

1,033 and 1,024 of the year 1863, and No. 139 of the year 1864) consists in combining with the operation of punching described in the specifications of the above-named patents a preliminary operation of drilling, that is to say, the patentees take a solid ingot, bloom, or block, either of steel, homogeneous or other metal, and proceed by means of tilting, swaging, rolling, or other equivalent means to reduce the said bloom or block (while in a heated condition) into the desired preliminary shape they may require, either for a gun barrel mould or mould for a piece of ordnance, or part of ordnance, and after dividing up or trimming the said bloom or block as described and set forth in the respective specifications of the before-recited letters patent, they have found it in some instances desirable while using some descriptions of steel (and which also applies to the use of other metals) to drill a small hole concentrically through the mass in which they desire the punched hole to be, and the advantage derived from this new and additional operation (which forms the sole feature of the invention) is, that it will afford a positive concentric lead or direction for the subsequent operation of the punch or drift, thus ensuring great mechanical accuracy in concentrically displacing the metal from the centre to the extent of the hole so punched into the surrounding mass, the complete concentric position of such displacement affording additional means for centrally operating on highly condensed metal, the use of which may for many purposes be preferred. *Patent completed.*

1342 C. J. APPELBY. *Improvements in steam cranes.* Dated May 16, 1865.

This invention consists in an improved form and arrangement of gearing for propelling steam and other cranes on railways or ordinary roads. The radiating gear is generally, and by preference, as follows: viz., a worm on a shaft (usually the crank shaft) gives motion to a worm wheel, on the underside of which is a clutch box to take a friction clutch. This worm wheel is carried in bearings on the side frame or other part of the crane, and revolves (by the motion given by the worm above named) at right angles with the frame of the crane. A vertical shaft, with a pinion at the bottom, gears into a wheel which is fixed on the crane post, and immediately above the base plate, or into internal gear on the base plate itself, this pinion is at rest, excepting when the clutch is thrown into gear with the clutch box and worm wheel, and the crane then "radiates" or revolves round the crane post in the usual manner. In order to make the crane travel on its wheels, the patentee has a large wheel with gear on its outer diameter, which is loose (not keyed) upon the crane post, but the pinion gears into it, and is worked in the manner above described. On the under side of the large wheel last named he places bevel gear, and a pinion gears into it which is keyed on to a shaft. This shaft is carried in bearings below the base plate, and has a pinion on the other end which gears into a wheel or wheels on the one or other of the axles which carry the travelling wheels of the crane, or he uses a second motion shaft, as he finds most convenient, which drives the travelling wheels. In order to travel the crane backwards or forwards, in whatever position the jib may be relatively with the travelling carriage, he employs a friction strap on the crane post, or adopts any other convenient mode of fixing the crane jib in the position it is required to be, and he then throws the friction clutch on the vertical shaft in gear; this causes the large wheel to revolve on the crane post, and thus gives motion to the gearing connected with it, and propels the whole machine backwards or forwards as may be desired. As more power is exerted in moving the crane than in radiating or revolving it, when the friction strap, or other mode of fastening the crane in the position required, is released, the crane radiates or revolves in the usual manner. *Patent completed.*

1343 G. ELLIOT and S. B. COXON. *A new or improved spring apparatus to be applied to the bearings of the axles of pulleys or drums used in colleries.* Dated May 16, 1865.

The object of this invention is to diminish the strain upon the pit ropes, which are carried over a pulley or drum at the lift by the employment under each pulley or drum bearing of a spring apparatus consisting of a cylinder containing a piston, to the back of which steam air or gas is admitted. The piston rods are connected to the bearings, each of which is free to move in a frame. The steam or elastic fluid is introduced by means of pipes into a pair of steam cylinders placed at such angle of inclination as shall be most expedient, and of calculated area to overcome the weight of (at least) the empty cage and tubs. The amount of spring can be regulated by the length of cylinder, or by applying rests upon the slides or motion bars, the pipes are attached to the ordinary steam pipes at or near the cylinder of the winding engine, within view of the engine-man; the admission of steam being regulated by an ordinary valve or cock. Any desired amount of pressure may be gained under the pulley cylinders by throttling the pipes conveying the steam to the cylinders. Instead of steam, air, or gas, water may be used the pressure being gained from an ordinary accumulator. *Patent completed.*

1344 R. and H. HARRILD. *Improvements in printing machines.* Dated May 16, 1865.

These improvements relate particularly to those single-cylinder printing machines in which the cylinder, after each impression, is caused to rise, and is again brought down to produce the following impression. The first improvement relates to the plunger-blocks of the cylinder-shaft; these are bored out, and the bearings in which the said shaft revolves, which are made to slide in the plunger-blocks, have their sides turned to correspond with the portion of the plunger-blocks which is bored. Secondly, the cylinder is raised and lowered in the following manner: Across the lower portion of the machine, and directly under and parallel with the cylinder, a shaft is supported in bearings. Each end of this shaft is furnished with a short crank, the pin of which works in a square-shaped block, which is free to slide sideways in a slotted eye formed in the lower extremities of two rods, the upper extremities of which take hold of the bearings in the before-named plunger-blocks; and when the crank-shaft is caused to make a partial turn, at the right intervals these rods draw down or raise up the cylinder. The said rods are guided to maintain them vertical. The cylinder is prevented from descending, when desirable, in the following manner. On the before-named crank shaft is fixed a third and double-ended crank, each end furnished with a pin. A cam on the driving-shaft of the machine is employed to cause the crank-shaft to make a partial turn at the right intervals, for the purpose of raising or lowering the cylinder. The connecting rod of the said cam terminates in a gab, which takes hold of one of the pins in the

said double-ended crank, for the purpose of turning the shaft. A lever, also furnished with a gab, and united to the extremity of the said connecting rod by a link, when caused to turn on a centre which supports it, lifts the connecting rod gab out of gear with its pin, and brings its own gab into gear with the other pin; this being effected when the cylinder is up, it remains up, the said lever being secured in its new position. This same movement of the lever is employed to throw the cam on the driving shaft of the machine, which gives motion to the feed board of the machine out of gear with the board, so that it ceases to act while the cylinder remains up; this is effected by connecting the said lever by a link with the connecting rod of the cam for actuating the feed board, which it lifts out of gear with a pin. A curved jointed lever is employed to open the grippers at the right time, which lever is worked by the cam for giving motion to the feed board. "Riders" are placed on the ink rollers, the spindles of which at one extremity are screw-threaded, and the threaded portion works in a nut which is supported on the side frame of the machine, in consequence of which, as the riders are caused to revolve by resting on the ink rollers, they also receive a motion in the direction of their length alternately in each direction, as the table of the machine comes and goes. A cam, furnished with various grades, is employed to give motion to the vibrator roller. A roller is placed on each side frame of the machine to facilitate the putting on and the removal of the form from the machine. The patentees cause the ductor or ink cylinder to revolve by mitre gear, which can be put out of gear with it by slacking a friction washer, when the ductor may be turned by hand. *Patent completed.*

1345 H. BESLEY. *An improved corn, seed, and manure drill, parts of which invention are also applicable to other similar agricultural implements.* Dated May 16, 1865.

In this improved drill the patentee forms holes in the back, front, or bottom of the manure, corn, or seed boxes, one hole being over each tube, according to the number of drills in the width of the machine, and he places two or more rollers or pulleys running the whole width of the machine; round these rollers or pulleys passes a series of endless chains, bands, or cords, through the corn and seed boxes, each of the same passing out through one of the openings in the back of the box or boxes, and returning underneath the same. One or more of these rollers is driven by means of spur gearing, chain or band, or partly by chain or band, from one of the running wheels of the machine; or both may be driven if preferred. The endless bands or cords are provided with cups, holes, or other such contrivance, for retaining the corn or seed, or which, as the rollers revolve, take a certain quantity of the corn or seed from the box through the openings, and as they pass over the rollers or pulleys, deliver the same into the tubes, which, in turn, convey it to the drills. The manure is pushed by the stirrer on to the endless chain fixed round the pulley, and thus conveyed to the tubes, and thence to the drills. *Patent completed.*

1346 J. DAUGLISH. *Improvements in ovens for baking bread.* Dated May 16, 1865.

This oven is constructed long in proportion to its width, and is divided into several sections, with a furnace or fireplace and flues, with apparatus for regulating the heat of such section. There are also glazed openings on one or both sides at intervals in order that the progress of the baking may be observed, and, where necessary, gas or other artificial lights are applied exterior of such openings, so as to light the interior of the oven. One end of the oven is so arranged that the loaves, or such like articles to be baked, either in tins or shapes, or on trays or surfaces, may be readily removed into the receiving chamber at the mouth of the oven when the hood or cover is raised. The mouth of the oven is also provided with a sliding door, which is arranged to be closed when the hood or cover of the receiving chamber is opened, as heretofore explained. Within the oven is an endless chain of plates of sheet iron, or it may be of other material, which is periodically moved a short distance after the hood or cover to the receiving chamber is closed, and the sliding door at the mouth of the oven is open. This endless chain of plates is similar to what has been before used in ovens. Ovens constructed according to this invention may be divided into any desired number of sections, according to the purpose to which they may be applied. *Patent completed.*

1347 J. TAYLOR. *Improvements in machines for testing the strength of chains and cables, and for other like purposes.* Dated May 16, 1865.

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

1348 H. A. BONNEVILLE. *Improvements in flour mills.* (A communication.) Dated May 16, 1865.

The patentee claims the aëration and cooling of flour mill stones by closing the eye of the runner with a metallic or other plate, and placing in the said eye a cylinder through which the grain falls on the bed together with openings, to which are adapted funnel-shaped aërating tubes for bringing the outer air between the cylinder and the eyes, and from thence with the grain between the grinding surfaces of the stones. *Patent completed.*

1349 H. A. BONNEVILLE. *Improvements in hydrometers for ascertaining the strength of spirits, and the specific gravity of fluids.* (A communication.) Dated May 16, 1865.

This invention is based on the principle that fluids rise in capillary tubes to a greater or less height, according to their specific gravity. The improved apparatus consists in a capillary tube which is immersed to a suitable depth in the fluid to be assayed, and from which the air is exhausted by aspiration, when the fluid rises to a certain height, where it stops. A graduated scale placed near indicates the degree of strength or specific gravity of the fluid. *Patent completed.*

1350 W. EASTON, E. MOORE, and W. GILLIES. *Improvements in the construction of pumps for raising water and other liquids.* Dated May 16, 1865.

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

1351 W. BROWN. *Improvements in machinery for manufacturing clay and pattern soles.* Dated May 16, 1865.

This invention consists in improved tools or instruments for holding the blocks of wood for making clog and pattern soles, and partially formed soles; also in improved arrangements of rotary cutters for cutting clog and pattern soles entirely, or to a great extent in the direction of the grain of the wood. The blocks of wood to be converted into clog or pattern soles are held in clamps each provided with a movable jaw or jaws to fit soles of different lengths;

these clamps are traversed along a table by a screw and nut, or partial nut, or other equivalent means. The rotary cutters for cutting the edges and top and bottom of the sole are arranged in pairs revolving in contrary directions, and they are mounted in swivel bearings jointed to swivel arms jointed to the table; these swivel arms are drawn by springs towards each other and against fixed templates of the shape of the portion of the sole under operation. By this means the cutters which operate in succession impart the requisite shape to the blocks of wood, and when the edges have been cut, the blocks are turned one-fourth round to bring the top or bottom in line with the cutters, or the top and bottom may be cut first and the edges afterwards. *Patent abandoned.*

1352 W. WRIGHT. *The treating of burnt ores of copper for the production or extraction of cobalt and nickel.* Dated May 16, 1865.

In working burnt copper ores by the wet method, there remains a large quantity of liquor from which the copper has been precipitated, and which has been found to contain, amongst other things, cobalt and nickel; this liquor the inventor causes to be mixed with lime, or milk of lime, alkali waste, or its liquor, or any substance capable of precipitating the cobalt, nickel, and other metals in solution or some of them. This precipitate is dried, mixed with from 30 to 40 parts of sand, 15 to 20 parts of alkali waste, 15 to 10 parts of slack, and, if practicable, substances containing arsenic. The whole is then introduced into a reverberatory furnace, and, when properly melted, is skimmed, and another charge added, until there shall be a sufficient quantity on the hearth. It will then be found that the cobalt and nickel have formed a species which can be tapped off and may be refined in the usual way. *Patent abandoned.*

1353 M. DEYRIES. *Improved apparatus for facilitating communication by signals between different parts of a railway train.* Dated May 16, 1865.

The inventor proposes to accomplish the first part of this invention by placing in the compartment of carriages composing a railway train, a pulley, either suspended from the roof, or affixed to any part of the interior framing of the carriage, which, being pulled, will cause a signal placed on the roof and over the doorway to drop outwards, and at the same time pull the trigger or spring of an alarm-gong placed in the guard's van. The dropping of the signal over the doorway indicates to the guard the spot or compartment to which his attention is sought to be drawn. The second portion of the invention refers to the means of communication by signal from guard to driver, and this the inventor proposes to effect by the former striking an alarm-gong similar to that mentioned in regard to communication from passengers to guard. *Patent abandoned.*

1354 H. E. DIXON. *Improvements in letter clips or paper holders.* Dated May 16, 1865.

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

1355 P. O. LAFONT. *Improvements in apparatus to be used with breechloading firearms and ordnance.* Dated May 16, 1865.

The patentee claims the improved construction of cartridge, or cartridge end-piece (culet) combining a place for percussion cap with a pin or spring piston for exploding the same, as described. *Patent completed.*

1356 R. A. BOOMAN. *Improvements in breechloading firearms, and in cartridges and bayonets for breechloading firearms.* (A communication.) Dated May 16, 1865.

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

1357 R. LUDDICOAT. *Improvements in machinery for making rivets, bolts, spikes, and other similar articles.* Dated May 16, 1865.

This invention consists, chiefly, in the revolving plates or discs carrying dies operating in combination with other dies for cutting off the blanks from rods or bars of metal, and forming the same into rivets, bolts, or other articles, the said rod or bar being brought to the dies by means of self-acting feed rollers. The invention cannot be described without reference to the drawings. *Patent completed.*

1358 W. MONTGOMERIE. *Improvements in locomotive engines.* Dated May 16, 1865.

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

1359 S. SWENSON. *Improvements in vessels or receptacles for containing oil and other liquids.* Dated May 16, 1865.

This invention consists in making vessels or receptacles for containing oil and other liquids in two pieces in such a manner that, when the two pieces are fitted one within the other, they form a square or rectangular shaped vessel or receptacle. This the inventor effects by taking a piece or strip of sheet metal, and turning it up at its sides, so as to form a projecting flange. He next bends this piece or strip of metal into a shape so as to form two sides and one end of the said vessel; he next takes a second piece or strip of metal of dimensions slightly smaller than the first, and forms along its sides also a projecting flange, and bends it in the same manner as the first piece, thus forming the remaining two sides and end of the said vessel or receptacle. He then places the second piece within the first, when the flanges of the outer piece overlap the inner piece, and are soldered together in the usual manner, thus making one complete and strong vessel for containing liquid. *Patent abandoned.*

1360 J. WORRALL and T. HUGHES. *Improvements in machinery or apparatus for stretching and drying textile fabrics, or parts of which said apparatus are also applicable to other machines wherein fabrics are required to be distended.* Dated May 16, 1865.

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

1361 G. WALTON. *Improvements in apparatus used in distilling hydrocarbons.* Dated May 16, 1865.

The patentee claims forming upright retorts used in distilling hydrocarbons with an inclined bottom to facilitate the discharging the spent matters from the retort. *Patent completed.*

1362 A. CHATVANE. *A new mail catching apparatus for bags or packages without stopping the express trains or others.* Dated May 16, 1865.

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

1363 C. O. CROSBY. *Improvements in machinery or apparatus for tapering, pointing, or reducing wires or rods for spindles, hatchel teeth, pins for dresses, and similar articles.* Dated May 16, 1865.

This invention relates to improvements in machines for reducing and tapering or pointing wire or other metal rods, such as spinning spindles, hatching teeth, dress pins, and similar articles, and consists in placing, automatically or otherwise, the pieces of metal to be tapered, reduced, or pointed into revolving spindles which will present the said pieces successively to one or more rapidly vibrating hammers, the said spindles having a lateral movement for introducing each piece under the hammer, and withdrawing it therefrom for enabling the hammers gradually to draw the wire, tapering or reducing it in diameter or to form it to a point as desired. *Patent completed.*

PROVISIONAL PROTECTIONS.

Dated July 20, 1865.

1894 W. la Penotière, Essex-street, Strand. Improvements in breechloading firearms, and in the charges and projectiles to be used therewith.

Dated July 25, 1865.

1932 J. H. Johnson, Lincoln's Inn-fields. A new or improved detergent solution to be used in the washing or cleansing of wool and woollen fabrics. (A communication.)

Dated August 12, 1865.

2093 W. Bette, Wharf-road, City-road, capsule manufacturer. Improvements in the manufacture of capsules.

Dated August 15, 1865.

2106 J. H. Johnson, Lincoln's Inn-fields. Improvements in the preparation or production of spongy metals, and in their applications. (A communication.)

Dated September 20, 1865.

2394 J. H. Johnson, Lincoln's Inn-fields. Improvements in railway carriages and other vehicles. (A communication.)

Dated September 27, 1865.

2482 C. H. L. Wintzer, Hütten-Director zu Georg-Marien-Hütte bei Osnabrück, Königreich Hannover. Improvements in separating phosphorus from iron and other metals in metallurgical processes.

Dated October 17, 1865.

2682 W. Beardmore, Parkhead, Lanarkshire. Improvements in furnaces.

Dated October 19, 1865.

2698 T. Roulledge, Ford Works, near Sunderland, paper manufacturer, D. Bentley and J. B. Jackson, Lodge Banks, Bury, Lancashire, engineers. Improvements in hydraulic presses, and in apparatus connected therewith.

Dated October 24, 1865.

2748 A. V. Newton, Chancery-lane, mechanical draftsman. Improvements in sewing machinery for using waxed thread. (A communication.)

Dated October 26, 1865.

2767 G. W. Bacon, Paternoster-row, publisher. An improved apparatus for gymnastic exercises. (Partly a communication.)

Dated October 28, 1865.

2778 J. Ombé, Belfast. Improvements in machinery for the preparation and spinning of flax and other fibrous substances.

2784 W. and E. Westmoreland, Nottingham, sewing machine manufacturers. Improvements in the construction and arrangement of sewing machines, and in the apparatus employed therein.

Dated October 30, 1865.

2795 W. Deakin, Great Barr, ironmaster, and J. B. Johnson, Tettenhall, Staffordshire, roll turner. Improvements in the manufacture of ordnance, whole or in parts.

Dated November 1, 1865.

2809 E. A. Phillips, Southampton-buildings, Chancery-lane, civil engineer. Improvements in lanterns for burning coal oil, petroleum, and other hydrocarbon fluids. (A communication.)

Dated November 4, 1865.

2844 H. J. Sanders, Brighouse, Yorkshire, commercial traveller. A new or improved machine for drawing corks from bottles.

2847 J. Nadal, Newman-street, Oxford-street. A new or improved bottle fountain for pocket and other purposes.

Dated November 7, 1865.

2863 T. Grayson and J. O'Donoghue, Liverpool. A new and improved cement.

2865 W. Kaplin, engineer, and J. Clarke, master mariner, Liverpool. Improvements in steering gear for navigable vessels.

2868 H. Bateman, Bernes, surveyor. An improved apparatus for lighting cigars or tobacco.

2870 F. Frange, Liverpool, merchant. Improvements in the manufacture of steel. (A communication.)

Dated November 13, 1865.

2911 W. T. Hamilton, Upper Rathmines, Dublin. An improved apparatus for cutting tannins.

2918 E. Guthrie, Liverpool. Improvements in the manufacture of bricks for building and other purposes, and in apparatus therefor.

Dated November 14, 1865.

2930 W. E. Newton, Chancery-lane, civil engineer. Improvements in safety apparatus for the prevention of accidents upon railways by working signals or alarms, in order to attract the attention of the guard or driver of the train. (A communication.)

Dated November 16, 1865.

2947 M. Caton, overlooker, and H. Holden, mechanic, Preston, Lancashire. Improvements in power looms for weaving.

2949 O. Sarony, Scarborough. Improvements in the rests or apparatus employed when taking photographs of the human figure.

2950 A. V. Newton, Chancery-lane, mechanical draftsman. An improved manufacture of caramel. (A communication.)

2951 A. V. Newton, Chancery-lane, mechanical draftsman. An improvement in the roasting of coffee. (A communication.)

Dated November 17, 1865.

2953 S. H. Huntly, Upper Baker-street, Regent's Park. Improvements in apparatus for obtaining fresh water from salt and impure water, also applicable for ventilating purposes.

2955 J. H. and G. R. Smith, West Plumstead. An improved method of drafting patterns for coats, waistcoats, and other close fitting garments, and apparatus to be used in obtaining the measurements for the same.

2956 W. H. Cope, Bostock-street, St. George's-in-the-East, engineer. An improved machine for taking off the shirs from cotton seed and cleaning it.

2957 G. Carter, Willenhall, Staffordshire, smith. Improvements in the manufacture of bevelled or convex iron washers, and in machinery to be employed in the said manufacture.

2958 J. R. Cooper, Birmingham, gun manufacturer. Improvements in breechloading firearms.

2959 T. J. Perry, Highfields, near Bilston, Staffordshire, ironfounder. Improvements in machinery for the manufacture of moulds for casting metallic wheels.

2960 W. Clark, Chancery-lane, engineer. Improvements in knitting machine needles. (A communication.)

2961 E. A. Brooman, Fleet-street, patent agent. Improvements in the manufacture of shawls. (A communication.)

2963 T. M. Tennant, Edinburgh, engineer. Improvements in furnaces.

2964 W. E. Newton, Chancery-lane, civil engineer. An improved process for hardening malleable and non-malleable cast iron. (A communication.)

2965 J. Harbert, Kidderminster, gasfitter. Improvements in the production or manufacture of gas for heating or illuminating, and in the retorts and apparatus employed in such manufacture.

2967 L. G. Speyer, St. Maurice-Fossé, Paris, engineer. Improvements in the manufacture of bricks or building blocks.

2968 W. Payton, Sewardstone-road, Victoria Park. Improvements in means or apparatus for measuring the passage or flow of liquids, for raising and forcing fluids, and for obtaining motive power, also in means for the manufacture of parts of such apparatus.

Dated November 18, 1865.

2971 S. H. Huntly, Upper Baker-street, Regent's Park. Improvements in cooking apparatus.

2974 H. Clifton, Queen's Hotel, St. Martin's-le-Grand, engineer. Improvements in sewing machines. (Partly a communication.)

2975 I. Lazarus, Birmingham, jeweller and factor. Improvements in bows or ties for articles of dress.

Dated November 20, 1865.

2978 A. Rickett, Birmingham, agent. An improved machine or apparatus for cleaning or dressing currants and other fruits.

2979 J. B. Fenby, Birmingham, mechanical engineer. Improvements in fastenings for safes' doors and other doors and lids, and for other like purposes.

2980 J. B. Edge and E. Hird, Bolton, Lancashire. Certain improvements in mechanism or apparatus for spinning and doubling cotton or other fibrous substances.

2981 C. Whitney, Kensington. Improvements in breechloading guns, and in cartridges for breechloading guns.

2986 G. P. Hemming, Winchester-street, Maldon-road, Kentish Town, and H. Coyle, Great Marylebone-street. An improved trap or liquid seal to the covers of cisterns, pans, jars, tubs, and other vessels or chambers.

2987 W. Clark, Chancery-lane, engineer. Improvements in bleaching leathers. (A communication.)

2988 J. Fitt, Cleckheaton, Yorkshire, machine maker. Improvements in sewing machines.

Dated November 21, 1865.

2989 R. and T. E. M. Walters, Pelsall, Staffordshire, metal rollers. Improvements in machinery for cutting or shearing sheet iron and other metallic sheets or plates.

2990 S. Bennett, Manchester, brass founder and copper smith. Improvements in cocks for steam, water, air, and gases at high pressures, and also in gauge cocks and water gauges for boilers and sediment tubes for cocks and pipes.

2991 F. Pope, Mark-lane, City. Improvements in locks. (A communication.)

2994 G. Smith, Upper Thames-street, City, G. Smith, jun., and O. W. Smith, Mare-street, Hackney. Improvements in hair brushing apparatus.

2998 T. E. Harding, Leeds, machinist. Improvements in the application of pressure to the rollers of spinning, preparing, and other machinery.

2996 A. V. Newton, Chancery-lane, mechanical draftsman. Improvements in apparatus for condensing exhaust steam and heating air by the heat abstracted in effecting the condensation of such steam. (A communication.)

2997 W. Parsons, Toronto-terrace, Brighton. An improved ash fastening for windows.

Dated November 22, 1865.

2998 W. Wells, Manchester, and S. Marland, Clayton, near Manchester, oil refiner. Improvements in apparatus for obtaining artificial light from volatile liquids or fluids.

3001 A. V. Newton, Chancery-lane, mechanical draftsman. An improvement in ejectors for discharging bilge water and for other purposes. (A communication.)

3002 S. A. Bell, Epping-villas, Stratford. An improvement in the manufacture of friction matches and tapers.

3003 W. Blit, West Ham, Essex. Improved apparatus for effecting a communication between the passengers of a railway train and the guard or driver, or both.

3004 S. Hunter, Newcastle-on-Tyne. Improvements in anchors.

3005 A. Lancashire, Engineer's Department, Great Northern Railway, King's Cross, engineer. Improvements in machinery or apparatus for stamping or impressing railway or other tickets.

3007 J. J. Field, Upper Gifford-street, Caledonian-road. Improvements in the manufacture of soap.

PATENT APPLIED FOR WITH COMPLETE SPECIFICATION.

Dated November 23, 1865.

3013 E. G. Lamson, Windsor, Vermont, U.S. Certain new and useful improvements in breechloading and repeating firearms. (A communication.)

LIST OF SEALED PATENTS.

Sealed December 1, 1865.

1828 E. Eastman

1831 W. Townsend

1833 C. de Berge

1834 T. Gentle and J. Allmark

1838 P. Coombes

1838 A. J. Aspinall

1838 J. Robertson

1839 J. H. Johnson

1840 A. A. Brooman

1847 D. Barker

1850 E. A. Brooman

1851 A. and A. W. Pemberton

1855 V. Duerne

1857 W. Tongue

1863 S. E. Tucker

1865 B. Stell, T. Broughton, and F. Hall

18610 W. Edson

1611 G. E. and J. Keats

1618 V. Polterin

1621 W. Clark

1656 W. Clark

1658 J. Scholl

1655 W. Clark

1668 O. H. Gardner

1689 E. Eastman

1773 J. Braithwaite

2152 J. Bowden

2221 W. P. Gragg

2245 O. Bennett

2312 W. E. Newton

2314 J. Caethlag and W. Bassett

2349 S. Wales

Sealed December 5, 1865.

1658 T. Smith

1640 J. Ferguson and R. Miller

1571 W. W. Hulse

2153 G. G. Dennis

2316 G. T. Bonfield

2469 G. T. Bonfield

2485 B. Wien

NOTICES OF INTENTION TO PROCEED WITH PATENTS.

From the London Gazette, December 5, 1865.

1888 O. Rosson. Portable charge holders.

1894 W. la Penotière. Breechloading firearms.

1903 E. M. Wauzer. Sewing machines. (A communication.)

1911 W. Diaper. Safes.

1917 W. Wapshare. Cooking.

1924 L. Petre and E. S. Tucker. Ornamental tables.

1927 M. J. Roberts. Adhesion between pavilions.

1931 J. H. Johnson. Lacing boots. (A communication.)

1936 W. and J. Richards. Sal-ammoniac.

1937 J. Belicard, jun. Velvets.

1950 T. Brown. Coffinets.

1964 E. Sabel. Iron. (A communication.)

1967 V. Baker. Utilising water power.

1973 J. J. Stoll. Continuous motive power.

1976 E. Sabel. Iron rails. (A communication.)

1977 J. Lawson and E. G. Fitton. Flax.

1978 A. Applegath. Printing in colours.

1983 T. W. Tobin and Col. Stodars. Illusory exhibitions.

1985 T. B. Paton. Limes.

1988 W. Singleton. Scissors for knives.

1991 F. Ransome. Slabs.

2012 E. Sabel. Sheet iron. (A communication.)

2015 E. L. Ransome. Coating surfaces.

2016 E. Sabel. Iron. (A communication.)

2029 H. A. Bonnevill. Cheeking farns of cane. (A communication.)

2031 A. V. Newton. Gun wipers. (A communication.)

2038 J. H. Johnson. Ornamentation of glass. (A communication.)

2060 W. O. Dodge. Firearms.

2105 J. F. Boetius. Furnaces. (A communication.)

2135 A. and W. Young. Type composing machines.

2150 J. B. Austin. Stopping bottles.

2190 A. V. Newton. Skates. (A communication.)

2219 H. Terrell and T. Don. Feet.

2330 D. Keys. Watches.

2369 H. A. Bonnevill. Save-alls. (A communication.)

2441 J. Parkins. Bordering envelopes.

2482 O. H. L. Wintzer. Separating phosphorus from iron.

2531 O. P. Button. Cover for dishes. (A communication.)

2706 E. E. Middleton. Laying telegraph cables.

2748 A. V. Newton. Sewing machinery. (A communication.)

2760 J. Johnson. Crossings.

2784 W. and E. Westmoreland. Sewing machines.

2870 F. Frange. Steel. (A communication.)

2947 M. Caton and H. Holden. Power looms.

2964 W. E. Newton. Hardening malleable cast iron. (A communication.)

3013 E. G. Lamson. Repeating firearms. (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 £20 HAS BEEN PAID.

3188 J. T. Caird

3214 G. F. Griffen

3315 T. Waller

3243 C. F. Olms

3249 H. Swan

3266 R. Hornsby, jun.

3310 S. B. Whitfield

3336 T. E. Vickers

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

2734 J. Coulson

2746 G. W. Rales

2757 W. Robertson and J. G. Orchar

2751 L. Bissell

2837 O. Hodgson

2964 R. Hornsby, jun.

LIST OF SPECIFICATIONS PUBLISHED

For the Week ending December 2, 1865.

No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.
157	0	164	1	170	10	176	0	182	0	188	1
158	0	165	10	171	0	177	1	183	10	189	1
159	10	166	8	172	4	178	0	184	0	190	0
160	0	167	0	173	2	179	0	185	0	191	10
161	10	168	0	174	1	180	10	186	10	192	0
162	10	169	0	175	0	181	0	187	0	193	0
163	0										

THE MECHANICS' MAGAZINE.

LONDON: FRIDAY, DECEMBER 15, 1865.

THE SMITHFIELD CLUB SHOW.

NOTWITHSTANDING the general anticipation to the contrary the Smithfield Club has held its show this year, and in spite of the serious drawbacks consequent upon the cattle plague, there is a very respectable display of beasts. The show altogether reflects no little credit on all concerned when the disadvantageous circumstances under which it has been produced are taken into account. The centre of the Agricultural Hall is devoted as usual to the exhibition of the live stock, whilst surrounding them on all sides are placed agricultural mechanical appliances of every denomination, the galleries being set apart for the smaller and lighter kind of implements. With the oxen, sheep, and pigs we have nothing now to do; we therefore turn from the animated sirloins and haunches in the hope that we may meet again—on Christmas day. With the implements of husbandry, however, the case is different. Here is our distinct province. With these, then, let us proceed to deal. The arrangements are very similar to those of last year, the same exhibitors occupying the same stands, which is a rule we hope always to see observed, as it enables each to appear in his own place, as it were, and to be the more readily found. A superficial glance fails to detect anything very novel or striking, but a closer inspection reveals here and there many little improvements in detail by which we learn to measure progress. Following the order observed in the catalogue we commence with the basement of the Hall, or, as it is termed, "the downstairs department." Here we come first upon our old friends, Ruston, Proctor, and Co., of Lincoln, who send a couple of portable engines and two portable circular saw benches. In the latter machines several improvements have been introduced; the slide fence is noticeable for the facility with which it may be adjusted, the extreme delicacy and accuracy of its motion, and its adaptation to all kinds of work. It combines in one fence the parallel, transverse, and feather-edged or diagonal cutting motions; it may be set to any size of saw, and is worked to a gauge marked on the table in eighths of an inch. This firm also exhibits one of Woodford's centrifugal pumps, which have the advantages of great simplicity and non-liability to get out of order, having no valves and only a single flyer instead of the ordinary disc for the expulsion of water. The pumps do not require priming before starting, and are not liable to stoppage or derangement by the admission of stones or other solid substances. In a recent notice of the Blackfriars Bridge works, where these pumps are largely employed, we had occasion to refer to the large percentage of useful effect obtained for the power employed.

Messrs. Wallis, Haslam, and Stevens, of Basingstoke, make a very good show of finishing, threshing, dressing, and othersimilar machines. They exhibit the Worcester prize threshing machine, to be worked by a seven-horse or eight-horse engine. An important improvement has recently been effected in these machines; this consists in the addition of an arrangement which allows the corn to be passed through the hummeller or not in its passage to the separator by merely moving a slide. The machines are fitted throughout with Messrs. Wallis, Haslam, and Stevens's patent spherical self-adjusting bearings which run with the least possible amount of friction. For shafts and spindles which run at high speeds, or are at all liable to heat or wear crossways in the bearing, these bearings are invaluable, as they instantly adjust themselves to the slightest variation in the line of direction of the shaft. At the same time they are perfectly steady in

work and, as they wear equally throughout the whole length, they last much longer than the ordinary description of bearing. The vibrating caving board and riddle are suspended on Coulson's patent spring hangers, by the use of which no less than sixteen bearings requiring oil in an ordinary machine are done away with. A further improvement consists in the attachment of a chaff bagging apparatus. Instead of the chaff being blown over in the usual way on to the ground, it is caught in a box having a perforated back, and is blown through a connection to the elevator where the chaff is raised by a revolving fan to a hopper, to which is attached the receiving bag. In the Excelsior harrows exhibited by this firm, the tooth is formed with a grooved head, which fits on the side of the beam and clips it tightly, thereby throwing the strain on the tooth direct on to the beam. A bolt passing through both serves to maintain the different parts in their relative positions to each other; this bolt passes through a tube or distance piece, which maintains the harrow beams at a proper distance apart. When the whole is put together and the bolts are tightened up by nuts, the machine is almost as rigid as if in one piece. Messrs. Wallis also exhibit a simple and ingenious sackholder, in which the usual wear and tear of sacks by nails is obviated; sacks even of the lightest material are not worn by it, and a great saving of manual labour is effected by its use. From their works at Leiston, Messrs. Garrett send two portable engines, a locomotive traction engine, and a horizontal engine, besides threshing and dressing machines, and a host of minor but equally useful implements. The improvements we here find are, first, in the portable finishing, threshing, and dressing machines, in which the fan case is made of an eccentric shape, by which an increase in the blast and a reduction in the power are attained. Next comes Chambers's patent broadcast manure distributor, which is manufactured by this firm, who have constructed the machine upon an entirely new principle. The most recent and important improvement is the use of a patent metal in the delivery barrel which will not corrode with the salts and acids contained in the manures. This firm also show turnip and mangold seed drills fitted with Chambers's patent manure barrel and scrapers, which can also be made to act as broadcast manure distributors.

Messrs. Hornsby and Sons, of Grantham, are no new hands at reaping machines, although they have not been so prominently before the public as many other makers. More than seventeen years ago this firm constructed and experimented with one of the first reaping machines made in England. They have constantly followed the development of each new machine, avoiding errors on the one hand, and perfecting meritorious points on the other, until they have succeeded in constructing reapers and mowers that took the leading prizes at the great all-England trials of the Royal Agricultural Society in the present year. They exhibit a large variety of implements, amongst others their semi-manual sheaf side-delivery reaper, which is a great novelty of the class. Its capacity for dealing with every variety of crop has been well proved, and at the Plymouth trials it took first prize. The draught has since been reduced, and it now works better by an improved arrangement of four delivery chains, clearing a broader horse track than it did at the Plymouth trials with five chains. In Messrs. Hornsby's combined mower and reaper the alterations for reaping consist in the insertion of a slow speed pinion, a more convenient seat for the raker, a fresh dividing board, similar to that used in their manual reapers, and a drop sheaf grated platform. An eight-horse prize portable engine was also exhibited on this stand, together with several ploughs and other implements of great merit. Messrs. Tasker and Sons, of Andover, have lately introduced important improvements in combined threshing machines. These improvements consist in delivering the chaff after it is separated from the corn without the aid of com-

plicated machinery or any consumption of power. The improvements can be put to any machine; they conduce to a saving of time, as there is no waste or chaff to collect at the end of the day's work, and no additional attendance is required. Messrs. Tasker also exhibit Seaman's new patent trussed-beam harrows, in which the teeth are simply plain pieces of iron cut from the bar and pointed. They are held in their places by a wrought-iron band or ferrule which surrounds the parts forming the beams or frames of the harrows, the teeth being driven tightly through the holes in the band and between the bars. By these means each tooth is held separately in its proper position and the whole harrow is firmly held together as if in one solid piece, no holes or screws to the teeth or beams being required. Mr. Charles Burrell, of Thetford, shows an improved agricultural eight-horse power single cylinder locomotive engine, in which the most recent improvements are the introduction of two chains for driving instead of one, so that the engine is driven from both sides. There is also a neat arrangement of side feed, and in the steering apparatus a chain is passed round a shaft. The engine is fitted with Aveling's patent screw for tightening the chain; it has a link motion reversing gear, weighs but six tons, and has the appearance of being more compactly arranged than last year.

Messrs. Tuxford and Sons, of Boston, come out strong in portable engines, showing a ten-horse power patent housed engine, with two cylinders, a ten-horse power portable horizontal engine, improved so as to burn half a cwt. of coals per day for each horse power, and three other engines of three, two, and one-horse power respectively. They also had some saw tables and centrifugal pumps for drainage or irrigation purposes. Of carts and waggons, Messrs. Hayes and Son, of Stamford, send some good specimens in their vehicles which carried off the prizes at the Plymouth meeting in July last. The prize pair-horse waggon is made for general purposes, and is very light, with oak framing and plank sides with broad fixed rungs or sideboards. The front wheels look under the body, and it will turn in the room it stands upon. It is fitted with front and hind harvest ladders, which are readily affixed or removed, and a simple brake, which can be put in action without stopping the horses. Of course Messrs. John Fowler and Co. are well represented, though not so much by quantity as by quality. We first notice their ten-horse power single cylinder engine and windlass combined, which is fitted with a clip drum, and worked for steam cultivation. The cylinder is steam jacketed, combined with the dome, and being placed on the front of the engine takes the steam from the quietest position in the boiler, thus ensuring dry steam in ascending inclines. These engines are now constructed to travel either one or three miles per hour; the slow speed of one mile per hour will enable the machine to work over the softest land without straining. They can at any time be used for traction purposes, and are adapted for any work for which portable engines are suitable. Messrs. Fowler also show a four-furrow balance plough and cultivating machine, constructed of iron, and adjustable to the different widths of furrow; at the same time the rigidity of a riveted frame, so essential to the durability of a steam-going implement, is retained. A number of operations can be performed by this machine with but little alteration. Messrs. Fowler also exhibit a seven-tine cultivator and an excellent portable ten-horse power engine. Messrs. Crosskill show their clodcrusher, and a collection of carts and other implements, for the excellence of which they have earned a high reputation; we do not, however, find anything novel this year, and we therefore pass on to the next stand. Here we find Messrs. Clayton, Shuttleworth, and Co., of Lincoln, with a goodly array of the machines for which they are far-famed. Ten traction, portable, irrigation, and fixed engines, several single, double, and treble-blast threshing and finishing ma-

chines, various straw elevators, corn mills, and saw benches, complete the list of exhibits. The most important feature in the traction engine is the patented compensating intermediate motion, which is self-acting, and enables the driving wheels to accommodate themselves to the sharpest curves without strain or loss of power; both wheels at the same time are kept in gear and receive the full power of the engine. In an eight-horse single power cylinder self-propelling engine we note some improvements for diminishing or accelerating the speed. There are two pinions on the crank shaft cast of different diameters, so that the smaller one forms a bearing for the larger one when the latter is in gear. The intermediate wheel between the crank and second motion shaft is raised and lowered by a very simple arrangement so as to suit either wheel. Another improvement consists in the introduction of a revolving axle in a long bearing, the advantages of which are obvious. In their double-blast threshing machine Messrs. Clayton have introduced patent adjustable screens to suit any kind of grain. Before the corn passes through the screen it passes over changeable riddles, whereby the chaff or any extraneous matter is separated from the corn and passes again into the machine. The threshing machines also have the addition of a chaff bagging apparatus, which is very simple and adds but little to the cost of the machine. An eight-horse power horizontal fixed engine is shown, in which all the wrought-iron work is case-hardened. The bed plate is placed on a metal foundation, as is also the outer bearing for the flywheel shaft, thus to a considerable extent superseding brickwork.

