expected that both the narrow and broad gauges will be brought down to the wharves, and as Penzance is the last and first port on the Western Coast of England, and by the natural construction of Mounts Bay vessels can come in and leave by any wind, when they cannot reach an eastern port, therefore the promoters anticipate that a large trade will be developed by its construction; and at the same time it will offer an excellent place of refuge for wind-bound vessels, which is so much wanted on that part of the coast. The breakwater will be built on the caisson principle, but after a much improved method, which will expedite the work, and give it greater strength. The wharves will be built so that vessels can discharge afloat. Messrs. Trescowthick and Floyd are the engineers, and their estimated cost is about £120,000.—*Building News*.

GUN TRIALS.

Two Palliser rifled guns have just been proved at the Woolwich butt with two rounds of 27½ lb. of powder, and shot of 115 lb. weight each. One of these guns has fired 800 rounds, and the inner tube has been replaced. The other gun formerly had a steel tube inside the coil tube. The steel tube was a supposed improvement on Major Palliser's plan. It did not fully answer the anticipations, as it split the first time the gun was fired. The gun, however, did not burst, as has been erroneously stated in some of the morning papers. The tube has been replaced with a coiled tube similar to those of Major Palliser's other guns. The guns are old 68-pounders, condemned as unfit for service. They will be sent at once to Shoeburyness, where they will be fired with 22 lb. charges and shots of 115 lb. weight each. The proof was highly satisfactory, the Ordnance Select Committee having reported that no rifled gun of any kind has as yet fired so many rounds with the same amount of charge with equal success. After the proof of Major Palliser's guns, a couple of Captain Blakeley's seven-ton hammered cast steel guns were brought forward in front of the butt, and having been loaded with 30 lb. of powder, and shot weighing 200 lb. each, were fired two proof rounds, most successfully. The guns are manufactured to the order of the Swedish Government to form a portion of the armament of one of their naval corvettes. A large number of guns of similar diameter—namely, 8½ in., have been recently manufactured by the same company and despatched to the Governments of Spain, Portugal, and Japan. We understand that Captain Blakeley is now engaged in turning out two mammoth guns—the one of 13 in. bore, and the other of 15 in. They will carry charges respectively of 90 lb. and 100 lb. of powder, and 900 lb. and 1,300 lb. shot.

ON THE DISCOVERIES IN CHEMISTRY APPLIED TO ARTS AND MANUFACTURES.

By DR. F. CRACE CALVERT, F.R.S.

(Concluded from page 249.)

Now, let us return to the subject under consideration, viz., that a spectrum is produced by the decomposition of light when it is refracted at an angle of 60 deg.; and that the result of that decomposition is the production of three primary and four binary or complementary colours. Further, that the red portion of the spectrum represents calorific rays of light; that the green and yellow represent light-giving rays, and violet and the rays beyond it the chemical or actinic rays of the same. Philosophers have for a long period been able to measure accurately the intensity of the heat-giving rays, by means of a thermometer or the thermoelectric pile; and though we had a general knowledge of the intensity of the chemical rays of light, still we had no method of accurately measuring its real intensity, and conveying our results and observations to others, till Professors Bunsen and Roscoe filled up this important gap. These gentlemen's researches will be of great service to science and to society, as they will throw much light on many meteorological data, and enable a chemist to study with more precision than has been previously done the chemical phenomena of vegetation and other phenomena connected with the chemistry of agriculture. For example, the thermometric observations giving the mean monthly or yearly temperature of a country by no means yield all the data required for the estimation of the true climate.

