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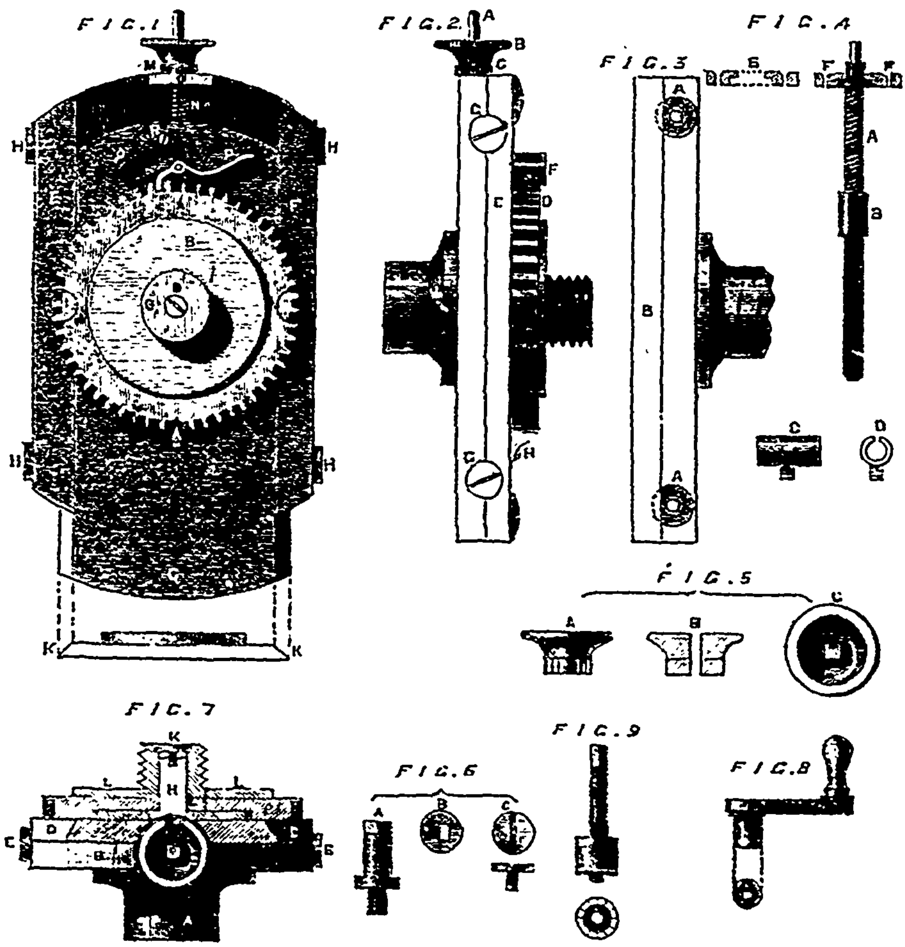


HOW TO MAKE AN ECCENTRIC CHUCK.

HOW TO MAKE AN ECCENTRIC CHUCK.

(*Concluded from page* 215.)

As the work has already been levelled underneath, be sure that the bottom of the chuck is quite level, and that the casting rests perfectly upon it. Turn it up, and now drill for the pin, and also turn a little recess in the end of the screw, to take a washer and screw (as shown in the drawing, Fig. 6), the pin being squared for $\frac{1}{16}$ in., and also drilled and tapped for a screw, which will hold this part firmly in its place upon the eccentric slide. If the screw upon the nose of the chuck and mandril is $\frac{3}{4}$in. diameter, with the usual coarse thread, the centre pin can be made $\frac{1}{2}$in. diameter, or nearly so, which will give a very firm bearing to the division or click-wheel, and stand the strain of turning up wood upon the chuck without fear of its bending or yielding in any way—a matter essential, but not always attended to.

The main parts of the chuck, being now complete, should be put together, mounted on the mandril, and finally connected wherever necessary. The chasing of the nose should be done, or at all events finished when the slide is in place, though it may be begun at a previous stage. I have presupposed hand-work throughout, and, therefore, hand chasing; but if a traversing mandril is on the lathe, all risk of a drunken thread is, of course, avoided, as it is also if Cooke and Sons' excellent contrivance for originating screws is at hand. We now have to make and fit the leading screw, divide the chuck-wheel, and fit it with either click-stop or tangent-screw. The first may be $\frac{3}{16}$ to $\frac{1}{4}$ diameter in the screwed part, which will lie in a groove or channel in the lower plate. This may be filed out or it may be cast in the plate at first. Here, as in other parts, is room for variety, the screw and slide being differently arranged by different makers. If the casting is like the drawing, there need be no apprehension of weakening the lower plate by cutting a channel, a great part of which will be opposite its thickest part, and it might even penetrate the plate without material harm. The screw is made with a squared end for the winch-handle, beyond which is a round part, and next a shoulder or flange, which lies beneath a little steel plate attached by screws, the brass being recessed to receive it. A nut is screwed firmly into the under side of the sliding-plate, through which the leading screw passes stiffly; and this nut of brass should be sawn across on the lower side to cause it to spring, and thus grasp the screw, that it may work easily yet stiffly, with as little back lash as possible. Observe the slide moves away from the winch-handle, so that it does not come in its way as its eccentricity is increased. By mounting the slide and screw in this way, both can be readily removed for oiling, cleaning, &c., it being only necessary to take off the small steel plate which retains the head of the leading screw The slide with this attached to it by the nut can then be pulled straight out, and it can be replaced and secured in a few seconds. This mode of connection may be reversed if preferred, the nut being screwed into the bottom plate, and the screw held by a plate attached to the slide. In this case, when the latter is removed the screw will remain in its nut, and the slide will pull out by itself. As the slide carries the screw, the eccentricity of the latter must take place in the direction of the winch-handle, The distance to which the slide can be thrown out depends on the position of the nut, as this, by coming in contact with the end of the recess in which the screw lies, in the lower plate, prevents further movement; and it is generally so arranged that when this nut is stopped by the head of the screw in the other direction, the nose of the chuck shall be concentric, and in one line with that of the mandril, in which position the holes for the steel pins previously mentioned will be opposite those in the foundation plate. The chuck will then have no eccentricity, and can (and generally must) be used to put the final touch of the chisel upon the work to be decorated. In no other way can it be made to run absolutely true when shifted from the mandril screw to that of the chuck, although one is a counterpart of the other. The leading screw should have 10 threads to the inch, and its head should be marked with 10 lines, numbers being engraved at every second line, which should be twice as long as the intermediate ones—$\frac{1}{100}$th of an inch can thus be obtained—a small pointer of steel, or a mere line on the end of the chuck, serving as an index point. The marked head of the screw is of brass, and, having a milled head, suffices instead of the winch for moving the slide through small distances. But when several turns are needed, the little winch-handle will be found far more convenient In addition to the divisions upon the screw-head, an inch should be marked in tenths, on the slide itself, with an index-line on the face of the steel guide-bar adjacent to it Unless the reader is well up to his work, with the necessary means, also of reliable quality, at hand, I should recommend him to have his leading screw cut for him and divided, and also the click-wheel. Indeed, he *must* have it done, unless he has a dividing plate, and some kind of wheel-cutting engine, either attached to the lathe or otherwise. In London, and in many provincial towns. there will be no difficulty in this, and the cost will not be great. If, however, he determines to do this for himself, he should consult "J. K. P's' excellent directions in the English Mechanic, (Vols XII, p 277, XIII, 113, XI., p. 12,) and I might say *passim*, for "J. K. P." has given full details of this work, and also of racking for a tangent screw, far better than I could do, even if had time, which at present I have not. But when I say that wooden clocks have been made to keep good time, the wheels of which were cut with a saw and narrow chisel, which fact I vouch for, the division of a chuck wheel can scarcely be called an *insurmountable* difficulty, even without slide-rest and revolving cutters, and if the lathe pulley is divided it can *certainly* be done by hand. But far better is the plan recommended, to go to a clock or lathe maker, and get it done well. The tangent screw and wheel is by many preferred to the click wheel, but is not much better in reality, and more difficult to make, and I am writing for such as are compelled to do as well as they can with the simple appliances of an ordinary workshop. The catch is a simple affair, kept down by a spring, and needs no detailed description The dividing wheel should have 96 teeth at least, which is the usual practice, but if the wheel is racked instead, the face may be also divided into 100, every five such divisions being marked. I decidedly prefer a large-sized wheel, reaching to the edge of the chuck, or nearly so. If the screws on the guiding-slips are counter-sunk this is easily arranged; if not, the wheel can be fitted to stand a little off the plate below it. The adjusting screws to tighten the guides are inserted in the edge of the lower plate, their heads being generally recessed to enable them to press the guide bars. This recessing is done with a pin-drill or counter-sink, like Fig. 9—a very useful tool, and one easily made. The hole is first drilled, then countersunk to form the recess, and then tapped. The different parts of the chuck in the drawings are lettered as follows:—

Fig. 1.—Chuck complete, showing A, dividing wheel; B, a shoulder or raised part on the sliding plate, seen again at D in Fig. 2, to keep the chuck a little off the slide—it is not essential; C, the screwed nose of the chuck, kept in place by the screw D in the centre; E, F, guide bars of steel, G, sliding plate, shown as thrown out by the action of the screw N, H, pressure screws acting on the guide bars; K, the sliding plate seen edgewise to show the chamfers, M, brass movable head of screw, graduated; N, leading screw; O, small steel plate, to retain screw head in its place; P, catch, kept up by spring Q, which is attached by screw R.

Fig. 2.—Profile of chuck, showing A, the squared end of screw; B, its movable head; C, divided part of the same; D, dividing wheel; F, catch; G, G, pressure screws; H, steel pointer, used when divisions are marked on a second circle.

Fig. 3.—This is given merely to show the countersunk recesses in the lower plate for the heads of the pressure screws, B, one of the steel strips which the heads of these screws overlap, as shown.

Fig 4.—A, leading screw; B, its nut, shown again at C, D, E and F. F, show how the steel plate is recessed to take and retain the head of the leading screw; this plate is recessed or let into the end of lower plate held by small screws at F, F.

Fig 5.—A movable head of screw B; section C, plan of the same.

Fig. 6.—A pin on which dividing plate turns, squared to take B, a thin washer, and also drilled in the centre for the screw C.

Fig. 7 is a cross section; B, being the foundation plate, D, the guide slips; E, the tightening screws; the central pin H is here clearly seen; F is the click wheel, recessed below to fit over the turned boss on the sliding plate, O; C is the head of the leading screw; L is part of the wheel, E, slightly raised upon its surface, K is the screw to hold the wheel and nozzle to the sliding plate.

Fig. 8.—Winch handle.
Fig 9.--Pin drill or counter-sink.

J. L in *English Mechanic*.

ERRATUM.—In the portion of this article given on p. 214, in the first col., tenth line from bottom, read $\frac{3}{16}$ instead of $3\frac{1}{16}$.

THE CUTS IN CARPENTRY.

To perfect and complete this excellent system of cuts, the same principle as that given on the preceding plate for the right angle will be applied to the acute and obtuse, which include all that can be made. To him who aims at proficiency, a thorough knowledge of these cuts is indispensable.

Our first illustration will be the equilateral triangle, that is, a figure having three equal sides, the plan of which is seen at Fig 1, and Fig. 2 its elevation. The method to find the cuts for the sides of this, and also a bevel that will mitre the angles. Let 2 S be the given height, and B S the given angle that the work is to make when finished Now commence at Fig 3, let A B C make one of the angles on the plan, also let B S incline the same as that at Fig 1, then bisect A B C, draw a line through the intersection; make B K square with B S Now anywhere on B C, say H, square up a line cutting at R take H for a centre, and for a radius a circle touching the line B S, and cutting at C; join C R, and in the angle is seen the bevel that will make the mitre on the edge of the stuff To find the cut for the sides, again take H for a centre, and for a radius a circle touching the line B K, and cutting at P; join P R, which produce the cuts for the sides, this being understood.

Let us proceed to the explanation of Fig. 4, and give the method by which to find the cuts for the sides of the hexagon, and also the bevel that will make the mitre for the angles. You will notice that 2 B is square with one side of the hexagon, and the dotted line from its base having cut at B. We will now suppose that the perpendicular 2 S is the given height, then, by joining B S we have the width of the sides, and also the angle which they are to make when standing in position. Fig 5 will convey this idea.

Now commence at Fig. 6, and let the angle A B C equal one of those at Fig 4; then, from the point B draw B S, to correspond with the angle B S 2, seen at Fig. 4: now bisect A B C, and through the intersection draw a line; then, anywhere on B C, say H, square up a line, cutting that from B at R, make B K square with B S, now take H for a centre, and for a radius a circle touching the line B C and cutting at P, join P R, and in the angle is seen the bevel for the mitre on the edge of the stuff. Again: Take H for a centre, and for radius a circle touching the line B S, and cutting to the right of B; this intersection and R being joined, give the angle, in which is seen the bevel that will cut the sides.

Remember, in all cases the edge of the stuff is square, that is to say, for the application of the bevel.

THE CABINET-MAKER AND UPHOLSTERER.

It is the business of the cabinet-maker and upholsterer to prepare the furniture of rooms, such as tables, chairs, drawers, &c., and most of the operations of preparing the wood are performed at a *bench* (fig 371). This is made very strong, the joints being connected by means of screw-bolts and nuts. The surface is made flat and true, and there is a trough for holding small tools. One of the chief operations performed at this bench is the planing of wood, for which purpose the plank or other article is laid on the surface, and is prevented from slipping by means of the iron *bench-hook*, *h* (shown in a separate figure, 366). This has teeth which hold the wood, and prevent it from moving sideways, but as these teeth might injure a nearly finished article, there is a square *wooden stop*, *w* (shown separately, fig. 369); there are other stops (see also fig. 370). All these stops fit in mortices, and can be placed at any required height, or depressed, so as to be flush with the bench At the side of the bench are two *screws*, *s* and *s'*, which, with the *chop*, *c*, form a vice, the screw, *s'*, is furnished with a piece, *g*, shown detached, called a *garter*, which goes into a groove in the neck of the screw, *s'*, so that when both screws are opened, the screw *s'* serves to bring the chop, *c*, outwards. The chops open many inches, and hold work by the sides or edges, so that small boxes, drawers, and other work can be held between them. The end-screw, *e*, draws out the sliding-piece, *p*, and serves to hold thin works, and also works by the two ends, and is useful in making grooves, rebates, and mouldings. The holes in front of the bench are for an iron stop, *i*, the face of which is slightly roughened, and there is a similar stop in *p*, so that on placing pieces between these two stops, they will be held securely by turning the screw, *e*. There is also an iron holdfast, *a*, the straight arm of which fits into a hole in the bench, and it is useful for holding squared pieces of wood, when making mortices or dove-tails. the work is fixed by a blow on the top at *o*, and is released by a blow at the back at *l*. There is a pin in one leg of the bench at *p*, for fitting into one of the holes in the same leg, for supporting the end of long boards, the other ends of which are fastened by the screws, *s*, *s'*.

The planes in general use are the *jack-plane*, for course work, the *trying-plane*, for giving the work a better figure, and the *smoothing-plane*, for finishing the surface. The plane is furnished with a *tote* or *handle*, which is held in the right hand, the front being grasped with the left, and the body of the workman is pressed down on the work, so as to throw part of its weight on the plane. The best planes are furnished with a double iron (fig 360), united by a screw, but the lower piece is alone used in cutting, the upper or *top-iron* assisting the ascent of the shavings. The *plane* (fig 377) is a form in common use in Europe, the projecting handle or *horn* being held in the left hand, while the right is placed on the back of the stock. Grooves, mouldings, rebates, &c. are made by means of planes of the required form, so that the iron may cut out the wood as it moves along. (See fig 368.)

Among the joints used by the cabinet-maker, none is more common than the *dove-tail*, fig 358. Such joints are used for joining the ends of boards at right angles with each other, as in boxes, drawers, &c. In toys and common works, a kind of sham dove-tail is used, by planing the edges to be united, at an angle of 45°, slightly securing them by glue, and then making upon the angles with a back-saw, a few cuts, leaning alternately upwards and downwards: pieces of veneer are then glued and drawn into the notches. The work is then said to be *mitred and keyed*, and the whole is tolerably strong Fig. 356 shows the separate parts of the common dove-tail joint, the lower board showing the pins, and the upper the dove-tails. In cabinet-work it is usual to make the dove-tails on the front or more exposed part of the work, and the pins are cut of only one fourth the size of the dove-tails, so that but little of the end wood may be seen. To produce close joints, nice work is required. The work is nicely set out or marked, and the cuts are made with the *dove-tail saw*, which is one of the numerous saws with backs to keep the blade straight. The wood between the dove-tail pins may be cut out with a *bow* or *turning-saw*, which is a small saw set in a frame also for the purpose of keeping it straight, and the spaces are pared out with the chisel, driven with the mallet. The pins are usually made first, and the dove-tails are marked from the pins. The gauge lines should be left in sight; so that the dove-tails may be a trifle too small, so as to compress the pins, and produce a close joint.