Messrs. William Ball and Sons, of Rothwell and Northampton, are strong in ploughs and waggons, having been successful in securing numerous medals and prizes at various times. Their Plymouth prize cart presents a novelty in the tipping arrangement, which is worked from one side by a simple spring, and when in position the body is perfectly secured to the shafts on both sides. Since the Plymouth meeting, an arrangement has been introduced by which the tail-board is worked with a spring catch on one side which acts on the other. The tail-board is fixed on an iron tail-piece, and on loading takes its bearing on the tips. A specimen of the light two-horse Plymouth prize wagon was also exhibited, fitted on springs for town use. Mr. J. S. Underhill, of Newport, Salop, showed a new six-horse power traction engine, a patent threshing machine for finishing the grain for market, and Bruckshaw and Underhill's patent corn elevator for threshing machinery. There were likewise models of sundry useful farm implements and specimens of wire fencing. Our attention, however, was particularly arrested by Mr. Underhill's recently invented wheel for traction engines. The wheel tyre is of such a form that the imprint left by it on the ground is a zigzag; the section of the tyre is nearly that of a contractor's rail with the flanges removed. From out to out of the zigzag measures about 12in., that being the breadth of the wheel face, although the tyre is only about 4in. broad. The object is to avoid projections on the wheel face, the form of the tyre permitting it to take a grip in the earth. This novel construction of the wheels enables the engine to travel through any locality, be it street, arable, or turf land; consequently great things are expected from it as an auxiliary to steam traction cultivation. This form of wheel affords a considerable amount of elasticity, but we would suggest the addition of a thin web on the inside of the tyre, thus filling up the angles formed by the course of the tyre, and rendering it impossible for the wheel to sink beyond the depth of the tyre in soft soils. These wheels are now being practically tried on a traction engine near Market Drayton, and some experiments have been made which up to the present time have proved their efficiency. We have now arrived at a stand over which a very well-known name appears—that of Messrs. Howard, of Bedford, who occupy a considerable space with their cele-

brated ploughs. Among these is their champion plough B. B., which came off victorious at several of the all-England ploughing matches this autumn. We believe Messrs. Howard have won this year the largest number of prizes open to all England, no less than twenty-seven in number. Their double-furrow ploughs have the beams made of double ribbed steel, and combine great strength with lightness. In light land these implements effect a saving of one horse and a man. The digging ploughs are furnished with skeleton or digging breasts, which, in turning over the furrow, break or pulverize the soil. One of Messrs. Howard's twelve-horse ploughing and traction engines, which is about to be sent to New Zealand, is shown. It may be remarked that in this engine is introduced the great peculiarity (noticed last year) in the position of the boiler, which, instead of being fixed lengthwise, is placed across the framework. By this arrangement on the steepest hill the water level never varies sufficiently to leave any part of the fire-box or tubes uncovered. Another important point is that the steam space is not diminished whatever the incline may be upon which the engine is working. Messrs. Howard show Bulstrode's patent snatch block sling, which is a valuable addition to steam cultivating apparatus worked by a stationary engine. By the use of these slings no more time is lost when the plough arrives at the headland than is requisite for the man to change his seat. Another admirable invention is the adaptation of the screw pile to the anchorage of the snatch block in a certain class of lands.

Messrs. Aveling and Porter show admirable specimens of eight-horse power portable engines and eight-horse power agricultural locomotives with all their most recent improvements. An engine of the latter class obtained the first prize gold medal at Mecklenburg Schwerin, and a ten-horse power engine of the same class received the prize medal of the Exhibition 1862. Messrs. Aveling's travelling rope porter is also exhibited. These useful implements are fastened to the rope at intervals behind the cultivator or plough as it leaves either headland; they travel across the field with the rope and are taken off as they return; they can be released instantaneously. The rotary harrow, pulveriser, and twitch extirpator of Messrs. Holmes, of Norwich, which obtained the silver medal at Plymouth, is exhibited in their collection of farm implements. The action of this machine is to fork out the twitch or stubble without breaking it, and, by the fork barrel revolving at a great speed, to leave it lightly on the surface of the soil. It pulverises the soil to the depth of five inches on light soils, getting under the twitch and bringing it up to the surface without breaking it. In their corn and seed drills the coulter is fixed to steel springs instead of levers, by which means the machines are simplified, reduced in weight and cost, and all lever joints are superseded. The Beverley Iron Company put in a good appearance, their clodcrusher and roller with self-cleansing action standing out well amongst their other exhibits for having obtained numerous medals and prizes. This roller consists of cast metal discs, or roller parts placed loosely upon a round axle so as to revolve independently of each other; the outer surface of each roller-part is serrated and has a series of sideway projecting teeth which act perpendicularly in breaking clods. Each alternate disc is made three inches larger in diameter than the rest, and the size of the holes in the large discs is correspondingly increased, so that both the large and small discs touch the ground and none of them can rise up over a clod without lifting all the rest. The difference in the size of the alternate discs causes them to revolve in different circles, and thus enables them to work on moist or adhesive soil without clogging. The Beverley Company show a liquid manure or water cart, with a good arrangement for distributing liquid manure or water by means of a spread board 6ft. long, which is suspended from the back

to the cart so that it can be adjusted and set level when watering along hill sides. A trough with four flexible tubes is substituted for the spread board when watering in rows instead of broadcast. The Beverley compound action mills are most useful of their kind; their efficiency does not depend altogether upon the sharpness of the grinding surfaces as in ordinary cases, but is owing to a powerful shearing or wrenching action, which is peculiar to these mills. They are of the roller mill kind, but are so arranged that the axis of each roller lies in a different plane to the other, so as to cause the grinding surfaces, when revolving, to cross each other at the point where they are nearest in contact. A lateral wrenching action is consequently produced in combination with the ordinary crushing power of the rollers. Of course the Plymouth prize pair-horse wagon, with its light yet strong appearance, stands prominent.

As might be expected, Messrs. Ransomes and Sims, of Ipswich, have a most attractive stand, for their ploughs have attained a world-wide reputation and have won prizes and medals innumerable. The combination of lightness with strength in these implements is as remarkable as it is successful. The turn-wrist plough is one of the novelties of the season; it is made expressly for use on the Devon and Cornwall hills. By an ingenious arrangement this plough can be turned from one side to the other without delay or difficulty. The solid frame harrows are of an entirely original construction; the framework consists of wrought iron riveted together and not connected by the fastenings of the teeth. The teeth are of plain square iron and may be lengthened when worn without the aid of a blacksmith. The teeth are held each by a loop and nut against the framework, a cotter preventing the nut becoming loose. In Messrs. Ransomes' jointed harrows, instead of the teeth being fixed in a rigid frame, they are attached to a jointed frame, which allows them to follow all the irregularities of the soil. The teeth being allowed to play in this manner gives the whole harrow a much freer action and helps it to pulverise the soil. Amongst the various food-preparing machines manufactured by Messrs. Ransomes may be mentioned Biddell's root-pulper, in which, by a peculiar arrangement of the knives, the roots are prevented from jumping up or sliding sideways. The machine consequently requires less power and less time to do a given amount of work than is necessary with most other pulpers. Messrs. Brown and May exhibit some portable pumping and other engines; the former are fitted with Holman's well-known cannon pump, which adds an important feature to the ordinary portable engine. This engine forms an effective steam fire engine, and the pump being made of brass is well suited for pumping and distributing liquid manure. *Appropos* of fire engines, we observe the leading manufacturers of these machines are well represented. Messrs. Merryweather and Son exhibit one of their steam fire-engines, constructed from the joint designs of themselves and Mr. Edward Field, C.E., and in which there are no very material alterations from the engine shown by them last year, the arrangements adopted by that firm having proved highly satisfactory in practice. A working model of the "Field" boiler, which is applied to all these engines, was exhibited at work in one of the yards attached to the hall. It was driving one of Miller's patent self-acting donkey pumping-engines, which was described and illustrated in the *MECHANICS' MAGAZINE* for the 24th of February last. This model worked so satisfactorily that it attracted a number of visitors to the spot, thereby causing inconvenience; consequently the attendant had to desist working the model. In operation it was certainly surprising to see the amount of power given off by so small a boiler. The donkey-engine threw about five gallons of water per minute, and is, we believe, about to be applied to Merryweather's steam fire engine.

One of Shand, Mason, and Co.'s powerful steam fire-engines was also exhibited by that firm. And here for the present we must close our notice of the Smithfield Club show; we shall, however, resume the subject in our next, as there yet remain many worthy objects for notice both downstairs and in the galleries.

GRAPHOTYPE.

At the meeting of the Society of Arts held on December 6th, Mr. H. Fitz-Cook read a paper on a new method of producing, from drawings, blocks for surface printing, without the aid of the engraver, to which the name of "graphotype" has been given, and last week's number of the Society's "Journal" contains some illustrations printed from blocks produced by the new method. The new process is the invention of Mr. De Witt Clinton Hitchcock, one of the foremost draftsmen and engravers of New York, and was suggested by a little incident which Mr. Fitz-Cook thus related:—"In the summer of 1860, Mr. Hitchcock, in the course of making a drawing on box wood, found it necessary to alter a portion of his design by erasing it and re-whitening the exposed surface of the wood. The material used for this purpose was the enamelled surface of an ordinary visiting-card, softened by water and a brush,—a method known to most draftsmen on wood. The card employed happened to be one printed from a copper plate, and after the removal of all the enamelling, as described, the artist discovered that the printed letters were undisturbed, and standing up in bold relief." His first attempt to carry out the idea which this circumstance instantly suggested to him was made upon a slab of chalk, sawn from an ordinary lump, and on one surface made as smooth as possible by scraping. He drew upon the smoothed surface of this piece of chalk with ink and a quill pen, using as ink silicate of potash, or "water glass," coloured with indigo, and when the lines of the drawing were dry he brushed away, by means of a tooth-brush (but not using water, as when removing the enamel from a card), all the portions of the chalk surface upon which there were no lines. "The lines of the drawing," we are told, "being literally composed of stone, withstood the assault of the tooth-brush, but the intervening particles of exposed chalk succumbed, and vanished in a cloud of snowy dust, leaving the impregnable lines standing in relief, inviting a proof of their strength by printing on paper. This could not be done until the whole mass of chalk was changed into stone, by saturating it with the liquid glass, but in half an hour the chalk block was inked and printed in the ordinary way by burnishing." Ultimately, as the result of a great number of experiments, Mr. Hitchcock elaborated a process which seems likely to supersede wood-engraving, if not for all, at least for many purposes, being much cheaper than wood-engraving, and having moreover the great advantage of infallibly reproducing the artist's every touch, however delicate, with the most perfect accuracy. In its present shape the process is conducted as follows. An artificial chalk block or plate is first produced by grinding the best French chalk to fine powder, mixing this powder with water to a thin cream and separating the portion which precipitates first, repeating this operation several times, in order to ensure the complete separation of any hard or coarse particles, drying the very finely-divided chalk thus obtained and sifting it, through wire-cloth having 10,000 holes to the square inch, on to the surface of a perfectly smooth plate of zinc, placing a plate of highly-polished steel on the top of the even layer of chalk-flour thus obtained, and then submitting it to powerful hydraulic pressure. On removing the pressure and lifting off the steel plate, the chalk is found to be firmly attached to the zinc plate, and to present a perfectly smooth upper surface, which only requires to be

"sized," in order that the ink to be used in drawing on it may not "spread," to be ready for the artist. The latter proceeds as in the ordinary method of drawing on wood, first making a red chalk tracing on the block or plate, and then, with sable hair pencils of various sizes, drawing his design line for line, exactly as he wishes it to appear when printed. The ink used is a mixture of glue and lamp-black, and dries instantly, so that one series of lines, of whatever thickness, may be immediately crossed by others. The drawing being completed, the portions of the chalk surface intervening between the lines of the drawing are disintegrated and removed, to the depth of an eighth of an inch or so, by means of brushes, some of them of fitch-hair and others of silk velvet, and the chalk block is then hardened by being soaked in a solution of an alkaline silicate. A mould is then taken from the chalk block, and a type-metal cast produced from this mould, by the ordinary processes of stereotyping, and it is this type-metal cast, and not the original block, that is used to print from. "The process is so delicate," says Mr. Fitz-Cook, "that the impression of the thumb wetted with the graphotype ink, skeleton leaves, feathers, and other objects to which nature-printing has been applied, can be made to give beautiful impressions in the ordinary type-press, whilst the finest hair-line that the artist can make will stand equally well with the bolder work." The type-metal cast may be obtained with ease within three hours after the completion of the drawing on the chalk surface, so that the new process has an immense advantage over wood-engraving, not only as regards cost, but also as regards the time occupied between the completion of a drawing and that of the block by means of which copies of it may be multiplied by the printing press. While thus cheap and expeditious, the new process reproduces the artist's work with an absolute accuracy unapproachable by the most skilful engraver.

CONNECTING RODS.

MECHANICAL motions may be resolved into two kinds—sliding and rotary. With the former a direct action is attained, which does not require adjustment and is not liable to looseness or a transverse wearing of the surfaces in contact. When a rotary motion is required, it is obvious that an adjusting mode of connection is imperative to maintain fixed centres or distances. The strains imposed on the rods transmitting the power are in a line with the centre of action; thus the wearing surfaces are duly affected. Many arrangements of adjustment are in use. In most cases the tightening of the brasses is in one direction; hence the rod becomes longer in proportion to the wearing of the surfaces. A clearance at the back end of the cylinder is often allowed to admit of the shifting of the piston and rod. Now, the pistons of cylinders (in order to cause an effective discharge or rather exhaust) should have as little clearance as possible. In marine engines we find the clearance for the piston $\frac{1}{16}$ in. to $1\frac{1}{2}$ in., while for locomotives the former would be deemed an extreme case on the wrong side for economy. The action of the steam is to propel the piston for a given length, after which impetus or momentum completes the stroke. The lead of the slide valve on the piston causes the steam to act as a cushion or spring at the termination of each stroke. The connecting rods are subject to longitudinal strains, which are tensile and crushing. The wearing surfaces are of course at the connections at each end. The back or small end of the connecting rod is liable to less wear than that connected to the crank pin. In order to define the true form and the best mode to preserve the requisite length the strains imposed must be duly considered. Let it be presumed the piston is at the back end of the cylinder, and the steam is exerting its pressure, due to the lead of the slide valve—the strain imposed will be crush-

ing direct. The bearings of the crosshead and crank pin will be acted on, only on the inside, or towards the cylinder. On the crank ascending, the same crushing strain will be in operation till the completion of the stroke, the wearing surfaces being affected in a line with the angle assumed by the rod. On the descent of the crank the action of the steam is reversed, likewise the strains; hence the adjusting portions are tested—a matter of the greatest consideration, to which we will revert. Engines, when the pistons move at high velocities, are subject to momentary shocks unless exactness of adjustment be maintained. How often do we find, even in slow or moderate speed engines, that the piston at the up or down stroke causes a shock to the whole structure! Perhaps it is difficult at all times to define the cause of this defect, but in nine cases out of ten the adjustment of the connecting rod will be found to be faulty. Before proceeding with a description of the best arrangement, it will be well to analyse some of the examples now mostly in use. Modern connecting rods for large beam engines are usually of cast iron, with wrought-iron cotters, gibs, straps, and gun-metal bearings. Rods of this class are generally ornamental, the section at the centre being a cross, while the termination at each end is circular, with a beading. When the gibs and straps are dispensed with the ends are of course hollow, to receive the brasses, a single cotter being used for adjustment. In some cases these rods are made heavier or stronger than requisite, the extra weight being used to balance the piston; such a practice is universal with mining engineers. There is one great evil in this mode of balancing, and that is, the unequal distribution of the metal. We are conversant with examples where the area of the cross section is six times of that at the crank end. Such a practice causes an unnecessary load on the bearings, and likewise increases the causes for adjustment. When double cranks are used, unless the pin be of more than the usual length, that portion of the rod working between the cranks is subservient in width to the space alluded to; hence an unequal distribution of metal throughout. Rods having double ends are generally solid, with a cross-piece, loops, gibs, and cotters making good the connection. Wrought-iron connecting rods are now universal, being mostly adopted by makers of stationary, horizontal, locomotive, and marine engines. For the former, a great deal depends on the guide block and crosshead. Should double guides and a T crosshead be used, the rod must imperatively be double at the connection, each side being a duplicate of the other.

The old gib, cotter, and strap seem to retain their positions amongst the many other later examples, doubtless owing to the compact appearance they present. We, however, give a preference to the T-head caps and bolts, or the semi-solid heads, on account of the process of manufacture, which we will describe. The strap-end connecting rod has square ends, or rather that of a parallelogram in section, the remaining portion being turned. The strap requires exact fitting, while the cotter and gib holes must agree, with an allowance for adjustment. The shaping machine may perfect the ends of the rod and exterior portions of the straps, but the inner portion of the semicircular end must be adjusted by hand to fit the outer brass. The gibs and cotters may be finished in the shaping machine, with the exception of the fitting ends of the latter. In some instances the straps are turned beyond the cotter holes, which is cheaper than planing or filing. A good method of preventing the cotter becoming loose is to split the small end, and tap or sew a hole in one half: a stud being inserted will open or enlarge the end transversely. The brasses must have flanges to prevent lateral looseness. Unless a separate adjusting cotter be used the main cotter can never be firmly tightened, and an undue strain is thus thrown on the gib ends. Double gibs

are preferable to single, on account of the double clasp the strap is thus subject to. The strains imposed on this connection are tensile for the strap, shearing for the gibs and cotter, and crushing for the brasses; hence the proportions should be well considered. With engines moving at high velocities, and having extremely short rods and strokes, the strains are considerably increased; hence we find that for engines of the class in question, this form of rod is being rapidly discarded. The length of the rod in proportion to the stroke of piston is a matter of the greatest consideration; stroke 1, length of rod 2 to 3, are the two extremes, a happy medium being obtained by stroke 1, rod 2-5. The angle assumed by the rod when the crank, or rather the piston, is at half-stroke greatly affects the gibs; in fact, with short rods, a tensile strain is imposed at right angles with that of the rod. We have known instances where the gibs had been stretched $\frac{1}{2}$ in. beyond their original length, owing entirely to these causes. The connecting rods for locomotive engines are of the gib and cotter type. Those applied to the driving wheels must, under any circumstances of wear, retain the original length. In order to ensure this the adjusting cotter of the one end acts against the inner brass, while for the other end the cotter acts on the outer brass. The ordinary gib, strap, and cotter are not as much used for locomotive connecting rods as they were ten years ago. The mode of securing the strap when used is, by a bolt or two bolts in the place of a gib or gibs, nuts and check-nuts being also adopted in some cases to adjust the cotter, while in other examples the ordinary split cotter is still resorted to, with a stop-stud in the rod. In order to ensure greater strength the strap is often dovetailed into the rod, so that the tensile strain on the gibs or bolts (whichever may be used) is greatly reduced if not prevented. In some cases two stop-studs are used, and an adjusting cotter on each side of the brasses; this mode effectually retains the original length of the rod, but the surfaces of the cotters being small causes in some instances lateral looseness, especially with high velocities; hence we find the single cotter more universal. A primitive form has been lately revived; the large end of the rod is of a forked shape to receive the brasses, a distance piece and a bolt retaining the same. A cotter on the inside causes an adjustment. This mode is, perhaps, the most simple of any, but the process of manufacture is much the same as for the ordinary strap and gib, although the two latter are dispensed with in the present case. Connecting rods with hollow solid ends have lately been much introduced, although the process of forging may be said to be more difficult and liable to defect. The cavity for the brasses can be slotted or filed to the requisite size and shape. The brasses are flat on all sides, hence planing is available. The inside flange is loose and secured by studs after the body is inserted. In other examples the inside flange is dispensed with, except at the front end, the cavity in the rod being longer than the brass; the latter is fixed by the cotter only, the back outside flange making a plain exterior. With rods of this class the adjusting cotter can be either within or beyond the bearing. The flanges being located or extended accordingly, it is almost needless to add that the cotter being recessed in the brass prevents lateral play. Another means of adjustment is by a screwed wedge or cotter in a line with the bearing, instead of at right angles with it. Outside stops bearing against the flanges of the brasses retain the position of the same, and effect an adjustment at the same time.

We have thus far dealt with the rods at present mostly used for land engines. It will be noticed that the means of adjustment in all the examples to the present has been by the cotter. Now, with this mode it is obvious that, on the wearing of the surfaces and the cotter acting against the back of the brass, the

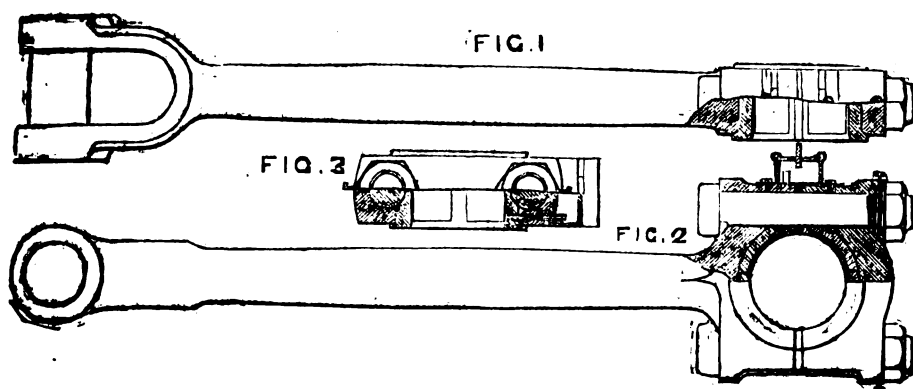
latter has a very small surface employed to retain its lateral position; the flanges are thus susceptible of sudden strains. We find for marine engines the adoption of the strap, gib, and cotter an almost isolated example. The class of engines now alluded to are more generally of the horizontal type. Much depends on the type of engine as to what form of connecting rod is the best. For trunk engines there is a certain amount of difficulty in adjusting the brasses, owing, of course, to the locality of the same. A universal mode with single trunks is to bore the rod for a given length beyond the trunk; a steel rod being inserted acts against the front brass, and a cotter of the ordinary kind, screwed at one end with a shifting gib, ensures a perfect adjustment. The end of the rod in question is hollow in one forging, the brasses being inserted instead of clamping the rod. A second form of marine connecting rod consists of a hollow end, similar to the last example, but the means of adjustment is by a screw and check-nut at the extremity of the rod. The two examples now under notice are particularly applicable where height is of importance, the first mode being in practice for single trunks and the latter for hollow single guides. The remaining examples worthy of comment and in general use are different in construction but alike in principle; the rod is forked at the crosshead end with a pin, adjustment being attained by the guide block. The crank end of the rod may be said to be the portion that is varied in design and arrangement. In one example the end of the rod is of a T form, the brasses are flat in the connection, and the cap at the extremity is simply a plain piece of wrought iron, with holes to receive the securing bolts. The second arrangement consists of a semi-solid head, divided centrally transversely. This cavity is bored to receive brasses, which are turned to a corresponding diameter. The securing bolts are situated on each side of the bearing, sufficiently close to prevent the shifting of the brasses. When this position for the bolts is not maintained the brasses are either hexagonally fitted or turned as before alluded to, with projections to retain the correct position. When flat brasses are adopted the bolts are subject to tensile strain only, as the T end of the rod and the cap prevent disarrangement. We have already alluded to the fact that the adjusting portions of the rod were tested mostly, if not wholly, on the descent of the crank. Now, presuming the piston to be at the front end for the direct-acting, or at the back for a return connecting-rod engine, we shall perceive the correctness of this statement. The strain imposed on the rod is entirely tensile, or the rod itself has a tendency to remove the pressure from the inner portion of the bearings. The connection made by the bolts transmits the strain to the cap, or outer end of the rod; hence the outside brass is brought into close contact with the bearing. It is obvious from these causes that the adjusting portions of the connecting rod are affected greatly by the tensile strains imposed. With short connecting rods a certain amount of tensile strain is undoubtedly in operation when the crank is at half-stroke, owing, of course, to the angle assumed. With semi-solid heads this evil is greatly mitigated, as the bolts are better sustained in the back and front portions of the rod.

With reference to the processes of manufacture of the two last examples, the T head is, perhaps, as simple as can be conceived. That and the cap can be planed and the ends turned; the brasses are planed and bored, so that hand fitting is dispensed with. In the case of the semi-solid head, turned brasses are undoubtedly cheaper than the hexagonal shape, the remaining portion being as in the first example. The difference of manufacture in these types and the strap and gib kind is sufficient to warrant the more general adoption of the two former. The nuts generally adopted are turned (slightly less than the size of the

nut across the flats) for a given length or height from the base line; a groove is also made to receive the point of a stop-stud. In some instances a ring is used with a pin on one side, the stud being screwed into the ring, which, encompassing the nut at the turned part, prevents the latter from becoming loose. A second system of safety consists in dispensing with the ring and pin, and by recessing the cap to receive the turned portion of the nut, the desideratum is gained. Another mode is to forge a flange on the nut with a groove in the same, a stud with a cross handle ensuring adjustment and security. Stops and securing-studs have been arranged similar to a ratchet and spring, but the complication doubtless prevents its more general adoption. In order to ensure an even adjustment gun-metal slips are sometimes used between the brasses, while in other examples wood is deemed sufficient. A better mode than either is, to make each nut a pinion at the bottom; a centre pinion with a lock-spring would ensure exactitude of adjustment and security. The means of lubricating the bearings have often been discussed by marine engineers. To the present the suspended oil can and wiper on the brass retain their original position. Tubular oil cups are sometimes adopted, but where a large surface requires due lubrication the simple wiper is introduced.

We have thus far explained the use and design of the connecting rods of the present day, and we will now consider the kind best adapted for each class of engine. For large beam engines, the cast-iron rod, with wrought-iron straps, gibs, and cotters, is undoubtedly correct; but with engines of moderate power, the marine type is best fitted. For horizontal engines for land purposes, again, the marine type is undoubtedly the best yet introduced. Locomotive engineers have different ideas as to the best form of rod and mode of connection and adjustment. Undoubtedly the dovetailed strap end is the strongest of the kind when a ready disconnection is required. Connecting rods with hollow heads are stronger perhaps than any others, but this is counteracted by the peculiar shape of the brass necessary for the rod in question. The perpendicular forked rod (although primitive) is not to be despised, as it possesses all the advantages of the strap without its evils. Of all the devices, the dove-tailed strap and the forked end claim most attention. The rods noticed for marine engines being of the latest and best improvement, it is but fair to admit that each has its peculiar advantage. The arrangement alluded to for the single-trunk engine is an ingenious device, but we would suggest that the semi-solid head, or that with the flat brasses, be adopted in the place of the ordinary strap, &c., as now used. The hollow head, with the adjusting screw at the back, is simple, but imperfect, and a better means of adjustment could be attained by the central rod and cotter before alluded to. With reference to flat brasses, T heads, and flat caps, we certainly admit the simplicity of manufacture and connection, but were stability considered we should select the semi-solid head as the better mode. Our reason for this is, that the bolts have more support than with the T head and flat cap, a matter of the utmost importance with high velocities. In order to render our views on the present subject more clear, and at the same time of practical utility, we call attention to the illustration of a marine connecting rod embracing all the best improvements. Fig. 1 represents the plan of the rod, the larger extremity being half in section and half complete. It will be seen that the brasses are flanged into the wrought iron, in order to prevent a lateral movement. Fig. 2 represents the side elevation of the rod, the head being half in section, half complete. The brasses are turned and the rod bored to receive the same. The securing bolts are as near the bearing as practicable; the brasses are a certain fixture, as far as regards circular movement. The

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lubricator is separate, being secured by studs. The wiper is centrally located. Tubes are situated on either side of the upper bolt, so that a perfect diffusion of the oil is certain. This last point will be readily understood by referring to fig. 3, which is a front elevation, half in section, half complete. As regards the proper proportions of the details now under notice, three points have to be duly considered—first, pressure of the steam; second, area of the piston; third, ratio of rod to the crank. The first entails pressure per square inch, the second, sectional area, and the third, rigidity or prevention of deflection. Now, to define the correct proportion will be to consider the material employed. Having determined this, the remainder is a matter of simple calculation, but withal the observance of natural laws is imperative.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

TITANIFEROUS IRON.

ON the 24th of last month some account was given in this journal of the results of some experiments made by Messrs. D. Hipkins and Sons, of West Bromwich, with some iron, smelted by Mr. Charles Martin's patented process, from the titaniferous iron-sand of New Zealand. Other firms have since been experimenting with specimens of this iron, with results quite as satisfactory as those previously obtained by the Messrs. Hipkins. To the account of the properties of this almost unprecedentedly fine quality of iron which we gave three weeks ago, we may now add that a "heat" of it can be puddled in sixty minutes, which is just half the time per heat which the process of puddling usually occupies, and that the loss of iron in the process is only one-fourth of the usual proportion of loss. Moreover, this titaniferous iron has the remarkable property of completely resisting the action of hydrochloric acid. The peculiar qualities which give it its great value are doubtless due, in part, to its entire freedom from both sulphur and phosphorus, and not exclusively to the titanium which it contains. Still, it seems to be pretty well ascertained that a small quantity of titanium very greatly improves the quality of both iron and steel, and hence considerable attention is beginning to be directed towards the titaniferous iron ore, or "ilmenite," which exists in such vast quantities in Sweden, Norway, and Russia, and also in Canada and elsewhere, and which, while it can be had in this country much more cheaply than the New Zealand iron-sand, which contains only from 9 to 13 per cent. of oxide of titanium, contains not less than 40 per cent. of that oxide. As yet, there are many difficulties in the way of smelting, on the great scale, ores of iron containing so much titanium as the European titaniferous ores contain, but these difficulties will doubtless yield to sufficiently persevering efforts to overcome them. It is not proposed to endeavour to smelt these ores by themselves; all that is contemplated is the admixture of them, in small proportions, with our ordinary English ores. The conditions, however, under which such a mixture can be satisfactorily

smelted, have yet, for the most part, to be ascertained.

METALLIC TITANIUM.

Until 1850, titanium in the free state had not been seen by human eyes. The existence of the metal was first recognised in 1791, by Gregor, who detected its oxide in a black ferri-ferous sand occurring in the bed of a stream in the vale of Menachan, in Cornwall. Four years afterwards Klaproth found compounds of it in the red schorl of Hungary, and gave it the name which it still retains. Subsequently, Wollaston found it in the slag of the iron furnaces of Merthyr Tydvil, in which a compound of it occasionally occurs in the form of small cubical crystals, having the lustre of burnished copper. These crystals occur much more abundantly in the slag from the furnaces in which the Cumberland hematite ores are smelted. Their specific gravity is about 5.3, they are so extremely hard as to scratch rock crystal, they are infusible before the blow-pipe, and they are unacted upon by either nitric, sulphuric, or hydrochloric acid. Wollaston, as also all later chemists until Wöhler showed the mistake, regarded them as being pure titanium; they are really composed of the cyanide and nitride of the metal, and contain about 18 per cent. of nitrogen and 4 per cent. of carbon. Liebig fancied that he obtained titanium, as a dark-blue powder, by heating fragments of recently prepared ammonio-chloride of the metal to redness in a glass tube, in a current of dry ammoniacal gas; but what he thus obtained was really only the nitride. The free metal was first obtained by Wöhler, in 1850, by reduction, by means of potassium, from the fluo-titanate of potash. As thus obtained it is "an amorphous grey powder, resembling iron reduced by hydrogen at a low temperature. Magnified two hundred times it appears in fritted masses, having the colour of iron and a metallic lustre. Heated in the air it burns with a lively scintillation. The smallest particle of the metal projected into a flame produces a brilliant star-like spark. Heated in oxygen it occasions an instantaneous dazzling flame like lightning, titanic acid being the result. Wöhler expresses his belief that there is no other body which burns so energetically in oxygen. It decomposes water feebly at the boiling point of the latter. At high temperatures it combines, not only with oxygen, but also with nitrogen, and even in this gas, remarkable to say, combination is attended with evolution of heat and light." Within the last few months we believe that titanium has been obtained in considerable quantity, in Birmingham, by a process differing but slightly from Wöhler's, and that the metallic powder yielded by this process has been fused into compact masses of large size. No practical applications have yet been devised for it, but a metal which exists in such abundance must doubtless be susceptible of many uses, the nature of which we shall learn in due time.

THE GASES CONTAINED IN MOLTEN IRON AND STEEL.

All who have witnessed the operation of casting either iron or steel must have remarked

the disengagement of combustible gas which takes place at the moment of pouring the metal into the mould. This gas has usually been supposed to be due to the decomposition by the molten metal of the moisture contained in the sand of the mould, but this explanation of the phenomenon has just been disproved by M. Caillietet, a most interesting note by whom on this subject was presented to the Academy of Sciences on the 13th of last month by M. Henri Sainte-Claire Deville. M. Caillietet's experiments leave no doubt that combustible gases are evolved by molten iron, during cooling, when the iron has not come in contact with either sand or any other body containing moisture, and that these gases always consist mainly of hydrogen and carbonic oxide. M. Caillietet at first endeavoured to collect the gases by pouring molten iron into a red-hot cast-iron vessel having a mouth of very small aperture, to which, as quickly as possible after pouring the iron in through it, he attached a tube connected with a kind of pneumatic trough. He found, however, that he could collect very little gas by this method, since most of the gas escaped before the mouth of the vessel could be closed by the fitting to it of the tube, and his next plan therefore was to use a conical vessel, having no bottom, but having an apparatus for the collection of gases attached to its upper part, and to plunge this vessel,—having first rendered it red-hot, in order to free it from all trace of moisture,—into the molten metal the gases contained in which he wished to examine. The difference between the temperature of this red-hot vessel and that of iron in a state of fusion of course caused the liquid metal which entered the interior of the vessel to instantly cool, and in so doing it always evolved gases, which always consisted principally,—if not entirely,—of carbonic oxide and hydrogen. There was always some nitrogen mixed with these gases, as collected, but M. Caillietet thinks that this may possibly have been due in part,—to the air with which the apparatus was of course filled at the commencement of each experiment. He gives the composition of the gaseous mixture contained in his apparatus after two experiments, in one of which an English "grey" cast-iron, smelted with coke, was used, and in the other a very good quality of French iron, smelted with charcoal. In the one instance the gases consisted of 33.7 per cent. hydrogen, 57.9 per cent. carbonic oxide, and 8.40 per cent. nitrogen, and in the other of 38.60 per cent. hydrogen, 49.20 per cent. carbonic oxide, and 12.20 per cent. nitrogen. M. Caillietet could not succeed in collecting by the same method the gases evolved, during cooling, by molten steel, the temperature of molten steel being so high as to instantly liquefy the vessels he tried; but he collected the gases from steel by another method, and found that they also consist chiefly of carbonic oxide and hydrogen. He is still pursuing his experiments, which may possibly lead to results of practical moment.

M. FLEITMAN'S PROCESS FOR OBTAINING OXYGEN.

We have several times referred to M. Fleitman's ingenious process for obtaining oxygen by the action of hydrated sesquioxide of cobalt on a solution of commercial chloride of lime. This process has been regarded as being many times more economical than the chlorate of potash process, by which oxygen is usually obtained; but recent experiments have shown that it is not so. Weight for weight, chloride of lime does not cost more than one-twelfth of the cost of chlorate of potash, but it only yields one-twelfth as much oxygen, a pound of chlorate of potash yielding thirty gallons of that gas, and a pound of chloride of lime only two and a half gallons. As regards convenience, the advantage lies altogether with the chlorate of potash process, a copper retort of one quart capacity sufficing for the treatment of enough chlorate of potash to yield thirty gallons of oxygen, while to obtain the

same quantity from chloride of lime at least three gallons of solution of that compound must be treated.

INFLUENCE OF HEAT UPON THE ELECTRO-MOTIVE FORCE OF VOLTAIC COUPLES.

M. Edmond Becquerel found some time ago that if a Daniell's, Grove's, or Bunsen's cell be raised to a temperature of about 100 deg. Fah., a much stronger current is obtained than when the cell is simply at the temperature of the atmosphere. As the resistance of a voltaic couple is greatly diminished by increase of temperature, M. Becquerel was led to inquire whether the increase of energy which takes place under the circumstances mentioned is due solely to diminution of resistance, or whether it is occasioned in part by an actual increase of the electro-motive force of the couple, and he ascertained that the electro-motive force of a Grove's cell is 4 per cent. greater at 100 deg. than at zero, and that this augmentation of its electro-motive force is mainly the result of an increase in the intensity of the reaction upon each other of the two liquids in the cell. F. Lindig has recently taken up the investigation at this point, and in the new number of Poggendorff's "Annalen" is a long account of the results of his researches. They go to show that it depends mainly upon the nature of the two liquids in a cell whether or not increase of temperature augments the strength of the current obtained from it. With some liquids, increase of the temperature of a cell considerably diminishes the strength of the current.

A CARBON-COMPOUND SENSITIVE TO LIGHT.

Dr. F. Gottschalk has found that graphitic acid,—of which more below,—is sensitive to light, the minute yellow crystalline scales of which the acid consists blackening very quickly when exposed either to direct sunlight or to diffused daylight, or to any powerfully actinic artificial light. Photographers are hoping that this discovery may lead to that of some simple and satisfactory process of carbon-printing, and several of them are studying graphitic acid very closely with a view to this end. One of the chief difficulties in their way arises from the exceedingly slight solubility of this singular body, which dissolves in water and alcohol only in very minute quantity, and not at all in any other menstruum that has yet been tried. Small, however, as is the proportion of it which will dissolve in water, paper soaked in its aqueous solution becomes reddish brown on exposure to light, any parts of the paper which may be protected from the light remaining quite white.

FORMATION AND CONSTITUTION OF GRAPHITIC ACID.

Graphitic acid is the only compound as yet known in which carbon certainly exists in one of its allotropic modifications. Carbon exists in the free state in three distinct forms: that of the diamond, or crystalline carbon, that of graphite, or semi-metallic carbon, and that of ordinary charcoal, or amorphous carbon, and when combined with other substances by any method of treatment except one devised by Sir B. C. Brodie in 1858 these three forms of carbon all yield precisely the same compounds,—all three of them forming carbonic acid, for example, when burnt with a free supply of oxygen, and the carbonic acid formed by the combustion of any one of the three being quite undistinguishable from that formed by the combustion of either of the others. Brodie, however, discovered that, when treated in a certain way with powerful oxidising mixtures, graphite forms a compound which is not formed when amorphous carbon,—he does not seem to have tried the diamond,—is similarly treated, and that the carbon in this compound is in a form in which it has properties so distinct from those of the carbon in all other known compounds into which carbon enters as to constitute it virtually another element. The carbon in this

remarkable substance has even a different equivalent from that of the carbon in all other known carbon-compounds, the equivalent of the carbon in all other carbon-compounds being 6, whereas that of the carbon in Brodie's compound is 53. Brodie therefore proposed that carbon as it exists in the compound in question should be named "graphon," and that the symbol "Gr" should be used for it, and the compound itself he called "graphitic acid." This compound is best formed by digesting pulverised graphite with a mixture of chlorate of potassium and nitric acid, at a temperature of about 60 deg. Centigrade, until yellow vapours are no longer given off, then washing in a large quantity of water, drying on a water bath, and repeating these three successive operations several times. Other oxidising mixtures than that of chlorate of potassium and nitric acid may be used, but the graphite cannot be converted into graphitic acid by only one digestion therewith, however prolonged. After the first digestion the graphite is still black; during the subsequent digestions it gradually passes through various shades of green to a sulphur-yellow, which is the colour of the crystalline scales of graphitic acid. Brodie regarded the acid as consisting of $\text{Gr}^6 \text{H}^6 \text{O}^{15}$,— Gr^6 being equal to C^{33} ,—but according to Gottschalk's recent analyses its formula is $\text{Gr}^6 \text{H}^6 \text{O}^{16}$.

A NEW HYDRAULIC CEMENT.

At the sitting of the Academy of Sciences on the 4th inst., M. Henri Sainte-Claire Deville announced that a very valuable hydraulic cement may be obtained by heating dolomite,—the abundant native double carbonate of magnesium and calcium, commonly known as "magnesian limestone,"—to between 300 and 400 deg. Centigrade, and then making it into a paste with water. The heat to which the dolomite is subjected should be above 300 deg., but should not exceed 400 deg.

DISCOVERIES IN AGRICULTURAL CHEMISTRY.

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

THE following is the fourth of the Cantor Lectures, delivered before the Society of Arts:—The largest number of organic substances are composed of only three elements or simple bodies, viz., carbon, hydrogen, and oxygen, and even in many the latter substance is absent—for example, in many essential oils and the products resulting from the destructive distillation of organic substances, whilst those which contain oxygen are chiefly represented by starches, gums, resins, organic acids, and fixed oils; another class, such as morphine, quinine, and indigo, contain nitrogen, in addition to the substances mentioned. There is another class of substances, limited in number, which contain sulphur and phosphorus, besides the four elements above cited; these are represented by albumen, corresponding to the white of an egg, or the serum of blood in animals; fibrine, represented in animals by the clot of blood; caseine, characterised in animals by the curd of milk. Therefore the whole of the organic matter of the vegetable kingdom is represented by the uniting together in various portions (influenced by particular molecular arrangements) of six elements, viz., carbon, hydrogen, oxygen, nitrogen, sulphur, and phosphorus. Although organic matters are composed of two or more of these elementary substances, they are never found in vegetable matters in their pure and isolated condition. They are always combined with a certain quantity of mineral matters which appear essential to the healthy condition of plants, and are, so far as we know, essential to the formation of the organic bodies themselves. Thus chemists have ascertained that plants generally contain lime, potash, soda, magnesia, oxide of iron, sulphuric acid, phosphoric acid, &c.