tology of the place, or of its plant or animal producing capabilities. For these purposes we require to have not only the amount of solar heat directly or indirectly reaching the spot, but likewise the amount of chemical active solar light which may be present there. This is strikingly exemplified by the following example given by Dr. Roscoe on a comparison of the mean annual temperature between Thorshawn, north latitude, 62 deg. 2 min.; west longitude, 6 deg. 46 sec.; temperature, 45.6 deg.; and Carlisle, north latitude, 54 deg. 55 min.; west longitude, 2 deg. 58 sec.; temperature, 46.9 deg.; difference, 1.3 deg. From these figures it will be seen that the mean annual temperature is nearly equal, but the quantity of sunlight falling upon those two places differs most widely, and we have a corresponding difference in true climatological results. Thus the flora of the Faroe Islands and the Shetland Islands is of a most limited description. Only hardy varieties of shrubs, and no trees or flowers, exist there, while at Carlisle we have a luxuriant vegetation accompanying a most sunny sky. How essential, then, are the rays of light to vegetation. These gentlemen have also ascertained that those rays are in ratio with the intensity of that light; and still further they are also in ratio with the chemical or actinic rays of the sun; and thus the researches of these savants will enable them to measure with accuracy those chemical actions. It is impossible, in a lecture like this, to render justice to their researches, therefore I must refer those who wish to consult them to the Philosophical Transactions of the Royal Society. Still I may state that these gentlemen's photochemical instruments are based on the following data, namely, that equal intensity of light produces in the same given space of time equal shades of tint on surfaces prepared with chloride of silver of uniform sensitiveness. Thus it is shown by experiments that a tint attained by paper so prepared is constant when the quantity of light falling upon it also remains constant. Light of an intensity of 50 deg. falling upon a paper for the time of one minute produces the same blackening effect as light of the intensity of 1 deg. falling upon it for the time of fifty minutes. Knowing these laws which regulate the degree of shade of the paper, and having a surface of a perfectly constant degree of sensitiveness, it is easy to obtain the absolute measurement of the chemical action of light.

The next discovery to which I desire to draw your attention is still in its infancy; but I am induced to refer to it from two considerations. The first, that it may render great service to society by enabling us to preserve the lives of many thousands of our fellow-creatures in our coal-mines and other underground works, and also because it is a beautiful illustration of the amount of knowledge that a man requires at the present day either to understand or appreciate fully the discoveries of others, or to enable him to attempt any original invention of his own. Unless a person possesses the rudiments of the leading sciences of the day he will never be anything but an imitator, and will never succeed in improving the inventions already made. It is certainly most interesting to witness how the most abstruse branches of science are brought to bear on arts and manufactures, and no better example can be given than the application of electricity under various forms to what is commonly called the telegraph. The invention which I am now about to bring to your notice is due to M. Dumas, a young French engineer, and to M. Breguet, of Paris, who is also practically connected with telegraphy. To enable these gentlemen to carry out their discovery they have had to study, and be perfectly acquainted with the researches of many of the most eminent men that science has produced during the last half century. Thus they employ the galvanic battery which was discovered by Galvani, and perfected by many philosophers, until brought at last to its present perfection. They use a mixture of bichromate of potash and sulphuric acid in a Bunsen battery. They have also had recourse to magnetic-electricity, first discovered by Faraday, and brought to its present perfection by the researches of M.M. Nobili, Mason, Becquerel, Joule, and others; and to enable them to construct their apparatus they have applied, with great ingenuity, the inductive coil, the result of many discoveries, and brought to great perfection by Ruhmkorff, the vibrating interrupter of Dancer, and also the condenser of Fiquier. Further, they must have had the knowledge of the stratified light and the application of it by Gassiot; the fluorescence of light by Stokes and Becquerel, and their applications to glass by Geissler. All these facts prove the correctness of my statement, how vast is the amount of knowledge required to make a little discovery. The apparatus invented by these gentlemen is portable, for a miner carries on his back the above-mentioned galvanic battery, and this generates the force required, which is multiplied, increased, and brought to light by the Ruhmkorff coil, which is also confined in the same leather case, occupying only six inches; the magneto-electricity passes through wires covered by vulcanised india-rubber, and these are in connection with a thick glass tube, in which a vacuum has been made, and this contains a fluorescent tube of

Geissler, which becomes luminous or fluorescent by the passage of the electricity through it, generated by the coil and the battery.