The cabinet-maker uses a variety of boring tools, the simplest of which is the *brad-awl* (fig 372), and the *awl* (372) The brad-awl is a cylindrical wire, with a chisel edge, but it is sometimes sharpened with three facets. The awl is square and sharp on all four edges, and gradually tapers off until near the point, when the sides meet more abruptly. Most of the boring tools used in carpentry are fluted to make way for the shavings, and they are sharpened in a variety of ways. The *gauge-bit* (fig. 361), also known as the *shell-bit* and *quill-bit*, is sharpened at the end like a gauge, and when turned round, it cuts the fibres round the margin of the whole, and removes the wood nearly in the form of a solid plug. The *spoon-bit*, (fig 367) is usually bent up at the end, so as to make a taper point: it is in common use for making the holes for the wooden joints of tables, &c. The *auger-bit* (fig. 463) also known as the *nose-bit* and the *slit-nose-bit*, is slit up a small distance near the centre, and the larger piece at the end is then bent up nearly at right angles to the shaft, so as to act like a paring chisel. The *gimlet* (fig. 382) is also a fluted tool, ending in a pointed worm or screw, for drawing it into the wood while the chief part of the cutting is done between the angular corner between the worm and the shell. The latter gets full of wood, when the tool must be taken out to empty it. The *centre-bit* (fig. 364), of which three views are given,

Fig. 2.

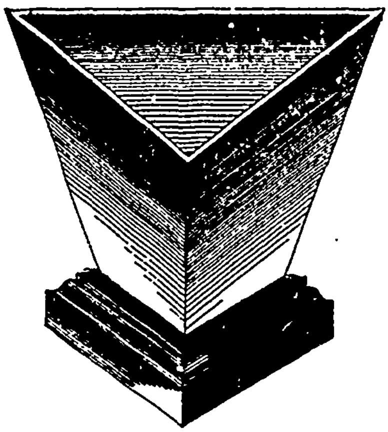


Fig. 5.

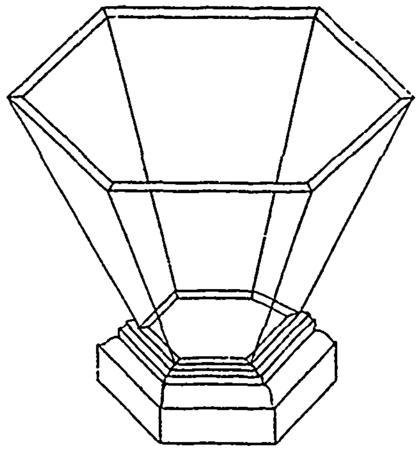


Fig. 1.

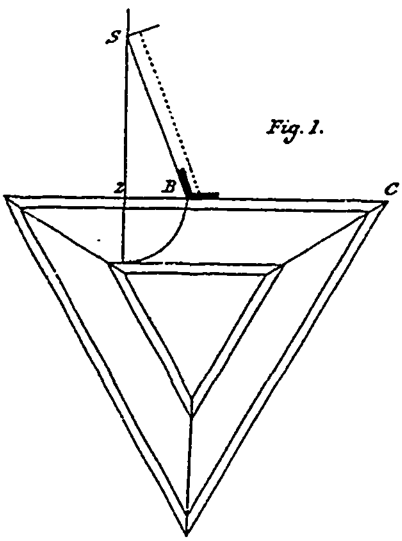
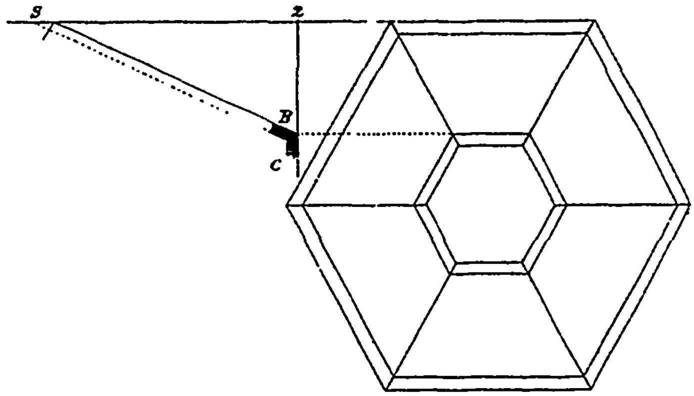


Fig. 4.



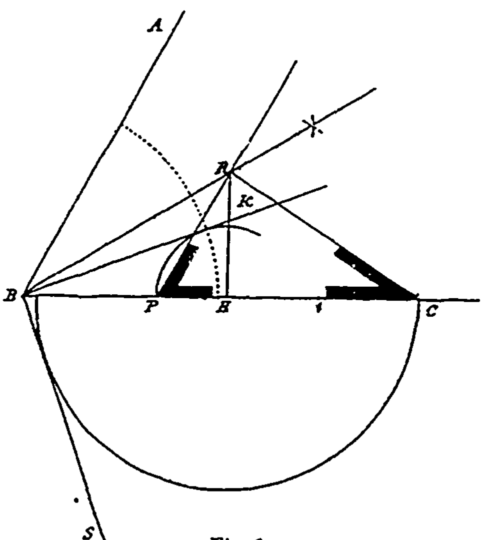


Fig. 3.

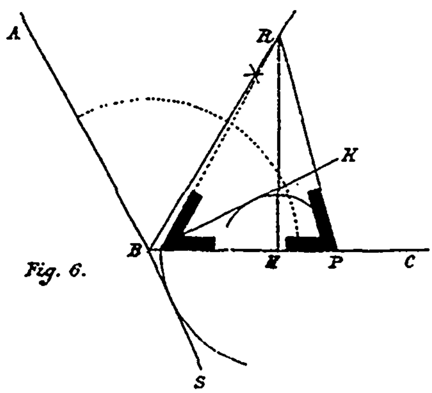
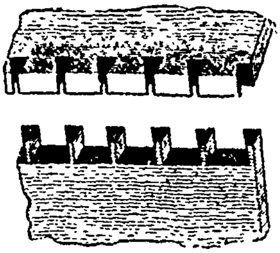
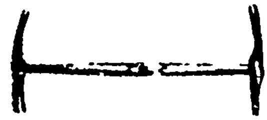


Fig. 6.

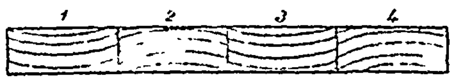
THE CUTS IN CARPENTRY.



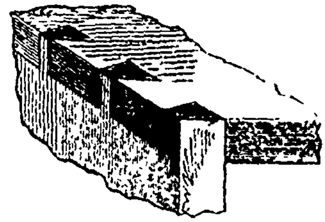
355. DOVE-TAILING.



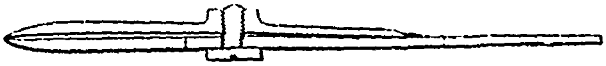
357. UPHOLSTERERS' HAMMERS.



359. JOINING WOOD TO PREVENT WARPING.



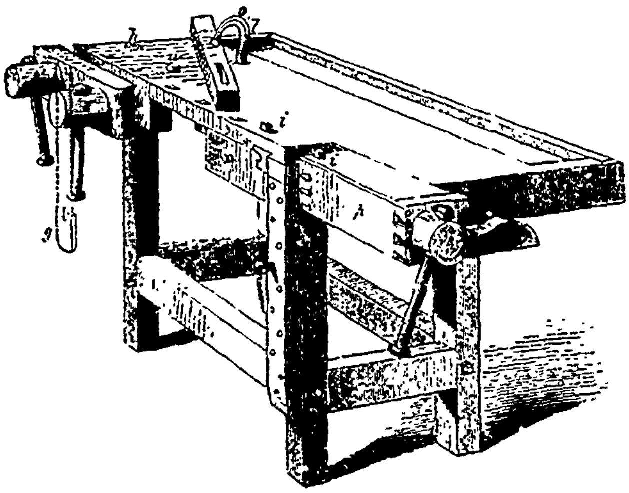
356. DOVE-TAIL JOINT.



360. PLANE IRON.

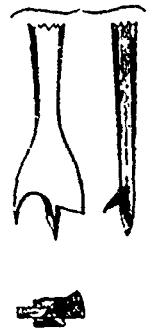
361. GOUGE-BIT.

362. TWISTED GIMLET.

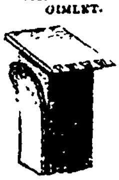


371. THE BENCH.

363. AUGER BIT.



364. CENTRE BIT

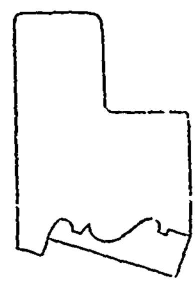


366. BENCH HOOK.

365 SCREW AUGER.

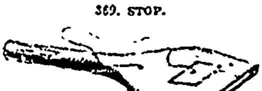
370. IRON STOP.

367. SPOON BIT.



368. MOULDING PLANE.

369. STOP.



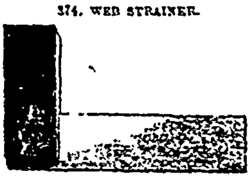
374. WEB STRAINER.

376 UPHOLSTERER'S SHOP.

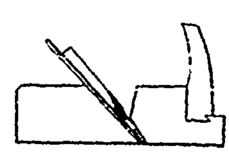
372. BRAD-AWL.

372. AWL.

373. STRAINER



375. SQUARE.



377 PLANE.

THE CABINET-MAKER AND UPHOLSTERER.

consists of three parts :—1, a centre, triangular point, or pin which serves as a guide ; 2, a thin shearing point or *nicker*, for cutting through the fibres ; and 3, a broad chisel edge or cutter, placed obliquely, for paring up the wood within the circle marked out by the point. There are a great many varieties of centre-bits : there are many boring-tools made with spiral stems, similar to the *twisted gimlet* (fig. 362), to enable the shavings to ascend the hollow worm, and thus save the trouble of withdrawing the bit so often. Of this kind is the *screw-auger*, fig. 365. There are an immense number of other tools which might be noticed, but we must refer the reader who desires to make their acquaintance, to the second volume of Holtzapffel's excellent work on "Turning and Mechanical Manipulation."

In the preparation of furniture, the taste of the artist may often be called into exercise, not only in promoting beauty of form, but in various carvings and inlayings. The French are distinguished for ornamental cabinet-work, especially for their *marqueterie* inlay, or the inlaying of woods of various tints in the form of flowers, ornaments, &c, ; as also for their *buhl-work* (so called from M. de Boule, a French cabinet-maker of the reign of Louis XIV.), in which metals are inlaid on grounds of tortoise-shell or ebony. In some cases, ebony cabinets are inlaid with precious stones, and a variety of woods and metals surmounted with carved figures, with perspective recesses, and innumerable drawers, &c. We may also refer to the art of *veneering*, or the covering of a common wood, such as the surface of a deal table, with a thin slice of some beautiful and costly wood, so as apparently to convert the deal table into a mahogany one. Marqueterie work, when applied on a bolder scale to the production of floors, is called *parqueterie*, and when applied to the decoration of wall panelling, it is known as *tarsia-work*. Of late years, porcelain panels have been inlaid in furniture with good effect.

The work of the upholsterer usually follows, or is dependent, on that of the cabinet-maker, and a glance at the interior of his shop (fig. 376) will give an idea of the nature of his work.

A SMALL MOTOR.

In our last we drew attention to the want of small motors suitable to domestic and other such purposes. In this number we are able to illustrate for our readers a very useful form of engine and water motor, which is also applicable as a pump, and thus meets in many ways the wants of users of small power engines or of small pumps. It works on the principle of an oscillating cylinder, in which the opening and closing of the ports is operated by the motion of the cylinder itself.

The machine we illustrate in its multifarious forms (as it appeared in *Stummeur's Ingenieur*) is made by a M. Haag, of Augsburg, who has given every attention to the production of a machine most suited to its purpose, and his Haag engine seems to be now daily becoming more highly thought of and sought after on the continent. To give some description of our illustrations, Figs. 6 and 8, show a water-motor which only requires to be attached to a water main to start work at once. It consists of a cylinder *f*, in which a piston, *e*, works up and down, and its cross-head is attached directly to the crank of the fly-wheel shaft *g*. The cylinder oscillates on two large hollow trunnions of considerable diameter. These trunnions, whilst serving as supports to the cylinder, at the same time act as inlet and outlet passages to the water.

The water supply enters through the passage *a*, and through the middle part of the hollow trunnion bearings. In the trunnions are two oblong orifices *c*, *c*, which are brought alternately over the central passage by the oscillation of the cylinder. In Fig. 6, the engine is shown at dead point, the two ports in the trunnions are standing over the metal bridge between the central and the side ports, and are therefore closed. As the fly-wheel, by virtue of its momentum, passes over the dead point it raises the cross-head end of the cylinder and causes the left-hand trunnion port to be in communication with one of the outside ports *d*. These two exterior ports *d* and *d*, unite together and have a common outlet at *b*. The water-pressure is thus admitted to one side of the piston *e*, whilst the other communicates with the exhaust passage. The stroke from left to right is thus produced, and when the piston has arrived at the other end of its travel and the cylinder is carried down, the opposite effects are produced, and the piston is driven from right to left. In this way a continual motion is produced. If needs be, the inlet and outlet attachments may be interchanged, and by so doing the direction of rotation will be reversed. A further advantage from the form of construction is found in the fact that the water pressure tends to carry the weight of the cylinder. For when the pressure is admitted into the pedestals, it presses upwards on the under faces of the trunnions and thus saves any considerable wear or friction in the trunnion bearings. This water-motor utilises as much as 90 per cent. of the whole effective power, which is a very high percentage, most water-wheels not realising more than about 25 per cent. The following are concisely the special advantages of this machine. That the bearing faces have a very small weight or pressure per square inch, and will therefore last a long time. They are also easily lubricated and adjusted, and further, in large machines the under bearing can be removed and easily replaced when worn. The engine can be arranged in any position to suit varying circumstances.

In consequence of this easy adaptability to any circumstances, this engine could be usefully applied where no other could be used. In the Figs. 4, 5 and 8, the water engine is shown in a vertical arrangement, in which the principle of action is exactly the same as in the horizontal arrangement which has been already fully described. In Figs. 1, 2 and 3, however, the arrangement of horizontal steam engine is illustrated. In this, as in the water motor, the steam admission to the cylinder is through narrow ports *c*, *c*, in the trunnions and bearing, being conducted thence from the entrance *a*, through the hollow bed plate and bearing blocks. But with these ports as in the water engine, the steam would have admission during the whole of the stroke, and would not, therefore, work economically. To remove this defect a separate expansion valve is used, which is in the form of two oscillating semi-circular slides *s*, *s*, which moving backwards and forwards on the spindle *t*, can be made to close the steam admission ports at any portion of the stroke. The steam is thus expanded in the passages, trunnions, and thus finally in the cylinder. The oscillating motion of the expansion valve is produced by a small crank throw *b*, on the end of the shaft. The connection is not, however, made to a fixed pin, but to a block *o*, which is perforated with a screwed hole, and can thus travel up and down the screw *z*, in the middle of the slotted link. The exact required rate of expansion may thus be regulated and fixed by the position of the block on the screw thread, effected by turning the screw *z*.

A further ingenious automatic variable expansion has however, been introduced, by means of which the governor can at any time adjust the rate of expansion to suit the variation in the work. This is effected by introducing an intermediate rocking lever *g*, which rocks on the fixed centre *v*. This fixed centre, however, is not rigidly connected with the rocking lever, but the latter is free to move up and down by sliding in a slot upon a block surrounding the pin. Thus with a constant travel in the rod, P, from the crank-shaft, the travel of the rod P, to the valve may be made to vary, according to the position of the rocking lever on the fixed centre. The position of the rocking lever is regulated by the rise and fall of the governor. The cut-off is thus automatically altered by the action of the governor. It is thus seen that the Haag engine is also eminently suited for a steam-motor, as well as a water-motor, and can again be arranged with much facility either vertically or horizontally.

In Fig. 9, we show a third adaptation of this chameleon-like machine, which seems to be capable of any arrangement. Fig 9, is the combination of two oscillating cylinders working on the same crank-shaft in the centre. The one at A, is the steam cylinder, and the one at B, a water-pump, thus forming a direct-acting steam-pump. The arrangement is compact, and should be very serviceable for the delivery of large quantities of water.

A GOOD DENTIFRICE.—Perhaps the following may be useful to some of your readers ; it is the receipt for the tooth-powder known as Betton's. If the cuttle-fish be carefully powdered it will not injure the most delicate enamel :—Powdered cuttle-fish, 4 lb. ; powdered orris-root, 4 lb.; finest prepared chalk, 1 lb.; musk, 8 gr.; oil of rose, 48 drops ; oil of lavender (Mitcham) 48 drops ; carmine, 2 dr.; liquor ammonia, 5 dr.; water, 6 oz.