Let us examine the principal sources from which plants derive the elements essential to their formation, growth, or healthy progress. The most important element of all vegetable substances, and which, in fact, characterises all organic matter, is carbon, or what is commonly called charcoal. This element is derived entirely in vegetables from a colourless, invisible, and slightly acid gas, having a specific gravity of 1.52, and also sparingly soluble in water—I mean carbonic acid. You will easily conceive, on reflection, what an enormous proportion of carbonic acid must be produced annually, when you consider the vast amount of vegetation which surrounds us, produced either by the hand of

man, under the influence of the plough, and other instruments, or by the rapid growth of trees and other vegetation which covers our hills and mountains. In truth, the Divine Being has provided for an abundant supply, for there exist many sources of production of this gas so necessary to vegetation. It is useless to record here the well-known modes of producing this gas by respiration and combustion, but I wish to call your attention to some more special sources of its production with which you may not be so perfectly acquainted. M. F. Kuhlmann, a well-known chemist, published in 1861 and 1862 a most interesting series of papers on the production of carbonic acid through the oxidation and reduction of the oxides of iron by their contact with organic matter. Thus he found that, if he took a clod of earth, the bulk of the iron existing on its surface was in a state of peroxide, mixed with a small quantity of protoxide, whilst towards the interior of the soil the reverse was observed. M. Kuhlmann thus found that the oxygen of the oxide of iron was conveyed to the organic matter to convert it into carbonic acid. He further made the remark that sulphate of lime was, as M. Chevreul had already observed, a powerful oxidising agent, or served as a conveyor of the oxygen of the atmosphere to the organic matter existing in soils, the sulphate of lime becoming converted into sulphuret of calcium. These results explain certain facts observed by two learned chemists, M.M. Boussingault and Loewig, who found that there existed large quantities of carbonic acid in cultivated soils, and especially in those that were highly manured, and that the production of this gas was continuous and most abundant. The following statement, taken from their researches, will satisfy you, I hope, of the correctness of the above assertion:—Carbonic acid: air, 0.4; recently manured soil, 5.4; recently manured soil, 235.3; vineyard, 283.4; forest loam, 70.6; forest land, 82.2; soil rich in manure, 420.6; meadow, 161.8.

Another source of the production of carbonic acid gas is one lately pointed out by a gentleman whom I cited last year with great, but not exaggerated praise, as a successful demonstrator of the untruth of the theory of spontaneous generation. M. Pasteur has demonstrated that wherever there is decay there is life—that, in fact, the rapid decay of organic matter depends in a great measure on the existence and maintenance of microscopic beings, and, as I stated in my last year's lecture, death is life. For M. Pasteur has shown that in all decaying matter exposed to the atmosphere, there exist mycodermis which carry the oxygen of the atmosphere to the organic matter, converting its carbon into carbonic acid, its hydrogen into water, its sulphur into sulphuric acid, its phosphorus into phosphoric acid. As to its nitrogen, other chemical actions come into play. There is still another source of production of carbonic acid, which I cannot pass by in silence, for though at the present day its activity is decreased by the better cultivation of land, its influence must have been very great when men were less numerous on the surface of our planet, and no doubt, even now, that source of production of carbonic acid plays a great part in the vegetation of wild forests such as those of Northern and Southern America. Dr. Lyon Playfair, Mr. J. A. Bannister, and M. Morin, proved some years since that certain small vegetable substances, known under the names of conifers and algae, had the property, under the influence of light, of decomposing carbonic acid; while, on the contrary, in diffused light or darkness they yield carbonic acid. Strange it is to think that often some of the trees of these wild forests carry on their surface or their bark the vegetables which are to destroy them by absorbing their sap, and to feed them by liberating the carbonic acid essential to their growth. As to the conifers, which exist in marshy lands, pools, and other stagnant waters, they disappear by the hand of man as he drains the land and improves it for agricultural purposes. Notwithstanding the abundant sources of the production of carbonic acid, the atmosphere appears to contain but a minute quantity, viz., four parts in 10,000. This fact may be regarded as owing, first, to a law discovered by Dalton of the extraordinary property which gases have of being diffused and mingling together; secondly, to the immensity of the atmosphere as compared even with the abundant sources of carbonic acid; thirdly, to its removal by constant vegetation, either on land or in the ocean; fourthly, that a great portion of the carbonic acid which is produced in the interior of soils is absorbed by the spongettes of plants. Liebig calculated, some years since, that if our sources of production of carbonic acid were to cease, and the present state of vegetation on the surface of our planet still continued, there was a sufficient amount of carbonic acid in the atmosphere to maintain it in full activity for a great number of years. As to the decomposition of carbonic acid by the leaves of plants under the influence of the chemical rays of light—scientific points which have engaged the attention of many chemists, among whom I may cite Boussingault, Dr. Gladstone, Grinwenden, and others—it is unnecessary that I should do more than state that the carbon of the carbonic acid is retained by the

plant and contributes to produce the organic matters which form the frame of it, whilst the oxygen is liberated in a pure state to contribute again to the reproduction of carbonic acid by fixing itself on the carbon of decaying matter, or that which is produced by combustion or animal respiration.

Nitrogen.—The absorption and fixation of nitrogen in plants are of the highest importance to vegetation, and no subject has more engaged the attention of chemists and agriculturists than the ascertaining how nitrogen was supplied to plants, for if the quantity of nitrogen is found but in small quantities in plants, still its supply to vegetation is essential to the growth and health of those plants. The quantity of nitrogen that a plant requires is but small, but still as it is an essential element to the formation of nitrogenated substances, and as these are always found most abundant in all newly-formed vegetable matters, such as the germ from the seed or the sprout of the plant, nitrogen must be freely supplied by the agriculturist if he wishes to obtain an abundant crop. Liebig's publications of 1841, proving the identity of the nitrogenated substances of plants, such as albumen, fibrine, caseine (legumine), with those existing in animals, and the exaggerated views entertained by Boussingault and Payen on the value of manures in accordance with the quantity of nitrogen they contain, led many chemists to investigate whether the nitrogen which plants require for the production of these nitrogenated substances was derived either from the atmosphere in its gaseous form, or from ammonia or nitric acid existing also in the atmosphere or in the soils in which the plants grew. An animated discussion, based upon a long series of researches, ensued between Boussingault and Ville, the latter contending that plants could absorb nitrogen from the atmosphere and fix it as a part of their organism; the former contending that the nitrogen contained in plants was derived either from ammonia or nitric acid. This discussion was still proceeding when Mr. Lawes and Drs. Gilbert and Pugh published, in the "Memoirs of the Chemical Society of London," 1863, such a complete and elaborate series of researches that chemists came to the conclusion that the nitrogen existing in plants was not derived from the atmosphere as nitrogen. There can be no doubt that the general tendency of scientific as well as practical investigation, as above stated, proves that it is most probably under the form of nitric acid, or more so in a state of nitrates, that nitrogen penetrates into plants, and becomes one of the essential elements of the formation of albumen, fibrine, legumine, or other nitrogenated substances which are found existing in vegetables. We shall as we proceed go more deeply into these interesting data, connected not only in a scientific point of view with agriculture, but having a most important bearing on its practical progress; and to give you here only one example of the importance of the subject under consideration. I may be allowed to cite the thousands of tons of guano which have been imported into this country with a view of supplying to plants the nitrogen they require for active vegetation. In fact, so much importance was attached some twenty years ago to the presence, and more so to the amount, of nitrogen in a manure, that the whole of its commercial value was based upon the real amount of nitrogen it contained; and although in the present day these views have been greatly modified by the publications of Liebig, which have shown that for the healthy growth of plants certain mineral matters are essential, and if not so essential as nitrogen, are as important, still the commercial value of a manure at the present day depends, in a great measure, on the amount of nitrogenated matter which it contains; and there can be no doubt that the ardent discussions which have taken place between the chemists who were in favour of attributing the whole of the value of a manure to nitrogen, and Liebig, who denied these views, and supported with his usual indomitable spirit, his all-exclusive mineral theory, led to the conclusion that if plants can live without the addition of manures, still that the use of them stimulates vegetation in a marked degree.

These views of Liebig were based on the fact that after he had noticed trees growing on a barren rock, he asked, whence did these trees derive the elements necessary to the formation of the organic tissues which enter into their composition? The reply was obvious—from the atmosphere. Therefore, if we give to plants the mineral elements, they can derive their organic construction from the elements existing in the atmosphere, and to substantiate those views, he discovered in rainwater, collected in the open country, away from all sources of pollution, nitrate of ammonia, results which were confirmed by Dr. Lyon Playfair, and by the researches of Barrall, which are shown in the following statement:—Rain water.—Paris: Nitrogen, 7.989; ammonia, 2.769; nitric acid, 21.800; chlorine, 1.946; lime, 5.897; magnesia, 2.800. No doubt the views of Liebig are correct in theory, and will suffice for a slow and feeble vegetation, but will not answer the requirements of active husbandry, especially with heavy soils, and this has been demonstrated beyond all doubt by the elaborate researches pursued for

years and at a great expense, by Mr. Lawes and Dr. Gilbert, who proved that if, on the one hand, an addition of a certain proportion of nitrogen is essential to vegetation, on the other a due regard must be paid to the nature and the amount of the mineral matters supplied to crops according to their peculiar requirements, as shown by the following statement and table:—Quantity of wheat on same land twelve to twenty years. Farmyard manure, 85 bushels per acre; unmanured, 15; superphosphate of lime, 18; salts of ammonia, 22; salts of ammonia and mixed mineral manure, 38; nitrate of soda, 25; nitrate of soda and mixed mineral manure, 34.

From the above you will gather that in the upper part of a bed (one metre in depth, and composed as above shown) there is far more nitre than in the lower portions of it. These researches of M. Millon threw much light on those published some years since by M. Boussingault, who ascertained the rate of proportions of nitre that existed in various qualities of soils and also the influence of manured land on the production of nitre in soils. Thus, M. Boussingault found that the quantity of nitre in non-manured land was a mere trace; in uncultivated land there were from 1 to 0.5 in 1,000 parts of soil, whilst in cultivated land, and in highly manured ground, 18 parts in 1,000. He further

TABLE SHOWING THE EFFECT OF AMMONIA SALTS AND MIXED MINERAL MANURE, Dressed Corn per Acre in Bushels and Pecks.

Plot	1852	1853	1854	1855	1856	1857	1858	1859	1860	1861	1862	1863	1864	Annual Average															
	B. P.	B. P.	B. P.	B. P.	B. P.	B. P.	B. P.	B. P.	B. P.	B. P.	B. P.	B. P.	B. P.	B. P.															
3	18	8	5	8	31	0	17	0	14	2	19	3	18	0	11	1	16	0	17	1	15	2		Unmanured. Mineral manure.					
5	16	8	10	0	24	0	18	1	19	2	23	8	19	0	20	2	13	8	15	1	17	8	19		2	18	1	2	3
17	24	8	8	2	44	0	18	0	31	0	26	1	33	2	20	2	25	1	18	2	27	8	21	1	18	8	3	1	Mineral manure and am- monia salts.
18	14	1	19	1	23	8	33	0	16	8	40	2	21	3	39	2	15	3	32	3	18	2	46	1	32	8	17	0	
10 A	21	8	9	3	34	1	19	8	24	0	29	0	22	8	18	5	15	0	12	3	23	0	39	0	32	8	7	0	Ammonia salts alone.
10 B	22	0	15	2	39	0	38	0	27	2	34	2	27	8	26	2	18	2	15	3	24	3	43	2	32	8	11	1	
7	26	3	23	2	45	1	33	0	36	8	44	3	39	0	34	2	27	2	34	3	35	3	53	2	36	1	20	8	Ammonia salts and mineral manure.

From these practical results, and many others which will be found in the papers published by Mr. Lawes, F.R.S., and Dr. Gilbert, F.R.S., in the "Journal of the Agricultural Society of England, 1863-4," it is evident that in this case, as in many others I could cite, extreme views always bring a medium result which time generally confirms as the correct one. I shall have to refer more minutely to these theories as I proceed with my lecture. Let me, meanwhile, call your attention to several chemical reactions which tend to modify organic matter, and render it fit to penetrate into plants, so as to enable them to yield the nitrogen so essential to vegetation. If the conversion of nitrogen into nitric acid, under the influence of certain mineral substances, has been known by its results for a long period in what is called the nitrification in the walls of our dwellings, still the demonstration of the conversion of ammonia into nitric acid is the result of comparatively recent researches. Even at the present day on the Continent it is believed (except by scientific men) that the moon has a great influence on the production of nitre in the walls of dwellings. Now, it is not the moon which has that power, but the sun, and as both move in the same direction the influence of one must be affected by the other, for as we know from the researches of Bunsen and others, as stated in my first lecture, that the intensity of chemical rays is in ratio with the intensity of light, it follows that it is the chemical rays of the sun which affect the conversion, and not the rays of the moon. At all events it is easy to conceive how ammonia can be converted into nitric acid in the walls of our dwellings, for sulphate of lime has the power of condensing ammonia, and no doubt, as demonstrated by Kuhlmann, of yielding its oxygen, thus converting its hydrogen into water, and its nitrogen into nitric acid, which in its turn destroys the sulphate of calcium, giving birth to nitrate of lime. We all know that formerly, not only the rubbish from our dwellings was used as a means of obtaining the nitre which was required to manufacture the gunpowder used at that period, but that artificial nitre beds were prepared so as to yield the nitrate of potash required for war purposes. Even until recently, in Switzerland and Norway, the peasantry were subjected to a tax of supplying the government every year with a certain weight of nitre which those governments required for the preparation of gunpowder. Many researches have been undertaken to try and throw light on the chemical changes which take place in the conversion of the nitrogenated organic matter existing in such bodies into nitrates. The most interesting series of researches published on this subject are those due to M. Millon, which you will find in the "Comptes Rendus de l'Academie des Sciences, 1864," in which he has shown that the production of nitre is in ratio with the quantity of vegetable matter, especially humic acid, that a soil contains, and that the most favourable land for the production of nitre is that which is called mould by gardeners. He further ascertained that if he made a mixture composed of ordinary earth 20 parts, ashes 4, mould 3, the production of nitre was most active, and also that the oxygen of the air had a great influence on its production, converting the ammonia resulting from the decay of the organic matter into nitric acid.

These facts are well illustrated in the following table quoted from his researches:—

NITRIFICATION.		Parts.
Soil {	Earth	20
	Ashes	4
	Decayed manure	3
		Quantity of nitre.
Upper layer		440
Middle do.		441
Bottom do.		009

observed that if he manured a piece of land, after 7 days there were 12 parts of nitre per 1,000; in 17 days, 81 parts; in 15 days more, 233; in 15 days more, 280; and in 15 days further, 260; and then the quantity decreased rapidly. M. Millon has clearly demonstrated that the substance which first absorbs, and then helps the conversion of the ammonia into nitric acid, is the one known by chemists under the name of humine or humic acid. The presence of a small quantity of nitrates and traces of nitre in uncultivated land may be due to two different sources. First, Liebig, as we have already stated, demonstrated some years since, and his results have been confirmed by other chemists, that there always exist in the atmosphere small quantities of nitric acid, which are brought down to the soil by rainfalls. Secondly, M. Cloes has recently demonstrated that the mere passage of purified air over porous substances is sufficient to force a small amount of air and oxygen to combine together so as to produce a small quantity of nitric acid. Further, all soils, so far as we are aware, contain organic matter, with which the soil comes into contact from time to time. The tenacity with which soils retain organic matter is very remarkable, for Uraldini has lately proved that if you treat a soil several times with strong muriatic acid, and wash the residue with water so as to remove all traces of acid, still, in that residue you will find the presence of organic matter. The following researches prove that the nature of this organic matter may be either considered as being similar to humine, as shown by M. Millon, or similar to cellulose, as shown by Verdeuil, or of a nitrogenated nature, as demonstrated by Baron Paul Thenard. The elaborate researches of this gentleman are most interesting in many points of view, and, without entering into details, allow me to state that he has extracted from decayed dung, as well as from soils, an acid which he has called fomic acid. This nitrogenated acid is insoluble in water, but freely soluble in weak ammoniacal liquors, thus facilitating its absorption by soils when rotten dung is laid on land as a manure. But this solubility of the fomic acid soon disappears, for immediately that fomic acid comes in contact with peroxide of iron or oxide of aluminium (alumina) it forms an insoluble compound, which presents great stability, explaining at once how land manured one year can retain with tenacity the essential nitrogenated elements of the manure which it had one, two, or three years previously. What enhances the value of these recent researches is that Baron Thenard has succeeded in producing artificially the acid which he has discovered in rotten dung, and that by simply heating starch, sugar, gum, or substances existing in straw and other vegetable matters, with ammoniacal salts or nitrates, it being employed by him as a substitute for what we may conceive takes place under the slow action employed by Nature to accomplish her general purposes. If Baron Liebig's views respecting the importance of adding mineral matters to exhausted soils were too exclusive, as tending to establish that it was necessary to use other vegetable and animal manures for a farmer to produce remunerative crops, still, there cannot be a doubt that he has rendered great service to the progress of agricultural chemistry by drawing the attention of scientific men to the general composition of soils, and enabling them to point out the essential mineral substances that a soil should contain for it to claim the title of being fertile.

The most complete and elaborate researches which we possess on this intricate subject are due to one of our leading agricultural chemists, Dr. A. Voelcker, who has published in this year's "Journal of the Royal Agricultural Society of England" (p. 128), of which society he is the appointed che-

VARIABLE SPEED.

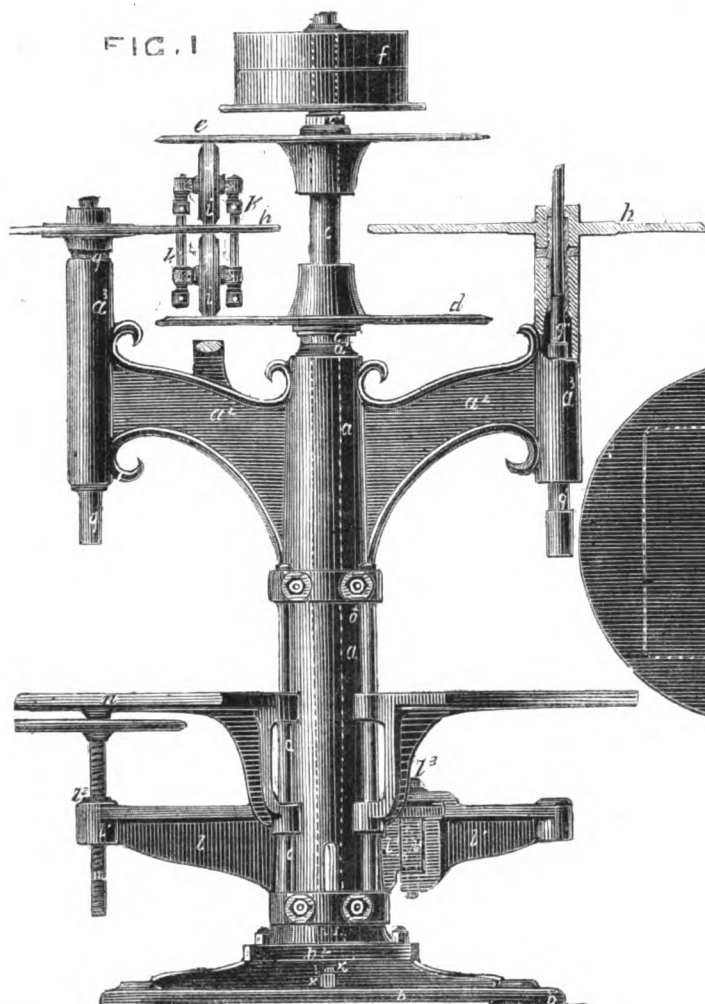
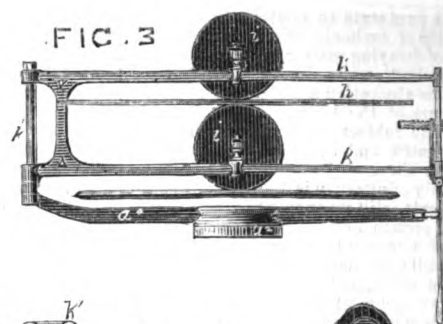
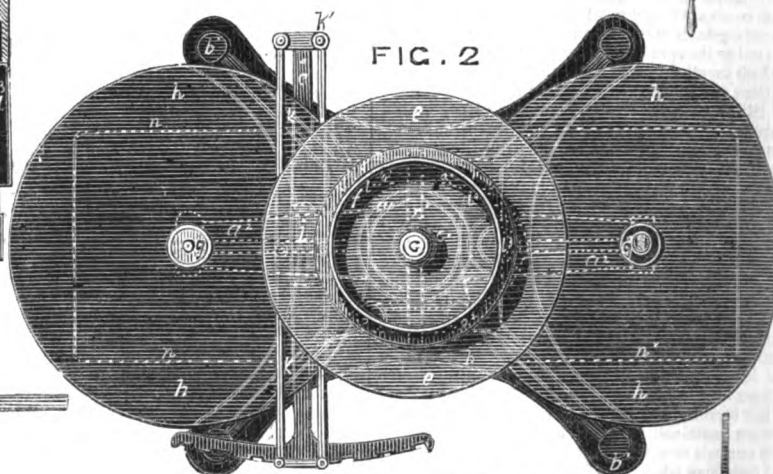
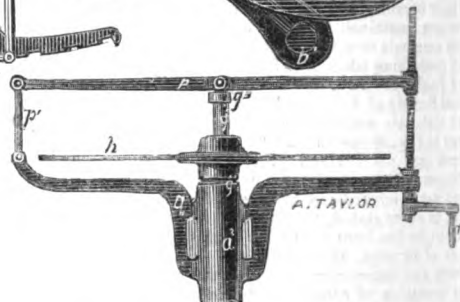


FIG. 4.



mist, a paper on some of the causes of the unproductiveness in soils, and the following table will give you not only an idea of the extent of his labours, but also point out the difference there is in the composition of soils, and that if in a soil there exists a great excess of one substance, as compared with others that compose it, that soil becomes unproductive:—

COMPOSITION OF UNPRODUCTIVE PEAT LAND, CLAY, CALCAREOUS, AND SANDY SOIL.

	Calcareous soil.	Sandy soil.	Clay soil.	Peaty soil.
Moisture	...	2'65	—	—
Organic matter and water	...	4'56	7'94	49'07
Oxides of iron and alumina	7'80	5'93	10'95	10'88
Carbonate of lime	73'807	'39	'86	2'29
Magnesia	'825	...	'26	'75
Potash and soda	traces	'28	'39	'90
Phosphoric acid	'242	...	'10	'06
Sulphuric acid	1'546	...	'30	1'04
Silica	16'716	86'19	—	—
Insoluble silicious matter	6'090	...	79'20	35'01
	100'000	100'00	100'00	100'00

Dr. Voelcker summed up his researches on the unproductiveness of soils in the following words:— Having spoken at some length of a variety of conditions which appear to me to affect the fertility of the land, my subject perhaps may be usefully brought to a close by a brief statement of what, in my opinion, the chemical analysis of soils can determine, and what it necessarily must leave undecided. In the first place, I would remark that the chemical analysis of soils can give very decided answers to the following questions:—1. Whether or not barrenness is caused by the presence of an injurious substance, such as sulphate of iron or sulphide of iron? 2. Whether soils contain common salt, nitrates, or other soluble salts, that are useful when highly diluted, but injurious when they occur too abundantly? 3. Whether or not barrenness is caused by the preponderance of—organic matter, or lime, or sand, or pure clay? 4. Whether sterility is caused by the absence or deficiency of—a.

Lime. b. Phosphoric acid. c. Alkalies, especially potash. d. Or available mineral (ash-constituents) matters generally. 5. Whether clays are fertile or barren? 6. Whether or not clays are usefully burnt and used in that state as manure? 7. Whether or not land will be improved by liming. 8. Whether it is better to apply lime or marl or clay on a particular soil? 9. Whether special manures, such as superphosphate or ammoniacal salts, can be used (of course discreetly) without permanently injuring the land, or whether the farmer should rather depend upon the liberal application of farm-yard-manure that he may restore to the land all the elements of fertility removed in the crops? 10. What kinds of artificial manures are best suited to soils of various compositions? 11. Whether deep-ploughing or steam-cultivation is likely to be useful as a means of developing the natural stores of plant-food in the soil? 12. Whether the food of plants in the soil exists in an available or inert condition?

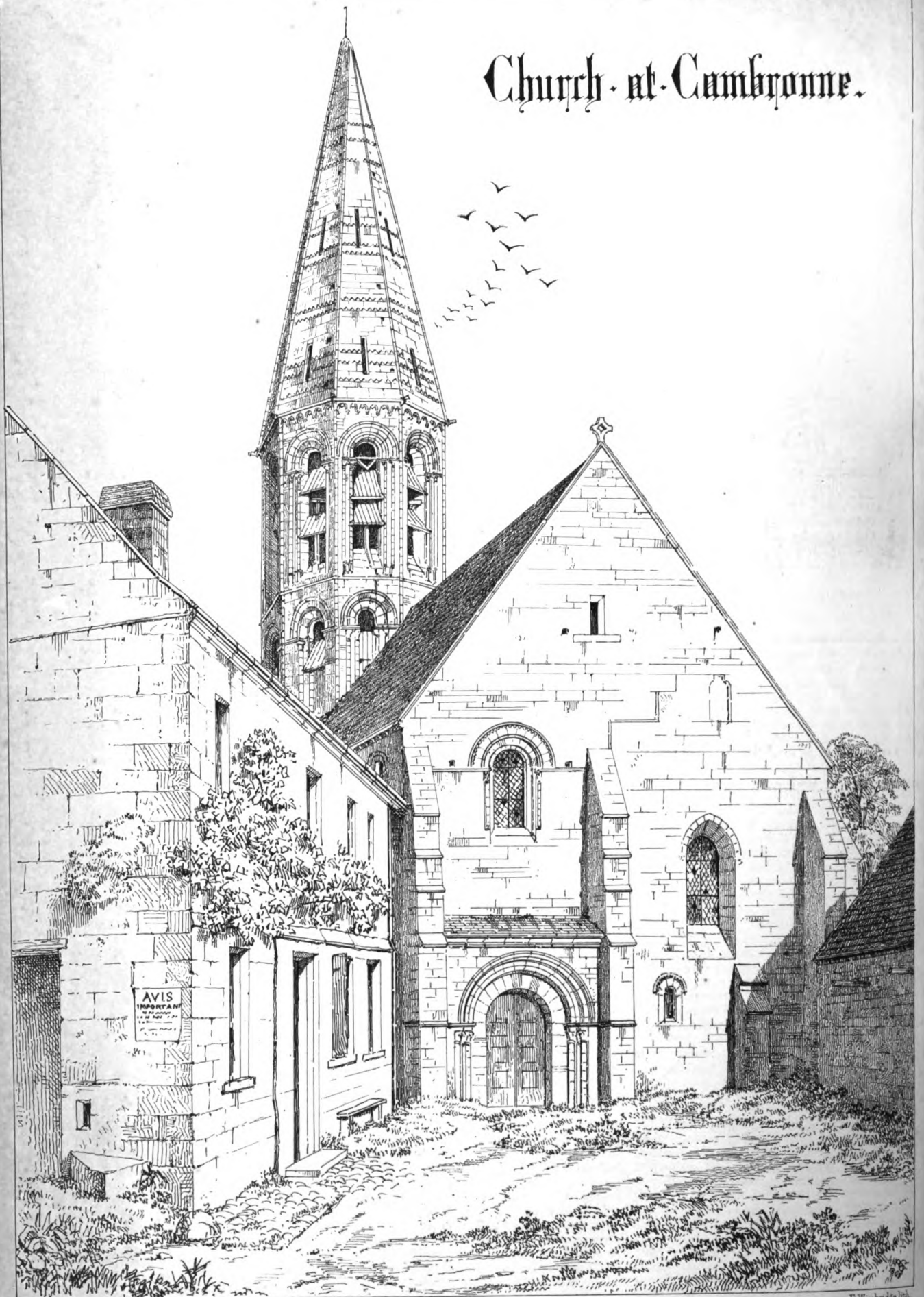
(To be continued.)

VARIABLE SPEED.

MR. JOHN COMBE, of Leeds, engineer, has patented an invention which has for its object improvements in the action and arrangement of drilling machines, turning lathes, and other machine tools in which the capability of obtaining a variable speed is required. The accompanying engravings illustrate the means which have been found to answer in carrying the same into effect. Fig. 1 is a front view, partly in section, and fig. 2 a plan, with some of the parts removed, of a drilling machine arranged according to this invention; figs. 3 and 4 are side views of some of the parts. a is an upright cast-iron hollow pillar firmly bolted, as shown, to a cast-iron bottom or foundation plate b, having 4ft. b', projecting diagonally from the four corners, sufficiently wide to give stability to the upright pillar. In the centre of the bottom plate b is fixed a step or bearing b', to receive the pivot end of an upright shaft c, which passes down through the hollow pillar a, and is capable of revolving freely in a socket a' at the top of the pillar a. Immediately above the socket a' on the upright shaft c, is keyed fast a horizontal disc d, the upper surface of which is turned true and level; above this disc d another disc e is also keyed fast on the upright shaft c; the disc e is

turned true and level on its lower surface, so that the two surfaces of the discs d and e, facing each other, revolve in perfectly parallel planes. The upper portion of the upright shaft c has a screw thread out thereon, and is provided with a nut c', by which the two discs d and e can be brought into closer proximity to each other as required; or the requisite adjustment may be otherwise obtained; above this nut c', on the shaft c, are placed the usual fast and loose pulleys f, by which motion is communicated from the driving strap to the machine. The shaft c is capable of being raised or lowered to a slight extent by turning the screws g, and thereby raising or lowering the bar a', on which the step or bearing b' rests. A projecting bracket a' is cast on the upright pillar a; this bracket a' has a socket a' cast thereon, which is bored out in a direction parallel to the axis of the upright shaft c; through this socket a' the drill spindle g is capable of revolving freely, being retained therein by two collars g', which fit against the upper and lower ends of the socket a'. On the upper end of the drill spindle g is keyed a horizontal disc h, which is turned true and level on both sides, and is placed between the two discs d e, carried by the upright shaft c. The three discs d e and h are of such diameters respectively that their circumferences intersect one another to about one-third of their diameter. A pair of friction rollers i, with solid leather surfaces, are suspended on rods or bars k, forming a kind of parallel motion working on two studs k', carried by the projecting arm a' formed on or affixed to the bracket a'; these friction rollers i are so placed respectively between the three discs d e and h that the friction of the discs d e, carried by the driving shaft c, transmits motion in an opposite direction to the intermediate disc h, carried by the drill spindle. It will be seen by reference to the engraving that the parallel motion which carries the friction rollers i is so arranged that the rollers i are capable of being traversed sideways to and fro between the axes of the driving shaft c and the drill spindle g, so that the nearer the friction rollers i are brought to the driving shaft c the slower will be the speed of the drill spindle g, and vice versa; the friction rollers i are capable of being fixed in any required position between the driving shaft c and the drill

Church at Cambryonne.



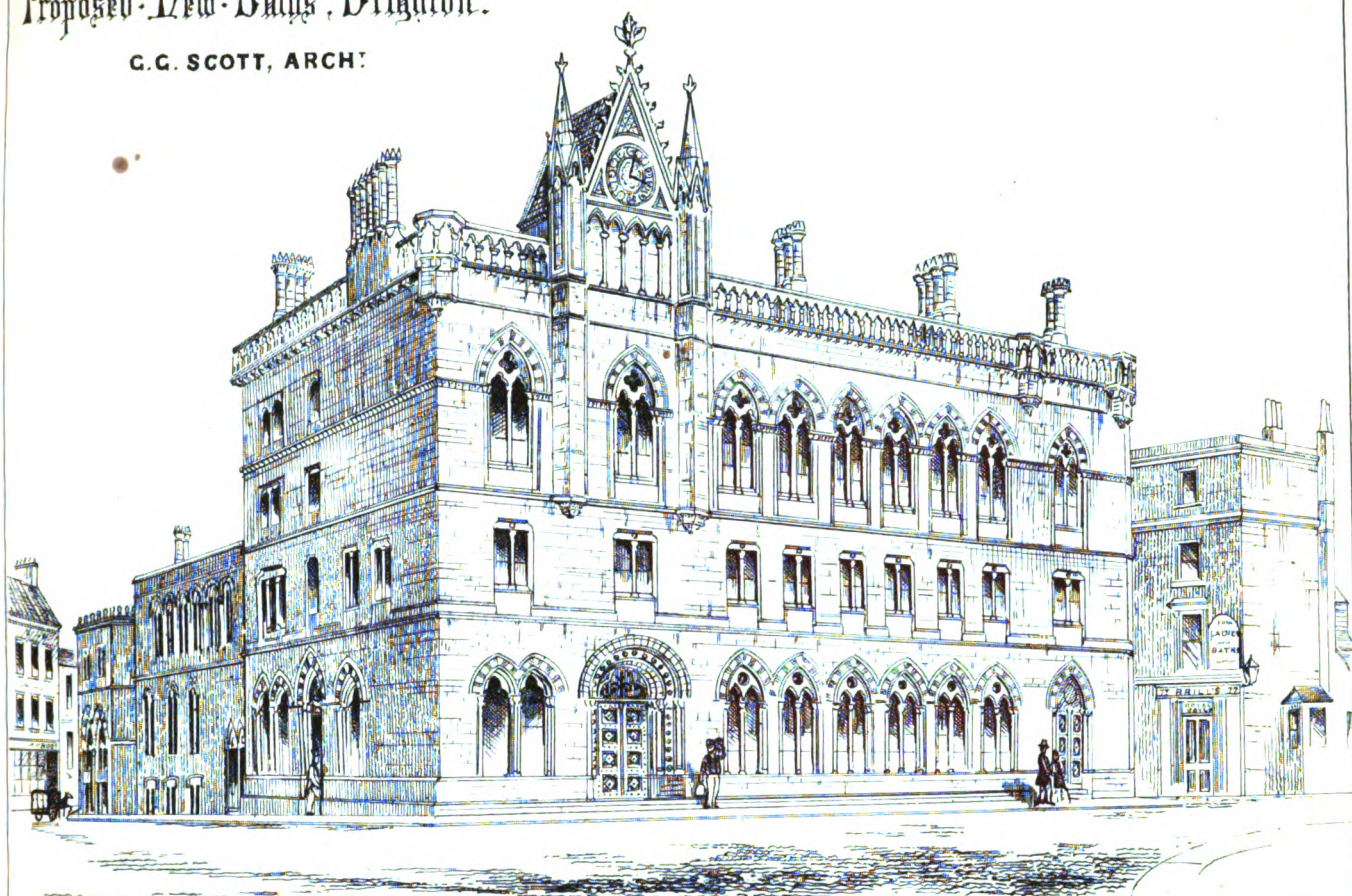
R.W. Edis, del.

E. Winbride, lith.

Gothic Architecture in France, N^o 24.

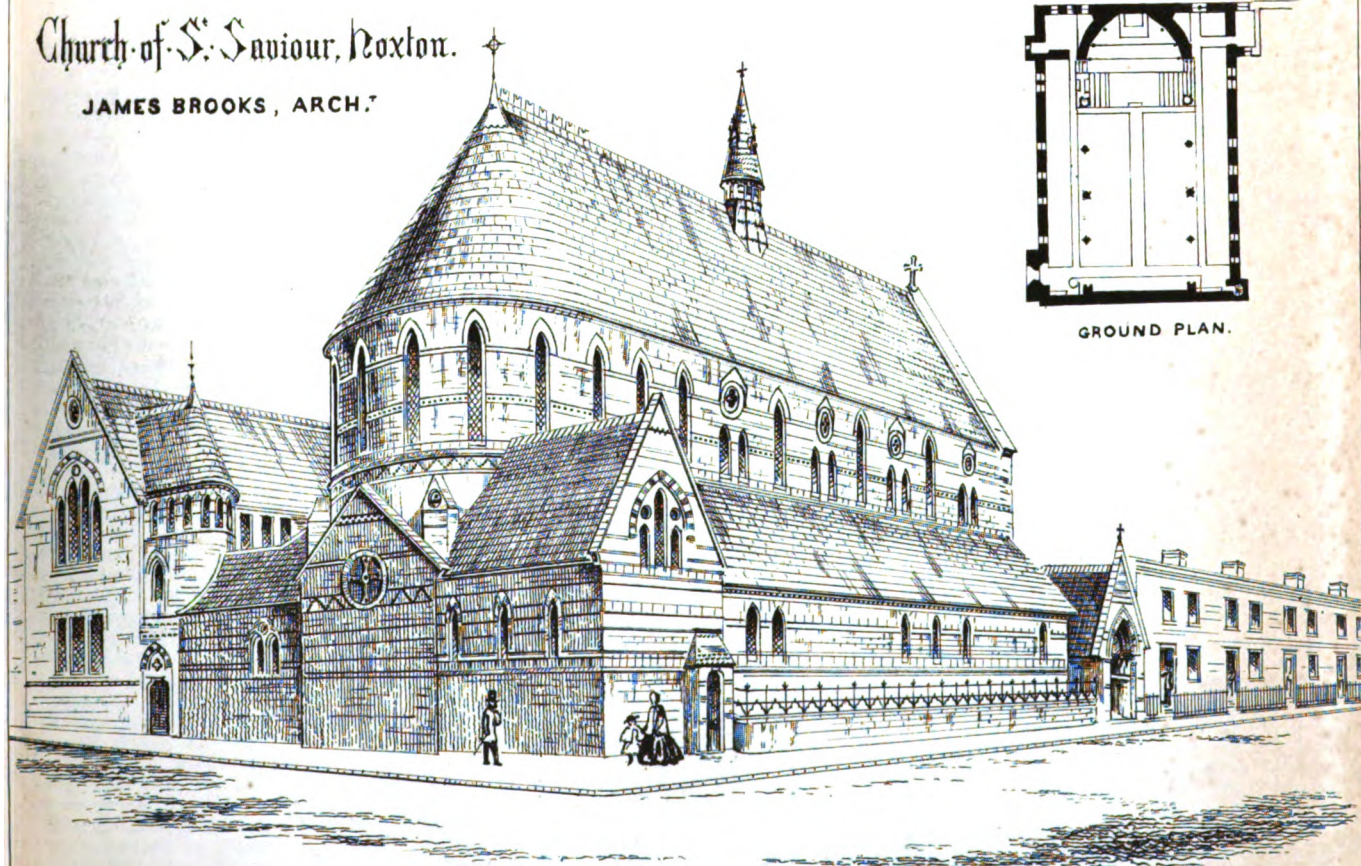
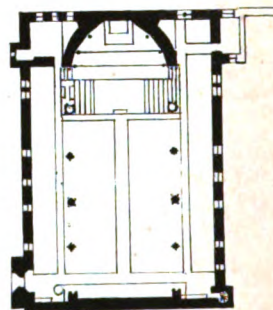
Proposed New Baths, Brighton.

G. G. SCOTT, ARCHT.



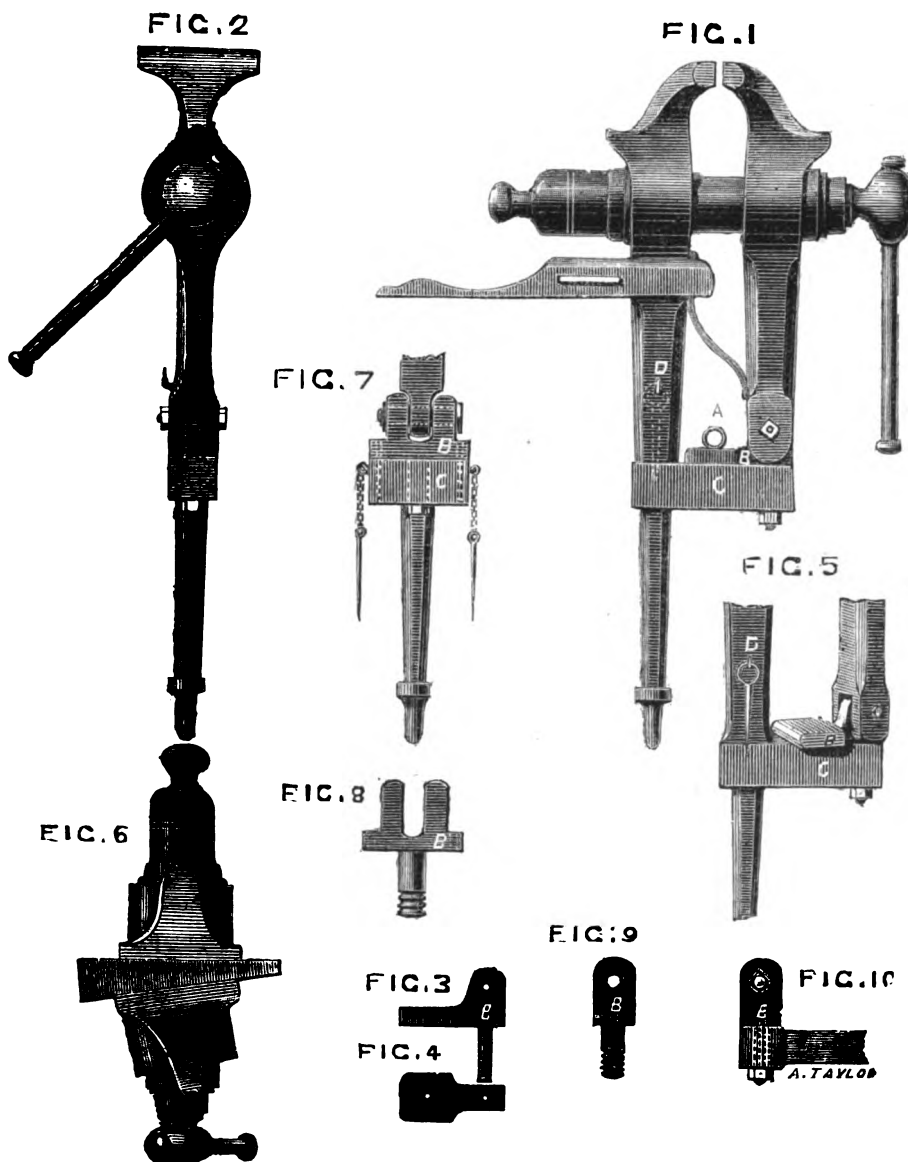
Church of St. Saviour, Noxton.