Although both light and electricity are most interesting subjects, and could well be made the subject of many lectures, still I am bound to leave them on one side, and draw your attention to other facts deserving of notice. It is well known to all chemists and philosophers that matter has a great tendency to assume a geometrical or crystalline form, and that whenever the atoms of matter are sufficiently free for molecular attraction to have its full influences attraction between the atoms takes place, and gives birth to well-defined crystals. The following examples can be cited:—The slow condensation of the vapour of iodine, which gives rise to well-defined crystals, as well as those of camphor and other volatile bodies. When sulphur, bismuth, and other substances are melted, and allowed to cool slowly, and the excess of the fluid remaining among the crystals is poured off, well-defined crystals are found to exist in the mass, which apparently would have disappeared had not the excess of fluids been poured off, for in this case the molecules of the remaining fluid mass would have solidified among the crystals, and would have prevented the observer from seeing that the molecules when freed in the fused mass had assumed a crystalline form. The tendency of molecules to assume a geometrical form presents in many instances curious phenomena. Thus, for example, a vessel may contain acetic and carbolic acids—and if, say at a temperature of 40 deg. or 50 deg., a crystal of either of those substances is placed in contact with its own fluid, the entire bulk of fluid passes in a few seconds into a solid crystalline mass. The manifestation of that force is also beautifully illustrated in the following instance:—If a tin plate be heated to a moderate temperature, and a drop of water be allowed to fall on its surface, and the plate be dipped for a few minutes into weak muriatic acid, it will be observed that the whole surface of the plate is affected, and that where the water fell it has assumed a most beautifully waved and iridescent surface. If this surface be examined under the microscope it will be found that under the influence of the vibrations generated by the cold fluid falling upon the heated plate, the mass of molecules have passed from their amorphous condition to that of a crystallised one. We all know this alteration in the tin-plate surface was particularly applied many years ago to produce variegated surfaces on our tea-trays and other similar domestic vessels. It should also be stated that this effect was greatly enhanced by the skilful application of coloured varnishes, which increased the value of the mercantile article. This discovery, which is due to an eminent chemist of the name of Froust, clearly proves, as those before cited, the power which matter has to assume a crystalline form. I cannot, however, refrain from adding the following instances, in which the mere vibration of particles of matter is sufficient to change amorphous bodies into crystalline ones. The first is that which often takes place in the iron used on railways. The most striking example is that of the iron links used to unite waggons where it is found that the fibrous, tenacious link made of malleable iron is transformed into a crystallised, brittle link by the constant vibration it is subjected to by railway traffic. Another example is that shown by the peculiar action exercised by intense cold on the molecular state of iron, as shown by the brittleness of the metal in Russia and other cold climates; this was the case in December, 1859, in England, when, as will be remembered with regret, many railway accidents occurred, owing to the rails becoming crystallised and brittle.

The power which molecules have to assume a crystalline form has recently been the study of Mr. F. Kuhlmann, an eminent chemist of Liele, and he has given to that force the name "crystallogenic." I shall endeavour to lay before you a short epitome of his researches, which are not only interesting in a scientific point of view, but also in consequence of the mode in which he has applied it in connection with arts and manufactures; and those who take an especial interest in the matter will read with pleasure his researches in the *Comptes Rendus de l'Académie des Sciences de Paris*. M. Kuhlmann, having mixed a certain class of substances which crystallised with facility, as mannite, sulphate of zinc, iron, copper, with a thick solution of gum, or any other substances interfering with the free crystallisation of these substances and having spread the mixtures on glass, he found, by exposing such prepared plates to the atmosphere, that gradually the water would evaporate, leaving a dry mass, in which could be observed most beautiful arborisations. Each of the solutions will produce a well-defined design which is not always identical, although operating under the same circumstances. Still they assume very similar forms, being in some instances that of stars, and in others that of leaves and wreaths. These modifications are obtained by the strength of the solution, the nature of the salt, and the mode of preparation. Kuhlmann further observed that, if amorphous substances, such as magnesia and sesquioxide of iron, or chromium, be mixed with bodies