EQUILIBRIUM TOOLS FOR DRILLING AND BORING

THE operation of drilling or boring tube holes through boiler plates and other similar work has hitherto been a somewhat complex and costly process by the ordinary methods in use. We will assume, as an example, that a 3 in hole is to be drilled accurately to a circle marked out on a tube plate ⅜ in or ⅝ in hole in the centre with an ordinary drill. This hole which is to act as a guide for the accuracy of the subsequent work must of necessity be carefully drilled in the exact centre, to a circle first set out on the plate, and it is well known that drills are very apt to "run" this way, or that way, according either to the form in which they are ground, or according to the perfection or imperfection of the centre-punch mark from which they start, or from the defective condition of the drilling machine itself, any of which causes, or all combined, will produce irregular work. This "central-hole drill" labours under the disadvantage of all ordinary drills, as compared with "cutters," inasmuch as considerable pressure is required to force the centre or V edge of the drill into the iron to the extent of the thickness of the shaving "drilling" taken off by the cutting edge at each revolution of the drill: and the blunter the drill the greater is the pressure required to enable the drill to cut at all. Added to this, the hole through a ¾ in. plate is not complete till the drill has been fed down through a depth of 1 in. or 1¼ in or more, according to the length of the V point of the drill. After this hole has been made, a second work has to be done and generally this is performed by a cutter specially made for the purpose, either of the shapes shown by the annexed sketches or of some such form. In these cutters the centre portion is supposed to fit the hole first drilled, and to be the guide to insure a true hole of the larger diameter. As often as not, however, the central pin does not fit the hole well, a defect which, whatever may be its origin, ends in the result being either a bad hole, or one out of its proper position, or even a combination of the two.

In fact to produce a good set of tube holes all over a boiler tube plate with anything like accuracy such as is now required in all first-class work, is almost impossible by these ordinary drills and cutters, while the cost is seriously greater than it should be, if only the minimum amount of work were but performed that is necessary to remove a circular piece of iron from the plate, say about ⅛ in. or ¼ in. less in diameter than the tube hole required.

A drill or cutter capable of accomplishing this task to the highest degree of perfection, with a minimum of "setting," out, with the least amount of drilling machine power and in the shortest time due to the thickness of the plate and the diameter of the hole, seems to be the desideratum towards which many have striven. Such an instrument, however, appears to have been recently invented by Mr. McKay, and successfully brought into use by Messrs Mensies Blagburn, of Newcastle-on-Tyne, and from all that we can learn of its performances when in regular use, and from what we have ourselves seen of its working, we are inclined to think the new equilibrium drilling and boring tool, constitutes a decided improvement in this class of machinery.

From the illustrations we give on page 233 the general form of the arrangement will at once be clear to most of our readers, and a few words of description will explain its mode of action. Reference to Figs 4, 5, 6 and 7 of the engravings which show one arrangement, it will be seen that it consists of a main body or shell of which the upper end is turned to fit the socket of a drilling machine, while the lower part forms a cylinder or case containing a ram or plunger. Into the ram L, there are two short studs screwed through two slots formed in the outer case, by means of which a pair of spiral springs may keep the ram fully home till caused to move as will shortly be explained, and to draw it home again when the movement is over. This ram is also bored out from its upper end and contains an inner plunger or ram of steel, having a collar or shoulder at its upper end, and a pointed centre at the lower end. It will be seen that each of these two rams is fitted with an hydraulic leather within the case, and that they are in fact hydraulic rams. A small hole at the top of the chamber S, permits the tool to be charged with water or oil, and when the hole is closed by a screw plug, the apparatus will be ready for work, with the exception of putting in the required cutters M, according to the size hole to be cut. It will be evident that if the centre point be placed upon a centre-punch mark made on a plate to be drilled, and the pressure of the "feed" of the machine be brought down upon the case, that the inner ram J, will move upwards within the cylinder S, and that the oil having no way of escape will press hydrostatically within the chamber and force the larger plunger downwards. The cutters M, will thus be brought down to the surface of the plate while the centre remains also in the centre mark. If the machine be now started it will be evident that the "feed pressure" will cause the cutters to perform their cutting work while the centre pin still remains upon the first centre. So soon as the cutters have passed through the plate and if there be no resistance underneath, the central pin will at once push the core down by the hydrostatic pressure due to the resistance afforded by the two external springs, which will draw the larger ram home directly the hole is made. On reference to Figs 1, 2, and 3, the same main principles somewhat differently carried out will be seen. In this arrangement, three cylinders are formed in the case or body, the central chamber O, contains the inner or centre point ram of the former one, and the two side chambers act, each of its own account and in equilibrium, as the one large ram already described. In this tool the cutters are differently formed and are also more easily constructed, and the equal pressure exerted by the fluid on each ram insures a fair division of labour seldom rightly obtained by such forms of cutters as we at first described. The results of the use of this boring tool are first, perfect accuracy of position when once a clean and deep centre-punch mark has been made, secondly, a true hole with a minimum quantity of metal cut away by cutters, thirdly, the work performed is done in the least time compatible with the circumstances of the case.

The tools for tube hole boring supplied with each holder are made so as to cut holes varying ¼ in in diameter to suit the two ends of boiler tubes. Thus a 3 in size is arranged to cut both 3 in. and 3¼ in. holes and so on.

In actual work we are informed that, whereas it has been usual to pay from 3½d. to 5d. per hole when using the ordinary kind of drills and cutters, the same work can be much more perfectly done by McKay's patent equilibrium boring tool for 1d per hole. The adaptation of this tool to other purposes than tube-plate drilling is only one of arrangement, and is likely ere long to be very fully carried out.—*Iron.*

BELGIUM announces for the coming year an exhibition of quite novel and eminently praise-worthy character, namely an exhibit of apparatus designed in any manner to save life or health. The project has been undertaken at the suggestion of the "Société Royale des Sauveteurs de Belgique," whose labors and publications in the cause of humanity are warmly acknowledged. A feature of the exhibition will be the experimental trial of apparatus as far as this is practicable. Experiments on the river or the sea will take place at Antwerp or Ostend, and the factory owners have signified their desire to co-operate in aiding the conduct of such trials as can only be made in workshops or factories.

The following is a summary of the several heads or classes under which exhibition is desired:

Class I.—Preservation of life in case of fire.

Class II.—All apparatus, engines, &c., for the preservation of life in or on water, or for the prevention of danger to the same.

Class III.—Apparatus for the prevention of accidents in crowded thoroughfares, tramways, and railways.

Class IV.—Assistance in time of war.

Class V.—Medical and sanitary arrangements for the preservation of public health.

Class VI.—Means of prevention of accidents and of safety as applied to industry.

Class VII.—Domestic and private medical arrangements.

Class VIII.—Medicine, surgery — pharmacy in connection with the preceding classes.

Class IX.—Institutions for improving the condition of the working classes.

Class X.—Health in connection with agriculture.

Instructions have been received from England by the agent at Sydney, of the Cape Breton Coal Mining Company to close their mines owing to the large quantity of coal on the banks unsold.

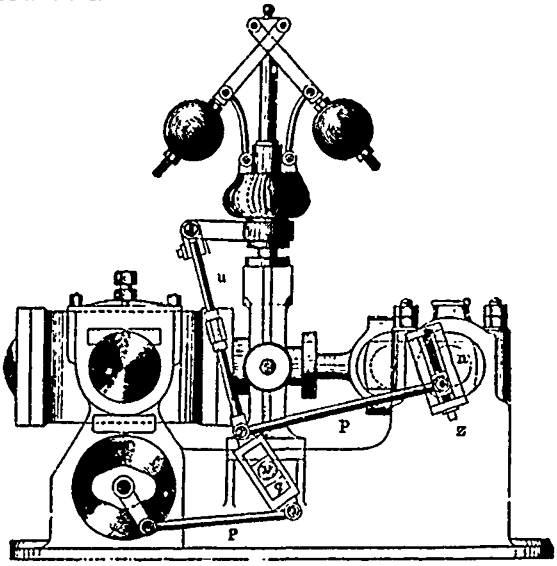


Fig. 1.

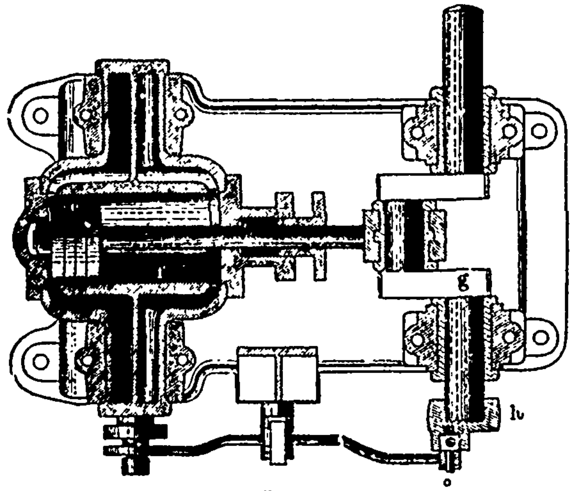


Fig. 2.

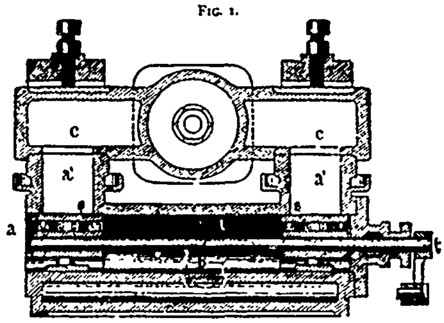


Fig. 3

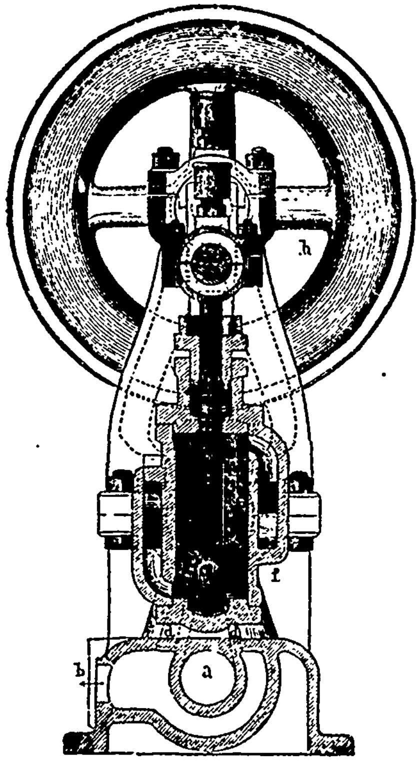


Fig. 4.

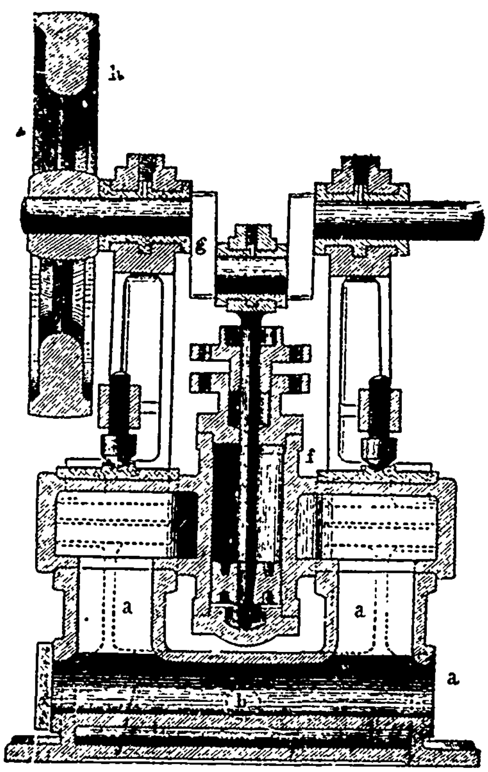


Fig. 5.

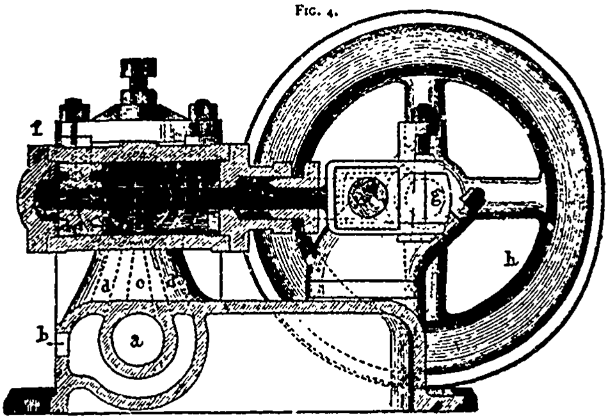


Fig. 6.

A SMALL MOTOR.

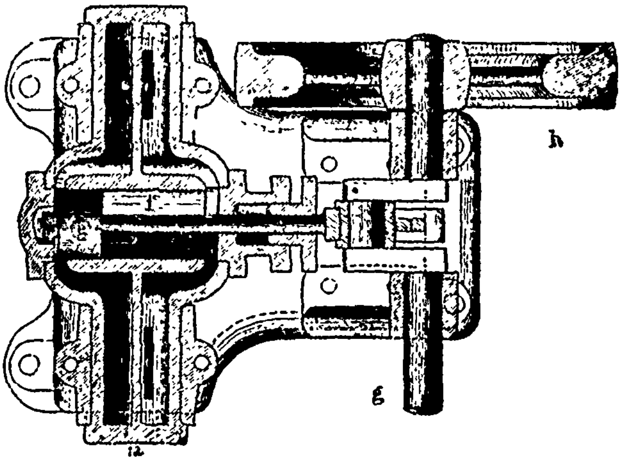


Fig. 7

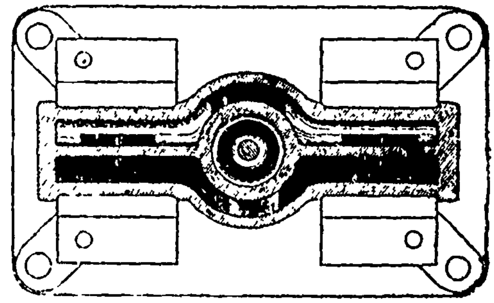


Fig. 8.

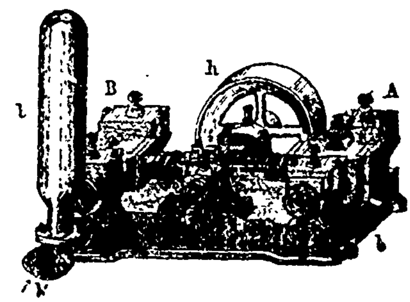
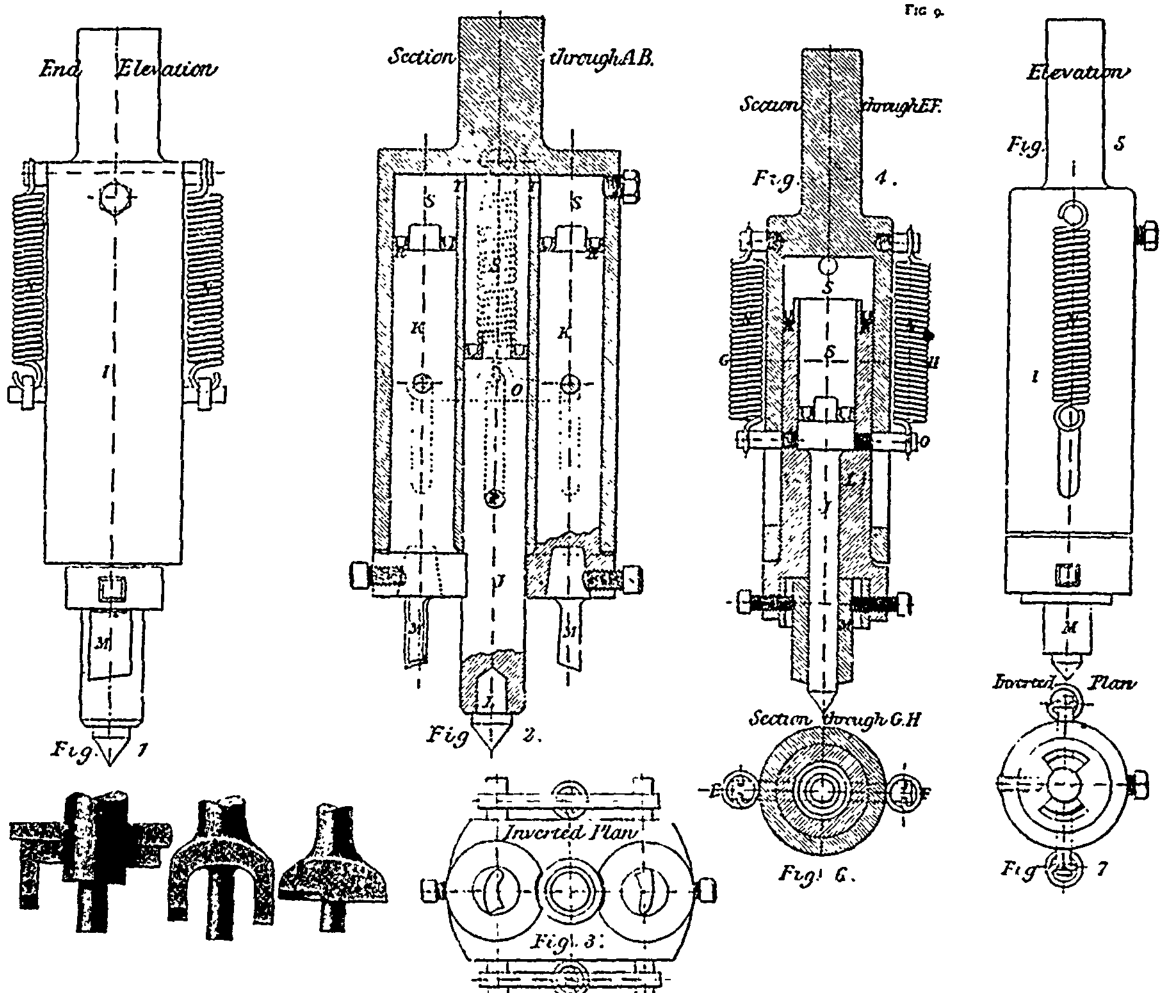


Fig. 9.