JAMES BROOKS, ARCHT.



GROUND PLAN.

PARALLEL JAW VICE.



spindle *g*, as shown in the engraving. On the lower part of the upright pillar a bracket *l* is cast, carrying a short socket or boss *l'*, the axis of which is in a line with the axis of the drill spindle *g*. This socket or boss *l'* is bored out to receive a brass nut *l''*, through which an upright screw *m* is passed, on which the table *n* which carries the article to be drilled rests; by means of the screw *m* the table *n* is raised and lowered as required. The table *n* is provided with four sockets, which slide freely on two upright parallel bars *o*, so as to cause the table *n* to rise and fall in a vertical direction when acted upon by the screw *m*.

In order to secure a perfect balance, as well as economy in the construction of these machines, it is preferable to make them double by casting on the pillar two sets of brackets on opposite sides, carrying two tables and drill spindles, to which motion is given by one pair of discs *d e*, and one upright shaft *c*. Some of the parts are shown in the engraving repeated on each side of the machine, and are marked with similar letters of reference. When it is required to drill articles of a greater length than could be accommodated on the tables *n* or *n**, the table *n** and the bracket *l** are turned out of the way, and the article to be drilled rests on the ground. For this purpose the rod *o'* is removed from the machine and the table *n* is turned upon the rod *o'* to one side, whilst the bracket *l** is turned on the pin *l'* out of the way when set at liberty by removing the set screw *u*. And in order that the drill may be capable of approaching to and receding from its work, the upper part of the drill spindle *g** is formed with flat sides passing through a socket *g***, so that the drill spindle is capable of rising and falling through the socket *g***, and yet controlled to rotate therewith; on the socket *g*** is fixed the disc *h**, as shown; the upper end of the drill spindle *g** is extended through the socket *g*** and its upper end is

formed to receive a pin g^2 , which is capable of revolving therein, but is secured thereto by a screw cap g^3 , as shown. By reference to fig. 4 it will be seen that the pin g^2 is at its upper end pinjoined to the arm p , which is at one end pinjoined to a link p^1 connected to the bracket q , as shown, whilst the other end is provided with a nut capable of turning therein, through which a screw r passes; the lower end of this screw is provided with a handle r^1 , by turning which the drill spindle g^* is raised and lowered as required. In applying the differential motion to turning lathes, the intermediate disc h is placed on the back end of the spindle of the fixed head, and to overhang the bearing, so that the circumference of the disc h may extend below the level of the gantry. Arms projecting from the cheeks of the fixed heads carry bushes in which revolves a shaft c , carrying the belt pulley and the two driving discs d e for each fixed head, the studs carrying the parallel motion for traversing the friction rollers being fixed to brackets below and at the back of the gantry. In a similar manner would a like motion be applied to other machine tools requiring such motion, and a competent workman will readily make such modifications as will be necessary in adapting it to other machine tools.

PARALLEL JAW VICE.

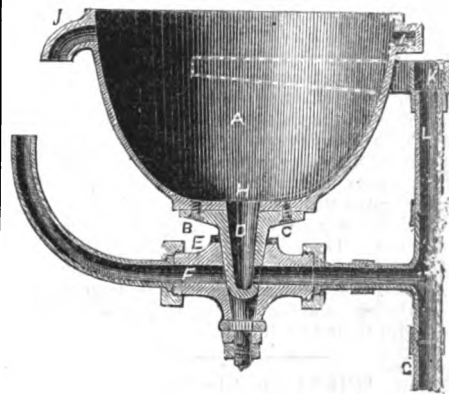
MR. WILLIAM JOHNSON, of Sowerby Bridge, York, toolsmith, has patented an improved vice, which is manufactured by Messrs. Ibbotson, of Sheffield. The invention consists in constructing the movable jaw of vices so as to render the vice capable of gripping all parallel work as firmly as ordinary bench vices, as well as taper objects when required. The inventor forms a solid crossbar or supporting piece for the movable front jaw on the leg of the fixed jaw, as in ordinary bench vices, and makes a hole in the free end thereof, in which he inserts perpen-

diouclarily the pivot of a swivel ; this pivot passe through the support, and is held down by a nut below screwed on its projecting point, which is threaded. The lower end or leg of the movable jaw is attached to the upper side of the swivel by a horizontal pin or bolt, passing through them both, from which a portion of the swivel extends towards the leg of the front jaw on the upper surface of the supporting piece, forming a lever, and through a hole in the end of which, and a corresponding hole in the support, a loose pin is passed, and remains as long as the vice is only required for ordinary work. When, however, the vice is required to grip a taper object, this last-mentioned pin is withdrawn, and the front jaw working on the swivel is thus left free to adapt itself to or grip the taper object equally tight at both ends of the jaw.

Fig. 1 of the accompanying engraving is a side elevation, and fig. 2 is a front elevation, of a vice constructed according to this invention, the pin A being kept inserted through the lever of the swivel with the pivot B, into the support C below, so as to keep the movable front jaw always parallel with the fixed back jaw. Figs. 3 and 4 are respectively a side elevation and a plan of the swivel with pivot B. Fig. 5 is a view of that portion of the vice to which this invention relates, showing the pin A in fig. 1 withdrawn from the lever B and support C, and hung on a hook D, so that the movable front jaw may swivel round and grip a taper object, as shown in plan in fig. 6. Instead of the foregoing arrangement, the swivel is sometimes made with a lever and a pin on each side, the supporting piece being formed to correspond, as shown in figs. 7, 8, 9, and 10.

ROTARY WATER TROUGH.

THE accompanying engraving represents a rotary water trough or cistern for stables and other purposes, which has been registered by Mr. James Barton, of Oxford-street. The purposes of utility to which the shape or configuration of the new parts of this design has reference are the facility with which the water supply pipe and the waste pipe may be opened and closed as required, and the providing of means for carrying off the overflow. The engraving represents a vertical sec-



tion of this trough or cistern, showing the waste pipe open. A is the trough or cistern, B is a disc, to which the bottom of the trough is secured by screws C C. The disc B is fixed to the plug D of the two-way cock E; F is the supply pipe, and G the waste pipe. H is an aperture in the bottom of the trough, to allow communication with the cock E; I J are two recesses near the upper part of the trough, forming hand-holes, by which the trough can be turned. The recess J is open in the form of a spout to serve as an overflow orifice. K is a pan into which the overflow falls. L is a short pipe for conveying the liquid from the pan K to the waste pipe G. To open the supply pipe F or the waste pipe G, or to close both, the trough A, and with it the disc B and plug D, are turned to the distance required by means of the hand-holes I J.

THE "HERCULES" TARGET.

DURING the month of June last this target was subjected to the fire of three Armstrong 300-pounders, or 12-ton guns, fired with 300lb. rifled projectiles and charges of 45lb., 55lb., and 60lb. of powder, when it proved quite impenetrable by any single shot. It has again been tested at Shoeburyness to show its power of resistance to the most powerful artillery that can be brought against it. At the recent trial, which took place yesterday week, the 600-pounder Armstrong, or

22-ton gun, was brought against it at 700 yards' range, with rifled projectiles of from about 575lb. to 535lb. weight, and with charges of 100lb. of powder—charges altogether unprecedented in any rifled gun. Except where two shots have struck rather near together, the target is still victorious. The lower half of the "Hercules" target is faced with 8in. iron, the upper with 9in. iron; behind both is 12in. of horizontal timber divided by four horizontal plates, then a skin consisting of 2½in. plates, the whole being secured to the ribs, which are 10in. deep, filled in between with vertical timber. Behind the ribs are two linings of horizontal timber 18in. deep, not bolted, but confined by 7in. iron ribs inside all. There is another three-quarter iron skin within the innermost wood backing, making up the total thickness of the target to more than 4ft. With this armour it is proposed to protect the water-line of a ship, to be called the "Hercules," leaving the remainder of her sides as vulnerable as those of our ordinary ironclads, and the plan, if practicable, is undoubtedly of the greatest merit and importance. In the recent trial the target sustained altogether seven rounds from the 600-pounder. The first of these was a steel rifled shot of 575lb. weight, fired with a charge of 100lb. This shot left the gun with a velocity of 1,420ft. per second, and struck the target at 700 yards' range with a velocity of 1,280ft., burying itself completely, breaking the rib of the ship immediately in the wake of the blow, and snapping off a considerable number of rivet heads from the innermost skin. The second round was a repetition of the first, and, except that the shot deflected a little upwards, owing to its having struck where the target received the extra support due to the deck of the vessel, the result was nearly the same. After this a chilled iron Palliser shot of 580lb. weight, fired with the same charge from the same gun, struck the target with 1,380ft. velocity, and close to the hole made by the preceding round. The effect produced by this shot was very great. The inner skin and ribs of the target were torn asunder and a great quantity of the pieces of the shot were forced through, as langrage, into the ship. A third Palliser shot of chilled iron struck the same 8in. plate fairly, penetrated it completely, and lodged in the backing, cracking an inner rib. A blind steel shell followed, and struck the 9in. plate, breaking it up to a serious extent, but effecting very little penetration. Except with the Palliser shot, the present form of which has always proved unfavourable for accuracy, the gun shot remarkably well both on this occasion and on the Tuesday previous, when it was tested with the same enormous charges of 100lb. for accuracy and initial and terminal velocities. The very high velocity given to the 580lb. projectiles, varying from 1,420ft. to 1,460ft. per second, according to their greater or less windage, shows also that the gun and powder both did their full duty.

SCIENTIFIC DISCUSSIONS.

A new mode of conducting a discussion has recently been introduced at the meetings of the Society of Engineers. On Monday, the 6th of November last, Mr. Vaughan Pendred read a very able paper before that Society on "Locomotive Adhesion." The paper, as read, appeared in substance in the *Engineer and Mechanic's Magazine*. On Monday, the 20th of November, Mr. Zerah Colburn read from printed slips an elaborate reply to Mr. Pendred's paper. This reply occupied over an hour to read, and has since been published as a pamphlet, consisting of twenty-eight pages. The meetings of the Society are held fortnightly, and on the 4th December Mr. Pendred answered Mr. Colburn. But he laboured under the obvious disadvantage of not possessing a copy of Mr. Colburn's reply. Mr. Colburn, after enjoying the privilege of seeing Mr. Pendred's paper in print, and thereby being enabled to minutely analyse and expose his opponent, denied Mr. Pendred a similar privilege. Though asked for a copy of the printed slips, Mr. Colburn failed to supply them in time to be of any use to Mr. Pendred. We will not enter into the merits of the controversy on locomotive adhesion, we merely wish to record our emphatic disapproval of this new and unfair method of conducting a discussion. It may be a Yankee method, but it is essentially an un-English one, and we hope it will not be imitated in this country. It was certainly novel to

read an elaborate address from printed slips in reply to Mr. Pendred's paper. We never heard of such a thing being done before, but to refuse Mr. Pendred the privilege of seeing the reply, when Mr. Colburn had seen Mr. Pendred's paper, indicated conscious weakness and a desire and a determination to resort to un-magnanimous means to take an advantage of an opponent.—*Building News*.

PROPOSED PRUSSIAN POLAR EXPEDITION.

At the last meeting of the Geographical Society of Berlin, Captain Werner, of the Prussian navy, gave an interesting account of the polar expedition as projected by him for next year. His object is by no means confined to an attempt to reach the north pole, but is rather the exploration of the polar basin generally. The route he proposes to take is from Hammerfest to Spitzbergen and Gillis Land, and entirely agrees with that advocated by Professor Petermann. The whole expedition is intended to occupy only eight months, from about the beginning of March to the end of October. The captain hopes that the Prussian Government may still be induced to take the matter up, and furnish one, or perhaps two, small screw war-steamers of about the size and capabilities of the "Medusa," whose engines are of 200-horse power. If the government refuse its assistance he will then make an appeal to German patriotism, and endeavour to raise the sum by private subscription. According to the *Star* the estimates have been carefully made, and the sum required is £16,500 for one ship, or £33,000 for two. This is to include everything—purchase of ships, pay of crew, coals for six weeks, instruments, and provisions for three years, in case they should find themselves frozen in. Captain Werner, however, believes that by the aid of his engines he may avoid this danger. Perhaps he may do so as long as his coals last, but when they are exhausted he may find himself in a fix in every sense of the expression. Perhaps, indeed, he may be able to replenish his bunkers at Spitzbergen, and the investigation of the coal-beds there will be one of his first objects. For the purpose of making way through the ice, the vessel's bows are to be strengthened by iron plates half an inch in thickness, but with this exception the vessels are to be of wood. There are several insuperable objections to iron ships for a polar expedition. In the first place, no amount of swinging and adjustment in other latitudes would be sufficient to make the compass trustworthy in an iron ship when in such proximity to the pole as Captain Werner hopes to reach. Secondly, it would be impossible to make the vessel warm enough, and the crew would inevitably be frozen to death. And, thirdly, if a plate or two should be stove in by the ice the damage could not be repaired. The expedition is to consist of about sixty men per ship, all volunteers, and about half of them with sufficient scientific acquirements to enable them to handle a sextant, or to make such observations, magnetic or otherwise, as may be deemed expedient.

MANUFACTURE OF MANURE.

In the manufacture of manure according to an invention which has been patented by Mr. Benjamin King, of the Hall, Rushmore, Ipswich, the following ingredients are used in the proportions hereinafter stated, which may, however, be modified if desired. First take four tons of animal excrement or dung, which has been previously placed in heaps for some five or six months, in order that it may become well decomposed; this dung is to be sifted through a half-inch sieve to render it suitable for drilling. Next steep from two to four tons of bones in water, by preference dilute urine, for from twelve to twenty-four hours; then mix and entirely cover them with sulphuric acid, and allow it to stand until the bones become a jelly. In this state the softened bones are mixed with the excrement, together with about from eight to sixteen hundredweight of sulphate of lime. The whole of the ingredients are mixed in a boiling state and again placed in heaps until the manure becomes decomposed, which will require at least a month before it will be ready for use, and may with advantage be kept for a much longer period. It may be again sifted if desired, in order to tender it more suitable for drilling in the regu-

lated and proper proportion desired. The following proportions are preferred in forming the compound manure, but which, however, may be varied considerably according to the quality of manure it is desired to manufacture:—One ton of bones, one and a half tons of animal excrement, six hundredweight of sulphuric acid, four hundredweight of sulphate of lime.

BROMINE AND BROMIDES.

An invention has been patented by Mr. Louis Leisler, of Glasgow, which relates to improved means applicable for obtaining bromine and bromides from all substances containing that element, whether in large or small proportion, but peculiarly suitable for the treatment of what is known as German chloride of magnesian, of the residuary liquors from seawater, and of kelp liquors. The invention consists mainly in liberating the bromine from the magnesian or other liquor or substance by the action of bichromate of potash and an acid aided by heat, the bromine thus separated being passed through a condenser containing metallic iron, whereby bromide of iron is formed, from which pure bromine or another bromide, such as the bromide of potassium, may be obtained by easy processes. The inventor uses apparatus comprising a still, the bottom of which may be of cast iron, whilst the head is made of lead or stoneware, is large and dome-shaped, and has attached to it a curved leaden or stoneware exit pipe. The exit pipe communicates with a stoneware receiver, somewhat in the form of a Woulfe's bottle, but with provision for drawing off liquid from the bottom. The receiver communicates with a condenser, which consists of a long stoneware pipe. The still is filled with the liquor up to about the top of the cast-iron bottom, and heat is applied by means of an ordinary furnace arranged beneath the still. Whilst the liquor is heating, a saturated cold solution of bichromate of potash is added until there are about two pounds of the bichromate of potash to every hundred gallons of the liquor, and the same is thoroughly mixed with the liquor. Before the liquor reaches a temperature of 150 deg. Fah., there is added to it one gallon of hydrochloric acid (previously diluted with three or four times its bulk of water) for every hundred gallons of liquor operated upon, and the mixture is immediately stirred to thoroughly intermingle all the ingredients. The head is now put on, and the exit pipe, receiver, and condenser are all connected and the joints luted, the condenser having been previously filled with wrought-iron turnings, which are by preference large, light, and of a spiral form. The fire is so regulated as to keep the liquor steadily and gently boiling, and steam blowing uniformly through the condenser until bromine can be no longer detected. The bromine evolved with the steam unites with the iron in the condenser, forming bromide of iron, which, dissolved by a little water condensed from the steam, drops from the end of the condenser into a vessel placed to receive it. When all the bromine is evolved the still is opened, the remaining liquor is siphoned off, and a fresh supply poured in, the bichromate of potash and acid added as before, and the distilling operation repeated. The iron has not to be renewed until after many operations, as very little of it is consumed during each one. The bromide of iron obtained in this manner may be converted in the usual manner into bromide of potassium, or into other bromides.

To obtain bromine, the bromide of iron is heated with bichromate of potash and acid in suitable retorts, and the bromine which distils off is condensed and collected. To facilitate the primary evolution of the bromine, fragments of flint or the like may be placed in the still; or air or steam may be blown through the liquor to carry the vapours more rapidly to the condenser. Granulated zinc may be substituted for the iron turnings. Sulphuric or nitric acid may be substituted for the hydrochloric acid hereinbefore mentioned, and hypochlorite of lime, hypochloride of soda, red lead, chlorate of potash, or other substance, which will give chlorine with the acids, and liquors may be substituted for the bichromate of potash, as may also other chromates or combinations of chromic acid.

A short distance south of Mount Sinai is a curious patch of sandstone, occurring in the midst of the granite district, which has been quarried for stone for building at the Convent of St. Catharine.

POSTAGE STAMP AND GUMMED LABEL AFFIXER.

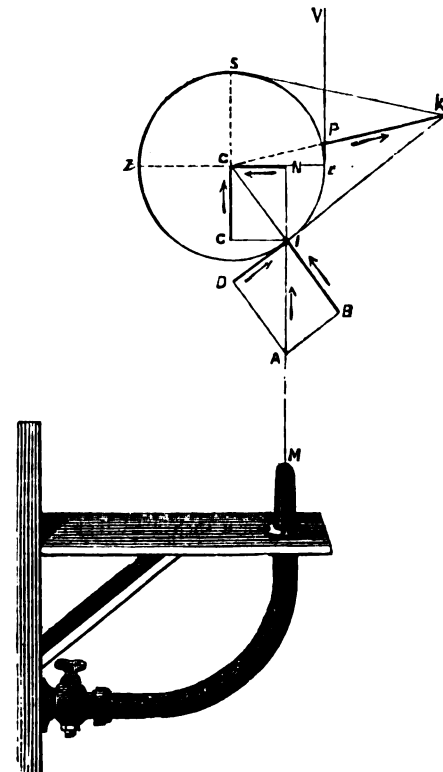
MR. HERBERT WILLIAM HART, of the Strand, engineer, has just patented some improvements in apparatus for affixing postage and other gummed stamps and labels. The apparatus consists of a box or case, the interior of which is made of a size and shape to receive the particular stamps or labels to be used. A thin lip or edge is applied just inside the open bottom of the case on one or more of its sides, and inside the case is fitted a plunger surmounted by a spring capable of being depressed by a knob or handle passing through and working in the upper part of the case. In the accompanying engraving, fig. 1 is an elevation and fig. 2 a vertical section of an apparatus constructed according to this invention; fig. 3 is an elevation partly in section, showing it charged with a number of stamps or labels. *a* is a box or case, the interior of which is of a size and shape to receive the stamps or labels to be used. This case is provided with a thin lip or edge, as seen at *s s*, just inside the open bottom and on all its sides. *b* is a plunger fitted inside the case *a* and surmounted by a spring *c*, which forces it towards the bottom of the case. *d* is a rod fixed to the upper side of the plunger *b*, and reaching to the top of a tube *e* attached to the top of the case *a*. The upper part of this rod is surrounded by a spring *f*, capable of being depressed by a knob *g*, when it is required to exert pressure on the rod *d* and on the plunger *b*. The case *a* is charged with stamps through a slot in the side or otherwise, gummed side downwards, and the spring *c* keeps the plunger down upon them. The lip prevents the stamps falling through the bottom of the case, but on the lowest stamp being moistened by being pressed upon a moistened sponge or otherwise, pressure upon the knob or handle *g* presses the moistened stamp out of the case and affixes it where required.

THE BALL AND JET.

The following explanation of the action of the ball and jet is given in the *Scientific American*, by Mr. Morris Peck, who has interested himself in experiments therewith. In working out the question, provide yourself with a tube, to one end of which is fixed a nozzle, the orifice of which is about 1-16th of an inch in diameter, and attach the tube to a fountain so that a smooth jet may rise perpendicularly about 5 ft. above the end of the nozzle. If now you place a cork ball, 1 in. or 1½ in. in diameter, in the jet, half-way up, it will be supported by the water, and will revolve rapidly around its horizontal diameter. If you wish to vary the experiment, in place of the ball, put a small ring of the same material, 2 in. or more in diameter, ½ in. wide, and 1-8 in. thick; and the effect will be even more pleasing than before. With a little skill and patience a small bullet or buckshot may be upheld in the same manner. Now remove the tube from the fountain and, having prepared a small cork ball 1-3rd of an inch through, by blowing gently through the tube a column of air will be found as effectual in sustaining this ball as was the jet of water in the first instance; and, if your lungs are tolerably good, it also may be replaced by a small round pebble, about the size of the buckshot, which will be supported 2 in. or so above the end of the nozzle, constantly vibrating up and down, and rapidly changing its position, on the jet, from side to side. This motion will often cause it to appear as if revolving around its vertical instead of horizontal axis.

In the engraving the direction of the jet, and the direction with which it strikes the ball, is represented by the line *A I*. This force may be resolved into, or is equivalent to, two others,

viz., *D I*, in the direction of a tangent to the circumference at *I*, the point of contact, and *B I*, in the direction of the radius that extends from the centre to the point of contact. The force *D I* will be expended in causing the ball to revolve, while *B I* will act on the centre of gravity *G*. In drawing the figure, we have made *B I* equal to *G I*, therefore the demonstration will not be impaired if we use *G I* in place of *B I*, which, for convenience, we will hereafter do. The force *B I*, also, or its equal *I G*, may be resolved into others, viz., *C G*, parallel to the direction of the jet *M I*, and *N G* perpendicular to the direction of the jet. The former of these,



C G, is employed in supporting the centre of gravity or elevating it, as the case may be; but it is evident that *N G*, the latter, tends to throw the ball off the jet, in a lateral direction. We have now four forces—first, *D I*, the rotary force; second, the weight of the ball, the depressing force—this, however, is counterbalanced by the elevating force *C G*, which is the third; and, fourth, the repelling force, *N G*. One is yet lacking, viz., a drawing force, to neutralise *N G*, and thereby hold the ball against the jet.

Imagine now a small steel spring to be fastened by one end to the jet, at *I*, and the other end to extend towards *K*. If such a spring could be so

fastened, and the end *K* were drawn around the ball and secured at *t*, its tendency would be to throw the ball in the direction of *P K*. Between *I* and *t* it would tend to draw the ball towards the jet, and also to depress it. Between *r* and *s*, it would tend to draw and elevate. Between *s* and *t* to repel and elevate. The resultant of the three would be represented by *P K*. When the water strikes the revolving ball the effect of the centrifugal motion would be to throw it off in the direction of the lines, *I K*, *r V*, &c.; much of it, however, adheres to the ball and is drawn around with it, and by its reaction produces an effect precisely analogous to the spring which we imagined to be fastened at *I*, and as a comparatively small part of the water is carried beyond *s*, our resultant will lie in the direction from *P* to *K*. This, then, is our fifth force by which *N G* is counterbalanced, and the ball retained in contact with the jet. To prove that it is this adhesion of the water to the surface of the ball and its reaction which constitute drawing force, let the ball be made as smooth as possible and well oiled, and you can no longer succeed in supporting it upon the jet.

Correspondence.

IRON AND GRANITE FORTS.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—The recent experiments at Shoeburyness do not furnish any reliable data as to the comparative value of iron and granite for defensive works, further than to prove anew what was well known, namely, that works built of stone have no chance when opposed to heavy modern ordnance. These experiments, which have cost the public about £8,000, would have afforded several valuable lessons had they been conducted upon some reasonable system, or even on no system at all. An indiscriminate assault upon the works, such as may take place in actual warfare, would at least have given a practical result. But what comparison can be drawn when one part of the works is fired at with steel and another with cast-iron shot, and one part with light and another with heavy charges of powder? The shields of the granite casemates were attacked with steel shot and the granite itself with cast iron. But the unfairness of the firing does not end here. The shield designed by the superintendent of the works was attacked in one instance only by a charge of 36 lb., whilst that of Mr. Chalmers was attacked by several rounds with 41 lb. charges. Nay, more, the latter shield had two distinct principles on trial in the backing—the one side of the shield having been constructed on a plan recommended by a distinguished R.E., the other on a plan suggested by Mr. Chalmers. In firing at the former, the 36 lb. charge was strictly adhered to, but against the latter the 10-inch gun was never used with less than 41 lb. of powder.

Under these circumstances I scarcely think that the Ordnance Select Committee can, in return for an outlay of £8,000, present to the Secretary of State for War a report worth eightpence. Those who wished well to our national defences and those who desired to see our engineering prestige rescued from such blunders as were committed by the Admiralty, were hopeful that Lord de Grey would not be misled as the Duke of Somerset had been. But there is great reason to fear that blunders equal in magnitude to that of the "Minotaur" class of ships will be committed in connection with our new forts unless his lordship can find men to conduct these experiments who will adopt some system and abide by it in testing the plans laid before him. The Duke of Somerset committed a great mistake in placing the construction of the navy in the hands of an inventor who naturally sees little value save in his own inventions. Lord de Grey is in imminent danger of falling into a similar error. For the War Office has its inventor also, in the person of Captain Inglis, R.E., superintendent of works at Shoeburyness. These men are not only in a position to officially recommend their own inventions, but they can influence the trials of others as well as their own. The tender treatment which the "Bellerophon" target received as compared with the trial of the Chalmers target was noted at the time, the test being at least 200 per cent. against the latter, and now when the same inventor comes in competition with an official in the War Department, the old game practised by Admiral Robinson and Mr. Reed is played over again. When one of Captain Inglis's shields was tried three years ago (he has had several made at the public expense), he had a large stock of spare bolts on hand, and as one was broken he replaced it by another before the firing was resumed—a privilege which it is needless to say has never been granted to an outsider. I have no inclination to become the advocate or apologist of any inventor or class of inventors, but in the interest of the public service I protest against

the growing tendency in both departments to exclude the engineering talent of the kingdom from a fair competition with professional officials.

Many simple people may consider with the *Saturday Review* that the recent experiments "settled the fate of granite as a material for a first-class fort," and that consequently the Spithead Forts will be built of sterner stuff. I am, however, by no means sanguine on that head. Our authorities are like the Scotch M.P., who had heard many a speech that changed his opinions, but never one that changed his vote. Many a shot has been fired at Shoeburyness that settled the fate of a target without leading to a single alteration in the ships which that target represented. The "Minotaur" target crumpled up under fire in presence of the Duke of Somerset himself, without producing any beneficial result to Her Majesty's service. When shot and shell went whistling through the "Lord Warden" target, scattering iron knees, bolts, and fragments of timber far and wide, the *Daily News* and other journals concluded that the ship could not be proceeded with on that plan, but the notorious failure of the target did not delay the work of constructing the ship a single hour or alter by a hair's breadth the arrangement of her armour. Nor is it likely (unless the Secretary of State for War himself assume the responsibility) that the officials of the War Department will prove recreant to their antecedents now. As the *Saturday Review* avers, "the slowness with which a newly-ascertained fact is acknowledged in the military and naval administration of England has been proved so often, and sometimes with such disastrous consequences, that it is impossible not to tremble when the results of scientific experiments accumulate too fast for the power of assimilation of the official mind." But England expects the Secretary of State for War to relieve the "official mind,"—assume the responsibility,—and save the engineering credit and cash of the country by submitting the question of iron forts (since iron they must be) to public competition.

Yours, &c.,

IRONSIDES.

[Our correspondent gives no reason why the Chief Constructor should not be an inventor. If Mr. Reed, or anyone similarly situated, patented his inventions and sold them to the Government during the time of his service, a reasonable objection might be urged. But we never heard of Mr. Reed doing any such thing. But to say that the Chief Constructor should not suggest improvements, or use his own inventions if he considers them the best for the purpose, appears to us simply absurd. Ed. M. M.]

ANCHOR TRIALS.

SIR,—From a paragraph in your number of the 1st inst., page 351, it would appear that there had been something like a fair test of the comparative strength of a Rodgers and an Admiralty anchor, resulting very much indeed in favour of the former. Perhaps you will allow me to state, for the benefit of such of your readers as may happen not to be very well up in this matter, that it is the practice to make the shank and the arms of anchors the same size as the throat, or that part where they unite. The size of the arm of a 111-cwt. Admiralty anchor is at that part 14½ in. the longest way of the oval, and the length of the arm is 7 ft. 1 in. Captain Rodgers has hitherto made his shanks and arms the same, and in the specification of this anchor they are so shown; but in the present case, when it is desirable to show something extraordinary, he makes the shank of a 74-cwt. anchor 14½ in., or the same as the 111-cwt. Admiralty anchor, and he makes the arm no less than 18 in., the length being only 4 ft. 8 in., or about the length of the arms of a 25-cwt. stream anchor made by Captain Rodgers, and sent to the Sheerness competitive trials. After this explanation I think no one will be surprised at the result.

Yours, &c.,

WM. ROBERTS.

Millwall, Poplar, E., Dec. 14.

CAST-IRON GUNS.

SIR,—Mr. Fairbairn, in a recent lecture on iron stated that iron guns, cast hollow and compressed by hydraulic power, could be made most efficient by being compressed while hot. My gun cast hollow, with an elliptical bore, as described in your number for November 17 last, so treated, would prove a cheap and most formidable gun, and could be cast of a power to throw shot of 1,000 lb. weight.

Yours, &c.,

J. NORTON, late 34th Regt.

Bray Club, Dec. 13.

Mitscherlich analyzed beer yeast, and from his analysis concluded that 100 grammes of dry yeast contain the elements of 4.28 grammes of anhydrous phosphoric acid. But this analysis does not prove that the acid was actually formed there.

Meetings for the Week.

MON.—Society of Engineers.—"On Giffard's Injector," by Mr. L. Orlik, 7.
Architectural Association.—"Heat, Light, and Ventilation," by Mr. R. O. Harrie, 7.30.
ROYAL INSTITUTE OF BRITISH ARCHITECTS, 8.
TUES.—Institution of Civil Engineers.—Annual General Meeting, 8.
WED.—Geological Society, 8.
THURS.—Linnæan Society, 8.
CHEMICAL SOCIETY, 8.
FRI.—Architectural Association.—Prize Essay on "Materials most appropriate for London Extérieurs," 7.30.

TO CORRESPONDENTS.

The *MECHANICS' MAGAZINE* is sent post-free to subscribers of 12 mo. 3d. yearly, or 10s. 10d. half-yearly, payable in advance. Post-office orders made payable to Mr. R. A. Brodman, of 165, Fleet-street, E.C.
Advertisements are inserted in the *MECHANICS' MAGAZINE* at the rate of 6d. per line, or 5d. per line for 6 insertions, 4d. per line for 13 insertions, 4d. for 26 insertions, and 4d. a line for 52 insertions. Each line consists of about 10 words. Woodcuts are charged at the same rate as type. Special arrangements made for large advertisements.

All communications should be addressed to the Editor, 165, Fleet-street.

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

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

RECEIVED.—H. D.—F. A. P.—C. A.—J. H.—R. F. F.—W. L. H.—J. W. P.—L. H. B.—A. C.—W. L. W.—R. M. O.—W. T. C.—R. G. S.—R. T.—W. R.—J. N.—E. T.—T. and Son.—D. M. T.—P. O.—J. H.—J. N.—W. W.—J. H. O.—W. R. T.—J. C.—W. H.—J. H.

Miscellaneous.

The council of the British Horological Institution have petitioned the Corporation of the City of London, to take measures for supplying the citizens with several public clocks, having hour, minute, and seconds hands, kept in electric communication with the standard clock at Greenwich. Liverpool, Newcastle, Edinburgh, and Glasgow are in advance of the City of London in having Greenwich mean time shown by their public clocks.

A statue of Saint Magdalen, in a church in Milan, and which has long been famous for weeping in the presence of unbelievers, was recently moved, in order to facilitate repairs. It was found that the statue contained an arrangement for boiling water. The steam passed up into the head, and was there condensed. The water thus produced found its way by a couple of pipes to the eyes, and trickled down upon the cheeks of the image. How truly is science the handmaid of religion!

A plan is proposed in Chicago, which it is understood is to be carried into effect, for tunnelling the Chicago river. The river is only about 12 ft. deep, and the plan is to exclude the water by cofferdams, and construct the tunnel in the open air, having the top of the tunnel come just level with the bottom of the river. The footpath is to be in the middle, with a carriage way on each side.

The difficult problem of storing petroleum safely for transport has been solved by Mr. David Jones, of Birmingham, who has invented a cask which meets the difficulty. The whole of the vessel is tinned, and the head is so fixed on that, unless the oil can make its way through sheet-iron, it is impossible for it to exude or any of its odour to escape. Besides being used for barrelling the oil, Mr. David Jones's welded tinned iron casks are adaptable to serve as oil cisterns, when such a use may be desirable.

Some interesting experiments have recently taken place at the works of the Mersey Steel and Iron Company at Liverpool, with the newly-erected apparatus for working the Bessemer process by gas. There are two furnaces, capable of receiving ten tons of metal each. In one of these, which is heated by gas, the iron is first melted, and in the adjoining one a composition of manganese is also melted. The two molten liquids are then run into a large crucible, through which a blast is forced by two powerful engines, and the combustion then clears the mixed metal from all impurities, and transforms it into cast steel, in which condition it is finally run into ingot moulds. The experiments were entirely successful.

An examination of the various iron plates submerged upwards of twelve months since in Chatham harbour, each coated with one of the numerous anti-fouling compositions, has been instituted by the officials of the establishment, when, with the single exception of a pair of plates coated with Gieborne's anti-fouling mercurial mixture, the whole were more or less thickly coated with shellfish and seaweed, while on the plates treated with the mercurial mixture scarcely a mussel was to be seen, excepting in places where the paint had been rubbed off.

The directors of the Warsaw and Vienna Railway Company have resolved to lay a double set of rails on the whole extent of their line on account of the great increase in their traffic.

The following are copies of a telegram received by a correspondent of the *Times* resident at New castle-on-Tyne, from Lisbon (per the British and Irish Magnetic Telegraph Company), No. 1, as originally delivered, and No. 2, the repeated message from London. "No. 1. Peral arrived and vermsains roppers inform visitoes lobl vent per continued." "No. 2. Peral arrived and vermsains roppers inform visitoes lobl vent per continued." Add to this that the message was nearly three days on its way, and we have a fine specimen of modern telegraphy. Slight mistakes may be overlooked, but it is unpardonable for any company, British or foreign, to transmit such rubbish as this.

It is stated that a valuable cannel coal has been found near Burslem, in North Staffordshire, and that oil has been extracted from it in quantity to make the manufacture very profitable.

Professor Agassiz is pushing forward his explorations in South America. His party now consists of four grand divisions, one of which has for its field the peninsula lying south of the city of St. Paulo, and between the Parana River and the Atlantic Ocean. The second division has the sea coast extending from Rio de Janeiro to Bahia, and as far westward as San Francisco River. The third division has the interior, lying west of the San Francisco and between the tenth degree of south latitude and the tropic of Capricorn. The fourth division, at the head of which is Professor Agassiz himself, has for its tract the great valley of the Amazon, including its tributaries. This and the coast section are the two most interesting, if not the most important fields.

A concentrated solution of chloride of zinc, which has been boiled with an excess of the oxide of that metal until it does not discolour litmus, will dissolve silk. By means of the dialyser the silk can be separated from its solvent in the form of a colourless inodorous solution.

A project has been set on foot to supply Rome with water from the springs at Arsoli under an exclusive concession from the Pontifical Government. The undertaking seems to have been principally promoted by persons connected with the Anglo-Romano Gas Company, a successful undertaking which has been in operation twelve years.

Since the close of the American war the iron shipbuilding trade at the South Wales ports has not been so brisk as it was previously, and builders in many instances have found it difficult to keep their yards in full employ. This is attributable in a great measure to the fact that blockade-running has ceased, and there is not now so much call for fast-going iron steamers as there was during the war in the States. The increased competition of foreign shipping is also another cause of the falling off in the demand for iron vessels. Despite, however, these drawbacks, the iron shipbuilders of South Wales have received a fair share of contracts.

The ground under steam boilers belonging to some cloth manufacturers in Trowbridge having sunk, excavations were made to a depth of 20 ft., where it is stated the earth was discovered to be on fire, and on examination the soil was found to be an unctuous kind of clay, similar to that in Yorkshire, and from which a fine clear mineral oil is said to have been extracted.

A letter of M. Béchamp to M. Dumas mentions that creosote appears to be the agent which most strongly opposes the development of organic ferments, but adds that it does not interfere with the life of ferments or animalcules when they are once developed.

The India-Rubber, Gutta-Percha, and Telegraphic Works Company have just completed and successfully submerged an experimental cable on Mr. Pigott's improved principle, across the Channel from the South Foreland to Cape Grisney, on the French coast. Should these improvements prove as successful as is anticipated, they will ensure an important reduction in the cost of manufacture, whilst combining greater durability with less liability to get out of order.

The curious substance called glycoogen by Claude de Bernard, was extracted by him from liver, by the following process:—The liver of an animal recently killed was cut into thin slices and thrown into a small quantity of boiling water. The whole was allowed to boil for an hour, and was then submitted to pressure. A small quantity of fluid was obtained, which, when treated by alcohol, yielded a white flocculent precipitate, and this, when redissolved in water, and re-precipitated by alcohol, was then found to yield with iodine and other reagents the characteristic properties of amylaceous substances.

The application of Messrs. Prentice's gun cotton is becoming very general in the mines of California and Nevada, the greatest satisfaction being expressed with regard to it in every instance in which it has been employed.

The compensation to be paid to the Duke of Northumberland for his house and grounds at Charing Cross will probably, it is said, be fixed at £150,000. The amount to be paid to the Duke of Cambridge for Gloucester House, the demolition of which is involved by the proposed widening of Park-lane, is estimated at £65,000.

The arrangements of the directors of the Atlantic Telegraph Company as to new capital are now completed, and several hundred miles of the cord are finished. The "Great Eastern" is chartered to go to sea in June, 1866, for the double purpose of laying an entirely new cable, and of raising the broken end of the 1,100 miles of cable laid this year, so as to splice additional cable thereto, and thus, if successful, furnish to the public a second means of communication. This 1,100 miles of submerged cable is ascertained to be in the most perfect order by tests taken from the time it broke, and still continued daily. The buoys at the end of it are washed away, but this is of no consequence, as they were intended only for a temporary purpose, the spot for grapelling having been laid down by solar observations, so that a good navigator can at any time sail to within half a mile of the broken cable.

The following statistics of Paris have just been published and are somewhat curious:—Paris has 50 barriers, 24 boulevards, 2,253 streets, 157 passages, 70 squares, 33 quays, 22 bridges, 11 palaces, 500 hotels, 33,341 houses, 225,000 households, 25,500 shops, 115 fountains, 28 great and 17 smaller markets, 12 hospitals, and 22 barracks, 10 public libraries, 250 educational establishments, 2 tobacco manufactories, a mint which coins £49,000 sterling per day, besides canals, charitable institutions, &c. The superficies of Paris covers 7,800 hectares (a hectare = 2½ English acres), and has 1,696,141 inhabitants.

A great engineering and scientific feat is now being performed at the Cornwall Furnaces, in Lection county, Pa. It is the building of a spiral railway around and to the top of the Cornwall Railroad, and revolves around the mountain, at some places over the tressel work, at others over high embankments, and again at others through ponderous cuts in the bodies of iron ore, until it reaches the very top of the mountain.

The Prussian Minister of Commerce has prepared a bill to introduce gradually a uniform rate of postage of one penny for the whole monarchy. The bill will be presented to the Chamber in the course of the next session.

The total number of passenger tickets issued by the railway companies of the United Kingdom last year was 229,872,165. In 1863 it was 204,699,466; in 1862, 180,455,727; in 1861, 173,778,218; in 1860, 163,468,572; in 1859, 149,807,146; in 1858, 139,193,699; in 1857, 139,008,888; in 1856, 129,347,592; and in 1855, 118,595,135. Thus in ten years the movement of human life on British railways nearly doubled. Allowance must, of course, be made for the additional extent of railway brought into operation; but while in 1855 the circulation attained an average of 14,323 per mile, in 1864 it had risen to an average of 16,612 per mile.

An American Exchange states that there is on the Camden and Amboy Railway a locomotive with cylinders of 38in. stroke, and a little over 14in. bore. They have been rebored. This engine has been rebuilt, and has now coupled drivers and 5ft. wheels. Originally it had single drivers, 10ft. diameter, behind the fire-box. The valve gear is on a return work, like most of the engines on this railway, and it has a flexible appearance, on account of the great length of the return cranks. We think this beats any modern engine for length of stroke, whatever it may do in working.