susceptible of crystallisation, and these added to a gummy fluid, the amorphous particles are drawn into the crystallising substances and follow the outlines; and if these are produced on surfaces, such as those of glass or porcelain, and heat applied, the gummy matter will be destroyed or volatilised, and the crystalline medium and the amorphous substances become incorporated and fixed in the porcelain, reproducing on its surface a crystallogenic design. These researches which I have the pleasure to lay before you will show you the probability of carrying out these results to a satisfactory issue. Of course, the glass or porcelain manufacturer will easily understand that he will have to use borax or phosphate of soda, or other flux, as a crystallising medium, if he wants to produce in his art the results that I have stated. M. Kuhlmann has applied his crystallogenic process with great success to photography, and also to the art of engraving metals. As the latter may have some interest, I will give you an outline of his process. It consists in producing a crystallogenic design on the surface of an iron or copper plate, and then applying on the so-prepared surface—say a sheet of lead or copper—and submitting them to high pressure when the design would be impressed upon the plate. The embossed plates, by being placed in a prepared solution, and in connection with a galvanic current, will easily give birth to a *fac simile* in relief, which can be used as a printing surface. It is with pleasure that I am able to state that, though I part with these interesting researches for the present, I shall have the satisfaction of referring to them again in a subsequent part of this course of lectures, when I shall speak of some researches of this gentleman which have a more immediate bearing on the progress of science.

It has been for a long time a disputed question whether the stained windows we all admire in old cathedrals could be restored in such a way as to resume the brilliancy they had at the time they were placed there by the artists. At all events there is now no doubt that this can be effected by the process discovered by my eminent master, M. E. Chevreul, as is proved by the application of it in connection with the restoration of stained windows existing in a well-known church in Paris—that from which the tinct of St. Bartholomew was soured, "St. Germain des Près." The process devised by M. Chevreul is highly practical; it consists in removing the stained glass from the windows, and dipping it for several days, first, in a weak solution of carbonate of soda of a specific gravity of 1.068, then washing it, and dipping it for several hours in a solution of muriatic acid of a specific gravity of 1.080. On the glass being washed and dried, it will be found as brilliant and beautiful as when it came from the hand of the manufacturer. M. Chevreul has found that the dim and dirty appearance which stained glass assumes by time is due, especially in large towns, to the various products of smoke being first condensed on the glass by fog and rain, and then, becoming oxidised, they act as a cement to various mineral matters, such as chalk, gypsum, oxide of iron, &c., which help to impoverish the transparency of the glass. The alkali acts upon the organic matter and dissolves it, while the muriatic acid removes the minerals. The durability of glass placed in our monuments is extraordinary, when we bear in mind the curious results published some years since by the eminent chemist, Pelouse, who observed that when window, bottle, and other varieties of glass were reduced to a fine powder, and mixed with water, they were soon acted on, yielding a large quantity of silicate of soda to that fluid, amounting in several cases to eight or ten per cent. in cold water, and even to thirty-six per cent. when the finely pulverised glass was boiled in water; and that, in many cases, it was a definite compound which was dissolved from the glass, namely, a silicate of soda, composed of three equivalents of silica and two equivalents of soda. M. Pelouse explains the extraordinary difference in the effect which water produces on glass when in large masses or plates, as compared with its influence on the same substance when reduced into a fine state of powder, by assuming that, in the first instance, water does not act because it seldom remains sufficiently long in contact with the glass to act upon the elements which compose it; while, in the second case, there exist numerous points of contact between the fluid and the solid body, thus facilitating the action of the fluid on the solid material. I am inclined to think that the peculiar molecular condition the surface of glass assumes, when manufactured in plates or otherwise, must exercise a great influence on the property which glass has to resist the action of water. If it were not so, how could be explained the limited action which watery fluids such as wine, cause upon the interior surface of a bottle though they remain in contact for many years? I can conceive glass assuming a peculiar surface by the pressure of the atmosphere, thereby producing a homogeneous one susceptible of resisting the action of water. A similar instance occurs in the case of polished steel, or of the rolled surface of wrought iron, or the skin of cast iron, which resist the chemical action of either air or acids in a far greater degree than does the interior of

the substances which compose those metallic bodies.