A SMALL MOTOR.



McKAY'S EQUILIBRIUM TOOLS FOR DRILLING AND BORING.

THE "EMPEROR" BELL

"What in the foundry-pit's deep abyss
Our hands with help of fire found,
High in the belfry of the tower
Our work to mankind wide will sound."
Schiller's Lied von der Glocke.

This famous new bell, which is to be hung in the southern tower of Cologne Cathedral, now rapidly reaching completion, after the impulse given at the close of the Franco-German war, is cast from French guns captured during that campaign, presented by the German Emperor to the committee charged with the work of completing that cathedral.

The bell has been cast at the machine works (to which is attached a bell-foundry) of Herr Andreas Hamm, at Frankenthal, an industrial town of the Palatinate; and it was only after two failures, and after untold anxiety and care, that he was able to produce the work which will hand down his name to posterity. It should be mentioned here that the first casting took place on August 19, 1873; the second, on November 13 of the same year; the third and successful cast was made on October 3, 1874.

Before describing his handiwork, let us have a look at its cradle. On entering the machine-works, we notice on the right the casting-pit, nearly 10 ft. deep, 20 ft. long, and 16½ ft. broad, with the temporary belfry, and a strong frame-work, to which the gin for raising the bell from the pit is secured. On the left is the furnace. separated from the casting-house by a wall. In the latter is an opening, permitting the running in of the molten bell metal into the mould. The usual mode of casting bells had to be somewhat departed from, probably on account of the huge size of the new bell; and we subjoin the following account of the difficult process.

In the pit a hollow core of brickwork was first erected; this received a coating of loam, and the whole was then smoothed by means of careful gauging until the exterior of the core presented the same dimensions and form as the intended bell. On this core, the so-called "false bell," or "model bell," was formed, also of loam. It had to be the exact counterpart of the real one; it received the same decorations and the same inscriptions, made partly of tallow and partly of wax. Another thin coating was then applied, to serve as a separator between the false bell and the "shell" of the bell. The latter rested on an iron ring, provided with eyes, and was bound round besides with strong iron hoops, to make it more secure. In the hollow core a fire was now lighted through an opening left at the top, and core, false bell, and shell were thoroughly dried and burnt hard; while at the same time the decorations and inscriptions of the false bell, formed of wax and tallow, melted. The shell was then lifted by means of chains, the false bell broken up, and the shell lowered again in its place, and the whole covered up. A tackle of eight sets of pulleys, which in its turn had to be raised by another set of tackle, was put up for lifting the new bell at the proper time out of the pit. The iron beam to which it was suspended had a diameter of 8 in. The furnace, with two grates at its working side each of an area of about 33 square feet, consumed at each cast twenty tons of coal. The metal was put in through an opening at the back of the furnace, on to the hearth, of an area of over 36 square feet. At the first cast, each of the twenty cannon used for the bell was pushed in resting on a truck. They weighed together about 50,000 lb. (German); to this was added 80 cwt. of tin. At the first cast the metal took from one o'clock at night until three o'clock the next afternoon before it was perfectly liquid, fit for running off; at the two following castings the time of melting was only ten hours, from five a.m. to three p.m. At the last cast, the filling of the mould took twenty-nine minutes and a half, without any mishap. But then followed four long, weary weeks of anxious waiting, before the shell could be broken; but when it fell, the master had the satisfaction of seeing that his labour had at last been crowned with perfect success.

A feeling of silent admiration steals over the beholder as he looks upon this mighty form, 10 ft. 8 in high, of a diameter of 11 ft. 2 in., which weighs 52,500 German pounds (over 25 tons), and which will receive a clapper or hammer of 9 ft. 10 in. long, weighing 1,530 lb. The bell, which has at the sound-bow a thickness of 13½ in., tapers towards the crown to a little over 3 in. The screw passing through the crown of the bell, and through the apparatus for receiving the hammer, is of corresponding size, weighing 996 lb., and carries a nut weighing 178 lb. The six arms forming the crown are decorated with angels' heads, and end where they join the bell in lions' feet. Below the crown, in three lines running round the bell, is the following inscription in Gothic letters:—

"Guilelmus, Augustissimus Imperator Germanorum Rex Borussorum pie memor caelestis auxilii accepti in gerendo felicissime conficiendoque nupperrimo bello Gallico instaurato Imperio Germanico. Bellica tormenta captiva aeris quinquaginta millia pondo iussit conflari in campanam suspendendam in hac admirandae structurae aede exaedificationi tandem proxima.

Cui victoriosissimi principis pientissimae voluntati obsecuta societas perficiendo huic templo metropolitano constituta F. C. P. IX. Pontifice Romano Paulo Melchers Archiep. Coloniensi A. D. MDCCCLXXIV."

"William the Most Illustrious Emperor of Germany, and King of Prussia, in pious remembrance of the heavenly aid granted him in the fortunate course and conclusion of the last French war, has ordered, after the restoration of the German Empire, a bell to be cast from captured cannon, of the weight of 50,000 lb., which is to be suspended in the house of God, now nearly completed. In accordance with this pious desire of the victorious prince, the society formed for the completion of this cathedral has caused it to be cast, under the Roman Pontiff, Pius IX., and the Archbishop of Cologne, Paul Melchers, in the year of our Lord 1874."

Under the figure of St Peter is the following inscription:—

"Voce mea coeli populo dum nuntio sortes
Sursum corda volant aemula voce sua.
Patronus qui voce mea templi atria pandis
Janitor et coeli limina pande simul."

"Send I with brazen lips to the peoples heavenly message,
Souls upwards soar, leaving earth; join, full of ardour, in song.
Thou, who through my deep voice of the fane the portals wide open'st,
Ope thou of heaven the gate, heavenly guardian, as well."

Opposite to the image of the apostle, is the German Imperial coat of arms, beautifully executed, with this verse below:—

"Die Kaiserglocke heiss ich,
Des Kaisers Ehren preis ich,
Auf heil'ger Warte steh ich;
Dem deutschen Reich erfleh ich,
Dass Fried' und Wehr
Ihm Gott bescheer'."

Emperor Bell I am named,
The Emperor's name make famed:
On holy ward I stand,
For German Fatherland
I pray? God grant it hence
Peace, welfare, and defence!"

In the first-named inscription is also the archiepiscopal coat of arms. The mottoes have Gothic borderings, successfully designed and executed. The pleasing appearance of the bell is further enhanced by parallel rings round it. The note sounded by the bell was to be the deep C, but according to the test committee it is C sharp; and it will, consequently be found not to be in tune with the other bells of the cathedral tried with them. However, should this prove to be the case, the evil, the founder is confident, may be remedied by somewhat planing down the sides.

The Emperor Bell, which was shipped at Frankenthal on the 15th of April, arrived safely at Cologne on the 8th of May. The somewhat lengthened voyage, which was interrupted at the principal towns along the Rhine, to give the inhabitants an opportunity of viewing the monster, was successfully performed. The transport from the wharf to the southern tower was accomplished without accident on the 13th of May, under the special supervision of Herr Hamm, amongst the excitement of thousands of spectators. A wagon had to be expressly made for moving it from the foundry on board a sailing-barge on the canal leading to the Rhine, and this was used again on its arrival at Cologne, for its transit from the river to the cathedral. An idea may be formed of the difficulties attending it when it is stated that it took eleven hours to move the mass a distance of 350 paces on a level roadway.

We may add in conclusion, that the new bell, next to those of Moscow (both not now in use, weighing respectively 193 tons and 63 tons; the former broken in 1737, the latter fell in 1855); that at Pekin, said to weigh 53 tons; and that of Novgorod (31 tons), is the largest in existence. It exceeds in size by far the largest of our English church bells: Big Ben, of Westminster, weighing only 14 tons; York Minster bell, 10¾ tons; Old Tom, of Oxford, 7½ tons; Exeter Cathedral bell, Great Tom of Lincoln, and St. Paul's bell, having a weight of 5½ tons and 5¼ tons respectively.—*The Builder.*

St. Thomas is putting up gas works, which are to be in operation next September.

THE CIRCULAR IRONCLAD "POPOFFKA NOVGOROD"

This vessel was designed by Vice Admiral A. A. Popoff for the Russian navy, and mainly intended for defensive purposes, being constructed with the view of combining a maximum tonnage with a minimum draught of water. This indeed, is the chief advantage of the circular form, as, owing to the greater displacement in comparison with the weight of hull, it enables vessels thus built to carry heavier armour and weightier guns than would be possible with those of the longitudinal form. This principle, which has been partly carried out by Mr. Reed in his broadening vessels to obtain greater displacement, has been found to answer most satisfactorily, and notwithstanding that the tonnage of the Novgorod is 2,491, she only draws 13ft 2in of water, with all weights on board, and with a longitudinal false keel The armour plates are 9 inches thick, and are "backed" with Channel iron to the amount of 2 inches, so that the armour is virtually 11 inches thick. Moreover, from its circular form, the Novgorod is of an uniform strength throughout, and presents no weak point. The deck, which measures 101ft. in diameter, is also plated to the depth of 2¾ inches, while a thickly armoured breastwork protects the guns which are worked in an open turret so as to ensure greater precision of fire, and which can be moved and fired either independently or together, as may be required. The guns are two in number, are 11 inch bore and weigh 28 tons each. The vessel is propelled by six screws worked by engines of nominal 480-horse power, which, however, can be worked up to 3000 indicated horse-power. The speed attained is said to equal that of the monitors, but as the vessel is to be used for defending the mouths of rivers and weak positions of the coast line, a high speed, though desirable, is scarcely absolutely necessary. The rolling and pitching of the Novgorod are said to be far less perceptible than in vessels of an ordinary type, owing to her flat bottom. She was launched in the early part of last year, at Nicolaieff, on the Black Sea. Another vessel of the same type is being constructed. She will be of a larger tonnage, and will bear armour 18 inches thick.

THE NEW OFFICES OF THE BURLAND-DESBARATS LITHOGRAPHIC COMPANY.

The need has long been felt of removing to more central and commodious premises, the publication offices of the *Canadian Illustrated News, The Canadian Patent Office Record and Mechanic's Magazine*, and *L'Opinion Publique*. The growth of the business created by these several periodicals, as well as the importance assumed by the custom work of the establishment, made easier access to the public a matter of great moment. But on the formation of the Burland-Desbarats Company, the necessity for a move became still more urgent and manifest, and steps were at once taken with that object in view. The result has been the erection, now proceeding, of a handsome building, in one of the most central situations of Montreal, wherein we hope to see the Company established in the course of the coming fall.

The building, of which we give a perspective view, is situated on Bleury street, near Craig. The lot it occupies is 80 x 70 feet, and the building proper 68 x 50. At the end of the building nearest Craig street, a passage of 12 feet gives access to the yard and boiler-house, which is to be erected independent of the main building. The whole area has been excavated, and the space under the planked yard will store several hundred tons of coal. The foundations have been laid with the greatest care, the soft nature of the subsoil rendering the driving of piles necessary. Over 300 large cedar piles have been sunk some seven feet below the foundations, great cedar floats laid upon them, the interstices filled with stone chips and mortar, and upon this sound and indestructible bed is laid the first course of the foundation, consisting of huge limestone blocks, five or six feet in length and width, and 15 or 18 inches thick From the precautions taken with this essential part of the building, the massiveness of the remainder may be inferred.

The front of the building is to be of cut stone, and is designed to possess great strength, and at the same time to give as much light as possible to the work rooms, for which purpose the piers and mullions are made light, and heavy projections on the cornices are avoided The first and second storeys of the rear elevation are built of cut stone piers and the balance of the height as well as the end walls are of brick work.

A stack of brick safes are carried up in the centre of the building from the basement to the fourth story.

The building will be 5 storeys high or 71 feet from pavement to top of main cornice The first storey will be divided into four compartments three of which are already rented as retail stores and the fourth will be used as the public office of the Company. The four upper storeys and the basement will be devoted entirely to the business of the Company.

On the roof will be erected the photographic room, 25 x 30, mainly of iron and glass, at a height where the dust of the street and the shadow of neighbouring houses will not interfere with the clear expanse of eastern sky

The building is to be of the strongest and most substantial character throughout

The contractors for the several works are: D. Dufort, for mason's work, A. Wand, for brick work; J. Luckwell, for carpenter work W J Cook, for plasterer work; ——— for painting and glazing; James & Son, for roofers' work; W. Clendinneng, for iron work.

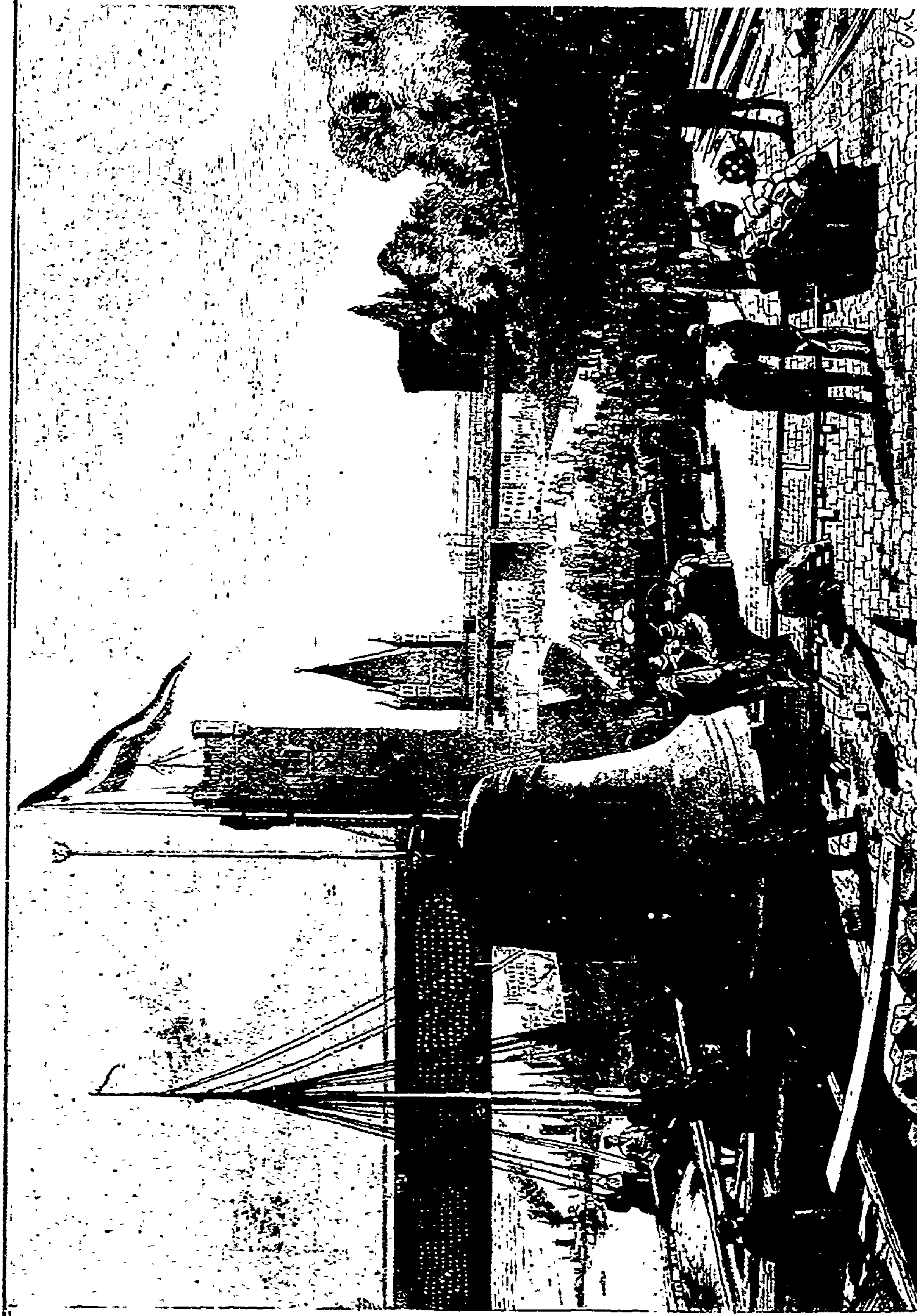
The total cost will be about $30,000. Messrs. Hutchison & Steele, are the architects, and Mr Kennedy superintends the erection Should all the contractors make as good progress, and do as good work, as the stone masons, we have no doubt that we shall be able in the fall to give a detailed description of the Company's works in the building, and invite our friends to come and see a model printing and publishing office.