The municipal council of Cherbourg at its last meeting voted a sum of 8,000*l.* to be expended in the preparation of a plan of a strategic railway from Cherbourg to Brest, with a branch to Couville, which will have the advantage of the shortest and most direct line.

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.—1378, 1406
BUILDINGS AND BUILDING MATERIALS.—1378, 1406
CHEMISTRY AND PHOTOGRAPHY.—1385, 1409, 1424
CULTIVATION OF THE SOIL. (including agricultural implements and machines.)—1369, 1371, 1396
ELECTRICAL APPARATUS.—1385, 1376, 1390, 1412
FIBROUS FABRICS. (including machinery for treating fibrous pulp, paper, &c.)—1383, 1391, 1423, 1428, 1430, 1439

FOOD AND BEVERAGES. (including apparatus for preparing food for men and animals.)—1401, 1405
FURNITURE AND APPARATUS. (including household utensils, time-keepers, jewellery, musical instruments, &c.)—1367, 1377, 1379, 1384, 1389, 1397, 1402, 1406, 1407, 1413, 1414, 1415, 1417, 1418, 1420, 1427, 1432
GENERAL MACHINERY.—1380, 1380, 1411
LIGHTING, HEATING, AND VENTILATING.—1370, 1381, 1386, 1395, 1400, 1410, 1322, 1435, 1437, 1438
METALS. (including apparatus for their manufacture.)—1399, 1429, 1434
MISCELLANEOUS.—1365, 1366, 1375, 1387, 1392, 1393, 1416, 1419, 1421, 1425
ROADS AND VEHICLES. (including railway plant and carriages, saddlery, and harness, &c.)—1374, 1398, 1426, 1431
SHIPS AND BOATS. (including their fittings.)—1394
STEAM ENGINES.—1404
WARFARE.—1382, 1403, 1433, 1436

1365 W. HAIGH. *Certain improvements in mechanism or apparatus for making and cutting cardboard.* Dated May 17, 1865

These improvements consist in arranging a series of rolls of paper in a frame, so that when such rolls are delivered the paper, each alternate continuous sheet shall be passed under the rollers immersed in a sizing trough by means of a guide, or be operated upon by sizing brushes or other sizing apparatus, whereby both surfaces of such alternate lengths shall receive a coating of adhesive material, after which operation they are to be brought into contact with the remaining dry or unsized lengths of paper by means of pressure rollers, thereby making one compact or solid board, which, as it is being delivered from the pressure rollers, becomes operated upon and cut into lengths by a knife actuated by a lever or other equivalent. *Patent completed.*

1366 C. FISCHER and J. C. W. MAAS. *Stamping, printing, or signing letters, papers, or other objects.* Dated May 18, 1865

This invention consists in stamping, printing, or signing letters, papers, or any other objects of equal or different sizes by means of two cylinders. The lower of these two cylinders is movable upwards and downwards to allow objects of different thicknesses to pass through. The upper cylinder is supplied with several stamps and needles, all of which start forward when the objects to be stamped are, through the motion of the machine, brought in contact with them, the needles drawing the objects between the cylinder without injuring either, and the stamps leaving their impress on the objects. The stamped objects are then with regularity delivered on a small table, which moves downwards in proportion as it is filled. The machine is therefore a self-feeding and self-delivering machine. *Patent abandoned.*

1367 H. RUSHTON. *The application of a certain kind of goat's hair in imitation of human hair to the manufacture of head-dresses, moustaches, and all kinds of false hair, and the process of preparing the same.* Dated May 18, 1865

This invention consists in rendering Llana goat hair suitable for the above-named purposes by submitting such hair to certain purifying processes. *Patent completed.*

1368 T. FANOUX. *Improvements in rotary magnetoelectric machines.* (A communication.) Dated May 18, 1865

The object of this invention is to facilitate the collection of the electrical currents generated in the movable parts of the machine, so as to direct them immediately through a fixed conductor, and thence to transmit them to a given point. For this purpose the patentee leads the currents from each coil or group of coils by means of a conducting wire to a piece of metal, the general receiver of the electricity on the revolving axis carrying the discs, but which is insulated from the shaft, as well as from its bearings and from all other objects, except at the point where a fixed insulated conductor is in contact with the revolving piece of metal in such a way as to unite all the separate currents into one. *Patent completed.*

1369 C. B. BILLIPS. *Improved apparatus for distributing liquid manure.* Dated May 18, 1865

This invention will probably be described in a future No. *Patent completed.*

1370 W. R. WILLIAMS. *Improvements in dry gas meters.* Dated May 18, 1865

This invention relates to the novel construction of dry gas meters, whereby the meter is greatly simplified, the cost of manufacture lessened, and greater accuracy in measuring and recording obtained; and the invention consists chiefly in the employment of two or more flexible tubes in connection with series of rollers, which are arranged to pass over the surface of the said tubes in such a manner that the latter are alternately filled with a quantity of gas which is accurately recorded in its passage through the said tubes by a suitable index. *Patent completed.*

1371 W. MAHWARING. *Improvements in reaping and mowing machines.* Dated May 18, 1865

The patentee claims, first, the combination of two driving wheels and a flexible cutter with a gearing frame (by preference cast in one piece), which frame is so constructed that the bearings of the motion shafts form part of the casting or castings composing the gearing frame, and that the crank shaft is partially or wholly enclosed within such casting or castings. Second, sustaining the gearing frame and cutter bar by means of a panel attached to the lifting lever, which panel is engaged in a suitable notch in the draft frame on the same frame, the attendant in raising the gearing frame and cutter bar being by preference assisted by a spring which partly counterbalances the weight thereof. Third, hinging the cutter bar to the gearing frame by means of a prolongation of the main shaft pivoted between two cups. And with respect to the second portion of the invention, the patentee claims (in machines having a rigid cutter bar, a trussed main frame, and a revolving rake or rakes) placing the wheel which actuates the rake shaft, and of which the said shaft is the centre, between the upper and lower portions of the said trussed frame; and with regard to the third portion of the invention, he claims the arrangement of the teeth, tappets, slot, and pivoted portion of the platform, as described. *Patent completed.*

1372 T. MOLDEN, J. NEWSOME, and J. AKEROYD. *Improvements in the furnaces of steam boilers.* Dated May 18, 1865

This invention will probably be described in a future No. *Patent completed.*

1373 R. A. BROOMAN. *An improved method of securing corks or stoppers in bottles.* (A communication.) Dated May 18, 1865

This invention relates to securing corks or stoppers in bottles containing effervescent or fermented liquids, and consists in placing the strings which assist in securing the cork under the wire in such manner that the cork is left free by the simple drawing up by hand of the two strings, the ends of which are connected to a leaden or other plate or handle, and hang down outside the neck of the bottle beneath the ordinary metal capsule. *Patent abandoned.*

1374 J. MITCHELL and G. TILFORD. *An improved method of testing railway and other springs.* Dated May 18, 1865

The object of this invention is comprehended in part by the forcing of air into an accumulator by the aid of an air pump worked either by hand or steam power, and on the other part by forcing water into the same accumulator by a hydraulic pump worked by hand or steam power. The air being the elastic body, is compressed by the action of the water upon it, and when the required pressure is thus obtained, it is released from the accumulator by a lever acting upon a valve into a horizontal cylinder, which forces a ram, and consequently compresses the spring into a straight line, or beyond to any degree required, which returns to its original curvature by pressing a lever which opens a valve and releases a part of the accumulated water through a water pipe. *Patent abandoned.*

1376 E. A. VARLEY. *Improvements in the insulation of electric telegraph wires.* Dated May 18, 1865

This invention has for its object an improvement on the insulator commonly known as C. F. Varley's double V insulator, and consists in making the earthenware cups with bands at the top and bottom of the upper portion of the cup. The effect of this is to counteract any irregularity in the shape, and to ensure the full advantage of the length of the fitting. *Patent abandoned.*

1377 J. LAINO. *Improvements in sewing machines.* Dated May 18, 1865

This invention relates to that class of sewing machines used for "over-heading," in which a spiral needle is employed, and an important feature in this invention consists in forming the said spiral needle partly hollow, for purposes which we cannot here describe in detail. *Patent abandoned.*

1378 W. EASSIE. *Improvements in machinery for driving piles.* Dated May 18, 1865

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

1379 C. COPUS. *Improvements in the construction of bedsteads.* Dated May 18, 1865

The object of this invention is to manufacture bedsteads that will have as little tendency to harbour vermin as iron bedsteads, and will yet retain the sightliness of the present Arabian and French wooden bedsteads. To attain this end the patentee combines wood and iron in the construction of bedsteads in such manner as to form all the joints of metal, while in French bedsteads the head and foot-boards will be retained, and in Arabian bedsteads the cornice and foot-board of the ordinary or any approved construction will be retained. *Patent completed.*

1380 E. A. RAYMOND. *An improvement in atmospheric forging hammers.* Dated May 18, 1865

This invention consists in a cup-shaped packing for the piston rod secured in place by a movable ring that is kept in position by the end of the cylinder, so that the simple act of placing the head upon the cylinder secures the cup packing. At the ends of the cylinder the patentee forms annular ribs that act as packing expanders for shaping the edge of the cup leathers to the interior surface of the cylinder, and also as buffers for the piston to strike against, at the ends of the cylinder, should any circumstance cause the cylinder head and piston to come into contact. By these devices the hammer is rendered permanent in its action if adapted to the circumstances under which it is used. The invention further consists in making the end of the piston rod tapering, and the hole in the hammer of the same form, and the patentee finds that the friction is sufficient to hold the parts together, but they may be easily separated if required. *Patent completed.*

1381 G. H. BROOKES. *Improvements in sliding gas pendants or chandeliers.* Dated May 19, 1865

To break or reduce the sudden shock or noise now felt and heard in some sliding gas pendants or chandeliers when in motion, or on their reaching their extreme points of motion, the patentee introduces springs or some elastic or yielding substance, or both combined, and at either ends of the rods or tubes, or inside or outside the same, or around the wheels, or pulleys, or tubes, or other parts of the said pendants or chandeliers; and he so adjusts the spring or other substances aforesaid that, on the opposing parts or points meeting or coming into contact with each other, the shock and noise will be considerably broken and reduced. *Patent completed.*

1382 S. ENRALL. *Improvements in breech-loading firearms.* Dated May 19, 1865

This invention relates to breech-loading firearms of the kind called "drop down" or "snaw" guns, and consists in certain mechanical arrangements or combination of parts for working the bolts, whereby the breech ends of the barrels of the said guns are held down against the face of the break-off for discharge and released from the said break-off for recharging. *Patent abandoned.*

1383 T. MARSDEN. *Certain improvements in apparatus to be employed in spinning cotton and other fibrous materials.* Dated May 19, 1865

The patentee claims the novel application and use of felt, flannel, or equivalent material permanently secured to the lower surface of the bobbins, so as to revolve with them, instead of placing the felt on the rail and detached from the bobbin, as hitherto employed. *Patent completed.*

1384 H. DE MORRAY. *Improvements in sewing machines.* Dated May 19, 1865

The patentee claims combining with sewing machines working with a crank and connecting rod mechanism which will absorb and reserve during portions of each revolution of the crank a part of the power exerted by the operator, and will give out the power so reserved during other portions of each revolution, in such a manner as to assist the crank over the dead centre, as described. *Patent completed.*

1385 T. RICHARDSON and M. D. RUCKER. *Improvements in obtaining certain compounds of nitrogen and of sulphur.* Dated May 19, 1865

In the manufacture of coal gas the purification is accomplished in several localities, by means of oxide of iron

When the oxide of iron ceases to act beneficially, it is thrown aside, and is known under the name of gas-refuse. This gas refuse contains ammonia and other nitrogenous compounds, together with sulphur, and the object of this invention is to obtain and apply the same to useful purposes in the arts. *Patent completed.*

1386 W. DAVEY. *Improvements in apparatus for washing or purifying coal gas and for producing ammoniacal water therefrom.* Dated May 19, 1865.

The patentee claims, first, constructing apparatus for freeing coal gas from ammonia and bisulphide of carbon, consisting of a closed vessel having a central chamber, the lower open end of which dips slightly beneath the coal of the water or other fluid contained in the vessel, and from which immersed edge of the chamber a grating or perforated gauze diaphragm, also slightly immersed beneath the level of the fluid, is made to extend to the sides of the vessel, so that the gas being made to pass into the central chamber depresses the fluid, so as to pass under its lower edge and beneath the grating or diaphragm, whence it rises through the openings or perforations thereof and through the shallow stratum of water over the grating into the space surrounding the central chamber, substantially as described; second, placing upon the aforesaid grating or perforated gauze diaphragm a layer of pebbles or other suitable granular substance, in order the more effectually to bring the bubbles of gas into intimate contact with the fluid, substantially as described; third, constructing the central chamber with its lower end immersed some depth into the fluid, and widened out, and forming in such immersed portion perforations or small openings in such manner, that the gas, in depressing the fluid inside the chamber, uncovers such perforation or openings, so as to escape through them, substantially as described; fourth, the employment of a series of two or more such before described apparatus acting in combination with each other, and with the system of pipes and valves, substantially as described. *Patent completed.*

1387 A. V. NEWTON. *Improvements in the construction of screws and screw drivers.* (A communication.) Dated May 19, 1865.

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

1388 G. READ. *Improvements in manumotive engines.* Dated May 19, 1865.

This invention relates to the apparatus for giving motion to the wheels whereby the carriage is propelled. For this purpose the inventor places a screw wheel on the driving axle of the carriage. Gearing into this screw wheel (as a substitute for the endless screw usually working in endless screws) is a disc having a series of friction bowls arranged round its periphery; these bowls take into the teeth of the screw, and by the rotation of the bowl disc cause the screw wheel to rotate and so propel the carriage. The inventor places this bowl disc on a vertical or inclined shaft, and continues it upwards to any convenient position for driving by means of a winch handle, or other convenient means on the top. He places a universal joint on this driving shaft, whereby it may be inclined and adapted to any position desired for the convenience of driving. He steers the vehicle by means of the fore wheel or wheels, mounting it or them on an axle, and in bearings in which the axle can be moved in the different directions required for steering the vehicle, such motion being given by means of a hand lever and connecting rod, or it may be operated by the feet of the operator. According to this arrangement the one hand is engaged in driving the winch handle, while the other may effect the steering. *Patent abandoned.*

1389 W. CLARK. *Improvements in the ornamentation of fabrics and leather.* (A communication.) Dated May 19, 1865.

This invention relates to ornamenting fabrics for ladies' dresses, and consists in the application of artificial leaves, fruit, and flowers, either separately or in combination, to the fabric, which artificial substance the inventor either cements or sews to the fabric in the flat, and the ornamentation may or may not more or less closely resemble the woven pattern. *Patent abandoned.*

1390 C. and S. A. VARLEY. *Improvements in telegraph supports, parts of the invention being applicable to other purposes.* Dated May 20, 1865.

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

1391 C. BRADLEY. *Certain improvements in machinery for spinning and doubling cotton and other fibrous substances.* (A communication.) Dated May 20, 1865.

This invention relates to the machinery employed in spinning and doubling cotton called the "mule," and is designed for the purpose of dispensing with the use of the sector as hitherto employed in mules to actuate the fallers in connection with the coping motion. *Patent abandoned.*

1392 W. E. NEWTON. *Improvements in apparatus for raising oil and other liquids from deep wells.* (A communication.) Dated May 20, 1865.

This invention consists in using within a well an alternate plenum and vacuum of air or gas, produced by an air pump or other equivalent means, the plenum and vacuum being applied by means of a conducting pipe which is passed down into the well, either within or without the well tube, which is provided with valves and chambers for the passage into the well tube of the oil or other liquids to be raised. *Patent completed.*

1393 J. A. CORREY. *Improvements in distilling apparatus.* Dated May 20, 1865.

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

1394 J. MARTIN. *Improvements in apparatus for steering ships, steamboats, and other sailing vessels.* Dated May 20, 1865.

One portion of this invention consists in the application of a second barrel or pulley to the axle or shaft of an ordinary steering apparatus to the second barrel or pulley. The inventor attaches a set of chains or ropes by passing them round it; each end of these chains or ropes is then passed round a pulley or barrel fixed on each side of the ship's deck, and thence brought back to the ordinary tiller and fastened to it in the usual way. The said barrel or pulley on each side of the ship's deck is fitted into a movable frame or carriage aliding in guides fixed to the deck; to this frame he fixes a toothed rack, and geared with this rack, but fixed in an independent standard, is a pinion or worm screw; on the axle of this pinion or worm screw he fixes a lever under the control of the steersman, so that, by turning the pinion or worm, screw motion is imparted

to the movable frame through the rack, the chains or ropes being tightened or slackened as the movable frame is removed from or brought towards the tiller. When the second set of chains or ropes is tightened, the said ropes control the steering apparatus as effectually as the first ordinary chains or ropes attached to the tiller; when slackened they cease to exercise any control. In calm or fine weather the inventor does not propose to use the second set of chains or ropes. *Patent abandoned.*

1395 W. and G. B. SMITH. *Improvements in wet gas meters.* Dated May 20, 1865.

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

1396 W. EDDINGTON, jun. *Improvements in apparatus for trenching and laying drain pipes for draining land.* Dated May 20, 1865.

According to this invention, the patentee prefers to employ a double plough beam, although a single one may be adapted to the plough beam or beams. He attaches two cutters, one behind the other, and so disposed as to traverse and sever the soil at a distance apart according to the width of trench to be made; the soil so cut or severed by the cutters, immediately behind the rear cutter, comes in contact with an inclined piece, which, as the plough progresses, lifts the severed soil, leaving the trench desired. In the rear of the inclined lifter of the soil is a curved guide reaching to the same depth as the inclined lifter, by means of which guide the patentee introduces and deposits the drain tiles. The sides of the trench are kept up by means of check plates, which extend throughout the length of the inclined lift, as also the curved delivery piece, which deposits the drain tiles. The plough is mounted on wheels, and regulated in its height from the ground by adjusting screws, somewhat in the usual manner, its operation being as follows:—When propelled through the ground, the two cutters make two vertical incisions in the soil to the required depth; the inclined lifter follows immediately behind, and lifts the slice of the soil forming the trench in which the tile-depositor follows; the drain tiles are placed on end by hand in a vertical guide-channel, which tiles, by their own gravity, slide down the curved guide, and take up a horizontal position in the ground, end to end, and closely abutting one on the other; the soil then falls in above the tiles, and the draining is complete. *Patent completed.*

1397 E. ATTENBOROUGH, S. MELLOR, and G. BLACKBURN. *Improvements in machinery or apparatus employed in circular knitting machines.* Dated May 20, 1865.

This invention consists in placing on the lower part of a stein or pipe (hereafter called pipe only) of the head of a circular machine, a toothed wheel, which gears into a similar wheel on a main driving shaft. The wheel on the pipe of the head has a recess on the inside, which recess contains a spring; this spring presses upon the pipe with a force sufficient to carry the head round when the toothed wheel is driven round by the main shaft. The pressure of this spring may be adjusted as required by turning a screw, the head of which projects beyond the pipe outwardly. Above the wheel and spring is a grooved pulley keyed fast on the pipe of the head; in this groove, on any convenient part of its circumference, is placed a wedge piece corresponding to the shape of the groove in the pulley. This wedge piece is free to turn on an axle secured to the framing of the machine; the wedge portion has a screw passed through it, by means of which the pressure of the wedge in the groove may be regulated to the greatest nicety, and projecting from the side of the pipe of the wedge piece is a stud, which takes into a hole in one end of a piece of metal, which said hole is slotted through one side of the piece. Under this hole, and at right angles thereto, is another hole, through which is passed a looped or hooked wire, under which the thread to be supplied to the machine is placed, and in the piece below the wire is another hole, in which is placed an axle standing at right angles to the axle of the wedge piece. The piece carrying the wire and receiving the stud before mentioned is so nicely balanced that, when the thread is broken, or the cop becomes empty, and the end of the thread is worked up, the wire falls, and depresses the upper end of the piece, carrying the wedge piece partly round, and effectually wedges fast the head of the machine until the wedge is withdrawn and the thread is replaced. *Patent abandoned.*

1398 J. ARMSTRONG. *Improvements in the permanent way and rolling stock of railways.* Dated May 20, 1865.

The patentee claims the construction of a double-headed reversible crossing for railways, with wing and point rails all in one piece, from an ingot of steel, bloom of iron, or other suitable material, to the section and angles required, by means of forging, pressing, or otherwise, substantially as specified. And, also, the method of casting an ingot of steel with one or more elongated core holes through the same at suitable distance to form the hole for passing upon the rollers for rolling after being hammered, substantially as specified. *Patent completed.*

1399 J. WELLS and J. REW. *Improvements in apparatus for the manufacture of "impressed gold" and similar paperhangings.* Dated May 20, 1865.

This invention relates to the manufacture of paperhangings of the kind known as impressed gold, and which have ornamented devices in gold leaf or other metallic leaf impressed or stamped upon them with an embossing action. In the improved apparatus the devices to be reproduced in metallic leaf are formed or fixed in relief upon a metal cylinder which is pressed towards a counter pressure cylinder having a surface of a suitable material, such as pasteboard or papier maché, which becomes impressed with a counterpart of the devices on the metal cylinder, so that the two will act as die and matrix upon the paper which is passed between them. Before passing between the cylinders, gum or adhesive matter, by preference in a dry powdered state, is applied to the parts of the paper to receive the impressed devices, the metallic leaf being also laid on the same parts. The metal cylinder is heated, whereby the gum is made to fix the metallic leaf, at the same time that the device is impressed or embossed on the paper. *Patent abandoned.*

1400 R. HASWELL. *Superseding the unsightly chimney pots now in use.* Dated May 22, 1865.

These improved chimney-pots are to be cast in glass of octagonal and other various patterns. The glass is to be red, green, blue, or any colours that may be wanted. The pot is a non-conductor of lightning, it is more ornamental, will last longer, and is far more easily cleaned by machinery than the common earthenware pots now in use. *Patent abandoned.*

1401 D. POWIS and H. BRITAIN, jun. *Improvements in the manufacture of wire gauze dish covers, plate covers, window blinds, fireguards, and meat safes.* Dated May 22, 1865.

According to this invention the inventors protect the edge of the wire gauze by means of a metal rim made of one piece of sheet metal in place of the two pieces ordinarily employed. The strip of sheet metal they use is folded along its middle, so that, when placed on the edge of the wire gauze, one half of the strip is on one side, and the other half on the other side of the wire gauze. By means of grooving tools, or by pressure otherwise applied, they close the two sides of the doubled strip upon the edge of the wire gauze, and fix it upon and protect the edge and strengthen the article. *Patent abandoned.*

1402 W. E. GEDGE. *An improved safety lock.* (A communication.) Dated May 22, 1865.

This improved safety lock consists in a novel combination of parts, the distinctive characteristic of which is that a door furnished with this lock cannot possibly be opened by any person unprovided with the proper key. This improved lock opens from the interior by means of a slight pressure and on the outside by an almost invisible draw bolt by means of a hollow knob with slide. The movement is produced by a balance which forms a lever and replaces the spring plate of an ordinary lock. This movement works the half-turn lock, which fulfils the functions of the two bolts required in other locks. This lock closes on the outside by a safety button, a result due to the presence of an eccentric within the lock. *Patent abandoned.*

1403 A. G. BIGGIE. *A casing intended to protect the stock and lock of firearms, with guiding caps to take aim.* Dated May 22, 1865.

The patentee claims, first, the application to firearms, and principally to fowlingpieces, of a sheath of leather, or any other supple material, or thin metal, or even of wood, but preferably of supple vulcanised india-rubber, to cover up the stock and preserve it from the shocks that might injure it. Second, a cap for covering the cock and lock, and fastened to the sheath by means of small buttons, and kept on the gun by a strip of india-rubber, or small steel springs, these caps forming no impediment to the action of the cock, and, in case of double-barrelled guns, enabling the sportsman to take truer aim. *Patent completed.*

1404 J. SHAND. *Improvements in fire engines.* Dated May 22, 1865.

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

1405 J. H. JOHNSON. *An improved apparatus for freezing, icing, and cooling liquids.* (A communication.) Dated May 22, 1865.

The patentee claims the application and use to and in the freezing or cooling of liquids of a carafe, decanter, or other form of vessel, containing within it a second vessel for holding the freezing mixture, there being no communication between the interior of the two vessels. *Patent completed.*

1406 W. HODSON. *Improvements in locks.* (A communication.) Dated May 22, 1865.

This invention has reference more particularly to locks for doors, and consists in so arranging a lock in combination with a sliding plate actuated by the key, that when the door is locked from the inside such plate is slid in front of the outside keyhole, thereby closing it, and thus preventing any tampering with the lock from the outside, in which position the plate is held as firmly as the bolt. Furthermore, the lock is so arranged that the door can be locked from the outside without moving the sliding plate, whereby the unlocking of the door from the inside is prevented. *Patent abandoned.*

1407 J. M. CLEMENTS. *Improvements in sewing machines.* Dated May 22, 1865.

This invention cannot be described apart from the drawings. *Patent completed.*

1408 G. FURNESS and J. SLATER. *Improvements in machinery applicable to the cutting off the upper parts of piles.* Dated May 22, 1865.

For the purposes of this invention a carriage is constructed to move on railway or other wheels, or to slide or move on rails or guides fixed on staging, or on a barge or other floating vessel. On this carriage a steam engine is fixed, in order to give motion by suitable gearing to a circular saw or saws used for cutting off the upper parts of piles. The shaft or shafts of the circular saw or saws employed are mounted on a pendent girder or framing, which is carried by this carriage, and is fixed to and hangs from a traversing frame or slide on the carriage. The girder or frame is capable of being raised or lowered in respect to the slide on the carriage, in order that the saws may work at the desired depth, and such saws may be caused to work above or below the water in a cofferdam or other work. *Patent abandoned.*

1409 R. MULLER, A. T. WELD, and J. FOLLIOTT. *Improvements in the preparation of materials to be used as substitutes for animal charcoal.* Dated May 22, 1865.

In carrying out this invention the patentees employ a porous artificially prepared matrix, which they impregnate with a solution of carboniferous matter, raising them of animal origin, by preference, and then char and subject the same to certain processes. The matrix in all cases is to be essentially of burned clay, and such as to resist the action of acid, and also the action of such heat as is necessary to char the animal or carboniferous matter with which the matrix is impregnated. *Patent completed.*

1410 P. A. LE C. DE FONTAINEMOREAU. *Certain improvements in lamps for burning mineral oils.* (A communication.) Dated May 22, 1865.

This invention relates to certain modifications or improvements in lamps having their level invariable, such as the Carcel moderator and other similar lamps, by which improvements they are rendered capable of burning petroleum and other mineral oils. These improvements consist, first, in the mode of rendering the piston and stuffing-box impervious. Secondly, in the mode of diverting the overflow of the oil back into the recipient. Thirdly, in the employment of a metallic wire gauze to prevent explosion when oils of low density are burnt, and to prevent also the introduction of foreign bodies into the reservoir. Fourthly, in fitting the moderator of the lamp into a low socket to suppress friction. Fifthly, in the application of a striking or alarm apparatus for giving notice that the oil requires to be pumped up. Sixthly, in the employment of a float set at the mouth of the oil reservoir to show when it is full. *Patent completed.*

1411 E. M'NALLY. *Certain improvements in apparatus for cutting or forming screws, which is also applicable for cutting pipes or tubes.* Dated May 23, 1865

The patentee claims, first, the adaptation and employment of one or more dies, cutters, or tools, each having two cutting edges, and moving in the arc of a circle as a radius, so as to present one cutting edge in the first cut, and the other edge in the second, or returning in the direction of unscrewing for the purpose of cutting or forming screw threads or metal blanks. Secondly, the use and application to screw-cutting lathes of cutters having two cutting edges, and moving in the arc of a circle, so that screw threads may be formed thereby, both by the backward and forward motion of the cutter. Lastly, the employment and use on the same stock of one or more cutters having two cutting edges, and moving in the arc of a circle, for the purpose of presenting the cutting edge at a certain angle for cutting or severing pipes or tubes, as described. *Patent completed.*

1412 H. WILDE. *Improvements in the production and application of electricity.* Dated May 23, 1865

This invention consists, firstly, in an improvement in the electro-magnetic induction machine, described in the specification of letters patent granted to the inventor on the 1st December, 1863 (No. 3,006). In this improvement a short circuit is made between the coils of the small magneto-electric machine and the coils of the electro-magnet whenever the commutator on the axis of the armature of the small magneto-electric machine is at the dead point, and the large armature of the electro-magnetic machine is enveloped with coils made of sheet copper, the whole width of the armature, instead of being wound with wire (as shown in the drawing accompanying the specification of the before-mentioned patent), and the coils are insulated from one another by means of a sheet of cardboard or other insulating substance of the same length and width as the sheet of copper, and it is coiled on the armature at the same time as the copper. The invention consists, secondly, in the application of the electro-magnetic machine described in the specifications of certain former patents to the heating, rolling, coiling, and welding of metals. The invention consists, thirdly, in the application of the magneto-electric machine to the prevention of the fouling of ships' bottoms, whether of iron or covered with copper or its alloys. *Patent abandoned.*

1413 I. W., and J. HOLT and J. MAUDE. *Improvements in dyeing and setting cotton, silk, woolen, and other yarns.* Dated May 23, 1865

For dyeing yarns, the inventors make a peculiar shaped bobbin consisting entirely of wire or light metal or material; the body of the bobbin consists of a longitudinal slope of wire attached to light end pieces, made circular or of any other convenient shape, to confine the yarn within the length of the bobbin; the yarn is wound on this skeleton bobbin, the body being perfectly open. The yarn is free both inside and outside, so that when the bobbin with the yarn on it is immersed in the dyeing matter, it will penetrate and dye every thread, whereas this cannot be done in the cop. They size the yarn in the doubling frame, using dissolved buffalo hide, the said solution being twisted in the yarn during process, by which every thread is sized singly, instead of sizing the warp altogether. This process also lays the fibre of the yarn and dispenses with sizing it, making it stronger because there is no chance of burning it. *Patent abandoned.*

1414 A. HERR. *Improvements in the treatment of clays and other materials with which they are mixed when used in the manufacture of china, porcelain, earthenware, and other like wares, and in ornamenting or decorating china, porcelain, earthenware, and other like wares.* Dated May 23, 1865

Before moulding or otherwise forming clays and the other materials with which they are mixed into useful or ornamental ware, whether china, porcelain, earthenware, or other like wares, it is desirable to remove the iron they contain, and this portion of the invention is carried out as follows:—The patentee subjects them, when in that state called by potters "slip," to the action of an electro-magnet composed of a disc or plate of soft iron having a convoluted groove or recess cut out of or otherwise formed in one of its surfaces for the reception of a bundle of small covered copper wires forming a coil; those spaces in the groove or recess not occupied by the coils the patentee fills with any suitable material, so that the face of the disc or plate of soft iron in which he makes the groove or recess presents an even and smooth surface. The disc or plate of soft iron is let into and forms part of the bottom of a trough or shoot along which the slip to be purified or freed from iron is permitted to flow in a shallow stream. When he wishes to put this apparatus into operation, he connects the ends of the coil of copper wire with the poles of a suitable galvanic battery, or of an electro-magnetic machine, when the disc or plate of soft iron will immediately become a powerful electro-magnet, and will attract and retain the particles of iron which may be suspended in the slip which flows over it. *Patent completed.*

1415 H. ADLER. *Improvements in clocks and timepieces.* Dated May 23, 1865

This invention consists of three parts—firstly, the combination of mechanism whereby the seconds' circle and seconds' hand form the end or point of and move round the face of the clock with the hour hand. The mechanism of this clock consists of a train of wheelwork and other parts, similar to the clocks and timepieces now in use, the hour and minute hands being placed precisely as in ordinary clocks. On the end of the hour hand is placed a circular piece of metal, round the border of which are marked the seconds in the same way as on watches. This hour hand is hollow. Motion is communicated to the seconds hand by means of a rod which passes through the hollow hour hand, one end of this rod works on a pinion on the arbor, the other end working on a very minute pinion wheel on the metal circle, which communicates to the seconds hand, the novelty of this part of the invention being that the seconds are carried round the face of the clock by the hour hand. The second part of this invention consists in making the clock case itself oscillate, and dispensing with the use of a pendulum. Thirdly, this invention dispenses with the use of a key. *Patent abandoned.*

1416 H. GIBBS. *An improvement in the manufacture of envelopes.* Dated May 23, 1865

In performing this invention the inventor proposes to prepare the seal lap that it will tear in a given direction on inserting the finger below the lap, and pressing it towards the seal. The direction in which it is desirable that the seal lap shall tear is in lines drawn from opposite sides of

the seal to a point immediately above the centre of the seal. For this purpose, therefore, he forms lines of punctures on the seal lap (after the manner of piercing postage stamps or cheques), which lines incline upwards and meet at a point a suitable distance above the seal. *Patent abandoned.*

1417 T. CALVERT and D. MONTGOMERY. *Certain improvements in looms for weaving.* Dated May 24, 1865

The patentees claim the novel arrangement and combination of apparatus for giving a variable tension to the warp at the required intervals, such as closing up the pick and shedding, and for governing or regulating the amount of tension at such intervals, as described. *Patent completed.*

1418 H. NUNN. *An improved mangle.* Dated May 24, 1865

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

1419 T. BEANLAND. *A screw gill protector.* Dated May 24, 1865

This invention has for its objects the prevention of breakages in screw gills or hackle frames, and, consequently, in the slivers of material under operation. To obviate certain defects on what is known as the draft or back wheel shaft of an ordinary hackle gill frame, to the clutches generally used the patentee places the shortest arm of a double bell-cranked lever, working on a fulcrum attached to the framework of the machine, which presses against the spring in the outer clutch. The arm parallel with the longer arm rests in a notch of a bar in adjunction with the strap or belt guide, and which, when the machine is in proper working order, retains the same on the driving pulley, whilst the horizontal arm carries a weight which may be adjusted according to the number of heads the machine has. Lapping or other disturbing causes arising, however, the clutches become disengaged, and the outer one pressing against the shorter arm of the bell-cranked lever elevates the end of the longer arm, and releases the detaining bar connected to it. A weight passes over a pulley, and connected to this detaining bar, imparts a horizontal motion, and in so doing throws the belt by means of the strap guide in adjunction with it from the fast to the loose pulley, and thus prevents the breakage that would otherwise occur. *Patent completed.*

1420 J. DALE and A. PARAF. *Improvements in calico and linen printing.* Dated May 24, 1865

The patentees claim, first, the preparation of ferrocyanide of ammonia by decomposing the ferrocyanide of potash with hydrofluo silicic, and saturating the filtered liquor of the fluo silicic of potash with ammonia. Secondly, the combination of these salts of ferrocyanide of ammonia or other bases with a salt of oxide of chromium, chrome alum, chloride of chrome, or similar salts, for the production of green colours upon cotton or linen by steaming. *Patent completed.*

1421 H. A. BONNEVILLE. *Improvements in hydraulic cranes.* (A communication.) Dated May 24, 1865

This invention consists in the application of hydraulic pressure and the screw, or the hydraulic pressure and the rack, in raising weights. This application is made as follows:—The piston rod of the hydraulic press is elongated and provided with a rack in the one case, and in the other with a screw thread. This rack or this screw acts in a system of toothed wheels or a drum around which the chain of the crane is rolled. The apparatus is set in motion in the ordinary way, by pumping any suitable liquid under the piston of the hydraulic press, which, being raised, acts on the drum, or on the toothed wheels, and thus winds up the chain and lifts the weight. *Patent completed.*

1422 C. T. MOLLER. *Improvements in lamps.* (A communication.) Dated May 24, 1865

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

1423 G. ASHCROFT. *Improvements in presses used for pressing cotton, wool, hay, and other fibrous materials.* Dated May 25, 1865

The object of this invention is to give greater facilities for moving the boxes used in connection with hydraulic and other presses into the positions proper for filling the said boxes with the material to be pressed, and afterwards into the position for the material to receive the pressure. For this purpose the box or boxes is or are arranged to be capable of revolving around a column or columns of the press, so that, after a box has been filled, it may be moved round so as to bring it under the press. *Patent completed.*

1424 G. A. CONRY. *Improvements in the retorts used in the manufacture of gas and in other distillations, which improvements are adaptable to evaporating vessels.* Dated May 25, 1865

This retort consists of a case in which an archimedean screw is fitted, the same having a handle or portion to which driving gear may be connected to its axis, which axis shall project beyond the case aforesaid, and by the rotation of this axis the screw will be kept in motion, and will continually agitate the material under process of distillation, so as to facilitate the liberation of its gases, and exhaust them from the material under operation, and by being provided with a stopper and a discharge door or opening, the operation may be carried on continuously without drawing the retort. *Patent abandoned.*

1425 J. RAMSBOTTOM. *Improvements in machinery employed in the manufacture of hoops and tyres.* Dated May 25, 1865

This invention relates to certain improvements upon the invention for which former letters patents were granted to the present patentee on the 7th January, 1864 (No. 48), and it consists in making the taper mandrel described in the specification of the said patent with shallow spiral grooves, so as to enable it to be introduced into the hoop partly by rotation on its axis, and partly by end pressure. The improved grooved taper mandrel may be used for expanding the hoops either in combination with a duplex steam hammer, as described in the specification above referred to, or in combination with lateral and edge rollers or blocks. Another part of the invention relates to the rolls employed in rolling hoops and tyres, and consists in making oblique grooves on the face of the roughing rolls to force the metal to one side of the hoop, for the purpose of forming the flange of the tyre. By this means a tyre may be rolled out of a cylindrical or slightly conical hoop. *Patent completed.*

1426 J. FINCH. *Improvements in the manufacture of cast-steel railway tyres.* Dated May 25, 1865

This invention consists in hammering a hollow tube of

cast steel on a mandrel until it is reduced in thickness, and then again hammering it between tools of appropriate shape for the purpose of raising projections to form the flanges of the finished tyres, and so solidifying the metal. *Patent completed.*

1427 D. WELSH. *Improvements in looms for weaving.* Dated May 25, 1865

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

1428 R. MAXWELL. *Improvements in applying coal tar colours to cotton and linen.* Dated May 25, 1865

This invention consists, principally, in preparing the cotton and linen either as yarn or thread, or when woven, for receiving the colour by treating it with a soap, or with an oil in a more or less saponified state. *Patent abandoned.*

1429 D. LAW and J. BENNET. *Improvements in apparatus for making cores and moulds for casting.* Dated May 25, 1865

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

1430 E. A. BROOMAN. *Improvements in machinery for separating or sorting fibres and filaments of different lengths and for forming them into a lap or fleece.* (A communication.) Dated May 25, 1865

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

1431 J. X. J. BARBAIX. *Certain improvements in brakes for railway carriages.* Dated May 25, 1865

This invention has for its object the stopping of railway carriages by utilising the force which acts on the buffer when the speed of the train is slackened, and the invention consists in transmitting the recoil movement of the buffers produced by the slackening of the speed of the train by means of rods suitably made and fixed to the rod of the buffers, and to a spring which acts direct by means of a lever upon the shaft of the brake, which is adapted to the carriage, or with which they are already provided. *Patent abandoned.*

1432 W. MADDERS. *Improvements in ornamenting table cloths and other articles with embroidery.* Dated May 25, 1865

The patentee claims the manufacture of ornamental table covers, and other articles, by uniting cloths or fabrics of different colours or material by edging stitches, or stitches of similar ornamental character, made by the machinery, substantially as described. *Patent completed.*

1433 E. PATON. *Improvements in firearms.* Dated May 25, 1865

This invention partially relates to a very simple method of making firearms to load at the breech, at the same time offering great facilities for the conversion of existing muzzleloading pieces into breechloaders. According to one method of carrying the invention into practice, the barrels are fitted with a hinge on the under side, by which they are united to the stock. A projecting hook is also formed on the under side of the stock, by means of which the barrels are locked in position for firing. The piece of metal forming the breech plate is extended along the stock, and a hole is formed in it through which the hook on the barrel passes; a movable catch working in the stock enters the hook when the barrels are brought down into firing position. The catch may be arranged in various ways; in some instances it is caused to move laterally on a pin or centre, a thumb lever being fixed at the lower or under side of the stock by which it is actuated, so as to unlock the barrels; and when the barrels are locked, the catch is held in the hook by means of a spring. When it is desired to load the gun or rifle, the catch is merely moved out of the hook by thumb pressure, when the barrels are immediately tilted upon the hinge in position for loading, the cartridges are inserted, and the gun is ready to be fired in a very short space of time. *Patent abandoned.*

1434 J. H. JOHNSON. *A new and improved mode of making and venting cores, and parts of moulds to be used in the casting of iron or other metal.* (A communication.) Dated May 25, 1865

This invention consists in forming cores and parts of moulds of moist sand or other material for pipes or other castings on a perforated tube or other form of any desired length or shape, such tube or other form having certain attachments hereinafter described, so that the effect of a vacuum may be obtained in order to strengthen the core or mould at the moment of casting, and at the same time to rapidly take away from the core or mould the gases generated by the molten metal, thus preventing the tendency to blowing or making imperfect work. With any of the ordinary means one or both ends of the tube may be attached to an air pump, or to a vacuum chamber placed at a convenient distance from the mould. When the casting is to be poured the air pump is first to be started, or a connection with the vacuum chamber opened, which will immediately cause the air surrounding the core to enter and permeate through the sand, and to find at length an entrance into the tube through the perforations therein. As the metal rises under and around the core, the gases that are produced inside the core by the heat of the metal will be forced by the effect of the vacuum tube, and thence discharged by the air pump; or made to occupy the empty spaces in the vacuum chamber. *Patent completed.*

1435 J. GIBBS. *Improvements in ovens or kilns for the manufacture of coke.* Dated May 25, 1865

The patentee claims, firstly, the alternation of the flues leading from one oven with flues leading from the adjoining oven or ovens, in such manner as that the said flues may mutually assist in maintaining the temperature of their respective ovens, and of each other, substantially as and for the purposes described. Secondly, the admission of air either through the charging holes or other openings in the highest parts of the roofs of the ovens to the spaces above those occupied by the coking charges, substantially as described. Thirdly, the method of admitting air to the alternated side flues of the several ovens, as required, by means of slides, substantially as described. Fourthly, the general arrangement and combination of parts constituting coking ovens, substantially as described. *Patent completed.*

1436 T. WILSON. *Improvements in breechloading firearms and ordnance, and in cartridges for breechloading firearms.* Dated May 25, 1865

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

1437 G. BRAY. An improved gas burner. Dated May 25, 1865.

This invention has for its object the production of a greater illuminating power from a given quantity of ordinary coal or other illuminating gas than is now obtained by ordinary burners from the same quantity. The patentee effects this by the use of double-headed burners, or burners so made as to emit two jets or sheets of flame, by preference at an angle of 30 deg. to each other, and also near enough to each other to allow the respective jets or sheets of flame to impinge upon and mingle with each other. More than two jets or sheets of flame may be used, if desired, similarly placed to each other, but he believes two to be most generally useful. The class of jet or sheet he prefers to use is that produced by what is technically known as the "hat-wing" burner, though of course others are applicable. *Patent completed.*

1438 H. GIBBS. Improvements in the manufacture of artificial fuel applicable chiefly to the kindling of fires. Dated May 25, 1865.