Whilst dwelling upon old materials, you will allow me to give you an outline of a process devised by M. Stahl for the preservation of antediluvian fossils. We are aware how interesting it is to preserve relics of past ages, giving us some of the conditions of the world at various periods. Those relics are exceedingly fragile, and after many clumsy attempts M. Stahl arrived at his discovery. If the fossil is compact and comparatively firm, it is saturated by means of a brush with melted spermaceti, but if it is friable, it is necessary to employ a melted mass composed of four parts of spermaceti and one of colophony resin, which in cooling gives great solidity to the mass of the fossil.

I would, in conclusion, draw the special attention to all artists who take an interest in decorative art to the interesting papers published recently by M. Oufroy on the one hand, and M. Wiel, of Paris, on the other; the first being in the "Technologiste" of last year, the latter in the "Annales de Chimie et de Physique," on their respective methods for covering a metal with another more valuable by its properties or precious by its qualities. These methods have a special reference to cast iron or wrought iron. In Paris these processes, which may be regarded as not only ornamental but useful, have been applied with great success. Thus, for example, instead of the dirty, pitchy black lamp-posts which ornament our English towns, there can be seen in Paris elegant, well-designed, bronze-like posts, which are pleasing to the eye. The same can be said of the fountains on the Boulevard Sebastopol, the Place de la Concorde, and many other public promenades in Paris, which excite the admiration of foreigners visiting that city.

Correspondence.

THE PROBLEM OF THE TORPEDO.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—The torpedo is gaining the attention to which it is entitled. It is an important matter, as it will most assuredly impose upon all maritime States the construction of navies, adapted to a change in naval warfare that is inevitable. The torpedo is not, however, a novelty. So far back as the time of Queen Anne, a vessel of about 300 tons was blown up in the river Thames. A history might be afforded of torpedoes; but we can dispense with history; we require to know what can now be accomplished by torpedoes in the present state of naval architecture, steam navigation, and of the various contrivances and means of applying explosive agents under the surface of the water. In January, 1845, an experiment with a torpedo, upon a small scale, was made in the Downs. The object of the experiment was to illustrate the experiment made by Captain Warner in the summer of the preceding year off Brighton, when he destroyed most completely the "John of Gaunt" by his "invisible shell," or torpedo in a very compact form. The two experiments were differently conducted; but, nevertheless, the smaller, as intended, threw some light upon the larger, and showed the application of torpedoes upon the ocean. The experiment in the Downs was conducted in the following manner:—A large boat was turned adrift, which represented a ship at sea; a Deal galley of four oars, armed with a torpedo, represented a steamer of great speed adapted to the service of such an arm. The torpedo was launched overboard from the galley, which towed it to the object of attack. The course of the galley was such as to pass ahead of the large boat, the object of attack, and, by a proper adjustment and management of the tow-line, the torpedo was brought under the bottom of the boat, the galley going at the top of her speed; and when the torpedo was so brought under the bottom of the boat, it exploded. The explosion was such as to bilge the boat extensively, and to throw up fragments of the boat with a column of water to the height of about 30ft., though the torpedo was charged with a few ounces only of explosive composition. The torpedo was exploded by pressure; it could explode only when in contact with the object of attack; the contrivance and arrangements for such mode of explosion are exceedingly simple, and equally safe in application. This short sketch may throw some light upon a subject of great national interest, but not yet understood by the multitude.

A NAVAL OFFICER.

October 21.

THE FRENCH GUN OF THE FUTURE.