NEW PRUSSIAN GUNS.

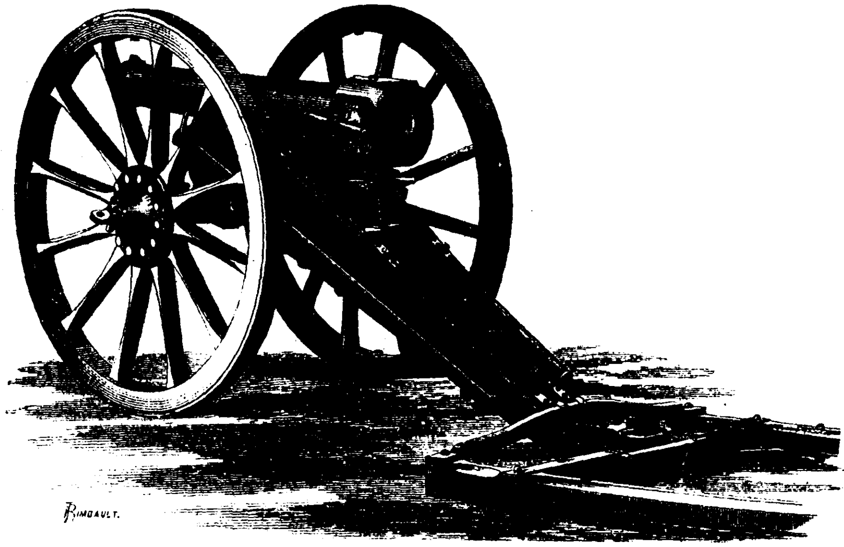
On page 237 we illustrate two of the new types of Prussian cannon, one a cast steel gun of 9 centimetres and the other a steel gun of 8 centimetres These guns have just been issued to all the Prussian artillery regiments, and they are said to be much superior to the guns used in the campaign of 1871. The smaller gun is exclusively for use in horse artillery, but the larger type will be used in all batteries. They are both furnished with the celebrated Krupp cylindro-prismatic breech-loading arrangement, an important feature in which is the gas-check ring, commonly called the "Broadwell ring," and which is now the subject of some discussion as to its original invention The official description and the results of the trials of these guns are not yet made public, but it is believed that for lightness, handiness and length of range, they are superior to the guns of any other service.

IMPERFECTION OF THE HUMAN EYE.

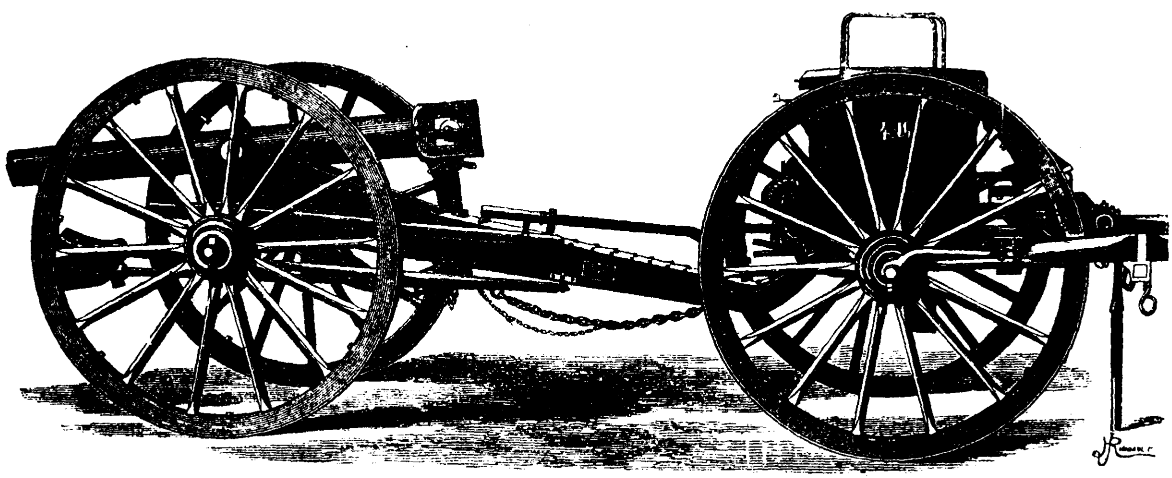
Prof M'Leod, in lecturing on this subject at the Physical Society, spoke of the chromaticity of the eye, and said there was abundant evidence of the defects of the organ in this respect. For instance, to short sighted persons the moon appears to have a blue fringe. In using the spectroscope the red and blue ends of the spectrum cannot be seen with equal distinctness without adjusting the focussing glass. A black patch of paper on a blue ground appears to have a fringed edge if viewed from even a short distance, while a black patch on a red ground, when observed under similar conditions, has a perfectly distinct margin. Professor M'Leod then explained that the overlapping of images in the eye produces the mental impression that there is no want of achromatism It is interesting to note that Wollaston considered that the coloured bands of the spectrum were really divided by the black (Fraunhofer) lines, and his statement that the red of the spectrum does not appear to have a boundary line "because the eye is not competent to converge the red rays properly," shows that he had very nearly, if not quite, discovered the achromatic defects of the eye. Dr Young ascribes to Wollaston the merit of having observed that when a luminous point is viewed through a prism, the blue appears to be wider than the red, the eye being incapable of recognising that the spectrum has the same width throughout its entire length An experiment was exhibited to show the relative distinctness of a dark line on grounds of various colours. A string or wire was so arranged that its shadow traversed the entire length of the spectrum, which was thrown on a screen by an electric lamp. When viewed from a short distance the edges of the shadow appeared to be sharp at the red end, but gradually became less distinct, until at the blue end nothing but a blurred line remained.



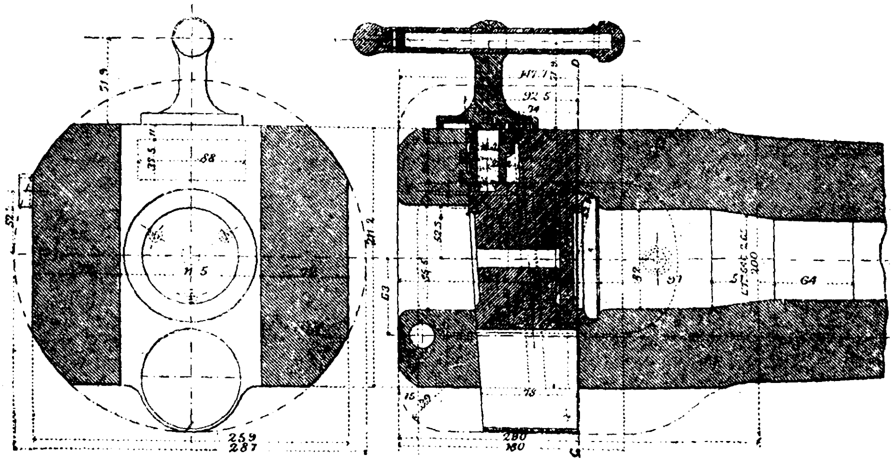
THE EMPEROR BELL.



9-Centimetre field Gun.



8-Centimetre Gun.



Breech closing Arrangement.

NEW PRUSSIAN ARTILLERY.

MECHANICS' MAGAZINE

MONTREAL, AUGUST, 1875.

MONTREAL WATER SUPPLY.

While we write a discussion is going on in the daily press with reference to the facts brought forward and the arguments used at the recent meeting of the Citizens' Public Health Association. On the one side it is urged that the water we drink is of the worst kind, that it abounds in organic and mineral matter and that living animals are peculiarly abundant in it, on the other side it is argued that the water cannot be so bad as stated by the scientific authorities since it has been drunk by certain individuals for many years and these people still live and enjoy robust health. There is no doubt but that our Montreal water is not clean and that it is to certain constitutions very hurtful. We have personally witnessed its harmful effects on children not accustomed to it and have moreover seen in water we have drawn for ablutionary purposes, animals that caused an involuntary shudder when we thought of the last glass of water we drew and drank off in the dark. With respect to purity it has been urged by Dr. Baker Edwards the lecturer at the meeting referred to above, and also by the experienced and able editor of the *Canada Medical Journal* that the water should be filtered at the public expense. This could be done at an expense of about $5.75, per annum per million gallons, and we should then have a water to drink that no one need be afraid to use.

There is one point in reference to water supply wherein Montreal and New York alike seem to be in the wrong and that is in the amount of water wasted. Here in Montreal we consume 65 gallons a day for every man, woman and child in the city; but this is eclipsed by the consumption in New York of not 95 gallons, as stated at the recent meeting but of 107 gallons which was, by the official figures, the daily amount furnished in 1874 to every human being in the city. From the experience of Liverpool where this subject of waste has been throughly and successfully dealt with it seems that an average consumption of 20 to 30 gallons per head is all that is really required and that thus Montreal pumps three gallons and New York five for every gallon needed. In New York the cry is now for more water and a plan is under consideration by which more water will be brought from Lake George, a distance of 200 miles There is, however, a strong desire on the part of many there to insist on what ought to be done here, too, the establishment of a system of furnishing water by meter to the consumer.

It is estimated that in New York this change alone would render unnecessary any enlargement of the water works for the next hundred years. As for Montreal it is clear from unimpeachable statistics that a system of supply by meter would save so much in the amount of water to be supplied that this could be thoroughly purified and supplied at a less cost than is now incurred for our over abundant supply of impure water. There is a mechanical question also of considerable interest which has been opened by the impurity of the supply. It is stated by Mr. Lesage that a heavy sediment has gathered in the pipes and that an extraordinary expenditure must be incurred to remove this. A similar state of affairs existed at Sydney, N. S. W., about three years ago, and was overcome in a very ingenious manner by the engineer of the water supply there, after trying various methods unsuccessfully he made some large circular brushes of the diameter of the pipes to be cleaned and forced them through the pipes until the sediment was entirely removed. The expense was stated to have been by no means so great as was at first anticipated. At any rate it seems clear that these reforms in our water supply need instant attention and there is every prospect that if properly carried out the result may be a saving and not an extra expense. In the meantime we advise all who can afford to do so to filter all the water they use for drinking purposes in private filters until the public filters are established.

THE KEELY MOTOR.

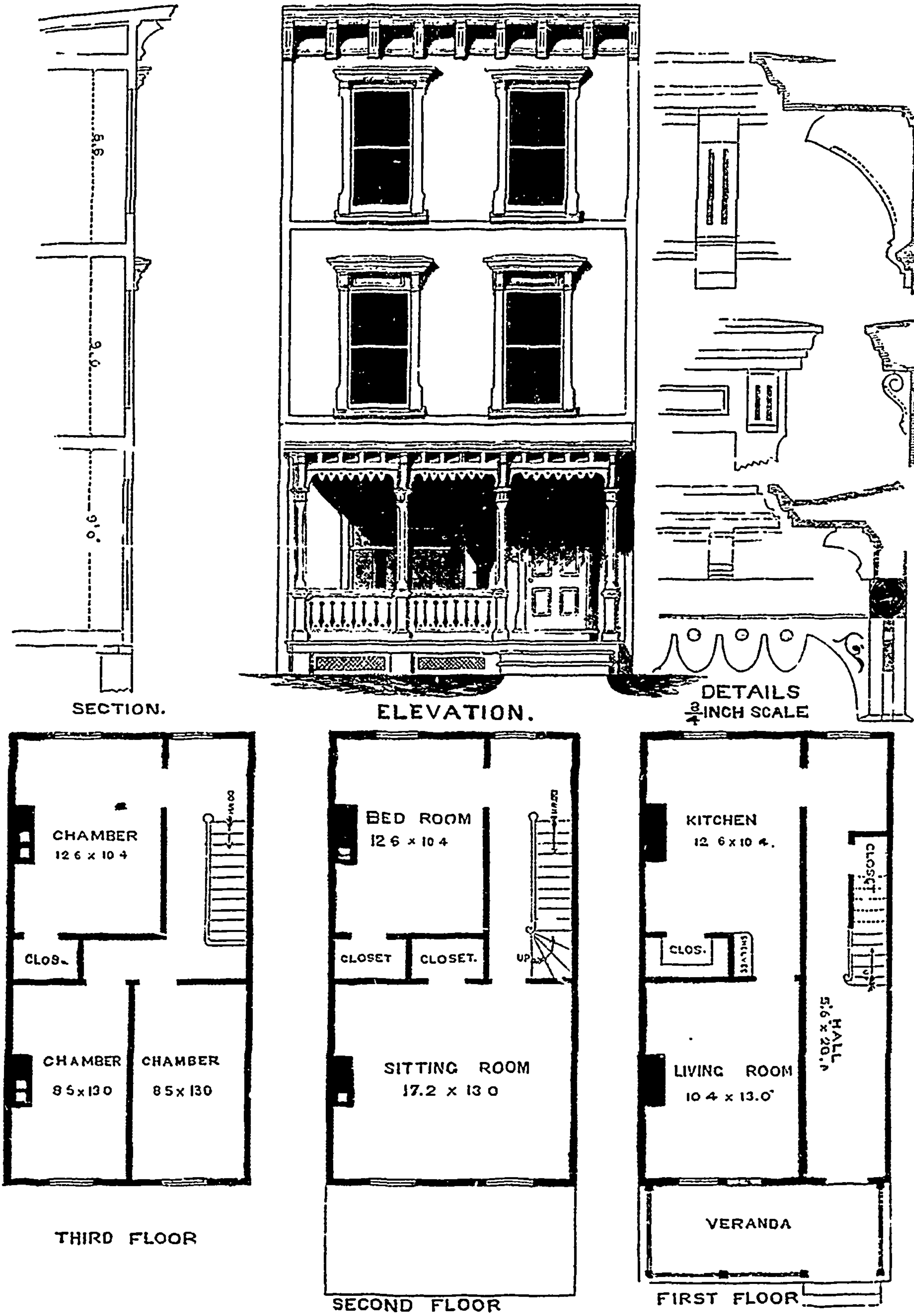
The undulatory theory seems to apply to plenty of things besides light and sound, in fact it seems to apply to almost everything. We have in commercial circles, waves of elevation and of depression and we have just such waves in religious circles. Some periods are remarkable for being prolific in great inventions and some for being barren. Then again every now and then a big wave comes along, bearing on it what promises to be the greatest and most wonderful invention the world has ever seen: and as the wave breaks on the shore the invention bursts like a bubble and there is nothing left. We are afraid that just such a wave as this last kind is now on the horizon. Like many other waves of this kind it advances very slowly—it has been in sight for nearly two long years but has not yet reached the shore. We refer of course to the new celebrated Keely motor about which such widely varying opinions are being expressed. The general public which puts its trust in the leading articles and descriptions of the New York *Tribune* and *Tr... or* of the *Toronto Globe* may well believe that we are on the eve of the promulgation of an invention which will revolutionize our mechanical world. We are to have a motor which at a nominal cost shall "produce a power to which there seems to be no limit" "a power which if used to drive a modern steamship could split it in two," &c. This power is not, however, the subject of so friendly criticism in scientific journals. These characterize it as "one of the biggest humbugs of the present century." "This latest Philadelphia swindle" —"a very clever trick," &c. In spite of all this, however, money to a considerable extent has been subscribed to develop the affair and to patent it all over the world. In a recent letter to the Scientific American protesting against its adverse criticisms and ridicule, Mr. Collier the legal adviser of the Company describes certain results which he saw produced with an engine of the value of $250, but of a size which he does not mention. These facts are accepted as true enough by the paper but as it says they all call for no acknowledgement of their value as scientific practical results.

Mr. Collier describes the "motor as follows: "I had seen in his workshop, a room say ten feet square a receiver charged with a vapor or gas having an elastic energy of 8000 pounds per square inch. I interrogated Mr Keely critically as to how he had produced this substance. Pointing to an inoffensive looking machine which stood in close proximity to the receiver, he said to me that he introduced a certain quantity of air into that machine under no greater pressure than was the capacity of his lungs, a certain quantity of water under no greater pressure than was the ordinary hydrant pressure at his residence, and then by a simple manipulation of the machine, unaided by any chemical substances, heat, electricity, &c., he converted a small quantity of the introduced water and air into the cold vapor then contained in his receiver. Another performance is as follows: Mr. Keely blows from his lungs for a period of thirty seconds into a nozzle upon the generator. He connects the same nozzle by means of a small rubber tube with the hydrant and lets in five gallons of water under a pressure of 26½ pounds to the inch, then shuts off the water. He opens the valve of a pipe of one-tenth of an inch bore, between the generator and a gauge or pressure indicator; and lo! the gauge indicates 10,000 pounds to the square inch. Such in sum and substance is the Keely motor as set forth by the learned counsel of the company and corroborated by various mechanical experts. The counsel goes on to say, in reference to the insinuation that money is being raised by an artful trick that the company is a private one; but we see a Wall street rumor to the effect that $7,500 was the latest offered for a share of $1,000 and we do not think that much trouble would be experienced in investing any considerable amount of money in stock. The whole thing resembles very much the affair of Paine in 1871, who professed that he was engaged in building a vessel which from an electrical cup would develop 500 horse power. Capitalists paid their money in readily for shares and that was the end of it. Of course it is impossible for us to judge at all correctly of the nature of this grand scheme. What evidence there is before us is of a nature conflicting or inconsequential. All we can say is that if Mr. Keely can really multiply power by his simple manipulation our present laws of physical science are valueless and a new era of physics is about to be established. As these laws at present stand before a pound can be elevated a foot, another pound must go down a little more than a foot, or a weight greater or less than a pound must go down as much less or greater a distance than a foot as the weight is greater or less than a pound. Or else we must have an expenditure of heat, or of acid and zinc in electricity of a certain well known amount before the pound can go up. But Mr. Keely dispenses with all this and absolutely creates the power or else finds it in cold water and air where it has hitherto evaded the search of the greatest scientific men. As we say above, Mr. Keely may have found this power there, but so far as we can find out the evidence of its existence has so far failed to lead any scientific man of any standing to believe in its existence.