This invention relates to the moulding of ventilating blocks to be used for the kindling and brightening up of fires, and in the construction of faggots for the like purpose. The blocks the inventor forms of slack or coal dust brought to a plastic state. This plastic compound he moulds into hollow blocks. He moulds the blocks with deep indentations at their sides, so that passages will be formed therein for flame to rise through the block. Thus, in kindling a fire with the aid of one of these blocks, he places it upon an ordinary faggot or wooden wheel, and on igniting the faggot the flame will play through and around the block and ensure its speedy ignition, when the fire will spread to the surrounding fuel. In place of the detached faggot and block of fuel he also proposes to combine the two. *Patent abandoned.*

1439 W. E. NEWTON. An improvement in the draping and other rollers used in preparing and spinning cotton and other fibrous materials and textile manufactures. (A communication.) Dated May 25, 1865.

This invention consists in covering rolls for preparing materials for spinning yarn and other textile manufactures with an inner covering or body of vulcanised india-rubber, gutta-percha, or other suitable gums, and with an outer covering of leather, parchment, paper, or other suitable flexible substance, these two coverings being united together by putting on the outer covering, while the inner covering or body is in a plastic state. The edges of the outer covering are neatly joined, and then the rollers are subjected to heat for the purpose of producing in the india-rubber or gutta-percha composition the change known as vulcanisation. *Patent abandoned.*

PROVISIONAL PROTECTIONS.

2716 T. Webb, Earl Shilton, near Hinckley, Leicestershire, hosiery manufacturer. Improvements in certain knitted fabrics, and in the means or machinery for producing the same. Dated October 21, 1865.

2760 F. H. Gossage, Widnes, Lancashire, soap maker. Improvements in apparatus for indicating and registering high temperatures. Dated November 4, 1865.

2866 J. O. Edington, Leicester-square, manufacturer. An improved mode of extinguishing fires in warehouses, offices, dwellinghouses, theatres, shops, and other buildings or structures. Dated November 7, 1865.

2864 C. J. Viehoff and J. A. Mathieson, Paris, engineers. Improvements in steering indicators and tell-tales. Dated November 8, 1865.

2876 R. Swire, Manchester, mechanic. Improvements in apparatus for grinding and pointing the cards on carding engines. Dated November 9, 1865.

2888 T. Berrens, Boulevard de Strasbourg, Paris, railway engineer. A new threshing machine worked directly on the threshing floor by oxen or horses. Dated November 10, 1865.

2892 T. Redwood, Montague-street, Russell-square. Improvements in the preservation of meat and the concentration of its juices. Dated November 11, 1865.

2896 W. Middleton, Ennismore Mews, Knightsbridge, engineer. Improvements in machines for fret cutting or sawing. Dated November 11, 1865.

2907 S. Hand, Hulme, and J. Slater, Salford, Lancashire. Improvements in railway signals. Dated November 14, 1865.

2934 J. T. A. Mallet, engineer, Boulevard St. Martin, Paris. A new or improved process for the manufacture of oxygen. Dated November 16, 1865.

2948 J. de la Haye, Bedford-street, Chorlton-upon-Medlock, Manchester, submarine engineer. Improvements in the construction of and in the method of laying submarine electric cables. Dated November 17, 1865.

2954 E. and J. Bullock, Leamington, Warwickshire. Improvements in the application of photography to the obtaining of printed proofs or impressions or engravings. Dated November 18, 1865.

2970 G. Taylor and J. Fernie, Leeds, iron and steel manufacturers. An improvement in the manufacture of steel castings. Dated November 20, 1865.

2976 T. B. Heathorn and J. H. G. Wells, North-street, Westminster. Improvements in gun carriages. 2985 G. Smith and C. Ritchie, Upper Thames-street, City. Improvements in brushes for hair dressing and other uses, also in brooms, and apparatus for cleaning, preparing, painting, coating, and smoothing surfaces. Dated November 22, 1865.

2999 T. W. Nicholson, Bell-yard, Gracechurch-street, lithographer. Improvements in and adaptation of cylinder printing machines to the double purpose of letter press and lithography, also a new mode of damping litho' stones, and a new mode of registering and pointing in such machines. 3006 J. H. Johnson, Lincoln's Inn-fields. Improvements in the manufacture of boxes or receptacles for merchandise. (A communication.)

Dated November 23, 1865.

3009 T. Redwood, Montague-street, Russell-square. Improvements in the preservation of animal substances, such improvements being especially useful when these substances are intended for use as food.

3011 J. Ellis, jun., Bristol, stay manufacturer. An improvement or improvements in the manufacture of stays and bodices. Dated November 24, 1865.

3015 G. W. Turner, Victoria Works, Tunstall, Staffordshire, earthenware manufacturer. Improvements in machinery or apparatus for making pottery, earthenware, or ceramic articles.

3019 G. Moreton, Cardiff. Improvements in lacing boots and shoes.

3021 R. Mallet, Bridge-street, Westminster, engineer. Improvements in mounting ordnance.

3023 W. E. Newton, Chancery-lane, civil engineer. Improvements in helical or spiral springs for upholstery and other purposes, and in machinery for manufacturing the same. (A communication.)

Dated November 25, 1865.

3025 W. A. Lytle, Secretary's Department, General Post Office, London. Improvements in furnaces.

3029 J. F. Bennett, Liverpool. Improvements in the means and apparatus for raising heat by the combustion of fuels of various kinds.

3031 J. Ferrier, Liverpool, naval architect. Improvements in the hulls and tackle of navigable vessels, and in the gear for propelling the same by wind and steam or other motive power engine, and clearing the same from water, and in apparatus connected therewith, to enable the said vessels to be converted into floating graving docks or lifts for raising vessels or other submerged or partially submerged heavy bodies to or above the surface of the water.

3033 J. H. Johnson, Lincoln's Inn-fields. Improvements in cork-cutting machines. (A communication.)

Dated November 27, 1865.

3039 J. Manifold, Liverpool, mast and block maker. Improvements in the construction of ships' parrels.

3043 W. R. Lake, Southampton-buildings, Chancery-lane, consulting engineer. Improvements in the mode of and means for preserving fruit and other perishable substances. (A communication.)

Dated November 28, 1865.

3045 F. Mols, Quartier St. Gilles, Brussels. An improved nautical safety apparatus.

3047 C. H. Newman, Oberthur, Surrey. A new kind of unfermented and unintoxicating malt liquor, which shall keep sound for any period of time.

3053 A. V. Newton, Chancery-lane, mechanical draftsman. An improved mode of obtaining printing surfaces by photography. (A communication.)

Dated November 29, 1865.

3055 J. Thompson, Soho-place, Napier-street, Sheffield. Improvements in the handles of tea and coffeepots and other similar articles.

3059 H. A. Dufrené, South-street, Finsbury, civil engineer. An improved apparatus for stretching and rolling fabrics for dyeing. (A communication.)

3061 G. Marshall, Pont Bllydd, near Mold, Flintshire, cooper. Improved apparatus for facilitating the treating or preparing of casks and other vessels to make them tight, and suitable for containing hydrocarbon and other fluids.

3063 J. E. Brown, Glasgow, engineer. Improvements in apparatus for embossing.

3067 C. S. Baker, Fleet-street. Improvements in the process of treating materials for the manufacture of paper and other similar textile fabrics, and in apparatus for the same. (A communication.)

PATENTS APPLIED FOR WITH COMPLETE SPECIFICATIONS.

Dated November 29, 1865.

3065 G. K. Snow, Middlesex, Mass. Certain improvements having reference to shirt collars, and mechanism for manufacturing the same.

3068 G. T. Bousfield, Longborough Park, Brixton. Improvements in machinery employed when weaving hair, and in preparing and treating hair for weaving. (A communication.)

Dated November 30, 1865.

3074 J. H. Johnson, Lincoln's Inn-fields. Improvements in sinking and operating wells, and in the apparatus employed therein. (A communication.)

LIST OF SEALED PATENTS.

Sealed December 8, 1865.

1564 H. Hunt and R. Hunter	1892 T. Swinburne
1582 R. A. Brooman	1956 W. E. Newton
1588 G. Bonelli	2000 J. Pickin and R. Bailey
1590 R. A. Brooman	2112 W. Clark
1593 W. J. Hixon	2302 W. Cory and J. H. Adams
1602 T. Routledge and W. H. Richardson	2426 J. Davidson
1628 M. Henry	2494 I. Smith and W. F. Batho
1708 W. E. Newton	2516 J. W. M. Miller
1790 A. V. Newton	2648 J. de W. Brinckerhoff
1816 G. T. Livesey	
1820 W. A. Lytle	

Sealed December 12, 1865.

1596 J. A. Millington and A. Allnut	1642 V. Baker
1598 J. J. Bodmer	1648 W. Clay
1600 C. J. Collins	1657 J. Parrish, T. Glasscock, and C. Thatchers
161 J. H. Johnson	1678 N. de Becker
1607 B. and S. Massey	1703 C. Worsam and G. Evans
1608 C. de Vendeuvre	1737 W. Schofield
1613 S. Courtauld and C. W. Atkinson	1749 J. Atkins
1614 H. Ormson	1760 M. Benson
1624 P. Lawrence and G. Jefferys	1811 G. B. Woodruff
1625 J. Harley	1913 W. E. Newton
1627 W. E. Gedge	1948 R. Mortimer
1629 R. A. Brooman	2023 J. A. Leon, G. Tessmond, and J. Kinsack
1630 R. A. Brooman	2033 G. B. Woodruff
1632 C. A. la Mont	2092 W. E. Newton
1633 W. T. Wauklyn	2437 J. Donnell
1636 A. Klein	2609 J. A. Moe
1638 G. Payne	

NOTICES OF INTENTION TO PROCEED WITH PATENTS.

From the London Gazette, December 13, 1865.

1972 B. Robinson and J. Varley. Combustion of fuel.
1974 A. Y. Behm. Oriolines.
1980 L. E. O. Martin. Locomotive boilers.
1992 M. P. W. Boulton. Motive power.
1996 J. M'Ewan and W. Neilson. Forcing water.
2002 W. W. Burdon. Reducing vegetable fibre to pulp.
2004 C. Hodgson. Pest.
2007 J. H. Tyler. Rolling leather.
2011 W. H. Brookes. Securing the reeds of for horns.
2017 L. Anderson. Horseshoes.
2020 A. Bleigh. Motive power.
2024 E. Wild and W. Wesel. Burners for lamps.
2025 F. G. Mulholland. Submarine telegraphic cables.
2034 H. C. Bandet. Musical instrument.
2036 H. Gearing. Sackings of bedsteads. (A communication.)
2039 J. Petrie, jun. Washing wool.
2041 C. H. Simpson. Lowering ships' boats.
2042 A. F. Oiler. Lamps.
2043 A. A. Foubert. Regulating the flow of steam.
2059 J. H. Radcliffe. Lubricating spindles.
2060 G. Harvey and A. Harvey, jun. Screwing bolts.
2063 H. Cartwright. Steam engines.
2068 J. W. Sumner and C. A. Scott. Bricks.
2077 T. Allcock. Stair rods.
2078 J. Farren. Cleaning flax.
2079 W. E. Newton. Making eyelets. (A communication.)
2090 J. Knowles. Lubricating the axles of waggons.
2115 W. Gadd and J. Moore. Looms.
2116 J. H. Johnson. Paper bags. (A communication.)
2123 P. Lawrence. Boots. (A communication.)
2149 W. E. Newton. Bricks. (A communication.)
2162 D. J. Jones. Examining the bottoms of ships.
2168 L. J. Levinson. Siphons.
2178 W. E. Newton. Well sinking tubes. (A communication.)
2186 G. Owen. Copying presses.
2187 C. A. Watkins. Supplying carbonic acid gas to tanks.
2312 W. Escon. Gas meters.
2316 F. Baldet. Condensing the steam of steam engines.
2384 R. Fox. Fastening metal plates to beams.
2567 R. A. Brooman. Rotary engines. (A communication.)
2577 T. Machin. Wooden spilla.
2591 W. Harris. Tanning hides.
2655 J. S. A. G. E., and F. F. Reading. Sleeve links.
2682 W. Beardmore. Furnaces.
2757 A. Krupp. Projectiles.
2795 W. Deakin and J. B. Johnson. Ordnances.
2809 E. A. Phillips. Lanterns. (A communication.)
2816 J. K. Farnworth. Raising railway carriage windows.
2886 W. D. Allen. Casting hoops.
2927 J. Williamson, J. Lindley, and J. Coleman. Brakes.
2956 W. H. Cope. Taking the fibre from cotton seed.
2980 J. B. Edge and E. Hird. Doubling cotton.
2991 F. Pope. Locks. (A communication.)
3025 W. A. Lytle. Furnaces.
3053 A. V. Newton. Printing surfaces. (A communication.)
3059 H. A. Dufrené. Rolling fabrics. (A communication.)
3065 G. K. Snow. Shirt collars.
3068 G. T. Bousfield. Weaving hair. (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 100 HAS BEEN PAID.

3260 T. G. Webb	3300 G. Jefferys
3262 L. Cristoph, W. Hawksworth, and G. F. Harding	3313 D. Chalmers
3279 R. E. Donovaa	3316 J. King
3281 W. Falliser	3348 G. Buchanan
3282 G. Lowry	3354 J. Varley and J. Crowther
3287 G. A. Haddart	3392 S. O. Lister

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

2794 R. A. Brooman	2815 A. Lamb and W. A. Summers
2808 J. Ferrabee and F. H. England	2848 W. E. Wiley
2838 W. Beardmore	2884 J. H. Selwyn

LIST OF SPECIFICATIONS PUBLISHED

For the Week ending December 9, 1865.

No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.
194	s. d.	6	202	0	4	211	0	4	220	0	4
195	0	4	204	0	8	213	0	4	221	0	4
196	0	4	205	0	10	214	0	8	222	0	8
197	0	4	206	0	4	215	0	11	223	0	4
198	0	4	207	0	8	216	0	8	224	0	4
199	0	10	208	0	4	217	0	4	225	0	10
200	0	10	209	1	10	218	0	4	226	0	4
201	0	8	210	0	8	219	0	4	227	0	4

NOTE.—Specifications will be forwarded by post from the Great Seal Patent Office (publishing department) on receipt of the amount of price and postage. Same 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.

THE
MECHANICS' MAGAZINE.

LONDON: FRIDAY, DECEMBER 22, 1866.

WESTON'S PATENT DIFFERENTIAL
PULLEY-BLOCKS.

THE proceedings of the High Court of Chancery are not ordinarily invested with an interest which extends far beyond those directly connected with them. The pen of a Dickens may sometimes render the driest of dry suits more than acceptable to the public at large, but far more frequently the learned arguments and consummately eloquent judgments fall unimpressively on our *effete* and tired ears. Occasionally, however, lawyers and suitors are not the only persons to whom a decree is of importance. A case in point is that of "Tangye v. Stott," which has recently been tried by Vice-Chancellor Sir W. P. Wood and a special jury, and which, from its great length, has probably tried their patience in return. This cause has doubtless interested most members of the engineering profession, especially those of the mechanical section. The trial was of certain issues, for the purpose of determining the validity of Weston's patent for the well-known differential pulleys, which bears date April, 1859, and which is impeached by the defendant on the ground of want of novelty and anticipation by prior use; and also for the purpose of determining the question of infringement by the defendant. The case raises a curious conflict of testimony upon the question of infringement more interesting than the discussion upon the patent, which is of a purely technical character. The plaintiffs are Messrs. Tangye Brothers, the well-known engineers of Birmingham, and manufacturers of the differential pulley, and the defendant is Mr. James Stott, a retail ironmonger in Rochdale. The defendant was charged by the plaintiffs with having manufactured and sold between the 1st of October, 1864, and the 14th of March, 1865, pulleys constructed according to Weston's patent. It was objected by Stott that Weston's patent was invalid, inasmuch as a working model of the pulley was exhibited at Bristol in 1831, and moreover that the invention was described in an edition of Dr. Carpenter's "Mechanical Philosophy, Horology, and Astronomy," published in 1844, had been actually used by a Mr. Moore, of Bristol, between 1830 and 1836, and by the defendant himself in 1867, in anticipation of the patent which was taken out by Weston in 1859. The case of the plaintiffs was that, although the differential principle, as applied to pulleys, was correctly laid down in Dr. Carpenter's book, and illustrated by Mr. Moore's model in the Philosophical Institution of Bristol, yet the actual working of that model and the description given in Dr. Carpenter's book were so imperfect that the proposed result could not be effected, and the system had been found practically useless until Weston had supplied the defects by using teeth or indentations in the periphery of the wheel or pulleys, so as exactly to fit into the links of the chain as it wound round, and prevent the slipping of the weight. In Moore's model, pins were employed, the effect of which was that the chain was constantly thrown out of gear and the weight slipped. Further than this the defendant was challenged to produce any evidence of the actual and not merely experimental use of pulleys made according to Moore's model. Priority of publication of the principle was not denied with regard to either the book or the model, but it was made very clear that Weston was the man who put the principle into practice and rendered it a success.

With regard to the second point of the case—the infringement—it appears from the evidence that in 1861, the traveller for the plaintiffs' licensees introduced Weston's

pulley to Stott, who took some time to understand its action, but when he had mastered it he ordered one, and subsequently a second. On the 19th of August, 1863, Stott exhibited one of the pulleys which he had bought at the Rochdale Agricultural Show, the description in the catalogue being "Goods exhibited by James Stott as Weston's Patent Pulley Blocks." Some time afterwards, however, having had his attention drawn to the passage in Dr. Carpenter's book, he proclaimed himself as having been the inventor of the differential pulley long before he ordered the pulleys from the plaintiffs' licensees. His story was that he and some of his workmen had set to work and made pulleys according to Dr. Carpenter's book prior to 1859, the date of Weston's patent. Had this been the case he surely would not have wasted the time of the licensees' traveller by asking a needless explanation, nor his own money by purchasing articles he could make much cheaper than he could buy. And why, too, should he have exhibited his invention as that of another man? The defendant further put forward three persons to swear to the sale of pulleys anterior to the patent. One of them, conscience stricken, unsaid at the trial all he had sworn to in his affidavit, and another, when called upon by the defendant's counsel, did not appear. It was also further proved that a letter had been written by the defendant in a false name, applying for one of the blocks, and stating that he did not quite understand the principle. This was the *so-disant* inventor! One more noticeable point remains; a pulley was produced in court which the defendant alleged was one of those made antecedently to the date of the patent and sold by him. It certainly presented a very rusty appearance, but Dr. Odling, who had examined it, pronounced the rust to have been artificially produced by chlorine to give the thing the appearance of age, and not by the oxygen of the air acting on the iron. The real issue, therefore, was whether the patent was invalidated by a prior disclosure of the invention in Dr. Carpenter's book, and whether the inconsistencies in the defendant's conduct could be satisfactorily explained. According to the description contained in the specification, Weston's invention consists of a new or improved pulley for raising weights, moving heavy bodies, actuating presses, and for other purposes. In the construction of this invention an endless chain is so applied to an axle of two different diameters in the two parts to which the chain is applied, or to two pulleys of different diameters, that two depending loops are formed by the endless chain, each of the said loops hanging from one side of one part of the axle, or one pulley, to the opposite side of the other part of the axle, or the other pulley. When pulleys are used they are made to rotate together by being fixed together, or fixed to the same axis, the axis in this case rotating with the pulleys. The specification proceeds to describe the mode of applying the endless chain and the details of the invention by reference to accompanying plans and diagrams. Omitting the more technical details, which could only be rendered intelligible by diagrams or models, the following passages of the specification are important:—

The peripheries of the pulleys are so shaped as to receive and engage with the links of the chain, as hereinafter described and illustrated in the drawings. . . . Upon the pin or rivet fixed in the frame of the pulley is a roller of two different diameters, having equal spaces between itself and the pulleys *a2* and *b2*, at those parts opposite the said pulleys, and at such a distance from them that the chain can only pass when the links are in the places formed to receive them. This device prevents the weight falling from the chain getting out of gear with the pulley, and also forces back any link which may have begun to rise from its place in the periphery of either pulley.

The specification concludes with the following passage:—

Having now detailed the nature of my invention, and the manner of carrying the same into effect, I

wish it to be understood that I do not limit myself to the precise details herein described and represented, as the same may be varied without departing from the nature of my invention; but I claim as my invention the new or improved pulley hereinbefore described and illustrated in the accompanying drawing—that is to say, a pulley consisting of an axle of different diameters in different parts, or consisting of two or more single pulleys of different diameters, the said pulleys being fixed together, or fixed upon the same axis, an endless chain being passed twice over the pulley in the manner described, and forming two depending loops, in one or both of which loops is a snatch-block, to which the article to be moved is connected.

Dr. Carpenter refers to the pulley in the following terms (s. 351):—"An extremely simple and ingenious application to the pulley of the principle which has been mentioned under the head of the Chinese wheel and axle has been devised by Mr. Moore, of Bristol. Its beauty consists in permitting an increase of power to any extent by the employment of only two pulleys." Dr. Carpenter, after describing and explaining the process in which a fixed pulley, with two grooves one larger than the other, and with an endless cord passing over the larger groove, and then beneath a lower movable pulley, was used, concludes as follows:—

As the cord has no fixed extremity, and as the action of the pulleys would be altogether destroyed if it had the power of sliding over them, it is necessary to take some means of preventing that. The simplest is the employment of a chain instead of a cord, the links of which are laid hold of by pins projecting from the surface of the wheels. The author may express his surprise that this ingenious invention has not come into more general use, since it enables any amount of power to be obtained without any corresponding enlargement of the apparatus or increase of friction.

Evidence was given on behalf of the plaintiffs by scientific witnesses as to the merits and originality of Weston's patent, and that no ordinary skilled workman would have been able to construct Weston's pulley from the description of a differential pulley given in Dr. Carpenter's book, and this will be confirmed by any independent engineer who will carefully consider the description we have set forth. With respect to Moore's pulley, which was produced in court, the plaintiffs' witnesses insisted that it was of no practical use for commercial or manufacturing purposes, and that, from the absence of the ordinary signs of wear and tear, very little work could ever have been done by it. On the second branch of the case, the question of infringement, evidence was given in support of the plaintiffs' case, the tenor of which we have already intimated.

For the defence, it was urged that the invention of the differential pulley by Mr. Moore, and the publication of the description in Dr. Carpenter's book, invalidated Weston's patent. Evidence—but of a very vague character—was given of the use of Moore's pulley in the erection of some schools, and of the manufacture of the pulley by the defendant in 1857, and their subsequent sale. As already observed, one of the defendant's witnesses gave evidence for the plaintiff, another was not forthcoming, and a third was severely reprimanded by the Vice-Chancellor as he left the witness-box. The defendant himself was involved in several contradictions during his cross-examination, and he admitted that the letter referred to contained a falsehood, and was written in a fictitious name for a person whose permission to write the letter he had not got. With respect to the rust on the pulley, an analytical chemist deposed that he had found traces of acid and ammonia (negating the inference that the rust was artificial), but admitted that he had not analysed it with the express view of finding chlorine, and that the tests he had used would not be reliable for that purpose.

With the foregoing facts in detail before them the jury had little difficulty in finding for the plaintiffs upon all the issues, and we do not well see how they could have arrived at any other conclusions than that the invention was a new one, that the specification was sufficient, and that the defendant had wrongfully used

the plaintiffs' patent. Moore's pulley, though an ingenious attempt, was not a practical invention in the fair sense of the term; otherwise surely it would not have been abandoned, it would have filled a better position than that of a mere mechanical curiosity. It ought to have been shown at work in court if it could work. And then, as to the manufacture and sale of the pulley by Stott prior to Weston's patent, that was refuted by the witness Farrell, who having originally made an affidavit strongly supporting the defendant's case, repented of his false oath, and stated on the trial that the contents of his affidavit were false, and under the direction of Stott he had fabricated in 1864 on an old billhead a receipt for a pair of endless chain blocks, purporting to have been sold to one Hartley, in 1857. He denied that such blocks had ever been sold in that year or before 1859, and deposed to the falsification of certain entries in the defendant's books. It may be urged that such testimony should be received with caution, but circumstances singularly corroborated this witness's evidence. Another man engaged with Farrell in the act of fabrication and falsification did not unswear his affidavit, but he took good care not to be examined upon it, by becoming *non est* when wanted. The story of the defendant was inexplicable, and his whole case full of contradictions. However, the jury could have had little difficulty in agreeing upon their verdict, which we cordially endorse. It is perfectly equitable, and justified by every circumstance of the case, and the satisfaction it affords will, like the interest in the suit, extend beyond those immediately affected by it, to the inventive, the engineering, and the general public. The differential pulley as a practical machine is not very old as will have been gathered from the fact of Weston's patent dating only in April, 1859; nevertheless over 26,000 sets have been sold by Messrs. Tangey since 1861. These pulleys have been provided with more than 1,500,000 ft. of chain, representing a lifting power of about 60,000 tons. The nett weight of iron used in the manufacture of the pulleys and chains exceeds 1,000 tons. Although the manufacture is entirely new, about 500 men and boys are already employed. We may mention that the late King of the Belgians, during the illness which preceded his death, was raised and lowered from one apartment to another by means of one of the set differential pulleys.

THE SMITHFIELD CLUB SHOW.

IN concluding our notice of the recent exhibition at the Agricultural Hall, we would first observe that the show was by no means confined to cattle and farming implements. There was a vast array of roots and seeds of every kind, some of the former being of gigantic proportions. There were, too, sewing machines, Perkins's baking apparatus in full work, pianos, watches and clocks, besides a variety of articles for domestic use and dairy goods, so that while farmers were arranging purchases for their departments, farmers' wives were busy making investments for theirs. One of the most useful articles for aiding dairy produce is the Jebb patent tubular churn, which was at work, producing butter in three or four minutes. The principal feature here is the introduction of air and water tubes into the churn; the water tubes, which are closed at the bottom, are for the purpose of attemperating the cream according to the season. The air tube, which is open at the bottom, admits the air to aerate the cream; the air being drawn down the tube by the rotation of the bottom dasher blades. This churn was described and illustrated in our issue for the 24th March last. But this useful machine was exhibited in the gallery, and to follow the course we prescribed for ourselves in our first notice we must not ascend thither before we have completed our tour of the lower department. So we resume our inspection of the heavier machines, amongst which we find a new solid-

axle haymaker, which Messrs. Ashby and Jeffery, of Stamford, have brought out since the Plymouth Show. This implement is constructed on a very simple principle, with double-action and reverse motion; the gear work is strong and consists of only two pinions at each end. The action is reversed by a simple movement of a sliding handle without opening any part of the machine. In the event of accident the main driving cog-wheel is readily renewed from the travelling-wheel, and is renewed without loss of time and at a small cost. Messrs. Ashby show several portable engines and a number of chaffcutters and cake mills. Messrs. Woods and Cockledge, of Stowmarket, show a couple of their vertical steam engines, but their speciality appears to be mills and root-pulpers, of which machines they have a goodly array. We may refer more particularly to their universal roller, crushing, and grinding mills, which cannot be too well known. They are of simple construction, and the only materials used are iron and steel. From the adaptation of its arrangements the grinding apparatus is enabled to grind or kibble at the same time that the crushing is going on. The disc root-pulper, which has taken several prizes, is a highly useful machine; it will cut up into the finest mince from 8 cwt. to 10 cwt. of roots per hour, and does not squeeze out the moisture from the roots in cutting. It works very easily owing to it having a large fly-wheel.

In the adjoining stand Messrs. E. R. and F. Turner, of Ipswich, make a good show, of a somewhat similar character to the last. They have a four-horse power portable engine of superior yet simple construction, the working parts being few and so arranged as to afford great facility for adjusting and cleaning. An excellent threshing machine for finishing corn for market; several varieties of oat, malt, and linseed crushing mills, together with some chaffcutters, well arranged horse gear work, and intermediate motions complete the list of exhibits here. The Lenoir gas engine, which has attracted considerable attention of late, was to be found on the stand of the Reading Ironworks. It has been improved in many minor details, and bids fair to come into general use, especially in localities where the steam engine is a prohibited luxury. On the same stand we notice a new series of chaffcutters for hand, horse, or steam power; they are constructed wholly of iron, and embody several improvements. Amongst the rest we may mention an improved shape of cutting knife, the covering in of all the wheels, and a simple and effective arrangement for stopping, throwing out of gear, and reversing the machine. For this purpose the handle of the lever is placed directly under the control of the man feeding, and all danger of his hand slipping on to the knives is averted. Mr. E. E. Allen, of Parliament-street, was again represented by his excellent double expansion engine, which we fully described last year, and which cannot fail to be appreciated as its economy becomes known. The effect of Wolfe's double-cylinder expansion engine is obtained with only one cylinder and piston and one slide valve. Messrs. Marshall and Co., of Gainsborough, without producing any decided novelty, at any rate sustain their well-known reputation for agricultural machinery. In their portable engines, threshing machines, corn grinding mills, and circular saw benches, a considerable amount of attention is displayed in the finish, and care has been taken to keep down superfluities. On the whole, this firm made a very good show. From the Wellington Foundry, Lincoln, Mr. William Foster sends a double-cylinder ten-horse power portable engine and a capital example of two and a half horse power horizontal fixed engine. Mr. Foster's portable engines can be used as fixed engines by removing the wheels and axles, the only additions requisite being a cast-iron base, answering the purpose of an ashpan under the fire-box, and a pedestal of cast iron, brick, or stone, at the other end. The brasses of these engines have

been improved by being made in three parts and adjusted by means of set screws. The engines are also fitted with very good direct-acting governors. Messrs. Robey, of Lincoln, show a twelve-horse power double-cylinder portable engine, the great feature of which was the reversing gear, which is as simple as it is novel. The eccentrics, of which there are only two, are loose on the crank shaft, capable of revolving without the shaft for half a revolution and driven by snugs. When reversing, the engine is stopped and the fly-wheel is turned once round by hand in the contrary direction to that in which the engine has just been running. When the steam is again turned on the engine runs reversely to its previous direction. This arrangement, however, is necessarily confined to small engines, but there is no reason why it should not be more generally adopted. Mr. Allchin, of Northampton, exhibits an excellent eight-horse power portable engine, which merits particular attention from the fact that in it steel has been adopted as the material for the boiler and fire-box. In fact, Mr. Allchin has effected a general introduction of steel in this class of engines, whereby he undoubtedly obtains an increase in strength and durability, and a decrease in weight. The steel boiler gives an economy in working by the admission of a much higher pressure than with iron boilers, thereby reducing the consumption of fuel and water. Another feature in Mr. Allchin's engine, worthy alike of commendation and copy, is the introduction of springs. There cannot be a question as to the decided advantages conferred by their use, and the trifle they add to the cost of the engine makes it a matter for wonder that they are not applied much more generally. When we have inspected the stand occupied by Messrs. Barrows and Carmichael, of Banbury, we shall have completed our round of the basement. Although Messrs. Barrows, in common with many other exhibitors, send nothing new, they also differ from some in that their work will stand the test of scrutiny. They show a ten-horse power portable engine with glist mill and driving strap. This mill is very portable and efficient, as evidenced in a trial by the Royal Agricultural Society. The result was that the quantity ground equalled six coombs per hour with eight and a half actual horse power; and with two and a quarter horse power it ground fine meal at the rate of seven bushels and a quarter per hour. These results dispose of the objection which has been urged against this mill—that it requires an enormous power to work it.

Wending our way upwards we soon arrive at the great emporium of generalities—the galleries. The show here loses its identity amid the endless variety of articles of domestic and general utility. We, therefore, have to make our selection from the mass of incongruities referred to at the commencement of this article. Passing by sewing machines, washing machines, and an endless variety of sausage machines—the contemplation of the latter giving rise to an uneasy sensation as their connection with the huge grinders just left below occurs to us—we come upon Messrs. Nalder's patent knife-edge fulcrum and spring beam arrangement for safety valves. This is a very suitable and efficient method of loading the safety valve; as the point of contact consists of a knife edge only, greater sensitiveness is attained and greater security ensured. The lever is flattened, and thus forms the spring which can never be locked, and is less costly than the ordinary Salter's balance. With slide-valve, pump, and similar rods, Nalder's blade springs save a joint; they do not require oiling and must be very durable. In the slide-valve rod there is this special advantage over the joint; the travel always remains the same, whereas with the wear of the joint, the travel of the valve itself necessarily alters. From their works at Wantage, Messrs. Nalder also send their noiseless winnow, a selection of corn screens and other implements. For variety in design and excellence in manufacture combined with cheapness, Messrs. Clin-

ton and Owens, of Whitefriars, hold their own in pumps. Cottage, garden, manure, and steam pumps, painted and galvanised, are here shown in every form, together with all their necessary appendages and appurtenances. Before we proceed further there is one point we may step aside to notice, and that is the adaptation of Messrs. White's wringing machine to the purposes of letter copying. By a simple arrangement this useful apparatus may be clamped to a table instead of to a washing tub, and thus forms a veritable copying machine. Close adjoining we notice some very well-finished driving bands for agricultural machines, which the Gutta-percha Company exhibit, with various utensils for the manufacture of which gutta-percha is so well adapted, especially a very well made malting shovel. Mr. Bowden's patent forge bellows and portable forges, exhibited by Messrs. Moser and Sons, of Southwark, impress one at once with their advantages; they are powerful, durable, and certainly cheap. The bellows give a greatly increased blast upon those of ordinary construction, and they can be worked by steam power and in single or double action. In portable forges, the No. 3 is equal in blast to the usual No. 4 forge with the ordinary bellows. Mr. William Sketchley, of Weymouth, sent his universal joiner, which took a prize medal at Dublin, and has also received one from the Royal Agricultural Society. The machine is capable of performing—and most efficiently too—the manifold operations of sawing, planing, tenoning, moulding, and boring; it effects these duties correctly and rapidly. Not the least interesting machine in the gallery, was Comstock's rotary spader, recently patented in England by Mr. E. A. Phillips, of Southampton-buildings, London. The spader is designed as a substitute for the plough in preparing the ground for seed in fields that have been once broken and the sod rotted. It is readily put in or out of working position by a lever worked from the foot board. The teeth or tines on the fork bars are about 7 in. apart; they are made of cast steel, and are self-sharpeners. The various parts of the apparatus are well proportioned for strength, and the machine is admirably adapted for working land that is comparatively free from stones, stumps, and roots.

One of the most compactly arranged stationary horizontal engines we have seen for some time is that sent by Mr. Henry Kinsey, of Nottingham. It is a high-pressure tank engine of six-horse power and requires no foundation. This is managed by mounting the engine entirely on a hollow cast-iron bed-plate, which carries the crankshaft pedestals at one end and the cylinder at the other. The fly-wheel is carried clear of the floor, and the bed-plate is utilised by converting it into a tank through which the waste steam passes and heats the feed-water. By a very good arrangement the water flows into the pump by gravity without suction, so that its action is almost certain. Whether we regard the design or the manufacture of this engine we are alike impressed with an air of decided superiority. A very capital compound-action mill was shown by Messrs. J. Patterson and Co., of Beverley, in which the grinding is effected by angular plates or discs. It forms a most efficient farm implement, and there is one adaptation to which we would more especially refer—the grinding of cotton seed. It is the only machine thoroughly adapted for this purpose, for by exerting a combined crushing and wrenching effect it tears the tough indigestible shell of the seed into many parts, and turns it out in a much finer state than is usually seen. The peculiar action of this mill allows seeds containing oil to be reduced to dry meal. Messrs. Charles Powis and Co., of Millwall, have recently turned out a new machine for sawing, boring, planing, moulding, grooving, rebating, and cross-cutting, in fact, an excellent practical illustration of *multum in parvo*, and invaluable to those who cannot afford space for separate machines for each purpose. The fence is so arranged that it can be

swung out of the way when the bench is required for cross-cutting, and it can also be set at an angle for cutting feather-edge boards. Agricultural railways, or rather tramways, ought to be in more general use than they really are at the present time, for they possess manifest advantages in manuring, harvesting, or carting away roots. They were first brought before the public at the York meeting of the Royal Agricultural Society in 1848, and six years later Mr. W. Crosskill patented some detail improvements. Mr. John Grant, of Linton, Kent, has followed the question up, and has produced a very good portable railway and truck. The rails are composed of light longitudinal sleepers overlaid with a narrow iron band. A thin iron plate is attached to each end of the sleepers, which slide into each other, and the joint is held tight by the passing trucks. According to the inventor, a speed of eight miles per hour has been attained on this railway; it certainly makes a very good job when put together, sharp curves being provided for by variations in the rail lengths. Although we have already extended our remarks upon the Smithfield Club Show somewhat beyond our original intention we cannot conclude without a word in favour of the excellent drills for all purposes exhibited by Messrs. Priest and Woolnough, of Kingston-on-Thames. Neither must we omit to notice the stand of Messrs. Powis, James, and Co., of Blackfriars, who in 1862 obtained the only medal given for first-class machinery for working wood. Their endless band sawing machines with the adjustment for preventing breakage of saws is well known and appreciated. Messrs. Worssam and Co., of Chelsea, whose *forte* lies in the same direction as that of the last-named firm, showed up well with their band-saw machines with self-acting canting tables.

NEGATIVE SLIP.

THE recent trial of H. M. S. "Bellerophon" attracted some attention by the anomaly which was then exhibited in the performance of the screw propeller, an anomaly which we will now proceed to consider:—If the screw which propels the vessel were to work in a stationary and solid female screw, the rate of motion of the ship would evidently be always proportionate to the rate of motion of the screw. A certain number of revolutions of the screw would necessarily effect a certain distance of motion of the ship. But as the screw rotates, not in a solid body but in the yielding material water, which is liable to be moved by the action of the screw, it would appear probable that a certain amount of the motion of the screw would be lost by the tendency of the aqueous particles to retreat from its blow; and it is, in fact, usually found that the rate of motion of the screw is from 15 to 40 per cent. greater in proportion than the consequent motion of the vessel, and this percentage of lost motion being due to the slip of the screw through the water, is technically termed the "slip." It has been found, however, in some cases that a comparison of the proportionate speed of the ship and of the screw showed a reversal of this usual occurrence, and that, instead of the screw moving comparatively faster than the ship, the ship has moved faster than the screw—that, in fact, the screw has apparently not slipped, but on the contrary caused a motion of advance greater in proportion to that of revolution than would have occurred if the screw had worked in a solid female screw. This overrunning of the screw being quite opposite to the slip which usually occurs, has been termed the "negative slip." The term may perhaps be somewhat likely to mislead, as it seems to assert that the slip of the screw due to the yielding nature of the water has vanished; though it does not appear probable that there is really less actual slip, or lost hold of the screw on the water, when what is termed "negative slip" occurs, than at any other time.

This negative slip occurred on the trial

of the "Bellerophon" to such an extent that, though the speed given to the ship was $13\frac{1}{2}$ knots, the velocity of rotation of the screw was only proportionate to a speed of $12\frac{1}{2}$ knots. A similar apparent anomaly has been observed before, in, for instance, the trial of the United States ship "Niagara." The most probable explanation which has been advanced to account for this fact, and which seems to be valid and sufficient, is that in such cases, owing to peculiarity in the form of the vessel, a column of water is drawn along in its wake, and that the screw acting in this water, which is itself in motion in the same direction as the vessel, may evidently revolve with less speed to induce the same amount of reacting force for the propulsion of the vessel than would be the case if the water were unmoved. If the screw worked in a stationary solid female screw, the absolute motion of the vessel would be in proportion to that of its screw, but if this solid female screw were itself in motion in the direction of the vessel's advance, it is apparent that a comparatively smaller velocity of rotation of the screw would result in the same absolute motion of the ship. A moving female screw for the action of the screw of the ship is apparently supplied by the column of water in the wake of the ship which partially accompanies it. It has been stated on good authority that, with some ships, this column moves at the rate of about four knots an hour, and this would be amply sufficient to account for negative slip.