SIR,—The service that the MECHANICS' MAGAZINE has rendered in ventilating scientific questions connected with the War Department, and thereby bringing to light and securing to the country many valuable inventions which would otherwise have been put on one side, is well known, and I am, therefore, gratified to find my humble exertions to advance the science of gunmaking, and my claims for consideration by the Government, so fairly appre-

ciated and upheld in the article in your journal of the 13th; and I am not sorry to find that your remarks have called forth a reply from Major Palliser, as by fair discussion, for which I feel assured you will open your columns, the truth will be discovered at last. Before, however, applying myself to answer Major Palliser's letter, allow me to refer to the observation of yours, to the effect that you can detect a difference between my proposal of 1860 and Major Palliser's of 1862, in the taper of the bore and the hollow screw or nut used by him. No doubt your observations are based on a perusal of my provisional specification of 1860, in which, as you are aware, it is only necessary to give in general terms a description of the invention, and in which consequently I did not specify any particular method of inserting the tube; but in the specification of the invention I sent in to the War Office in 1860, which contained more details, I distinctly propose that the gun should be bored slightly taper and the tube turned to correspond, in order to insure when simply forced into its place the proper amount of initial strain being placed upon it, so that even in this detail, as well as in the general principle, I forestalled Major Palliser. As to the hollow nut or washer he uses, whether this being placed at the muzzle instead of at the breech would evade my second patent of 1862 has yet to be decided; it at least fulfils, though in an imperfect way, the office of the screw I employ at the breech in confining the tube longitudinally.

Major Palliser asserts that I never proposed lining a cast-iron gun with a tube of coiled wrought iron; but this is an error on his part. So far back as the year 1855, I commenced a patent (March 6, No. 496) in which I specify constructing ordnance of coiled wrought-iron or steel tubes, which I abandoned from want of time to attend to it, and which Sir W. Armstrong subsequently worked out successfully. Now surely I could not be denied the use of an invention which I had presented to the public. I certainly considered myself free to use it, and when I first proposed to line cast-iron guns, I undoubtedly intended using coiled tubes if it suited me, but did not mention any particular kind of tube in my provisional specification of 1860, as I never contemplated claiming that particular combination as a speciality; this I could not do, nor can Major Palliser, for it has already been done by Mr. J. C. Haddon, in his patent of August 8, 1855 (No. 1,796), since lapsed, in which he describes making the tubes of coiled wrought-iron bars, and casting the gun upon such tube. If, therefore, Major Palliser rests his claim of originality on this combination, I fear it will prove a very slender one. However, although I cannot concede to him the right to prevent my using a coiled tube if I think fit, I certainly give the preference to steel, and am quite prepared to back my gun with a steel reinforced tube fitted into the cast iron, against any gun he can produce with a coiled wrought-iron tube having the gun cast on it. As regards his experiments with the 3-inch gun, in the first place the test was a very moderate one, and in the next, the gun was on too small a scale to prove anything; the tube, which of so small a size can be made very perfectly, would probably have done all the work itself without any assistance from the cast-iron casing, and therefore it would matter little how it was put on. As to the 9-inch 12-ton gun now being made, it will be time enough to talk about that when it has proved successful. I will not give expression to my opinion, lest I should commit myself in the way Major Palliser did, when he twice publicly asserted, previous to the successful trial of my gun, that it "possessed radical defects which would be fatal to its success." If Major Palliser's second gun, his discarded child, did not behave itself so naughtily as I described, I am sure I beg its pardon for a little freedom of speech; at any rate, it split its tube by Major Palliser's own admission, and I also heard it blew off its muzzle at the same time, which you must admit was very bad behaviour. As to his third gun, he does not allude to it; I presume that was his. Well, what did that do? It burst (I hope I am correct now) at the 81st round with the ordinary test a l'outrance, 161lb. of powder and increasing cylinders.

Now, in the MECHANICS' MAGAZINE of March 16th, 1860 (page 171), is an account of an ordinary cast-iron 68-pounder, cast at the Gospel Oak Works, which sustained 75 rounds, so that, comparing these two guns with ordinary cast-iron guns and keeping in view the greatly increased strength required of modern rifled guns, I think anyone of common sense and sound judgment would have decided that the attempt to strengthen them in this way was a complete failure. I presume, then, that the further encouragement given to Major Palliser to continue experimenting rested on the greater success of the first gun. But this was mine in every way. Why, then, at this period was I not called in, especially as I had then proposed a plan of improv-

ing on it? With respect to the last rifled 68-pounder of Major Palliser. This 5-ton gun, according to his own showing, fired 800 rounds, which disabled it, and its failure had commenced at the 750th. The charges were—20 rounds with 12lb., 40 with 20lb., and 740 with 16lb. and 100lb. shot, making altogether