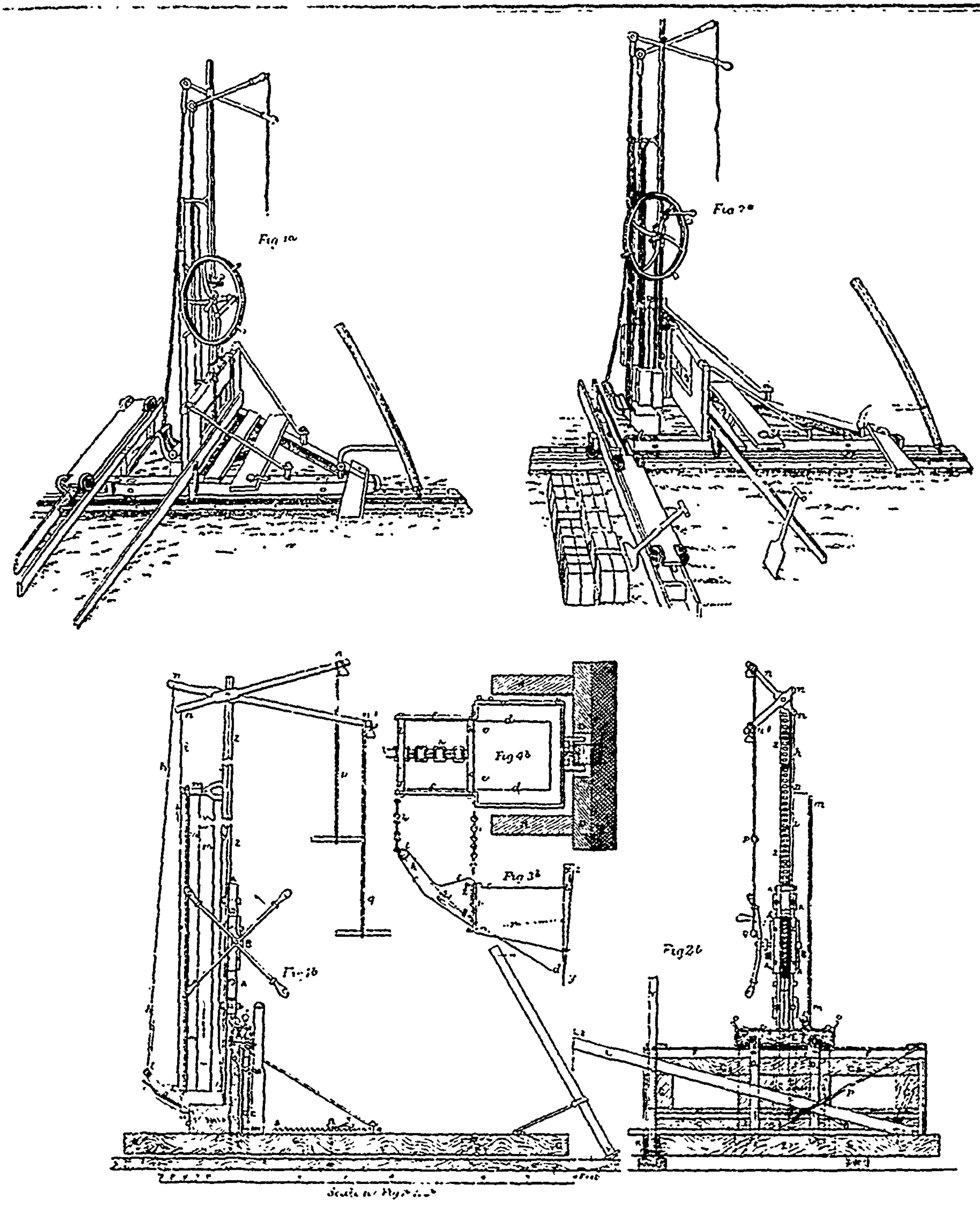
EARTH TO EARTH.

We remember reading, a long time ago, a sketch which supposed a being from some other planet to be transferred in the prime of life to this earth and endowed with all the privileges and trials incident to ourselves. Many of our customs are cleverly criticised, but the culminating point is reached by a question from the stranger as to the nature of a graveyard. He is then, for the first time informed of the fact that earthly beings are mortal. With some difficulty he is made to understand what death is, and, being at last clearly informed on the subject and realizing the fact that he too must die he exclaims, "How then is it possible that this the supreme change in our existence is not more universally spoken of and is not continually borne in mind." To his astonishment he is told that in select society the subject of death and its accompaniment the grave is tabooed and never approached except when rendered necessary in the case of a dear friend or relative. We were led to think of this sketch by the change which seems to have taken place in the general public mind on this subject. For some time past cremation and other modes of disposal of the body after death have been subjects of general conversation and debate in all circles of society, and we notice that the best society in England, the *haut ton*, has just been patronising an exhibition of an entirely new kind of coffins at the Duke of Sutherland's. As the *Saturday Review* says, the umbrella tents at Prince's were deserted and the Park passed by, while the fashionable world crowded the terrace at Stafford House, engaged in an inspection of various illustrations of the new form of sepulture invented or recommended by Mr Seymour Haden, and in discussing its sanitary æsthetic and other advantages. These "illustrations of the new form of sepulture,' were merely wicker coffins or baskets, just like waste-paper baskets but shaped like an ordinary coffin (see page 218) Some were double, with a space 2 in. or 3 in. in width between the inner and outer basket. This space is intended to be filled with charcoal in case any precaution against infection or decomposition may be required.

The following handbill, which was given to each visitor on entrance, contains all the necessary explanations:— "It is necessary, perhaps, to explain that the models shown are merely suggestive, and that the majority of them do not as yet fulfil all the conditions essential to their practical use. 1. The mesh in most of them should be larger than it is, and as open as is consistent with strength and the perfect retention of their contents, which contents, again, should consist of the larger ferns, mosses, lichens, herbs, fragrant shrubs, and any of the coniferæ, willows or evergreens, which are always to be had. 2. The osiers composing the baskets should be light (two thin ones being better than one thick one), and no more solid wood should enter into their construction than is necessary to preserve their form. 3. They should be of white or stained willow, without varnish or other preservative covering. 4. Accompanying each of them should be a narrow leaden band or ribbon, pierced with name and date of death, to be passed round the chest and lower limbs, and through the sides, and over the top of the basket: (i), for retaining the body in its position; (ii), for the subsequent identification of the bones; (iii), for sealing the coffin, as a guarantee that



DESIGN FOR CITY RESIDENCE, COSTING ABOUT $2,000.



BROSOWSKI'S HAND PEAT-DIGGING MACHINE.

the contents have not been disturbed. 5. In special cases linings of some imperishable material for a few inches upwards from the bottom will be necessary; and, in other cases, such modifications of the ordinary form as may ensure a complete inclusion of the body in wool, charcoal, or other disinfectants. Of these exceptional models No. 3 would seem to be, on the whole, the best for its purpose. 6. Other materials which are light, strong, perishable, inexpensive, adapted for carriage, and favourable to the dissolution of the body, may do as well and possibly better, than these wicker baskets. Readiness of carriage and the insurance of resolution being the main objects aimed at, several such materials do, in fact, suggest themselves, and may afterwards come to be employed."

Three different coffins are shown in our illustration. Enumerating them from the right hand to the left, they are to be distinguished as follows:—the first, an open wicker coffin for ordinary use; the second, or middle one, an open coffin which is lined with mosses; the third, a double coffin to be filled in with a charcoal lining, for a person who has died of infectious disease. The light and simple framework, shown in the foreground, is to be used for a bier.

The great advantage which would result from the adoption of this system of sepulture would be the disuse of envelopes *for the body which resist the natural processes by which it* would otherwise be resolved into its elements.

Mr. Haden showed clearly the danger of decaying animal matter in the soil, in the midst of a crowded population and pointed out that for the sake of the survivors it was necessary to favour the interment of the dead as soon as possible and to perform the sepulture so as to enable the natural decomposition of the body to take place as rapidly as possible. As regards early interment, he showed, also, a positive statement signed by the chief physicians and surgeons that completely sets at rest the common belief as to the danger of premature interment. On the whole we believe that the solution of this important question will be found in some system similar to this one rather than in cremation, deep-sea burial or any other much dissimilar to the system of interment which, by custom, has gained a hold on the public mind that it is impossible to loosen by argument however powerful.

We were compelled, from want of space, to omit from our last number the descriptions of the Russian Circular Ironclad and of the new offices of the Burland-Desbarats Lithographic Company They will be found in the present number.

HOMES FOR MECHANICS.

The architectural illustration we give on page 240, is designed to meet the wants of mechanics and working people generally, and is one of three houses intended for a lot having a frontage of 50 ft., each house being 16 ft. 8 in. wide by 30 ft. deep.

There is always a demand for good cheap houses, as real estate men know, and builders and others can not do better than to invest in this class of buildings, which soon yield a good return to their owners.

The design of one house here given is estimated to cost $2,000, and is materially different from the common tenements, inasmuch as each is complete in itself and separate, making it really a private residence.

The arrangement of the different floors will be understood *by reference to the plans. The aim has been to secure as great* a number of well proportioned rooms as possible in a house of such unusually narrow dimensions. The openings have been made large and spacious, as abundance of light and air are great benefits in a sanitary point of view.

GENERAL SPECIFICATION.

The foundations will have rubble wall of stone 16 in. thick. The interior partitions will be carried on girders resting on 12-inch piers of brick, placed at proper intervals. The superstructure is of wood, the frame being sheathed with the "novelty" siding, and having heavy building-paper underneath. The roof to be planked and covered with tin, proper gutters and leaders provided at the rear. Veranda roof also tinned. The ornamental work is effective and tasty, answering the purpose completely, and costing little to execute, 1-inch narrow pine flooring throughout. The walls and ceilings to be well plastered with two coats, the walls to be papered with a neat pattern of light wall-paper for the principal rooms.

Floor beams all 2 x 8 in., 16 in. on centers, furring beams for roof, 2x7 in., trimmers and headers, 3 x 8 in., girders, sills, *plates, and girts, 4 x 6 in. Studding, outside walls, 2 x 4 and* 3 x 4 in. placed alternately, 16 in. on centers; inside walls all 2 x 4 in., 16 in. on centers. Veranda rafters, 2x6 in., 18 in. on centers, plates, 5 x 6 in., posts, 6 x 6 in., chamfered as shown, and have caps and bases complete. The ornamental fringe work to be 1½ in. thick, the grain of wood to run vertically. The balustrade will be 1½ in. in thickness, and have cap molding and base. Ceiling of the roof to be nailed to the rafters, and slope with the same.

Fit up the lattice screen between veranda piers; these piers will be made of solid posts with the bark on, and boxed around; to show 12 in. square. Window architraves 6 in. *wide, and caps to windows as shown by the details given.* The brackets of the main cornice to be 6 in. wide, and sunken on the face as shown. Corner boards and belting courses 6 in. wide. All the above outside work to be of clear, well seasoned white pine.

Outside doors to be 3 by 7 ft., and 1½ in. thick, having fanlights overhead; other doors throughout to be 1½ in thick, 7 ft. high, and 2 ft. 8 in. wide; closet doors will be 2 ft. 6 in. wide. All the above to be provided with a good quality of locks, fastenings, butts, knobs, &c., complete. Sash to be 1½ in. thick, double hung, and have all necessary fastenings complete.

Bases for first and second floors 8 in. high, with 1½ in. molding on top; for third story, 6 in. high, with a beaded top. Architraves for first and second floors to be 6½ in. wide, and molded, those for the third floor and kitchen, 5½ in., those to windows will stop at the sill. The kitchen and living-room will have a chair-molding running around, 3 ft. high to the top. The stairs to be fitted up on strong carriages, with 1 in risers and 1½ in. treads, 4½ in. walnut rail, newels, etc., also fit up a step-ladder to the scuttle in the roof. Neat wooden mantels to be made for living and sitting rooms. Outside blinds 1¼ in. thick for front windows. Necessary shelves and *hooks placed where required in bedrooms and closets. The* painting to be two coats of white lead and linseed oil paint, this includes veranda floor, steps, lattice-work, piers, blinds, &c. The outside colors will be in two tints—the body color a delicate French gray, while the trimmings are to be two shades darker. The chamfer and perforated work will be brought out with bright vermilion, sparingly used.

—*Manufacturer and Builder.*

BROSOWSKEY'S HAND PEAT-DIGGING MACHINE.

This is a machine which is in pretty extensive use in some parts of Germany, and several specimens of peat are stated to have been excavated by it. Herr W. A. Brosowsky, of Jasenitz, near Stettin, has been building his peat-digger since 1842; it was probably the first of its kind, and a large number, it is stated 2300, are now at work—principally in north-east Germany and in Poland. It seems to have been the progenitor of the French *grand louchet*. With two men this hand apparatus is stated, by Herr Brosowsky, to be able to bring up from short depths of about 6ft. nearly 2000 cubic feet in twelve *hours. It weighs less than one ton. It consists of a cutter,* like the four sides of a box, with oblique edges, which by its own weight, and by means of a crank and rack work, is forced down into the peat to a depth that may reach 20ft. It can cut only at the edge of a ditch or excavation, and when it has penetrated sufficiently, a spade-like blade is driven under the cutter by means of levers, and thus a mass is loosened, having a vertical length of 10ft. or more, and whose other dimensions are about 24in. by 28in. This is lifted by reversing the crank motion, and is then cut up by hand into blocks of 14in. 6in. × 5in. Each parallelopipedon of peat, cut to a depth of 10ft., makes 144 sods. It can be used to raise peat from below the surface of the water, rendering drainage in many cases unnecessary. The Mecklenburg moors are now traversed by canals cut by this machine. It is, however, only properly applicable in rather shallow and wet moors quite free from wood and the roots of trees, being more especially of value where a thorough drainage cannot be carried out. On high bogs containing wood it cannot be used, and in any case, beyond a depth of about 9ft., this hand apparatus is only to be worked with great exertion.

The machine however is very extensively used in Europe and it may be of service to some of our readers to have a de*tailed description of it.*

Fig. 1*b* and Fig. 2*b* are respectively side and end elevations of the whole machine, Fig. 3*b* being a side elevation, and Fig. 4*b* a plan. It consists of a square box-shaped knife, *a*, *b*, *c*, *a*, the two cutting edges of which *a a*, *a B* and *B c*, each have a different inclination to the horizontal line. The hinder portion, *b*, *b*, of this box is fitted to the wrought iron bar *y*, the end of which tapers to a sharp edge *y*, by which the cutting action into the peat is so to say prepared, while offering a sort of guide into the peat mass. To the long bar *y*, *y*, is fixed a rack of wrought iron plate, geared into by a spur wheel keyed on a short shaft B, B, revolving in bearings on a fixed carrier A, A, and turned through a hand-wheel or a hand-winch, C, C, by the operative.

During the down stroke, or when the peat has to be dug into, the weight of the bar *y y*, of the rack *y*, of the cutting tool, &c, tends at first to force the tool down; this tendency has soon to be reinforced by turning the arms C, C, till at last a square prism of peat is cut out. It is to be noted, that in the space over the edge, *a*, *a*, Fig 4*b*, to the left, or in the same direction in Fig. 1*b*, there is no peat, this space being clear or filled with water, the knife *a*, *a*, *B*, *v*, has only to cut out three sides, so that the prolongation *f* of the knife box *a*, *b*, *c*, can descend without hindering the digging of the peat in the vertical direction. In other words, the machine is only intended to work at the edge of the excavation This front end of the cutter-box is intended to receive the broad even knife, *c*, *d*, sharpened on both sides Fig. 3*b*. The hinder portion of this knife is adjustable side-ways in grooves, and it serves to cut away the bottom of the prism of peat where it hangs to the whole mass.

The required movement is given to the knife *c*, *d*, by means of two chains *h* and *i* fixed thereto, and guided by being made to pass over long cylindrical rollers *k* and *l* fitted to the front prolongation of the cutting box. The other ends of these chains are fixed to levers *n* and *n'*, actuated from below by means of ropes *p* and *q*. It is seen that by means of a pull at the rope *p* the chain *i* is drawn up and the knife *c*, *d*, caused to cut away at the base of the column of peat. While the cutting box is being drawn up, the surface of the knife *c*, *d*, serves as a carrier for the isolated long prism of peat, while it is at the same time kept from falling sideways by means of a framing of hoop iron *m*, *m*, *m*, Fig. 1*b* and Fig. 2*b*. As soon as the block of peat has reached the surface it is cut by hand spades into sods, and thrown into barrows or small trams set on rails in order to be taken to the drying ground.