Another explanation which has been advanced to account for negative slip is, that the mass of water in contact with the screw is given a motion of rotation round the centre of the screw, and thereby has centrifugal tendency and motion engendered in its particles, and that these, therefore, moving in a partially radial direction, are forced against the blades of the screw, and that it is the action of these in excess of the reaction of particles forced directly from the screw, which sometimes produces negative slip. It does not, however, seem clear that centrifugal motion would ever be induced in particles to any very material extent, and the first explanation advanced appears too certain and too sufficient to require much additional reason.

It has been argued that there must be an advantage in negative slip, as a greater speed of ship is obtained with a smaller velocity of screw. This does not, however, appear to be at all the case. The work required of the screw is to overcome the water resistance to the ship's motion, and this amount of work to be done will be the same, as far as the screw power is concerned, whatever be the velocity of its revolution and its mode of effecting its object. Although when there is negative slip, the rotation of the screw may not be so rapid, yet it must be more forcible. Less force will naturally be required to cause a certain rate of revolution of the screw in still water than is necessary to enforce the same velocity of rotation when a stream of water is rushing against the screw at a speed of some three or four knots per hour. And it is of course inevitably on the screw that the necessity falls of imparting motion to the dead water which partially attaches itself to the progress of the ship. Negative slip seems to point out a faulty construction of vessel by showing that it creates a needless disturbance, and drags in its wake an unnecessary column of water.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

EXCEEDINGLY HARD IRON.

SOME years ago, M. Gaudin found that by heating iron, tolerably free from carbon, with a small quantity of boron, to a very high temperature, he obtained a product which could not be forged, but which possessed extraordinary hardness. He has now found that an equally hard metal may be obtained by adding to ordinary cast iron, in fusion, phosphate of iron and peroxide of manganese,—he does not mention in what proportions. The

product cannot be forged, but it casts easily, and is therefore readily applicable to the construction of such machines, or parts of machines, as require in their material extreme hardness rather than tenacity. The metal so produced is moreover singularly sonorous, and M. Gaudin accordingly proposes it as a material for bells. He finds that a still harder metal is producible by the addition of tungsten—again he omits to say in what amount—to ordinary cast iron. He states that this tungsten iron surpasses everything previously known as a material for tools for cutting rocks, and that crystals of it will cut glass as readily as the diamond.

SODA FROM CRYOLITE.

Cryolite is a double fluoride of aluminium and sodium, represented by the formula $Al^2 Na^2 F^6$, or $3 Na F + Al^2 F^3$. If it existed in sufficient abundance it would doubtless be used as the only source of soda, since soda may be obtained from this mineral by a much simpler and less expensive treatment than is required for the production of that alkali from the raw material it is most usually obtained from,—chloride of sodium, or common salt. If cryolite be ground, mixed with quick-lime, and heated in a current of steam, all the fluorine in it combines with the metallic base of the quick-lime, to form fluoride of calcium, while the aluminium and sodium with which the fluorine was previously combined are both oxidised, and their resulting oxides combine together, forming aluminate of soda. This compound is readily soluble in water, and if a current of carbonic acid be passed through its solution, carbonate of soda is formed and pure hydrate of alumina precipitated. One ton of cryolite will thus yield about two tons of deca-hydrated carbonate of soda, and about a third of a ton of pure hydrate of alumina. Unfortunately, cryolite is not an abundant mineral. It only occurs, so far as is at present known, in two localities,—at Evigtok, in the Arksut-fjord, in West Greenland, and, associated with chiolite, lithia mica, and fluor-spar, at Miask, in the Ural. At Miask, however, it exists only in very small quantity; the Evigtok bed is the only one worth working, and it is only about 300ft. long and 80ft. thick, can only be worked during about half the year, and cannot be made to yield more than about 10,000 tons annually. An American firm has just contracted for half this yield, finding it cheaper to import cryolite from Greenland, and manufacture soda from it at Boston, than to import soda, ready manufactured, from England. There must surely be more deposits of cryolite somewhere; let us hope that some one will soon find them.

THE HYDRAULIC PROPERTIES OF MAGNESIA.

The discovery, mentioned in last week's "Notes," of the remarkable hydraulic properties of magnesia, seems to have been made quite by accident. About seven years ago, M. Donny sent to M. Henri Sainte-Claire Deville some compact anhydrous lumps of magnesia, which he had obtained by calcining chloride of magnesium, and it happened that some of these lumps got placed under a tap in M. Deville's laboratory, and were thus constantly exposed to running water. After some months of such exposure they were examined, and were found to have become as translucent as alabaster, and hard enough to scratch marble. This was six years ago, and M. Deville was recently led to examine them again, when he found that six years' exposure to the air had not in the least changed them. He analysed them, and found them to contain 27.5 per cent. water, 8.3 per cent. carbonic acid, 1.3 per cent. alumina and oxide of iron, 57.1 per cent. magnesia, and 5.6 per cent. of sand. He concluded that they were essentially a crystallised hydrate of magnesia, resembling the mineral "brucite," which does not absorb carbonic acid, and he proceeded to test the soundness of this conclusion by making powdered magnesia, obtained by calcination

of the nitrate, into a paste with distilled water, and sealing this paste with some more distilled water in a glass tube. At the end of a few weeks the magnesia thus treated was found to have become quite as compact, hard, and translucent as the lumps above spoken of, and on analysis it was found to be a simple hydrate of magnesia, containing 69.3 per cent. of magnesia and 30.7 per cent. of water. This led M. Deville to try a great number of experiments with magnesia from various sources, and also with various mixtures of magnesia and other substances. He found that a mixture of magnesia and plaster of paris does not set under water, but that a mixture of magnesia with powdered chalk or marble forms with water a plastic mass, which by exposure to water for some time,—he does not specify how long,—becomes converted into a kind of extremely hard artificial marble. The magnesia which he found to form, by hydration, the hardest compound, is that known in France as "Balard's magnesia," being magnesia prepared by calcination of the chloride of magnesium which M. Balard obtains so ingeniously from the mother-liquors of sea water. This magnesia exhibits its "astonishing" hydraulic qualities in the highest degree when it has not been exposed to a heat above redness, exposure to a white heat diminishing its hydraulicity. The results of greatest practical moment, however, are those which M. Deville obtained with dolomite, which abundant natural compound, after being calcined at a heat *below dull redness*, powdered, and made into a paste with water, "forms under water a stone of extraordinary hardness." If the dolomite be heated to bright redness, so as to decarbonate the lime of the compound, as well as its magnesia, the paste formed with it does not set under water. The lime of the compound should remain in the state of carbonate, and only the magnesia be deprived of carbonic acid; then, the magnesia, in undergoing hydration, or combination with water, not only becomes hard itself, but in so doing binds together the particles of the carbonate of lime, and the result is a compact, homogeneous, and intensely hard artificial stone, upon which, when once formed, neither fresh water nor sea water has the slightest action,—so far, at least, as can be at present judged. Dolomite exists so abundantly,—there is one bed of it in this country which is not less than one hundred and fifty miles long, and is in some places six hundred feet thick,—that M. Deville's discovery of the new use it can be turned to cannot but prove of very great practical value.

ATMOSPHERIC OZONE.

Meteorologists have been taking sedulously for the last ten years what they have supposed to be ozonometric observations, by means of test papers prepared with iodide of potassium. Ozone is known to have the property of liberating iodine from that salt, and the discoloration, on exposure to the atmosphere, of papers prepared with that compound, in the manner in which the liberation of a portion of the iodine they contain discolours them, has been regarded as a sign of the presence of ozone in the atmosphere, while the amount of the discoloration has been supposed to indicate, relatively at least, the degree in which ozone was present therein. Whether the presence of ozone in the atmosphere really is proved by its action on iodide of potassium papers has been often called in question on the ground that, while the atmosphere consists in so large part of nitrogen, artificially-prepared ozone has been over and over again demonstrated to be incapable of existing, in the free state, in contact with that gas,—ozone and nitrogen, when in contact with each other, instantly entering into combination. Moreover, nitrogen is not the only atmospheric constituent the co-existence of which with free ozone is exceedingly difficult to conceive, for artificially-prepared ozone has always been found to be instantly destroyed by organic

matters, and such matters are contained everywhere in the atmosphere. This argument has been met by opposing arguments, which have hitherto carried conviction to the meteorological mind; but now one of the most eminent of continental meteorologists, Admiral Berigny, who for years past has given special attention to ozone observations, and who has been at great pains to organize arrangements for their being taken systematically throughout France, has come to the conclusion that the ordinary test-papers are not in the least degree reliable indicators of the presence of ozone in the air, and has prayed the Academy of Sciences to appoint a commission to inquire whether a really trustworthy test of the presence or absence of that remarkable body cannot be devised. In the course of a discussion of the subject which took place at a recent sitting of the Academy, M. Frémy gave the weight of his great authority to the Admiral's view of the matter, and while not denying that free ozone may exist in the atmosphere, showed pretty conclusively that its existence therein has never yet been proved. He pointed out that the re-agent with which the so-called "ozone papers" are prepared "is affected not only by ozone, but also by the oxygen-compounds of nitrogen, by ammonia, by formic acid, by essential oils, by the acid products of combustion, by dusts,—in a word, by all sorts of things which are held in suspension in the air," and he added that he "knew of only one certain test for ozone in the air, and that was the oxidation of silver by passing a current of moist air over the metal, and this test he had applied many times without obtaining any indication of ozone." The Academy has appointed the suggested commission, and as this commission consists of Chevreul, Dumas, Pelouze, Pouillet, Bous-singault, Le Verrier, Vaillant, Frémy, and E. Becquerel, and thus includes some of the most able of living chemists, its labours will doubtless throw light on the interesting and mysterious subject which it is appointed to investigate.

ALLEGED INFLUENCE OF CERTAIN BODIES ON THE PLASTICITY OF SULPHUR.

We recorded, nearly twelve months ago, the statement of MM. Moutier and Dietzenbacher that sulphur could be rendered soft and plastic by fusing it with very minute quantities of either iodine, paraffine, lamp-black, or certain other substances which those gentlemen specified. M. Keller, however, has just informed the Chemical Society of Paris that he has not found the fact to be as thus stated. He has tried, he says, every one of the substances named by MM. Moutier and Dietzenbacher, but has never found the sulphur fused with them to be soft and plastic, when cool, unless it were poured, when in the fused state, either into cold water, or, in a very thin layer, on to a very cold porcelain tile. As sulphur free from admixture with any other body is rendered plastic by being fused and thus suddenly cooled, M. Keller concludes that admixture with the substances in question has not the influence upon that element which MM. Moutier and Dietzenbacher supposed.

CONGELATION OF ANIMALS.

M. Pouchet has been investigating the results of reducing the bodies of animals to the temperature at which they freeze,—a proceeding, by the way, quite as cruel as vivisection,—and from a long series of experiments he has deduced the following conclusions:—"1. That the first phenomenon produced by cold is a contraction of the capillary vessels to such an extent that a globule of blood cannot enter; these vessels, therefore, remain completely empty. 2. The second phenomenon is an alteration of the blood globules, amounting to their complete disorganisation. 3. Every completely frozen animal is absolutely dead, and no power can reanimate it. 4. When only a part is frozen that part is destroyed by gangrene. 5. If

the part frozen is not extensive, and only a few disorganised blood globules pass into the circulation, the animal may recover. 6. But if, on the contrary, the frozen part is of considerable extent, then the mass of altered globules brought into the circulation when the part is thawed rapidly kills the animal. 7. For this reason a half-frozen animal may live a long time if maintained in that condition, since the altered globules do not then get into the circulation; but it expires rapidly as soon as the frozen part is thawed. 8. In all cases of congelation, death is due to the alteration of the blood globules, and not to any effect on the nervous system. 9. It results from these facts that the less rapidly a frozen part is thawed the more slowly the altered globules find their way into the circulation, and the greater are the chances of the recovery of the animal." It is to be hoped that no reader of these "Notes" will get "partially frozen" during the severe weather which Lord Portarlington tells us is at hand, but if any should have that misfortune, let him bear the foregoing in mind and take care not to get thawed too quickly.

MANCHESTER BOILER ASSOCIATION.

The last ordinary monthly meeting of the Executive Committee of this Association was held at the offices, 41, Corporation-street, Manchester, on Tuesday, December 12th, 1865, when, the President, William Fairbairn, Esq., C.E., LL.D., F.R.S., occupying the chair, Mr. L. E. Fletcher, chief engineer, presented his report, of which the following is an abstract:—During the last month 38 engines have been examined, and 445 boilers, and 8 of the latter tested by hydraulic pressure. Of the boiler examinations, 349 have been external, 8 internal, and 88 entire. In the boilers examined, 151 defects have been discovered, 15 of those defects being dangerous. The following is a statement of defects, omissions, &c., met with in the boilers examined from October 28th, 1865, to November 24th, 1865, inclusive:—Furnaces out of shape, 10; fracture, 13; blistered plates, 5; corrosion, internal, 18; corrosion, external, 27; grooving, internal, 7; grooving external, 3; feed apparatus out of order, 8; water gauges out of order, 21; blow-out apparatus out of order, 11; safety valves out of order, 4; pressure gauges out of order, 9; boilers without blow-out apparatus, 4; boilers without feed back-pressure valves, 10; cases of deficiency of water, 1.

One of the cases of furnaces out of shape, referred to in the preceding statement, arose from remarkable carelessness. The engineer had lighted his fire in the boiler without having the water brought up to its proper level, intending, as it is understood, merely to maintain a slow fire to air the flues. This would have been sufficiently hazardous even in competent hands, and should not have been done at all. In addition to this, however, he went away to his breakfast, and left the boiler, with the fire burning, in charge of a man who was quite incompetent to look after it. While the engineer was absent the man in charge got up a strong fire, and then perceiving that the water was not up to its proper level, set to work to pump it in by turning round the flywheel of the engine by hand. He was busily engaged in this way when the engineer returned, who at once shut off the water and drew the fire, fortunately in time to prevent the rupture of the flue, though not before the crown had become red hot, and brought down considerably out of shape. The engineer was quite right in drawing the fire, as well as in shutting off the feed water, and this course should be pursued whenever furnace crowns are overheated, provided that they are not so seriously distorted as to threaten to rend before the fire can be withdrawn, and thus to lead to the fireman's being scalded. The feed should, under any circumstances, be shut off, which might be done without danger. It should be stated, however, that the danger of pumping cold water into partially red-hot boilers has been very much overrated, and where the water is not injected directly on to the red-hot plates, it is very doubtful if any explosion would take place. The throw of a feed pump is but slow, so that the water would only rise gradually, and thus cool down the heated plates by conduction little by little before it covered them.

Four explosions have occurred during the

past month, by which ten persons have been killed and ten others injured. Not one of the boilers in question was under the charge of this Association. The following is the statement of explosions from October 28th, 1865, to November 24th, 1865, inclusive:—No. 36 (Oct.), colliery, full particulars not yet ascertained, 3 persons killed; No. 37 (Nov. 6), agricultural, full particulars not yet ascertained, two persons killed; No. 38 (Nov. 12), particulars not yet ascertained, no one injured; No. 39 (Nov. 23), single-flue, or Cornish, internally fired, 5 persons killed, 10 injured.

On account of the distance from Manchester at which these explosions occurred, in one instance as much as 300 miles, I have not been able to make a personal investigation of any one of them. When this is prevented it is very difficult to get reliable information. The ordinary reports generally state but little else than that a good deal of property has been destroyed, several people killed, and that a verdict has been found by the jury at the coroner's inquest to the effect that the explosion was perfectly accidental, and no one whatever was to blame in the matter. This does not throw much light on the cause of the explosion, and, though several lives may have been lost, little is gained by way of information to prevent the recurrence of similar catastrophes. This Association, therefore, is doing considerable service in investigating and publishing a report on the facts of as many of these explosions as possible, since otherwise, although several lives may have been sacrificed, as in the present instance, in which ten persons were killed, the public have practically no information as to the facts of the case.

The serious loss of life which has resulted from No. 39 explosion, five persons being killed and ten others injured, appears to have called so much attention to it as to render it to some extent an exception to the above remarks, and—after they were written—this explosion was made the subject of a special article in a scientific journal. From this it appears that the boiler was of the "Cornish" class, that it was 32ft. in length, and had a diameter of 7ft. 2in. in the shell, and 3ft. 7in. in the internal flue tube, which latter was made of plates 7-16in. in thickness, while the working pressure was 57lb. per square inch. The explosion was due to the collapse of this furnace flue, which was not strengthened with any flanged seams or hoops either of angle or T iron. It is reported that there was plenty of water in the boiler at the time of the explosion, and that the tube did not give way in the first instance at the top, but at the side, so that it would appear the collapse did not arise from overheating of the plates, but simply from weakness of the tube, a view which is corroborated by the consideration of the tube's dimensions. A furnace tube 32ft. long, 3ft. 7in. in diameter, and made of plates of 7-16in. in thickness, as this one was, should not be worked at a higher pressure than 38lb. on the square inch, even though perfectly cylindrical and in first-rate condition, unless strengthened, as it easily might be, either with flanged seams, encircling hoops, or other approved means; so that as this tube was not strengthened in this way, it was quite unsafe at the pressure at which it worked, viz., 57lb. on the square inch, and had the boiler been under the charge of this Association, the danger would have been promptly pointed out to the owners. Indeed, one would suppose that if they took that interest in the safety of their boilers which every steam user should do, they could hardly have been unaware of the necessity of strengthening furnace tubes as above described, from the reiterated instances of collapse given in the reports of this Association.

PHILLIPS'S PATENT GIRDER AND FIRE-PROOF FLOORING.

On Tuesday last some important experiments took place at Mr. Kirkaldy's testing works, the Grove, Southwark, with the above inventions, in the presence of a large number of practical engineers and other scientific gentlemen. Mr. Kirkaldy, who has long been known in connection with experiments on iron and steel, has recently erected an enormous machine, possessing testing powers from ten pounds to one million pounds, which records its own progress and conclusions with the certainty and exactitude of a chronometer. He conducted the experiments in person, assisted by Mr. Homan. The patentees of the girder, Messrs. W. and T. Phillips, of the Coal Exchange, were also present. The peculiarity of the new invention consists in the

flanges being rolled solid, instead of being riveted as heretofore, whilst the web is somewhat thicker than usual. The first experiment was with a light girder 8in. deep, with 2½in. flanges, and 20ft. between the supports; the weight was 22lb. per foot run, the iron being equal to ordinary Staffordshire plate. For the purpose of understanding the comparison it may be stated that the breaking weight of a similarly sized riveted girder is about four tons, the distributed safe load being about two tons. In the experiment with the new girder the old breaking pressure of four tons was immediately applied; when withdrawn after a short time it was found that the limit of elasticity had not been reached, as no permanent set was discernible. Five tons were then put to the centre of the beam, as before, which showed a permanent set in the metal, but to the smallest appreciable extent. The pressure was then increased for breakage, and at about seven tons the supports gave way, and the beam turned over from the machine. Examination was critically made to discover fracture, but, although a considerable vertical set had taken place, no separation of the metal was observable. The next experiment was a girder having the lower flange 2½in. by ½in., the top flange being 8in. by ½in., whilst the depth was about 16in.; this girder was riveted in the middle. The breaking weight of a similar girder with riveted flanges is ten tons, but the new solid rolled flange refused to move under that pressure, or even at twelve tons. The strain went on to sixteen tons, when it began to set only, and at eighteen tons it jumped out of the machine like the previous ones, through the giving way of the supports. A close inspection showed that beyond the slight setting this girder has suffered no injury whatever; and, as it so far exceeded Mr. Kirkaldy's expectations of its resisting powers, it was agreed to postpone the remaining experiments for a month in order that the testing machine should be expressly prepared for this unlooked-for new girder.

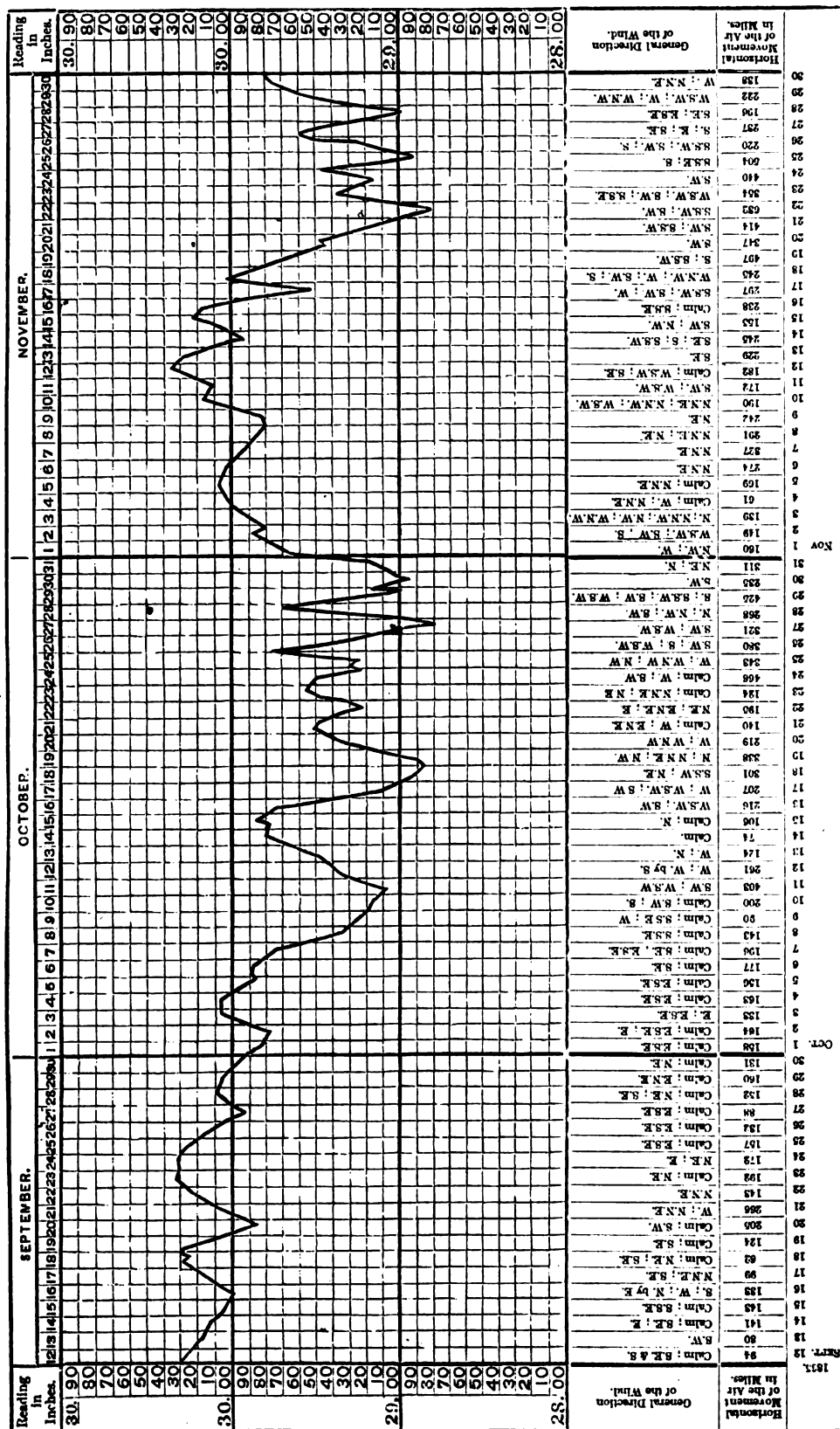
Advantage was then taken of the opportunity to inspect the Messrs. Phillips's new fireproof flooring. It consists of rolled iron joists 2ft. apart, with iron laths resting on the bottom flange. On these laths concrete is laid to the depth of four or five inches, and in the concrete the dove-tail timber joists are buried. The under side forms an excellent key for the plaster ceiling, which can be easily applied by any ordinary workman. It is believed that this floor can be laid as cheaply as any ordinary floor, and at much less cost than any fireproof flooring now used.

TESTING ARMOUR-PLATES.

A NEW method of testing experimental and sample armour-plates is about to be adopted by the Admiralty, and for which purpose the "Thunderer" target ship is being prepared. In all previous trials of armour-plates at Portsmouth, whether for ships or forts, the conditions have been a distance of 200 yards from the muzzle of the gun to the armour-plate, with the latter bolted on to the side of some old wooden frigate moored for the purpose in the upper waters of Portsmouth harbour, and the gun mounted on the deck of a gunboat. With the "Thunderer" the conditions are entirely altered, both gun and plate being mounted on board the ship at only 25ft. distance from each other. To attain this object the "Thunderer" has been cut down to her lower deck overhead beams, and 25ft. space of the lower deck converted into an iron-lined roofless room or proof house, one end of the room being formed by a timber-built bulkhead of immense strength, on which are bolted the armour-plates under trial, and the other end by an armour-plated bulkhead with portholes for four guns. The guns are laid at any particular part of the armour-plate required, and fired by means of a voltaic battery from below. Of the plates now ordered for trial one is for the iron-cased hydraulic vessel "Waterwitch," a vessel building for the Admiralty by the Thames Ironworks and Shipbuilding Company. This vessel is remarkable as having been designed on a plan expected to supersede all other steam vessels, screw or paddle, by proving the practicability of propelling vessels by sucking in a column, or "rope" of water, by a turbine wheel arrangement through a ship's bottom and squirting it again out of the ship through her sides. It is feared that, whatever results may be obtained, they will be rendered unimportant by the excessive cost of their production. The plate for this ship's armour is 4½in. thick.

ON THE VARIATIONS OF THE READING OF THE BAROMETER AND THE WEATHER DURING THE GALES.

DIAGRAM EXHIBITING THE BAROMETRIC VARIATIONS FROM SEPTEMBER 12TH TO NOVEMBER 30TH, 1865, WITH THE GENERAL DIRECTION OF THE WIND, AND THE HORIZONTAL MOVEMENT OF THE AIR, ON EVERY DAY, AS REGISTERED AT THE ROYAL OBSERVATORY, GREENWICH,
By JAMES GLASHEN, Esq., F.R.S.



above the average to the end of the month, being mostly above 30in., as shown in the diagram. The weather was exceedingly fine throughout the month. The highest reading in the month took place on the 23rd. There was a little decrease in the readings at the beginning of October, but on the 3rd day the reading again rose above 30in., and began to decline on the 5th, continuing to decrease till the 11th. Up to the 10th day the air had been mostly calm, and fog had been prevalent, but on this day the wind began to blow strongly from the W. and S.W. On the 11th the readings began to increase, and from the 12th the winds were light. A maximum barometer reading was reached on the evening of the 15th day. During the 16th the barometer readings decreased rapidly, and the wind increased in strength. A minimum reading of 28.69in. was reached by 9 p.m. on the 18th, with strong wind blowing. Unsettled weather followed this, and the barometer readings oscillated up and down, as will be seen by reference to the diagram, and the wind was frequently very strong, reaching 20lb. on the square foot on the 25th day. From this time to the end of the month, the oscillations of the barometer readings were very remarkable; a decrease of $\frac{1}{2}$ in. was followed by an increase to the like amount, and then in very unusually quick succession, another decrease and increase to almost the same amounts, these very large and rapid changes extending over very considerable tracts of country and sea. The large numbers at the bottom of the table on those days will show how strongly the wind was blowing.

From this time there is a general bold and continuous increase in the barometer curve to 30in. on the 12th of November, with mostly N. and N.E. winds blowing, and sometimes strongly. From the 13th day set in decreasing readings, which with checks, as shown in the diagram, fell to 28.62in. on the 22nd day. At Liverpool Observatory, on this day, the reading was as low as 28.31in., as recorded by John Hartnup, Esq., the Director of the Observatory; and from this time to the 28th day, there was a succession of disastrous storms. If we collate the number in the lower part of the chart together with different readings of the barometer, we shall find that when the readings exceed 30in., the average daily horizontal movement of the air was about 180 miles per day; about 30in., 160 miles per day; between 29.5in. and 30in., 210 miles per day; between 29.0in. and 29.5in., 260 miles per day; below 29in., 320 miles per day; thus showing that whenever the barometer reading has been above the average, the wind has been moderate, and that as the barometer reading decreases, the motion of the wind increases, and is the greatest at the lowest readings. It is impossible for me to urge too strongly the necessity of care when continuous declining readings are proceeding. The barometer may be almost neglected by the sailor when its readings range above the average, but when they descend below the average, it is a warning which ought never to pass unheeded; and when the depression is sudden, it is the sure and certain warning of the approach of storms. Such signs no sailor ought to neglect; yet they are neglected; and, what is more sad still, too many barometers sold as marine barometers are totally

The variations of the readings of the barometer at the Royal Observatory, Greenwich, in the period from September 12 to November 30, 1865, making altogether eighty days, are shown in the diagram and table, a copy of which I beg to send you herewith. The general directions of the wind are also given on every day, as determined from the records of Osler's self-registering anemometer, and the number of miles of horizontal movement of the air as self-registered by the use of Robinson's anemometer. During the latter part of this period there have been successive heavy gales of wind upon our coasts, causing sad disasters at sea, and calling very frequently into use the services of the lifeboats of the National Lifeboat Institution, and these, in most cases, have been attended with success in the saving of life; but unhappily in some few instances, as

must ever be the case, the gales have been so violent that life has been lost; and the most noble efforts on the part of the lifeboat crews, after toiling in some instances through the midnight storms, have failed entirely, the boats being unable to reach the distressed ships. A few particulars of the readings of the barometer during the period preceding these storms and during their continuance, cannot fail to be useful and interesting to the brave men who are ever ready to go off in these lifeboats, as well as to sailors and fishermen generally.

The readings of the barometer from the 1st of September to the 6th day were high, and above the average. On the 7th day it decreased a little below the average; on the 8th the lowest reading in the month took place,—viz., 29.76in.; and from the 9th day it was constantly

260 miles per day; below 29in., 320 miles per day; thus showing that whenever the barometer reading has been above the average, the wind has been moderate, and that as the barometer reading decreases, the motion of the wind increases, and is the greatest at the lowest readings. It is impossible for me to urge too strongly the necessity of care when continuous declining readings are proceeding. The barometer may be almost neglected by the sailor when its readings range above the average, but when they descend below the average, it is a warning which ought never to pass unheeded; and when the depression is sudden, it is the sure and certain warning of the approach of storms. Such signs no sailor ought to neglect; yet they are neglected; and, what is more sad still, too many barometers sold as marine barometers are totally

unfit for such an important purpose. During the last few years I have seen many of these instruments, and I have found them imperfect in numerous ways. Some of these defects I may enumerate here:—

Firstly, the upper portion of the tube is too small. Secondly, the relation of the interior bore of the tube to that of the cistern is neglected, so that the rise of the mercury in the cistern, caused by a fall in the tube, is not allowed for on the scale. Thirdly, the lower portion of the tube is generally too much contracted in the bore. Fourthly, the cistern is too small to contain the mercury when the barometer reading is low. Fifthly, the careless cleaning out of the internal bore of the tubes, and imperfectly freeing them from damp. The most serious of these errors is the third. It is well known that the tubes of marine barometers ought to have their bores contracted so as to steady the motion of the mercury when the ship is in a heavy sea. This, in some instances, is so carelessly done, that it has not the desired effect; but in most cases it is carried to a great excess. For instance, in some instruments the mercury will take from forty minutes to an hour to pass through the first inch after suspension, and many are so sluggish in their action as not to indicate any change in less than twenty minutes. This unnecessary contraction is very frequently the cause of entirely stopping the action of the barometer, as the minutest particle of foreign matter, or even the oxidation of the mercury itself, which, as an impalpable powder forming on the surface of the mercury in the cistern on moving the barometer, is displaced, and this in its ascent to float on the top of the mercury, chokes and closes the fine bore of the tube hermetically, rendering the instrument perfectly useless; and this is often not found out till the ship has left for sea. A barometer, therefore, acting well till disturbed, may be quite useless afterwards. The fourth named error is also one of great gravity; and for this error low-priced manufacturers are far more to be censured for their culpability than for their ignorance or carelessness—the size of the cistern is reduced to enable them to save a quarter of a pound of mercury. This great desire to cheapen instruments is most serious, as the indications of such instruments are absolutely deceiving, and at a time when the changes are of vital importance to the sailor. In many such barometers the mercury will not fall below, even if so low, as 29in., although a standard at such times may read 28·5in., or even less. Nor will such an instrument show any change till the mercury rises above 29in.; that is, the barometer says the mercury is stationary and steady at all times of the greatest phases of storms, and when every change should be instantly known by the sailor.

It is, therefore, not to be wondered at that some master-mariners hold the barometer in little esteem if supplied with instruments of this class. Mr. Pastorelli told me that he heard a captain say that he had the barometer removed, as it occupied some valuable space which was required for another purpose, and on arriving in the port of Liverpool, that very instrument was found broken in an obscure corner of the ship. This is a sad illustration, and proves the absolute necessity of improvement in the make of these instruments. By using large cisterns, tubes of proper capacity, scales which are known as contracted scales, chemically clean tubes, pure mercury, and properly contracted bores, instruments can be made which shall read with 0·01in. or 0·02in. at every part of their scales, when compared with a standard barometer, and they ought to and can be sold at a moderate price. The contraction of the tube in a marine barometer ought to be carried only so far as to allow the utmost freedom of action of the mercury without pumping. When the ship is in a heavy sea, when first suspended, the screw at the bottom of the tube being withdrawn as far as possible, the mercury should fall in the tube through the first inch in 40 sec. to 60 sec. It should fall through the second inch in less than 2 min., and should be at its true reading within or about 15 min. from the time of first suspension. Such an instrument, however quickly atmospheric changes may be taking place, will take up its true readings within 0·01in. within one or two minutes, and this degree of accuracy is practically correct. On removing such an instrument before packing, it should be taken down without touching the screw at the bottom, and inclined with its cistern downwards, at an angle of 45 deg. to

60 deg.; the tube will be filled in this position in three or four minutes; then hold the instrument horizontally, and drive the screw at the bottom nearly, but not quite, home. With these precautions, the instrument will continue good for many years—in fact, till broken. During the last few months I have had frequent interviews with Mr. John Browning, of 111, Minorities; Mr. F. Pastorelli, of 208, Piccadilly; and Mr. Zambra, of 1, Hatton Garden, who have undertaken to make marine and upright barometers of this character for my examination; and I have also undertaken to examine every one made by these makers, and to give a certificate with every instrument which complies with the above conditions. This will, I think, effectually meet the difficulty to which I have referred. I feel confident that if our seamen had been provided with truthful instruments during the fearful storms of Wednesday, the 22nd November last, and on the Friday following—the storms of those two days and nights would not have proved so disastrous as they did to life and property.

In corroboration of my remarks, I may mention one or two cases. Some four or five years ago Her Majesty's steamer "Porcupine" was cruising off St. Kilda, in the Hebrides. Captain Otter, R.N., carefully observing the gradual fall of the mercury to the extent of 1½in. between 8 a.m. on one day and 3·26 a.m., at once ordered his ship to be made as snug and tight as possible. The hurricane at the latter hour burst out with fearful violence, swept off the little island nearly the whole of the agricultural produce of the poor people, and caused lamentable havoc amongst the shipping and fishing-boats that happened to be out in those seas at the time. But the "Porcupine" weathered out nobly the storm; and in lieu of being in a thousand pieces, the good ship was engaged a few days afterwards in a mission of mercy in bringing food to the poor islanders. I am sure that every assistance will be cheerfully rendered by the National Lifeboat Institution to save life—whether by lifeboats, ship's lifeboats, seamen's lifebelts, fishing lifeboats, or, lastly, but not least, in its great and good work, by helping the sailor on board ship to possess a truthful and cheap barometer—a scheme which is indeed only an extension to the sea of the coast barometer system of the Institution; and thus prevent, as far as possible, by timely warnings on board ship, the necessity of calling into use the last but most glorious assistance—the services of the lifeboat itself.

JAMES GLAISHER.

Blackheath, December, 1865.

LITERARY AND PHILOSOPHICAL SOCIETY.

At a recent meeting of this society, Mr. Dancer, F.R.A.S., read a paper "On the Illumination of Opaque Objects under the high powers of the Microscope." The author's attention was drawn to a paper on this subject, by Mr. H. L. Smith, of Kenyon College, which appeared in the *MECHANICS' MAGAZINE* of October 20th, 1865. Mr. Smith had contrived a plan for the illumination of opaque objects by placing a small mirror in a rectangular box, which could be attached to any ordinary microscope; this mirror was made adjustable immediately over the opening of the back of the objective, a light was placed at the side of the box and reflected down through the objective on to the object. In this manner the object could be illuminated when the high powers were used. The author not having time to make one of Mr. Smith's apparatus, thought it possible to arrive at similar results by the employment of the binocular microscope, an instrument which is now more common than a monocular instrument. The trial quite answered his expectations. The simplest method, and one which gave good results, is to remove the eyepiece from the oblique body and fix a reflector on the top of the body in such a manner as to throw the rays of light down to the Wenham's prism, and thence through the object glass on to the object. If a plane mirror is employed, a lens of suitable focal length should be placed in the body in order to get the field of view entirely illuminated. A concave mirror or lensular prism can also be used for the same purpose, providing the focal length is adapted to the length of the body and object glasses. Various modifications can be adapted so as to vary the character of the illumination to suit the particular object to be viewed. In some cases the Wen-

ham's prism may be withdrawn a little, to produce the proper effect. Uncovered objects only can be seen to advantage, owing to the light reflected from the surface of the covering glass. The surface on which the objects are mounted should reflect as little as possible, and be a marked contrast in colour to the object.

At a subsequent meeting Mr. Dancer referred to the above paper and proceeded to describe another method of illuminating opaque objects, which, being equally applicable to monocular and binocular microscopes, appeared worthy of some consideration. In the method of Mr. H. L. Smith, and also in the use of the Wenham's prism, there is a considerable loss of angular aperture, which is a very important consideration; it occurred to the author that by modifying Mr. Smith's contrivance this loss might be diminished in some degree, and this has been attempted in the following manner. Instead of placing the mirror immediately over the opening at the back of the object glass, a small speculum 1·6in. in diameter is introduced into the front of the body of the microscope, 2½in. above the top of the objective. A lateral opening is made in the body at right angles to the speculum, for the admission of light to be reflected down through the objective to the object below. The interposition of the small speculum did not produce any disagreeable effect in the field of view, and in the examination of objects it was easy to use that portion of the field which was between the centre and the edge. With proper manipulation very good definition could be obtained by this method, when the speculum was of the proper curvature. This contrivance could always remain attached to the microscope without interfering with the general appearance of the instrument, and when the use of the speculum was not required, it could be withdrawn or turned aside out of the field of view, and the aperture at the side of the body might be closed by a small shutter. It was obvious that the use of the binocular body is not interfered with by this arrangement.

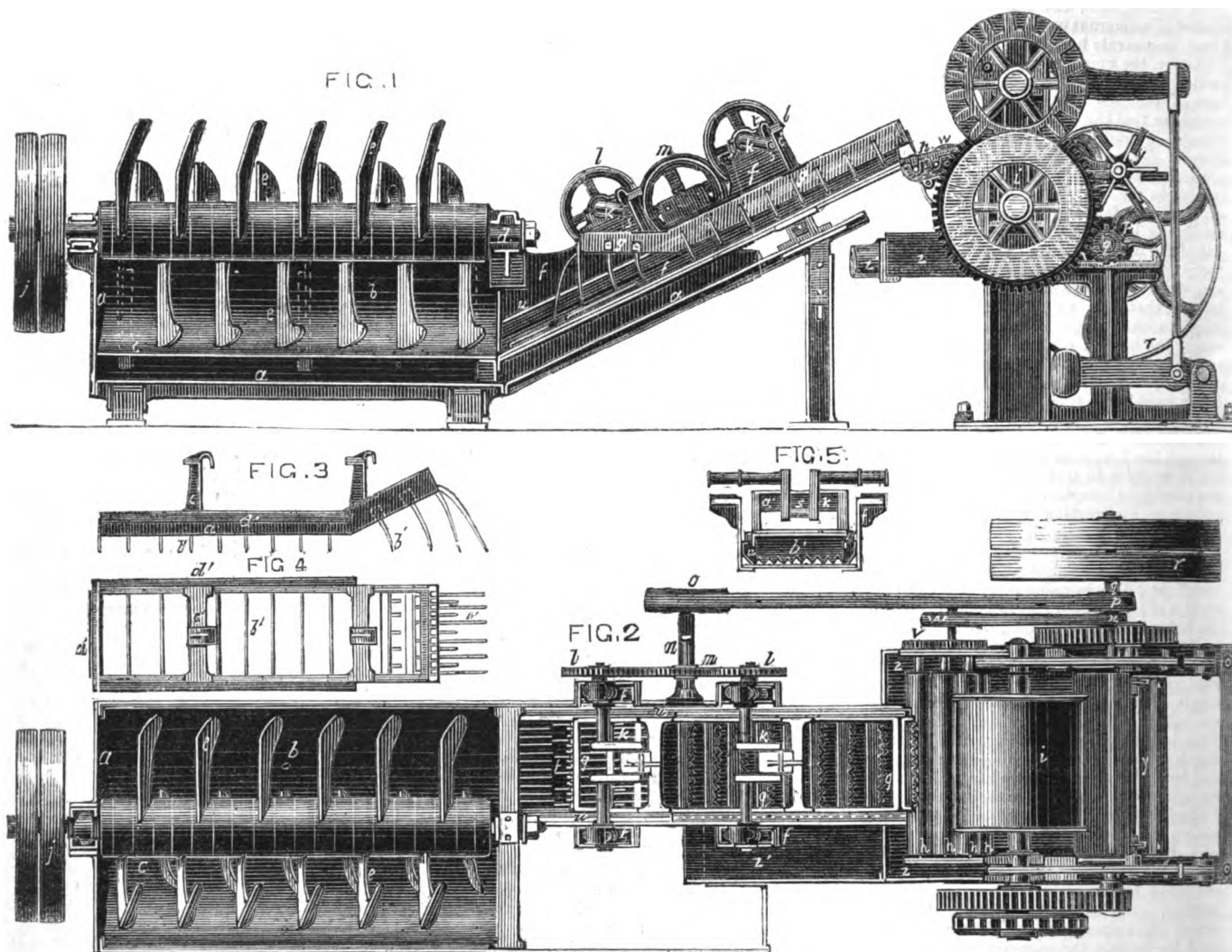
INSTITUTION OF CIVIL ENGINEERS.