12,880lb. of powder burnt and 80,000lb. of metal thrown. Compare this with my 3-ton gun; 510 rounds with 9lb. charges and 66lb. shot, 500 with 16lb., and 100lb. shot, and 10 rounds with 264lb. and 132lb. shot, the total of which is 13,105lb. of powder burnt and 84,980lb. of metal projected. This not only actually exceeds the Palliser gun, which is heavier by two tons, but there is also this important difference,—the Palliser gun failed, but the Parsons gun was as good as ever, as far as its strength was concerned, after the 1,010 rounds. Whether these facts were known to the Ordnance Select Committee, before they made the statement attributed to them by Major Palliser, that "no rifled gun has ever fired so many rounds with such charges as his 5-ton gun," I cannot say, but there is no excuse for a publication of it since the test of my gun has been made known, as the above facts show it to be altogether incorrect. Before the Palliser gun can be considered equal to mine, it ought to bear uninjured the same number of rounds with charges of the same relative proportion to its weight, that is to say, with charges two-thirds heavier than those sustained by mine, viz., 510 rounds with 15lb. charges, and 110lb. shot; 500 with 27lb. and 166lb. shot; and 10 rounds with 44lb. charges, and 220lb. shot. Why is not such a test as this applied to it now, instead of the paltry charge of 23lb. and 115lb. shot, which Major Palliser states it is now to be subjected to?

Whatever Major Palliser may say as to the object in reducing the calibre from 8in. to 7in., a simple sum in addition and subtraction will show that with his plan it cannot be helped. The outside diameter of the gun at the smallest part of the muzzle is barely more than 15in.; if the tube is 18in. and the calibre 7in., it only leaves 1in. of cast iron round it (a mere shell) and 3in. thickness of tube. Now, the experiments show that the 3in. tube is insufficient; what would be the result if the calibre of 8in. were retained and the tube reduced to 2in.?—Of course, a still worse failure. Therefore it is impossible by introducing the tube from the muzzle to retain the calibre, and get sufficient thickness of tube, and this is the real reason why the calibre is reduced. Now, by my plan, I can retain the 8in. calibre and get 4in. thickness of tube at the breech, making it what I please at the muzzle. As to the guns not admitting of firing with this calibre and suitable charges, that is a lame excuse. There was no difficulty in firing 16lb. charges and 100lb. shot from my 3-ton gun with a 6in. bore, and charges of 25lb. and 150lb. shot might be as easily fired from a 5-ton gun with an 8in. bore; a much more powerful gun would be obtained, which would be capable of firing the existing round shot with a charge of 30lb. if required.

I am, Sir, yours, &c.,

Blackheath, Oct. 25.

P. M. PARSONS.

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.—W. R.—Y. E. J.—J. H.—W. H. K.—V. W. V.—J. B.—W. H. H.—A. O. and Co.—J. H.—W. H. T.—W. W.—R. P. E.—J. H. E.—W. R.—J. H.—T. E. J.

G. H. (Wakefield).—We know of no other address than that given in the article in which Messrs. Smith's centrifugal apparatus is described.

M. M. (Brest).—Your suggestion will receive our attention.

C. G. (Olerkenwell).—Your letter is only suitable for our advertisement columns.

Miscellaneous.

The unexampled success which has attended the proceedings of the Credit Foncier and Mobilier of England (Limited) is evidenced by the highly satisfactory dividend and bonus of 40 per cent. which has just been declared. Besides these results the company had in hand on the 30th ult., £200,000, in the shape of a general reserve fund; £100,000 in a dividend reserve fund, and clear profits of £50,805 4s. 9d. In this prosperous state of matters, and on account of the increasing amount of business, the directors have decided upon allotting the remaining capital of the company, consisting of 100,000 new shares of £20 each, and on which only