While this is being carried out the cutter-box and apparatus have to be shifted on one side to the breadth of the knife. The way this is done will be rendered clear by looking at the framing of strong wooden beams, usually forming in plan a triangular framing G, and a vertical framing of the standards G, G, and horizontal beams G, G, held together by angle iron and tied by rods P, Q On the horizontal surface of the angle iron F, run rollers *t*, *u*, which belong to a second framing, consisting of the vertical beams D and the horizontal beams E and E', well tied together by strips of plate D', D'. To this second framing is fixed the carrier A, A, already mentioned, so that by shifting E, D, to one or the other side, the cutter-box is similarly adjusted.

On the pin *r*, running through the top-piece E, being withdrawn, the iron lugs *v*, *v*, being taken hold of, the working part of the machine can then be set sideways The vertical framing G', G', is generally made of such a width that four cuts sideways can be taken. When the peat has been dug out to the whole breadth of the framing, the machine has then to be shifted backwards by the width of the knife *aa a*, *B*, Fig. 4*b* To be able to carry this out, the strong horizontal beams G, G, of the framing form a triangular frame in plan, lying on its longest side, Fig. 1*b*, on two rollers K, K, which run in grooves formed in the bottom beam I, while the shorter side, the apex of the triangular in basis, lies directly on the flat surface of a long fixed beam H. In the direction of the width of the machine is a lever L, one end of which can be slightly oscillated up and down on a fixed bolt L, while grasping it at the free end L, it can be pressed down on the upper edge M' of a vertical standard M, in suchwise that the part of the framing lying over H is lifted up and the whole weight put on the rollers K' K'. On a second workman then moving the lever Y, Y, from left to right, Fig. 1*b*, one end of which rests on the bottom piece I, being also linked by X to G, the whole machine can then be shifted in the longitudinal direction of Fig. 1*b*. In order to fix the bottom framing G on the basis I, there are holes V, V, in the latter which adjust themselves to holes U in the beam G, in suchwise that iron pins R can be dropped into them. To facilitate this, a foot lever T is employed. S is a grooved foot-board for the workmen. Of the four men employed able to deliver daily from 12000 to 14,000 blocks of peat, No. 1 works the digging and cutting apparatus of the machine, No 2 helps in setting it, lifts off and cuts up the peat, No. 3 brings the freshly dug peat on one side, while No. 4 piles up the sods.

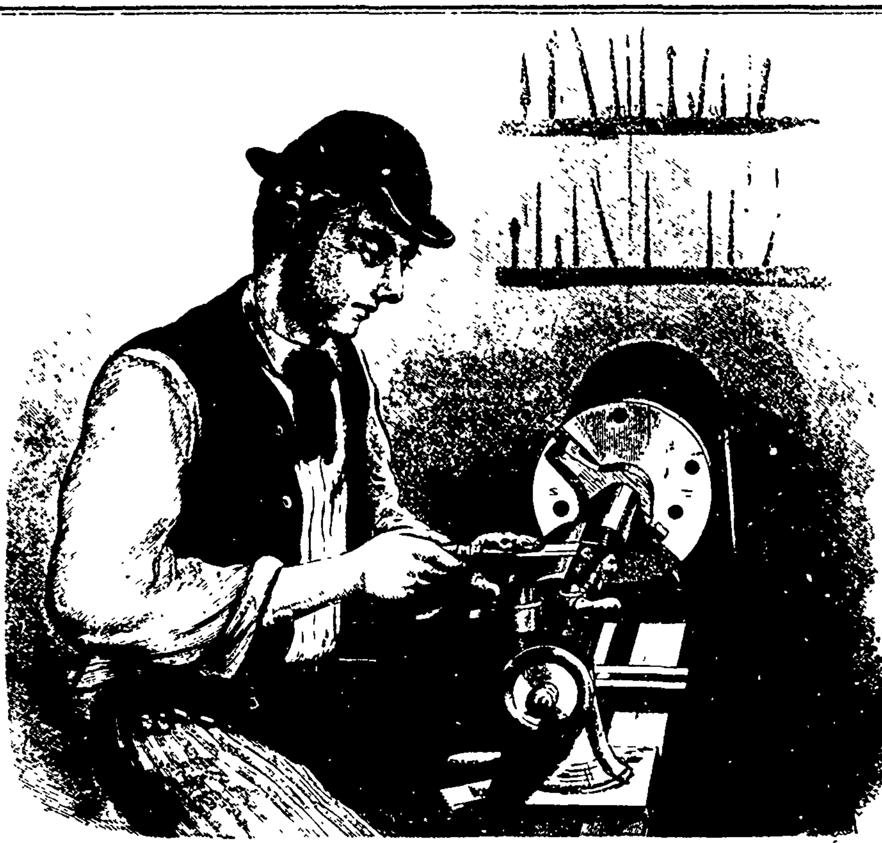
CHASING SCREW THREADS.

The operation here illustrated is that of chasing, or, in other words, cutting threads or screws, in the lathe, by hand, which is the most delicate operation performed in a hand lathe, and requires skill of the very nicest kind. In the early days of steam engineering, when screw-cutting lathes were unknown, good hands at chasing were eagerly sought At that time, many large engineering firms in England used threads of a particular depth and angle, unlike those used by others, to the end that the machinery manufactured by each firm could not be sent elsewhere for repairs. Among these private threads, the "Maudsley," and the "Sharp" threads attained most prominence. They were deeper than those now in use, and have been superseded by the Whitworth or standard thread of to-day.

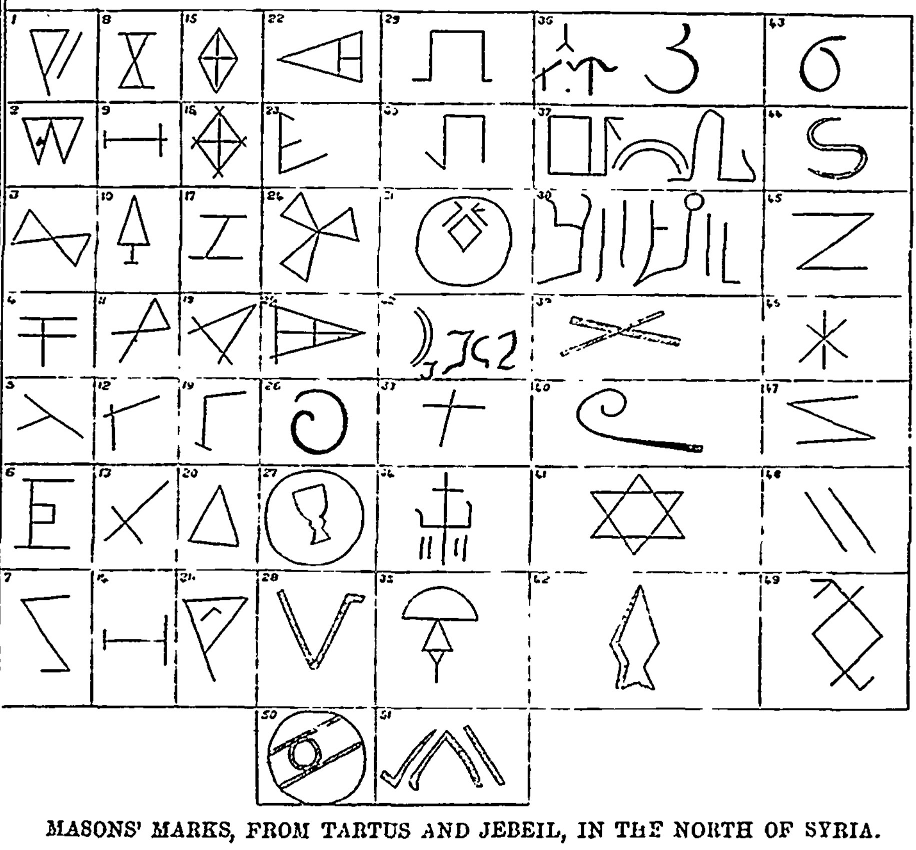
Thomas Maudsley, the founder of the celebrated engineering firm now known as Maudsley, Sons & Field, had, as far back as 1830, a remarkably efficient screw room, as it was then termed conducted under the supervision of Mr. Sheriff, who was probably the most expert chasing hand of his time. In Maudsley's private model room, screw cutting by hand was then carried to a high degree of perfection Among the eminent men who served their apprenticeship in this room were Sir Joseph Whitworth, James Nasmyth, and George and John Rennie. Among its productions was a model of the (at that time) monster (160 horse) marine engine built for the English man of war *Dee*. This model, which was displayed at the London Exhibition of 1851, had many hand-cut threads in it with a pitch of 100 to the inch, their fit being so perfect as to enable them to sustain very severe strains. The teeth of such a chaser are so fine that, to the ordinary machinist's eye, it would be taken for a scraper, nor would the error be perceived until the tool was applied to the work.

The first operation in chasing an outside or male thread is to start the thread, that is, to cut on the work a shallow spiral groove; this is accomplished by running the lathe at a fast speed, and passing the point of a graver or V tool, under a moderate pressure, along the end of the work, the heel of the tool being pressed firmly against the rest, which should be placed as close to the work as possible. This part of the operation requires a great deal of practice, to enable the operator to strike the thread at the correct pitch and true at the first attempt Beginners will find it an excellent plan to leave about three-eighths of an inch in length, of the end of the work to be chased, a sixteenth of an inch larger in diameter than the required finished size, so that, if the first few attempts to strike the correct pitch fail, the marks may be turned out without reducing the work below the required diameter. When a correct pitch is struck, the chaser may be applied, as shown in our engraving, and, while pressed lightly against the work, moved along the rest as nearly at the proper speed as can be judged, and the teeth will find the groove and travel along it. The chaser should be held so that its hind teeth press the hardest against the work, which will keep them in the starting groove, and act as a guide, while the front teeth extend to groove, carrying the thread forward to the requisite length. It is highly important to keep the rest free from the burrs made by the heel of the graver or other tool; otherwise the edge of the chaser will strike against them, and, being retarded in its course, will cause the thread to become "drunken." The leading bottom edge of the chaser should also be rounded off to enable it to glide over such obstructions on the face of the rest. If the metal upon which a thread is to be chased have seams in it, the starting groove should be cut as deep as possible, so as to keep the thread true. The front tooth should come even with the edge of the chaser, so that it will be a full tooth, and the tops of the teeth should stand at an acute rather than at a right angle to the left hand side of the (right hand) chaser, to the end that, when its teeth are parallel with the length of the work, the body of the chaser will lean to the right, and therefore stand well clear of the lathe dog or driver.

The following rules apply to outside or male chasers: For wrought iron or steel, the teeth should be hollow in their



CUTTING SCREW THREADS WITH A HAND CHASER.



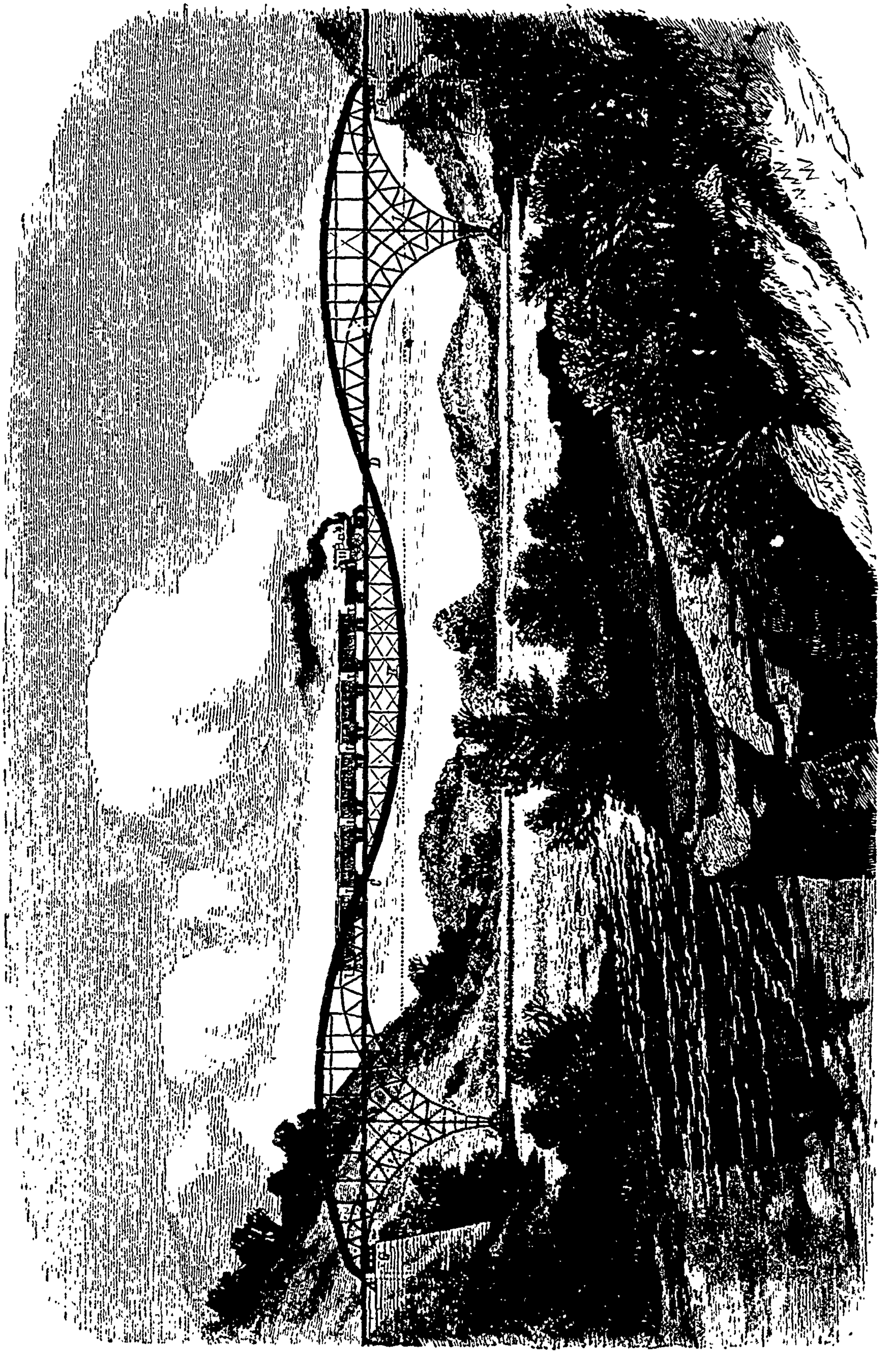
MASONS' MARKS, FROM TARTUS AND JEBEIL, IN THE NORTH OF SYRIA.

length, and should have top rake. For cast iron, the top face of the teeth should be level, or they will cut too freely and rip the threads. For brass, the teeth should be ground at an angle of which the points of the teeth are the lowest. The cutting edge of the chaser should be above the horizontal center of the work; and the body of the *chaser should be held as nearly* horizontal as will permit the teeth to cut, otherwise the positive or negative rake of the teeth will cause them to cut a thread deeper than themselves.

At the termination of the thread, it is necessary to cut a recess as deep as the thread, in order to give the chaser clearance, and prevent it from ripping into the shoulder, which would form the termination of the thread in the absence of a recess. It is a very common practice to cut this groove or recess with a V tool or graver point, instead of with a round nosed tool, thus producing a recess having a conical instead of a curved outline: the result being to very seriously impair the strength of the bolt, and cause it, under severe strains, to fracture across the section of the bottom of the groove.

In a series of experiments made a few years ago, by the English Government, upon targets representing ship's armor, the bolts were found to be unable to withstand the shock caused by the cannon shot striking the target; and it being observed that the fracture nearly always occurred across the section above referred to, the clearance grooves were made with a hollow *curve, which obviated the defect.* In this connection we may also remark that threads whose tops and bottoms are rounded are much stronger than are those whose angles terminate in a point or angular corner (a fact also demonstrated on the trial above referred to); hence those cut by hand are, in this respect, superior to those cut by the lathe.

Inside or female threads, that is to say, threads cut in the bore of anything, are cut by hand with an inside chaser, which cannot, under any circumstance, have rake upon the top face of the teeth, as the latter necessarily cut at a distance from the lathe rest; and were they made to cut freely, they would rip in, and more power would be required to hold them than can be sustained by the hands of the operator. It is a good plan to



PIERCE'S IMPROVED METHOD OF CONSTRUCTING BRIDGES WITH LONG SPANS.

bore a small hole in the top of the lathe rest, into which a small pin may be placed to act as a fulcrum, against which the back of the chaser can be pressed to force the teeth into the cut. Inside or female threads are started by pressing the chaser teeth lightly against the bore of the work, and moving it forward at the same time, the thread being started (if a right hand one) at the outer end of the bore, which is rounded slightly off so that the chaser shall not catch. Much experience is required to enable the operator to judge the exact speed of chaser movement required for any particular pitch of thread.