The annual general meeting of the Institution of Civil Engineers was held on the 19th inst., Mr. J. R. McClean, President, in the chair. The report referred to the twelve papers read during the past session, and stated that the number of elections had been 142, of decrees 21, of resignations 5, and of erasures 8, leaving an effective increase of 108, and making the total number of members of all classes on the books on the 30th of November last, 1,203. This was an increase of nearly 9 per cent. on the present number in the past twelve months. With regard to the Benevolent Fund, instituted about twelve months ago, the report stated that the donations actually received had amounted to £22,782 17s., and the annual subscriptions for 1865 to £712 16s., being in the former case a little in excess of the sum promised, and in the other an increase of 30 per cent. A private bill to be submitted to Parliament in the ensuing session, and for which plans had been deposited and the usual notices served, appeared calculated to affect very seriously the interests of the Institution. This was in reference to that part of a project entitled "Houses of Parliament Approaches," which contemplated the compulsory purchase of all the property on the north side of Great George-street, including the house occupied by the Institution.

After the reading of the report, Telford medals and Telford premiums of books were presented to Messrs. J. W. Bazalgette, C. Reilly, E. H. Clark, and Captain H. W. Tyler, R.E.; Telford premiums of books to Messrs. T. Hawthorn, E. Fletcher, E. Johnston, G. O. Mann, W. J. W. Heath, and J. Taylor; and the Manby premium in books to Mr. H. B. Hederstedt.

Votes of thanks having been passed to the officers for their services during the past year, the following gentlemen were elected to fill the several offices on the council for the ensuing year:—John Fowler, President; Joseph Cubitt, Charles Hutton Gregory, Thomas Hawksley, and John Scott Russell, Vice-Presidents; James Abernethy, William Henry Barlow, John Frederic Bateman, Nathaniel Beardmore, James Brunles, Thomas Elliot Harrison, George Wilmoughby Hemans, John Murray, George Robert Stephenson, and Charles Vignoles, Members; and Joseph Freeman and John Kelk, M.P., Associates.

WASHING AND DRYING WOOL.



In the specification of a patent granted to Mr. W. M'Naught in 1862, a washing machine is described, in which the fibre is fed into a trough at one end, and by means of screw blades or propellers on a longitudinal axis the fibre is carried to the other end of the trough, together with the liquid in which it is immersed, and there the washed fibre is deposited on an endless apron, which raises it out of the trough, and delivers it to squeezing rollers, whilst the liquid being driven through the apron returns under a false bottom, with which the trough is furnished, to the end at which the fibre is fed in. The present invention, which has been patented by Messrs. J. and W. M'Naught, of Rochdale, engineers, has for its object the improvement of such machines, and for this purpose (referring to washing machines) instead of employing an endless apron, which performs the office of a travelling sieve, they use an inclined stationary sieve or trough, upon which the materials and liquid are propelled; by the action of the screw blades the liquid passes through the sieve, and the materials are deposited thereon. From this inclined sieve or trough the materials are moved upon an inclined plane, by means of a series of scrapers attached to a frame. This frame rests on guides parallel with the inclined plane, and has a reciprocating motion imparted to it. The use of the guides is to support the frame and prevent the scrapers from rubbing upon the sieve or incline. When the fibrous material has been raised to the top of the incline it falls upon a series of rollers all revolving in one direction. These rollers convey it to the squeezers. The last of these rollers should be as small as possible consistent with strength.

In the annexed engraving, fig. 1 is a longitudinal section of one of the improved machines applicable for washing wool or other fibrous materials; and fig. 2 is a plan. In figs. 1 and 2, *a* is a cistern; *b* a false bottom in the same, supported by stays, and perforated for a short distance from the end *c* with small holes; *d* is a shaft supported in bearings on the cistern, upon which are fixed the propellers *e e*; *f* is an in-

clined sieve or trough, of perforated metal, or other material, up which the wool or other material is carried by means of the lifter *g* to the small rollers *h h*, and by them forwarded to the squeezer rollers *i i*. In figs. 3, 4, and 5 *a'* is a frame of wood, or any other suitable material, to which are fixed teeth or prongs *b' b'* for raking or carrying wool along; *c' c'* are brackets fitted to frame on which the cranks *k* act to give it motion; *d' d'* are strips on the frame by which it is supported as it slides along the ledges *u u*, and which prevent it from going too low into the sieve or trough *f*, in which it works, so as to keep the teeth or prongs *b' b'* from bearing on the bottom of the sieve or trough. The wool or other material to be operated upon is put into the cistern *a*, above the false bottom *b*, along with the necessary liquid. The shaft *d* being set in motion by pulley *j* carries round the propellers *e e*, which are so curved and set as, while scouring the wool, also to carry it along to the bottom of the inclined sieve or trough *f*, which is of sheet metal perforated all over with small holes. The lifter *g*, as before described, is made to move backwards and forwards in the sieve or trough *f* by means of the cranks *k k*, which are made to revolve by the wheels *l l*, which receive their motion from the wheel *m* fitted on the shaft *n*, on the other end of which is fixed a pulley *o*, set in motion by a strap from the pulley *p* on the shaft *q*, which is driven through the pulley *r*. The rake or lifter is lifted up by crank pins *s s*, as they enter the loops *t t*, and carried down towards the propellers as the cranks pass over the top centre, then, as the cranks continue to revolve, they drop the rake or lifter on to the ledges *u u*, and then by passing against the faces of the brackets *c' c'* they push the rake or lifter up the inclined sieve or trough, and so the wool or material is carried forward, and some of it is thrown over at the end on to the rollers *h h*, which are all made to revolve in the same direction, that is, towards the squeezer rollers *i i*, by means of the small wheels represented by dotted circles *v v* in figs. 1 and 2, which are also set in motion by the pulley *w* driven by a strap from the

pulley *x* on the shaft *q*. This shaft *q* also communicates motion to the squeezer rollers *i i* by a pinion and wheel; it also actuates the beater *y*. The beater *y* revolves at a high velocity, opening and throwing the wool or material to the back of the machine as it leaves the squeezer rollers. The water pressed from the wool as it passes through the squeezer rollers falls into a trough *z*, and from thence along another trough *z'* into the cistern *a*, and passing along under the false bottom *b*, when it is heated it rises through the perforated plate at *c*, where it comes again under the action of the propellers.

The improvements in drying consist in employing a series of rollers all moving in the same direction, actuated by carrier wheels, bevel wheels, worm wheels, or by other means, the peripheries of which rollers may be either perforated metal or wire gauze. At the opposite end to which the gearing is attached to such rollers is a pipe furnished with nozzles, which protrude into the ends of such rollers. Into this pipe heated air is forced, and conveyed by the nozzles into the interior of the rollers, from whence it escapes through the perforations in the metal or the meshes of the gauze. Underneath the said rollers is a corrugated shelf or platform fitted to the under side of such rollers. The fibrous material is laid upon these rollers, carried forward, and thereby subjected to the action of the heated air, and it is dried as it travels over them. These rollers may be either continuous or in tiers one over the other, and arranged so as to convey the material backwards and forwards, and to allow it to fall from the upper tiers to the lower.

The mechanism for working each of the 19-ton 300-pounder Armstrong guns, with which the "Bellerophon," 14, 1,000-horse power, is to be armed, is now in course of construction in the factory department at Chatham dockyard, the manufacture of the machinery being urged forward in order that it may be completed by the date the "Bellerophon" is ordered to be ready for undocking—the 31st proximo.

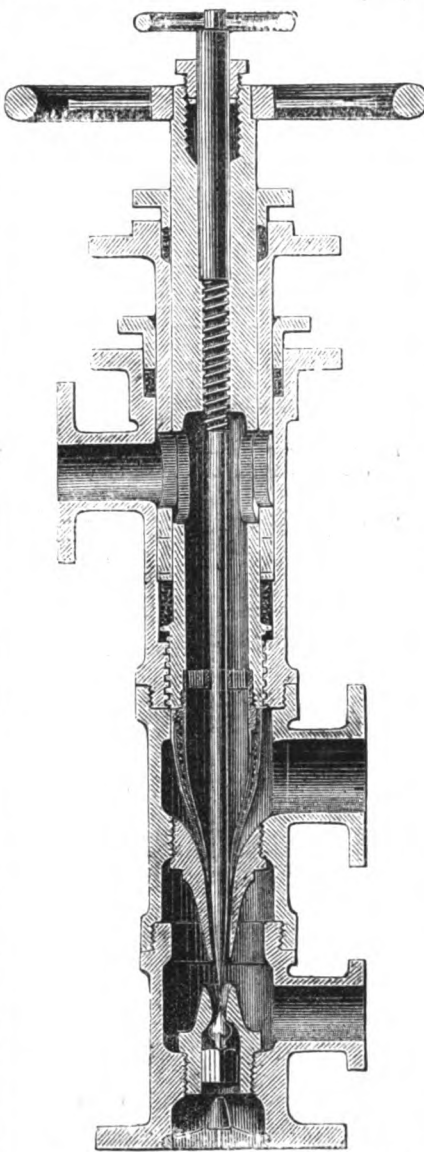
ON GIFFARD'S INJECTOR.

BY LEWIS OLDRICK, Memb. Soc. Eng.

THE following paper was read at the last meeting of the Society of Engineers, held on Monday, December 18, 1865, W. T. Carrington, president, in the chair:—Since Giffard's injector was first patented in this country in 1858 it has formed the subject of elaborate papers, followed by most interesting discussions, and some hesitation has, therefore, been felt in bringing the subject before the society, for fear of repeating what ought to be familiar to everyone who has had occasion to use the injector. There has, however, during each discussion still appeared to be so great a difference of opinion amongst engineers as to the proper explanation of the action of the instrument, that it may not perhaps prove uninteresting to go over the same ground again, so as to define a correct explanation of what takes place when the injector feeds water into a steam boiler, accompanied with such mathematical demonstration as may tend to prove the correctness of the assertions. Before going into this explanation, the author described the apparatus itself and its modifications, drawings of which were exhibited. The numbers of the injectors are taken from the diameter of the receiving cone, expressed in millimetres; thus No. 8 injector has a diameter of eight millimetres in the receiving cone. This original shape of the instrument has gradually been altered and improved by the eminent firm of Messrs. Sharp, Stewart, and Co., who are the sole licensees and manufacturers in this country. The first improvement made consists simply in making the receiving cone considerably shorter than it was originally, as it was found to be unnecessary for the successful working of the instrument. The next alteration was intended to obviate the evil arising, more particularly with high pressure steam, from the rapid deterioration of the packing above the steam cone. It did not, however, do so well as was anticipated, on account of the large surfaces still in contact, which caused considerable trouble in regulating the water supply, and it was ultimately abandoned for the plan now generally adopted. The combining and the receiving cones are made in one piece, and moved up and down by a pinion and rack, thus regulating the amount of water supplied to the injector. A short interval between the two cones is left principally for the escape of the overflow water, when the injector is first started. The pipe is in this instance placed considerably higher than is usually done, for several reasons—firstly, to allow the overflow water that collects in the chamber to be drawn into the boiler along with the ordinary current; and, secondly, to allow an additional amount of water, heated to a considerably higher temperature than could be taken through the combining cone, to pass into the boiler through the overflow chamber. Mr. Robinson, who has furnished all these details of improvements, has stated that as much as one-third of the total feed may be sent into the boiler as hot water. The only evil that might be anticipated from this construction is the tendency of the rapid current of water to drive the combined cones before it, and thus interfere with its proper action. This can, however, easily be avoided by screwing up rather hard the gland belonging to the spindle and pinion working the rack.

The injector has been improved for drawing water from a considerable depth compared with the usual distance of only 5 ft. to 7 ft. The object of this improvement was to increase the vacuum in the combining cone and overflow chamber, and thereby forcing the water by the atmospheric pressure up into the injector. As soon as this is done the injector is started in the usual manner, and the connection once being made it will continue, although the instrument has to fetch the water as much as 16 ft. The mode in which a vacuum of 9½ lb. is created is very simple. Steam is allowed to blow out into the atmosphere through a pipe which surrounds an inner pipe in direct connection with the overflow chamber, and thus causing a vacuum to be created in the latter of about 9½ lb., which enables the injector to raise water from a considerably greater depth than usual. There is another form of the apparatus for lifting water and forcing it to a certain height according to circumstances, but it is not intended for feeding into boilers. Mr. Robinson states that, in this apparatus, the velocity imparted to the water has been found to be equal to lifting it 1 ft. high for each pound of steam pressure employed, and that the height and

quantity of water raised may be varied in proportion to the pressure of the steam, and by increasing or diminishing the section of the annular space in proportion to the area of the steam nozzle. And, as an example, it may be mentioned that such an apparatus has been at work for some years in Yorkshire, and raised 780 gallons of water per hour to a vertical height of 27 ft., with a steam pressure of about 30 lb. to the square inch. In other instances, where water was to be lifted to a greater height than 1 ft. per pound of pressure, the ordinary injector has been applied with most satisfactory and even extraordinary results. Having now described the different improvements and modifications made in the Giffard's injector by Messrs. Sharp, Stewart, and Co., it is not proposed to notice all the other so-called improvements which have been patented by different gentlemen, but merely to describe a modification which seems to possess considerable merit. It is the invention of Mr.



Andrew Barclay, engineer, of Kilmarnock, Scotland.

The accompanying engraving represents Barclay's injector in vertical section. The difference between this and the ordinary Giffard's injector consists chiefly in extending the centre spindle beyond the steam cone, for the purpose of maintaining a free annular water space through the combining cone. This thin annular water space is regulated by the shape and adjustment of the centre spindle, so that the steam issuing from the steam nozzle continues with a vibratory motion down through the annular space forming the combining cone, completely expelling the air therefrom, thereby creating a vacuum in the water chamber sufficient to lift water from a depth below the apparatus equal to any common pump, whereas, with the Giffard's injector, a lift of about 5 ft. of water is the greatest the vacuum will generally allow. The adjustable packing is another important improvement in this injector, when lifting water from a great

depth, as it is evident a good vacuum cannot be obtained if this packing be in any way deficient. Should this packing deteriorate, and the vacuum become impaired, then the gland can be screwed down at any time without altering any other part of the apparatus, whereas this screwed packing in Giffard's original instrument cannot in any way be up when it ceases to be steamtight. The steam nozzle has in this apparatus an outer casing, with any non-conducting material enclosed between the two for the purpose of maintaining the temperature of the steam until it unites and mixes with the cold water in the annular combining cone, as priming or greatly saturated steam is very detrimental to forming a good vacuum. This injector is started in the same manner as the "Giffard." The small conical-shaped valve at the end of the receiving nozzle can adjust itself to the quantity of water passing through the opening in the valve seat. With this injector Mr. Barclay asserts that he can vary the quantity fed into the boiler from unity to five times as much, which is often a great advantage to the attendant, as he can keep the injector working constantly when set to the proper quantity. As all the different modifications of injectors are started in a similar manner, it will be sufficient to describe the mode of setting one apparatus to work only. Adjust, first, the combining cone by turning the small pinion geared into the tooth rack, cast on to the two cones, so that the annular space between the steam cone and the combining cone is suitable to the steam pressure. Next turn on a small quantity of steam by unscrewing the spindle in the steam cone, and leave it in this position until the water flows out of the waste pipe. Then turn on the steam in full by withdrawing the spindle completely, so as to give the steam full power to drive the column of water into the boiler. The overflow will now generally cease, and the injector is then working properly. Should, however, the overflow still continue, the combining cone must be lifted gently up by turning the pinion, so as to diminish the area of the annular space, and thus reduce the water supply. The overflow will then cease, and the injector is now full at work. If it is desirable to reduce the quantity of water fed into the boiler, it can be done by first reducing the steam supply and then the water supply, until the overflow again ceases to run.

(To be continued.)

AGRICULTURAL MACHINERY OF THE UNITED STATES.

THE following observations on this subject occur in a report by Mr. P. Sinclair "On the State of Agricultural Farms of the Great West:"—The vast range of country to be cultivated, the scarcity of men to cultivate it, the economy of machinery, the superiority of scientific cultivation over the older modes, and the peculiar necessities of the times have all tended greatly to stimulate the inventive genius of the nation to supply that aid to agriculture which has been already so abundantly provided for manufactures and commerce. It is not wonderful, therefore, when, looking on twenty acres of land, covered all over with machinery adapted to nearly every purpose, that we should come to the conclusion that here also the American farmer is placed in a superior position to the Old Country farmer, and that he should have less of the drudgery, and be more independent than it is possible to be where the appliances of his art are less numerous or perfect than here. The names of a few of the machines will indicate their use, and satisfy anyone acquainted with farming that America does not intend any nation on the earth shall excel her in agricultural progress. There are ploughs of all patterns and sizes for sodding, turning, breaking, spading, ditching, draining, trenching, sub-soiling, and general purposes. There are cultivators, cultivators and seeders combined, grain drills, corn planters, corn planters and cultivators, seed planters and sowers. There are reapers, mowers, self-raking reapers, reapers, mowers, and self-rakers combined, and reapers, mowers, and binders combined. There are novelties in harrows, horse rakes, field rollers, grain binders, reaping sickles, mowing knives, threshing machines and separators, fanning mills, corn and cob mills, corn crushers, grist mills, horning mills, cyder mills, churns, hay rakes and self-acting elevators, horse hay forks, pitching hay machines, portable hay presses, horse power hay presses, hydraulic hay presses, roller hay

presses, straw and hay cutters, smut machines, cane splitters, corn cutters, &c., &c. The cultivation of the Chinese sugar cane has led to the invention of sugar cane mills and evaporators of all shapes and sizes, and several ingenious gentlemen have invented various modes for enabling cattle to supply themselves with any quantity of pure water. Then there are all sorts of water pumps, elevators, portable steam engines, wood sawing machines, brick and tile making machines, machines for laying drain tile, portable gates, fences, sheepfolds, &c.

DISCOVERIES IN AGRICULTURAL CHEMISTRY.

By DR. F. CRACE CALVERT, F.R.S., F.C.S.
(Concluded from page 378).

BEFORE asking your especial attention to some of the most important mineral matters which exist in soils, I wish to say a few words on some of the researches published a few years since by Professor Way, in which that gentleman showed that soils had the power to retain with great tenacity certain mineral matters, which, although soluble in water, could not be removed from soils even when brought into contact with great quantities of water. He further demonstrates that if he made to percolate through a given quantity of soil certain soluble salts, such as those of soda, potash, and ammonia, these would be retained in the soil, whilst the acids with which these bases had been combined would unite with some of the elements previously existing in the soil, pass off, and the alkalies themselves remain fixed. Thus, according to him, the retentive power of soils was due to the presence in them of a small quantity of double silicate of alumina. Thus, for instance, a double silicate of alumina and soda, when brought in contact with lime, will part with soda and take up lime; but if this silicate, in its turn, is in presence of magnesia, the lime will pass in solution and the magnesia be retained. If, then, a salt of potash is employed, the magnesia will be removed from the double silicate and the potash take its place. If ammonia be brought in contact with the above silicates, except that of potash, it will substitute itself for soda, lime, or magnesia. These valuable researches prove to farmers that they have nothing to fear as to the loss of any valuable manure, such as compounds of ammonia and potash, which they might employ as manure on their lands, even if these were drained, for the potash or ammoniacal salts employed by them as manures and spread on the surface would not pass off in the drainings of the land, but be retained by the soil under the form of a double silicate until required by plants, and decomposed under the influence of that mild but still all-powerful force called vitality. The researches of Professor Way have been extended by those of Dr. Voelcker, who, instead of employing simple salts, employed complicated liquids on various classes of soils, namely, calcareous clay soils, and ferruginous, sterile, sandy soils, and obtained the following results:—1. That the calcareous clay soil absorbs about six times as much ammonia from the liquid manure as the sterile sandy soil. 2. That the liquid manure in contact with the calcareous clay soil becomes much richer in lime; whilst during its passage through the sandy soil, it becomes poorer in lime. 3. That the calcareous soil absorbs much more potash than the sandy soil. 4. That chloride of sodium, in conformity with the results of other observers, was not absorbed to any extent by either soil. 5. That both soils removed from the liquid most of the phosphoric acid. 6. That the liquid in passing through the calcareous soil becomes poorer; and, on the other hand, in passing through the sandy soil becomes richer in soluble silica. These researches of Dr. Voelcker led him to a somewhat different conclusion to that adopted by Professor Way. He does not think that the silicates of ammonia and magnesia that exist in soils have all the retentive power attributed to them by Professor Way, but that potash and ammonia are retained in soils by the peroxide of iron and alumina which they contain, acting as weak acids with respect to the alkalies. He also considers that it is the same oxides which act as fixing agents of the phosphoric acid that may be added on soils as manure, under the form of superphosphate of lime, or similar compounds. The researches of P. Thenard, Way, and Voelcker, point to the interesting fact that some of the most apparently useless elements in soils, such as alumina, oxide of iron, &c., are in reality the most useful, for although they do not take an active part in promoting vegetation, still they are the medium by which essential substances, such as fuming acid, phosphoric acid, potash, and ammonia, are retained and stored in soils until required to promote growth and vegetation.

Before drawing your attention to a few of the substances that a soil should contain, not only to enable it to support vegetation but to promote it in a high degree, I deem it my duty first to give here a few tables which shall give you an idea of the various mineral matters which chemists have found to exist

more or less abundantly in vegetables, and which are found to compose the ashes left by vegetable matters when incinerated. The following gives the amount of mineral matters in a thousand parts of many of our ordinary agricultural products:—Mineral matters in plants in 1,000 parts. Wheat, about 20; barley, 30; oats, 40; rye, 20; maize, 15; beans, 30; peas, 30; potatoes, 8 to 15; turnips, 5 to 8; carrots, 15 to 20; wheat straw, 50; barley straw, 50; oat straw, 60; rye straw, 40; meadow hay, 50 to 100; clover hay, 90; ryegrass hay, 95.

The second table gives you an outline of the relative proportions of some of the most important mineral substances existing, in the ashes of several of the commonest cereals and roots cultivated by our farmers:—

MINERAL MATTERS IN PLANTS.

	Wheat	Barley	Oats	Rye	Potatoes	Turnips
Potash	237	136	262	220	557	419
Soda	91	81	—	116	18	51
Lime	28	26	60	49	20	186
Magnesia	120	75	100	103	52	53
Oxide of iron	7	15	4	13	5	13
Phosphoric acid	500	390	438	495	125	76
Sulphuric acid	3	1	105	9	136	136
Silica	12	273	27	4	42	79
Chlorine	—	traces	3	—	42	36
	998	997	999	1009	997	999

These tables naturally point out the great variety of mineral matters that enter into the composition of the ashes of plants, and also will familiarise your minds with the important relations which some of those minerals have to the growth of plants which contain them. But before advertent to the part which some of these minerals play in vegetation, it is desirable that I should refer to the relative quantities of mineral matters taken from the soil where they are grown, in what is called by farmers a rotation of crops.

ROTATION OF CROPS.—QUANTITY OF PRODUCE REMOVED FROM ONE ACRE OF GROUND.

		lbs.
1st year—Turnips	{ Bulbs	51,000
	{ Tops	14,000
2nd „ — Barley	{ Grain	2,116
	{ Straw	2,040
3rd „ { Clover		2,030
„ { Ryegrass		2,060
4th „ — Wheat	{ Grain	920
	{ Straw	3,570
		77,736
Moisture	10,230	
Minerals	1,284	
		20,514

Organic

Although these tables illustrate the quantity of the mineral matters, their variety, and relative proportions existing in plants, and lastly the total amount of the various minerals which a rotation of crops removes from the soil, still they do not point out to you which are the most essential to vegetation. Perhaps the word “essential” which I have just used, is not correct, for all the mineral matters found in a plant must be essential to its existence and to its growth; but some of these minerals exist, generally speaking, in soils, and that in sufficient quantities for the wholesome growth of the plant; others are in minute quantities, and they are soon removed by successive crops, and if the mineral elements which compose that soil cannot by their decay or chemical decomposition set free, or bring into fit condition for the coming crop, these peculiar, rare, and still essential elements of vegetation, the soil will not reproduce the crops which require for their production those peculiar mineral substances. For example, a sufficient quantity of phosphates for turnips, or a sufficient quantity of potash for mangolds, or a sufficient quantity of silicates and phosphates for wheat and other graminous plants. It, therefore, becomes necessary that I should dwell for a few minutes on some of the most important mineral substances that should exist in the soil for peculiar crops, or should be added to it as a manure if that soil is exhausted of those treasures of vegetation.

The first substance belonging to this class to which I desire to draw your attention is phosphorus. It is only within the last fifteen or twenty years that the importance of phosphorus to vegetation has been demonstrated. Although experience had led certain farmers to the knowledge that phosphates—for example, ground bones—would promote the growth of meadow lands, still the honour is due to Liebig not only of having pointed out but proved the importance of phosphorus, or rather of phosphates, as essential elements of the rapid growth of plants, and especially of roots, for he was the first to call the attention of the agricultural world to the

benefits to be derived if, instead of using phosphate of lime in its insoluble state as it exists in bones,* it was added to soils either in a soluble condition or in one which might easily become so under the influence of certain agents to which I shall hereafter refer. It is since the publication of his ideas that we have had the researches of Bous-singault, Lawes, Dr. Gilbert, Dr. Voelcker, and Ville, who have shown on the one hand the importance of phosphates to vegetation, and on the other the extremely small quantities which exist naturally in soils; for chemists have been able to discover only traces of phosphoric acid in ordinarily cultivated soils, and these minute quantities had been traced as existing in primitive rocks forming those soils; and, although I am quite ready to admit that agricultural chemistry is still in its infancy, and can at the present time give only here and there useful information to the farmer, or insights into certain phenomena which take place in agriculture, still it cannot be denied that when we consider that it is only within the last twenty or thirty years that chemistry has really attempted to unravel the mysteries attending vegetation, and also to give a clear and scientific explanation of facts which hundreds of years have revealed to man, we cannot deny that in pursuing the same course for a hundred years, most invaluable and enlightened information will be thrown upon agriculture, and, instead of being the result of mere experience, which often leads to failures, the farmer will base his operations on sound and scientific principles, which will enable him to obtain from his land the full yield it is capable of producing. The best proof of the correctness of this statement is that in England, where chemical agriculture has made the greatest advance, farmers as a rule have ceased to allow the land to lie fallow—an operation which had for its object to allow the atmosphere to act upon the mineral elements of the land, so as to modify them in such a way as to liberate some of the scarce and still essential elements of vegetation, such as potash and phosphoric acid. In fact, so true is the rapid removal of phosphoric acid from what we call fertile land and its importance to the successful rotation of crops now adopted by most of the intelligent farmers of this country, that not only are bones imported from Australia, South America, and the continent, but even minerals, such as apatite, are imported from Norway, and phosphorite from Estremadura, in Spain, and also under the form of semi-fossilised guano, under the names of Lambro and Kooria Moorja guanos. But even these abundant sources of phosphoric acid do not appear to be sufficient to supply the large demand that there is at the present day for phosphates or superphosphates for agricultural purposes, for large quantities of fossilised coprolites abundantly found in Cambridgeshire, Suffolk, and Bedfordshire are used especially under the name of superphosphate of lime. As to the mode in which they are treated to produce the valuable agricultural manure (superphosphate of lime) I must refer you to the first lecture which I had the honour to deliver before you last year, in which also you will find the proportions of such superphosphates of lime, the average composition of which I shall take the liberty of repeating here:—Soluble phosphate, 22 to 25 per cent.; insoluble phosphate, 8 to 10; water, 10 to 12; sulphate of lime, 35 to 45; organic matter, 12 to 15; nitrogen, 0.75 to 1.5. Although superphosphate of lime is a soluble salt when added by the farmer on the surface of his land, either dissolved in water or in the state of a powder, still this solubility must rapidly disappear when in contact with the soil, for the soluble phosphate of lime is due to the excess of phosphoric acid which it contains, and the excess disappears when in contact with the soil as it meets, generally speaking, carbonate of lime or of magnesia, or oxide of iron, which neutralise the excess of acid, rendering thereby the remaining portions of phosphate of lime insoluble. It therefore becomes interesting to inquire how an insoluble substance becomes soluble to render it fit to be absorbed by the spongy roots or the roots of plants, so as to convey it into the plants themselves. This is effected by carbonic acid gas dissolved in water, which penetrates into soils, or by the fuming acid discovered in soils by Thenard, or by a non-neutral substance, similar in its composition to sugar, which has also the power of rendering soluble the insoluble phosphates existing naturally in the soil or added to it by the hand of man.

Dr. Voelcker published, in 1863, in the “Memoirs of the Royal Agricultural Society,” a most valuable

* The general composition of bones may be considered to be as follows:—

	Bones.
Organic Substances.	{ Blood-vessels
	{ Ossine
	{ Fatty matters
	{ Water
Mineral Substances.	{ Phosphate of lime
	{ Phosphate of magnesia
	{ Carbonate of lime
	{ Divers salts

able paper on the absorption of phosphate of lime and phosphatic manures by root crops. Among the many facts which had a direct interest for those employed in the cultivation of the soil, there is one connected with these researches to which I desire to call your attention, and that is the relative amount of phosphoric acid which is required by an average crop of wheat or of turnips per acre. You may observe in reading over the following table that whilst turnips require 39½lb. of phosphoric acid, wheat, which is considered a highly nitrogenated crop, only contains 25½lb. of the same substance. This statement is correct so long as you take the total weight of the crop produced by an acre of land, for one acre of land will produce 30 tons of turnips and about two tons of wheat; but if you take 100lb. of each of these substances, then, of course, wheat will contain a far larger proportion of phosphoric acid than the turnips:—

ONE ACRE OF LAND.

	20 tons of Turnips.		Wheat.	
	Bulbs.	Tops.	Grain.	Straw.
	1920lb	3840lb	1920lb	3840lb
Potash.....	132'	45'5	9'75	25'
Soda.....	6'25	7'	—	—
Magnesia.....	6'25	2'25	3'75	3'75
Lime.....	36'	68'5	1'	10'5
Phosphoric acid.....	28'25	11'5	16'25	9'5
Sulphuric acid.....	36'	25'	25'	5'25
Silica.....	3'	2'25	1'	128'75
Chloride of sodium.....	19'	18'25	5'	9'25
Chloride of potassium.....	—	11'5	—	—
Carbonic acid.....	47'25	36'25	—	—
	314'00	228'00	32'5	192'00

The researches of Mr. Lawes and Dr. Gilbert have demonstrated thoroughly the truth that the employment of superphosphate of lime as a manure is useful for promoting the growth of wheat, and is essential to the perfect success of a crop of turnips. M. Ville has also published important papers in the "Comptes Rendus of the Academy in Paris," on "The Influence of Phosphates on Vegetation," and the following showing will, I hope, convince you of the marked influence which they exercise on vegetation:—Phosphate of lime and alkaline silicates, 20'86; phosphate of lime, 18'80; earths and alkaline silicates, 0'60; earths, 1'84.

But the most interesting data at which M. Ville has arrived consist in that the presence of phosphates in soils determines a corresponding absorption of nitrogenated compounds by the plant; that is to say, that if phosphates are supplied to a vegetable, its growth will be partial; and if, on the other hand, ammoniacal salts or nitrates are supplied to it the growth will be imperfect; but if both of them be added to the soil, the absorption of the phosphate will be increased as well as that of the ammonia. This result is most interesting, not only in an agricultural point of view, but also as a physiological fact, for, until this important observation of M. Ville, scientific men had merely studied the immediate influence or absorption which the substance had on the vegetable or animal, without taking into account how these phenomena might be modified by the presence of others. I look upon the observation of M. Ville as one which will ultimately be far more appreciated than it appears to have been, and one which will lead to most important results in animal physiology and agriculture. I shall conclude these observations by giving you a table published by M. Ville, and which clearly sets forth the truth of these remarks:—

AMOUNT OF NITROGEN FIXED BY WHEAT UNDER THE INFLUENCE OF THE FOLLOWING SALTS:—

	Without nitrogenated compounds.	With nitrogenated compounds.
Phosphate of lime and alkaline silicate.....	8'15	20'08
Phosphate of lime.....	7'25	19'17
Earths and alkaline silicates.....	5'71	11'16
Earth.....	3'00	9'50

The extraordinary liberality with which the Emperor of the French has supported and encouraged all scientific researches or inventions which might tend to promote the welfare of his subjects is exemplified in the case of M. Ville, for the Emperor has not only built a special laboratory for his use, and placed a large greenhouse and other means of investigation at his disposal, but has also allowed him to experiment on one of his private farms. And this encouragement has not been lost, for M. Ville has arrived at some very valuable and practical results. Admitting that he wishes to ascertain what the soil is deficient in, so as to produce a full crop, he divides, say, an acre of land into four parts—adds to one portion superphosphate of lime; to another portion carbonate of potash; to another portion caustic lime; and lastly, nitrate of soda. He then places on these sections of the acre the va-

rious crops which are intended to be grown, and he soon finds out which of the four manures should be added to convert an ordinary yielding field into an abundant one. This simple and practical mode of proceeding has led him to use, as a general manure, which he calls mineral manure, the following substances:—Phosphate of lime, 4 parts; carbonate of potash, 4 parts; caustic lime, 1'5 parts; and nitrate of soda, 6'5 parts. The results have been most satisfactory, and among the many he has published during the last two or three years I shall simply give the following:—

TOTAL CORN PER ACRE.

Unmanured.....	990	926
Mixed mineral manure.....	1192	987
Ammonia salts.....	1471	1618
Mixed mineral manures and ammonia salts.....	2407	2295

STRAW AND CHAFF PER ACRE.

Unmanured.....	1625	1459
Mixed mineral manure.....	1804	1528
Ammonia salts.....	2536	2705
Mixed mineral manure and ammonia salts.....	4176	4016

Allow me to pass from these highly-interesting and practical results obtained by M. Ville to those not less valuable published by Dr. Voelcker on another mineral matter, which, like phosphoric acid, is only found in small quantities as a natural product in soils, and which, if absent, like phosphoric acid, renders the soil unprofitable to the farmer. That substance is potash. Dr. Voelcker has not only studied the action of one compound of potassium, say the caustic or carbonate of potash, but he has examined the action of these and also of sulphate of potash, chloride of potassium, and nitrate of potash, and to enable him to arrive at the correct result he had compared the action of these different salts of potash on various classes of soils, namely, calcareous stiff clay, fertile sandy loam, pasture land, marly soil, and sterile sand; and he has come to the general conclusion that when salts of potash are added to these soils, although the quantity retained by them varies with the nature of the compound of potassium used or the nature of the soil operated upon, still the soil will retain the potash and not allow it to pass off in the water which may issue from it by drainage or otherwise. If he employs a salt of potash, say the nitrate, sulphate, or chloride, the sulphuric acid, the nitric acid, or the chlorine will combine with the lime or the magnesia, and even in some instances with the ammonia which the soil may contain, while the potash will substitute itself to either of these bases which were in the silicate demonstrated to exist in soils by Professor Way.

As mankind increase on the surface of the globe, and their wants proportionately become greater, so by a marvellous and admirable dispensation of Providence, the power of the production of the soil to meet the wants of man is developed. A striking instance of this is given in the application of chemical discoveries to the cultivation of the land to make it commensurate with the growing requirements of the people. Thus, for example, we find stored in various parts of England—Suffolk, Cambridgeshire, and Bedfordshire—large beds of coprolites, or the refuse of antediluvian animals buried there for thousands of years unknown to man, and its value unappreciated. Further, chemists have discovered in Norway mountains of phosphate, under the form of apatite, and tracts of land of phosphorite in Estremadura, in Spain. The same remark applies with equal force and truth to salts of potash. Their supply up to the present time has been limited, as I stated to you in my last lecture, in speaking of the discoveries of M. Ballard, whose name I mentioned with no undue praise, as showing the benefits which society may derive from the extraction of a double chloride of potassium and magnesium from the ocean. Strange to say, within the last few years this identical salt has been discovered in large quantities as a mineral at Stassfurt, in Saxony, and although this mineral exists as a stratum under beds of ordinary common salt, and its discovery dates only three years back, there are at the present time 14,000 men employed in the factories which have risen on the spot for the extraction of the salt from its mineral, and its conversion into the various products required by the trade. This mineral, which has been called cannallit, and which assumes a thickness of 1,000, is composed in 100 parts, as follows:—Chloride of magnesium, 31'46; chloride of potassium, 24'24; chloride of sodium, 5'10; chloride of calcium, 2'62; salt of lime, 0'84; oxide of iron, 0'14; and water, 35'37. It may be considered as a definite chemical compound of 1 equivalent of chloride of potassium; 2 equivalents of chloride of magnesium; and 12 of water. I have not the slightest doubt that when this important discovery becomes generally known to our salt manufacturers, they will also turn their attention to the nature of the minerals composing the sub-soils of their salt-beds, and will discover cannallit, and thus confer on the country a great boon by promoting its agriculture. The popularising of this

fact may confer a great benefit on those salt-mine proprietors who are working their mines for rock salt, and who have not filled their mines with water, so as to take from them a brine containing the salt they require. I have no doubt that if cannallit is discovered in England, it will in many instances modify entirely the present method of working salt mines.

Lime.—Too much importance cannot be attached to the presence, in certain proportions, of lime in soils, for it is one of the essential elements of ashes of plants, and is necessary to their growth. In fact, Dr. Voelcker says:—"We know practically how essential the presence of lime is for the healthy growth of every kind of cultivated produce. On soils very deficient in lime, most crops, especially green crops, are subject to all kinds of disease; and consequently, roots fail altogether on such land, even if it has been liberally manured with good yard dung or guano. Up to a certain stage, corn and roots grown under such conditions appear to thrive well, but as the season advances they sustain a check, and at harvest time yield a miserable return. The remedy for such failures, which are not at all uncommon in localities where poor sandy soils prevail, is a good dose of lime or marl, and then, and only then, farmyard manure or guano may be applied to the greatest advantage. Marl or lime alone does not suffice for meeting all the requirements of our cultivated crops on such poor sands, and though calcareous minerals supply a most necessary element of plant-food, and by acting on the latent stores of food in the soil produce at first a most strikingly favourable effect upon vegetation, they soon fail to produce the desired effect if repeated too often, to the exclusion of other fertilising matters. On the other hand, the most liberal application of farmyard manure of the best quality never produces so beneficial and lasting an effect on poor sandy soils as when they have been previously well marled or limed. On such land no doubt the proverb holds good:

Lime and marl without manure
Only make the farmer poor.

But at the same time I have a strong impression that on such land manure, without lime or marl, does not help much towards paying the rent. There are some soils which swallow up manure, with, so to speak, an insatiable appetite, without ever feeling the better for the manure; they are appropriately called very hungry. On all such soils I have no hesitation in saying much manure is wasted, or the most is not made of it, if, previously to the application of farmyard manure, guano, &c., the land has not received a good dose of marl or lime. My recent filtration experiments point out the reason why marl or lime is peculiarly valuable on poor sands. It is not merely by supplying in a direct manner a deficient element of nutrition that lime acts so beneficially on such soils, but because it preserves in the soil the more valuable fertilising matters, which, like salts of potash or ammonia, rapidly filter through sandy soils, unless a sufficient quantity of marl or lime has been previously applied to the land. By these means the bases of the more valuable saline soluble constituents of rotten dung or of guano are retained in the soil, whilst the acids filter through it in combination with lime, a constituent which is, comparatively speaking, inexpensive."

The evening is too far spent for me to attempt to enter into the valuable researches of Mr. Lawes and Dr. Gilbert connected with low meadow lands and the feeding of cattle; but I would strongly recommend those who take an interest in these branches of science to consult the papers published by those gentlemen in the "Journal of the Royal Agricultural Society." I would also call your attention to a paper on the same subject by Mr. John Coleman, as well as a talented lecture which that gentleman delivered a few weeks since before this society, in which he gives most important information to the farmer respecting the cheap feeding of cattle. I hope that you are now convinced of the truth of the assertion which I made at the beginning of this lecture, that no country possesses men better informed than those who exist in England on scientific agriculture. In fact, we can boast, especially if we give the lead to Scotch farmers, of being the leading nation in point of agricultural progress.

Correspondence.

CONDUCTION AND INDUCTIVE RETARDATION.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—As you noticed in your issue of the 8th inst. Mr. Waterson's paper on Electric Conduction, perhaps you will allow me to make a few remarks on the same subject. It seems somewhat strange that any man should theorise on a matter which is placed, as I conceive, beyond the pale of theorisation by actual fact. Surface conductivity, I believe, is no new theory, nor is it peculiar to Mr. Waterson, but it should be a theory no longer. That gentleman may surely save himself the trouble