Beginners should always stop the lathe and examine an inside thread as soon as it is struck, for it is an easy matter to cut a double female thread in consequence of moving the chaser too fast, nor will the error be discovered until the thread is finished and the male thread applied, which will not, in that case, enter.

Double threads are those in which the distance from one thread to another is one half only of the actual pitch of the thread. Their nature may be more clearly understood by supposing a thread of five to the inch to be started by a tool in a screw-cutting lathe, and then supposing the tool point to be moved laterally so as to cut another groove, to the same depth, in the center of the spaces between the thread first cut. If a chaser having ten teeth to the inch be then employed to finish the thread, we shall have a double thread possessing all the elements of distance from one thread to another, depth, angle, and strength of a thread of ten to the inch, although the pitch will actually be that of five to the inch.

Double male threads, to be cut by hand, can be most easily started by the chaser, moving it twice as fast as would be required for a single thread, rounding off the corner of the bolt end and taking care to cut principally with the hindermost teeth.

Taps and all other work requiring great accuracy in the depth and angle of the thread should be finished by a chaser, the work (if of wrought iron or steel) being freely supplied with oil until the finishing cuts are taken, when soapy water should be substituted, which will cause the chaser to cut clean and smooth, and give neatness and finish to the threads of the tap. *Engineering.*

IMPROVED BRIDGE CONSTRUCTION.

The engravings on pages 245 and 248, illustrate improvements in the construction of bridges of long spans, on the cantilever and suspension principle combined. We are indebted for the engravings and for the following description to the *Scientific American*. The whole bridge from A, to B, Fig. 1, is composed of the middle truss C, D, of 316 feet and of the two end or side trusses A, C, and B, D, each 296 feet long, in all 908 feet. The arches under and sustaining the side trusses constitute the bottom or compression chords. The clear span between feet of arches is 680 feet. The curved line A, B, C, D, is a chain which is under constant tension and which extends to an anchorage at each end, at E. The arches are hinged at E, and F, and the ends of the bridge sit on curved beds of rollers at G. The chords F, D, are cut at the intersections C, and D, and joints are there placed, also to serve as hinges. Within these four hinges the structure is free to move according to thermal demands, and hence to retain its rigidity. Fig 2, page 248, shows how this system repeats in spans when one is not enough to cross over the river. S, T, shows the grade line, P and Q, anchorage of the curved tension members in their opposite arches, and R, a pier on which the spans compound one-half their respective weights. The inventor calculates that the greatest strain that comes on this bridge of 680 feet span is less than that of a truss of 450 feet span of like requirements. High ratio of cost in long spans is avoided, in the system here advocated, by the crossing of the chords at C and E, cutting one truss, as it were, into loops of three, reducing the depth of trussing and giving support to all by keystoning from underneath by tension in place of above or overhead by compression. The dotted line I, I, Fig. 1, shows how a second grade line may be suspended from the trussing above, and through that below, the straight chords.

The arches are made ribbed to provide stiffness under passing trains, but the amount of material is but little increased thereby.

SHEPHERD'S SECTIONAL BOILER.

We give on page 249 illustrations from *Engineering* of a sectional boiler exhibited at the recent Manchester Mechanical and Industrial Exhibition.

As will be seen from the engravings, the boiler consists of a number of sections, each of which is cylindrical at the upper part of its length, where it is 24 in. in diameter, while below this is a tapered portion, as shown. Each section is 6 ft. 4 in. high over all, and the particular boiler we are describing is made up of fifteen such sections, each of which may be regarded as a complete boiler of about 3-horse power. The vertical seams of the sections are all welded, while the circumferential rivetted seams have drilled rivet holes, and the plate edges are turned for caulking. The top hand-hole block and cover are of malleable iron, and the workmanship is throughout of the best kind.

At their lower ends the sections are connected, as shown, to cast-iron pipes through which the feed enters, and which are in communication with the blow-off cock. At the upper ends the sections are similarly connected to the steam-collecting pipe; these pipes being fitted with the safety and stop valves, as shown. We may add that each of the cast-iron pipes is tested separately to 600 lb per square inch, and the wrought-iron sections to 300 lb. per square inch. It should also be noted that there are no stayed surfaces, the form of the sections rendering stays of any kind unnecessary.

The setting of the boiler is, as will be seen, of a very simple character, and is such as can readily be constructed by an ordinary bricklayer, while it does not involve any excavations. Thus the sections are simply arranged side by side in a brick chamber, having the firegrate at one end, and an opening to the chimney face at the other, the bottom of this chamber being formed by cast-iron floor-plates, which shut off the feed pipes and joints at the lower ends of the sections from contact with the hot gases. A chamber is thus formed below the cast-iron plates just mentioned, to which access can readily be had for an examination of the pipes and joints when necessary.

It follows from the mode of setting that the current of hot gases flows approximately at right angles to the heating surface exposed by the sections, while this heating surface is all vertical or so steeply inclined, that no deposit is likely to rest upon it. The arrangement of the boiler in fact gives every facility for the deposition of sediment where it can do no harm, namely, in the lower range of pipes which are not subjected to the action of the hot gases.

As regards the performance of the boiler we are describing, we may state that a long series of evaporative tests have been carried out by the makers, these trials extending over six months, the public being daily invited to witness them The trials were made with a boiler consisting of 2[illegible] sections, this boiler evaporating from a temperature of 57 deg. from 60 to 65 cubic feet of water per hour. The boiler was worked at pressures varying from 70 lb. to 120 lb. per square inch, and the water evaporated was carefully recorded by a register fitted on the water tank. The coal consumption varied according to the quality used, the evaporation varying from 7 lb. to 9½ lb. of water per pound of coal.

The various parts of the boiler are interchangeable, and this, combined with the very moderate weight of the sections, renders the boiler easily transported, and gives every facility for building up a boiler of any desired size. The interchangeability of the sections also facilitates repairs and renewals, it being possible to remove a section and replace it in two hours if necessary, or the remaining part of the boiler can be disconnected and continue working. Besides being fired in the ordinary way, these boilers are also being employed to utilise the whole heat from furnaces and annealing ovens, and for chemical and other purposes, and altogether form a very good type of sectional boiler.

An alloy found useful in filling defects in castings, consists of lead 9 antimony 2, and bismuth 1.

Frosted glass, useful for screens, &c., is made by laying the sheets horizontally and covering them with a strong solution of sulphate of zinc. The salt crystallises on drying.

HOW TO REMOVE SPOTS AND STAINS FROM WOVEN FABRICS.

Taking out grease and other spots from clothes is an application of chemistry which has a practical interest for everybody. It demands a certain acquaintance with solvents and reagents, even though we may not understand the laws of chemical affinity on which their action depends. The general principle is the applying to the spot a substance which has a stronger affinity for the matter composing it than this has for cloth, and which shall render it soluble in some liquid so that it can be washed out. At the same time it must be something that will not injure the texture of the fabric or change its color. The practical hints we shall give are condensed from a variety of foreign sources.

The best substances for removing grease or oil are · 1. Soap. 2 Chalk, fuller's-earth, steatite, or "French chalk." These should be merely diffused through a little water to form a thin paste, which is spread upon the spot, allowed to dry, and then brushed out. 3. Ox-gall and yelk of egg, which have the property of dissolving fatty bodies without affecting perceptibly the texture or colors of cloth. The ox-gall should be purified, to prevent its greenish tint from degrading the brilliancy of dyed stuffs, or the purity of whites Thus prepared it is the most effective of all substances known for removing this kind of stains, especially from woollen cloths It is to be diffused through its own bulk of water, applied to the spots, rubbed well into them with the hands till they disappear, after which the stuff is to be washed with soft water. 4 The volatile oil of turpentine This will take out only recent stains, for which purpose it ought to be previously purified by distillation over quicklime.

An earthy compound for removing grease-spots is made as follows. Take fuller's-earth, fre it from all gritty matter by elutriation with water; mix with half a pound of the earth so prepared, half a pound of soda, as much soap, and eight yelks of eggs well beaten up with half a pound of purified ox-gall. The whole must be carefully triturated upon a porphyry slab; the soda with the soap in the same manner as colors are ground, mixing in gradually the eggs and the ox-gall previously beaten together. Incorporate next the soft earth by slow degrees, till a uniform thick paste be formed, which should be made into balls or cakes of a convenient size and laid out to dry. A little of this detergent being scraped off with a knife, made into a paste with water and applied to the stain, will remove it.

Tar and pitch produce stains easily removed by successive applications of spirits of turpentine, coal-tar naphtha, and benzine. If they are very old and hard, it is well to soften them by lightly rubbing with a pledget of wool dipped in good olive-oil. The softened mass will then easily yield to the action of the other solvents Resins, varnishes, and sealing-wax may be removed by warming and applying strong alcohol. Care must always be taken that, in rubbing the material to remove the stains, the friction shall be applied the way of the stuff, and not indifferently backwards and forwards.

Most fruits yield juices which, owing to the acid they contain, permanently injure the tone of the dye; but the greater part may be removed without leaving a stain, if the spot be rinsed in cold water in which a few drops of aqua ammonia have been placed, before the spot has dried. Wine-stains on white materials may be removed by rinsing with cold water, applying locally a weak solution of chloride of lime, and again rinsing in an abundance of water. Some fruit-stains yield only to soaping with the hand, followed by fumigation with sulphurous acid; but the latter process is inadmissible with certain colored stuffs If delicate colors are injured by soapy or alkaline matters, the stains must be treated with colorless vinegar of moderate strength.

Fresh ink and the soluble salts of iron produce stains which, if allowed to dry, and especially if afterwards the material has been washed, are difficult to extract without injury to the ground. When fresh, such stains yield rapidly to a treatment with moistened cream of tartar, aided by a little friction, if the material or color is delicate. If the ground be white, oxalic acid, employed in the form of a concentrated aqueous solution, will effectually remove fresh iron-stains. Acids produce red or other stains on the vegetable colors, except indigo. If the acid has not been strong enough to destroy the material, and the stains are fresh, the color may generally be restored by repeated soakings in dilute liquor ammonia, applied as locally as possible. Photographers frequently stain their clothes with nitrate of silver. The immediate and repeated application of a very weak solution of cyanide of potassium (accompanied by thorough rinsings in clean water) will generally remove these without injury to the colors.

HOW COLDS ARE CAUGHT.

(From the *British Medical Journal*.)

There are several well-known processes by which a cold may be caught. As a disease, there is nothing so common; and yet it is only very recently that anything like an approach to a knowledge of its pathology has been attained. There is now, however, a large accumulation of evidence which points very strongly in the direction that "taking cold" is actually "being cold."

Rosenthal has very carefully investigated the relations of the body heat, and has demonstrated the existence of a central heat producing area, and an external heat-radiating surface. A rise in temperature is due to the disturbance of the balance normally existing betwixt these two antagonistic areas. An excessive heat-production may produce fever; or this may be due to an impairment in the cooling processes, so that heat accumulates. Precisely the opposite of this leads to a lowering of the body-temperature; if the heat be lost more rapidly than it is produced, then a "chill" results.

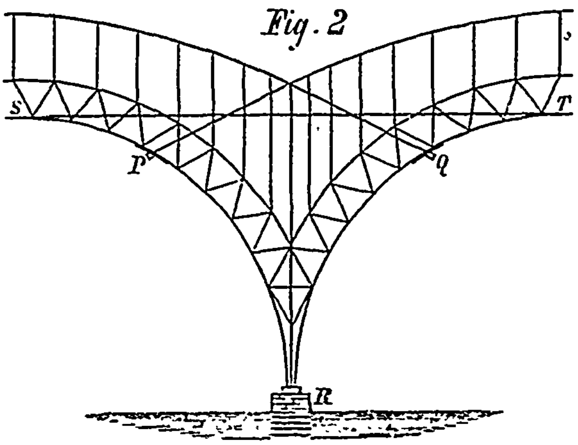
Let us see how this applies to colds, so frequently caught from a wetting. The clothes we wear are good non-conductors of heat, and so prevent the loss of body-heat which would occur without them. But let them become moist or saturated with water, and then they become heat-conductors of a much more active character, and a rapid and excessive loss of body-heat follows. Nothing is more certain, however, than that prolonged exposure in wet clothes is commonly followed by no evil results; that is, so long as there is also active exercise. The loss of heat is then met by increased production of heat, and no harm results But let the urchin who has been drenched on his way to school sit in his wet clothes during school-hours, and a cold follows. No matter how inured to exposure the person may be who, when drenched, remains quiet and inert in his wet clothes, he takes a cold. Here there is an increased loss without a corresponding production of heat, and the temperature of the body is lowered, or the person "catches cold."

The effect of exercise in producing heat is well known. Unless the surrounding air be of a low temperature and the clothes light, the skin soon glows with the warm blood circulating in it, and then comes perspiration with its cooling action. Here there is a direct loss of heat. Exercise, then, in wet clothes, produces more or less a new balance, and obviates the evil consequences which would otherwise result.

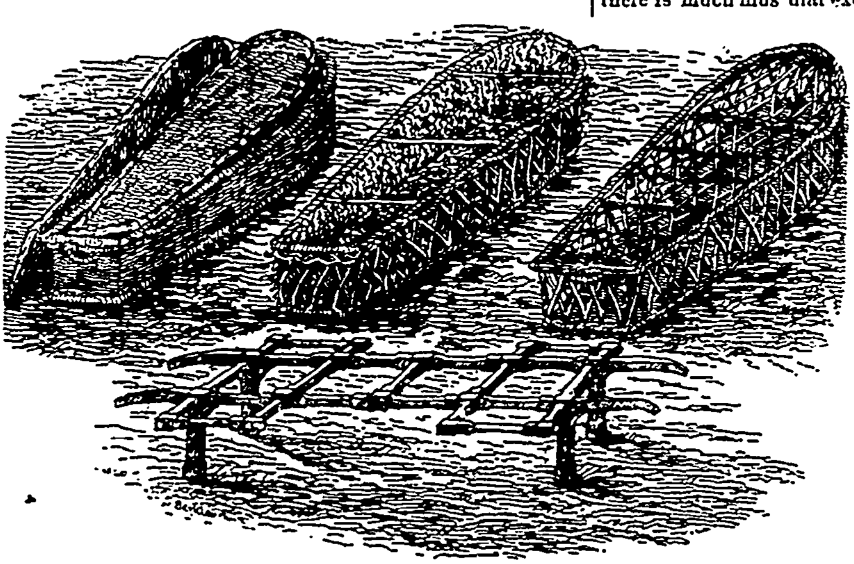
The loss of heat is more certainly induced if the skin be previously glowing and the circulation through the skin, the cooling area, be active. Thus a person leaves a ball-room with his cutaneous vessels dilated, and a rapid loss of body-heat follows, unless there be a thick great coat or a brisk walk; if the clothes become moistened by rain or be saturated with perspiration, the radiation of heat is still more marked. Such is the causation of the cold commonly caught after leaving a heated ball-room. It is probable that exhaustion is not without its effect in lowering the tonicity of the vessels, and so those of the skin do not readily contract and arrest the loss of heat.

Rosenthal found that a rabbit exposed to a temperature of 100 deg. Fahr., for some time had a lowering of the body-temperature of no less than 2 deg. for two or three days afterwards. The dilated cutaneous vessels had not sufficiently recovered their tone to contract and arrest the loss of heat. Those who live in superheated rooms readily take cold on exposure. There exists a condition of the cutaneous vessels which gives a tendency to lose heat, and less exciting causes will induce a cold.

A damp bed gives a cold, because the moist bed-clothes are much better conductors of heat than are the same clothes when dry. The temperature of the body is lowered, and a cold results. Long exposure in bathing leads to similar consequences. The second feeling of cold in bathing tells that the body is becoming chilled, and that the production of heat is insufficient to meet the loss. A run on the river bank,



IMPROVED BRIDGE CONSTRUCTION.



WICKER COFFINS.

or a brisk walk after dressing, commonly restore the lost balance.

The plan of permitting the wet clothes to dry on the wearer is very objectionable. The abstraction of heat from the body by the evaporation of moisture in the clothes produces a marked depression of the body-temperature, and a severe cold. This is most strikingly seen in the effects of a wetting in the Tropics. The smart shower or downpour is quickly followed by a hot sun and a breeze, and the loss of heat under these circumstances is considerable. The person is "chilled to the bone," and the effects are felt for a long time afterwards. The effect of the evaporation under these circumstances is illustrated by the Tropical plan of placing water in a vessel of porous clay, wrapping a wet cloth round it, and exposing it to a breeze. The water becomes distinctly cold.

The effect of a strong impression is equivalent to a longer action which is not so marked; and Behier, in the treatment of hyperpyrexia by the cold bath, found that either a long exposure or very cold water were necessary to produce a marked impression in the hyperpyretic condition. So a sudden sharp cooling, and a longer and slower process, alike produce those lowered temperatures which lead to severe and often fatal consequences.

But if "taking cold" is "being cold," how, it may be asked, does a feverish condition result? It is the normal course of a cold to cause a high temperature and then to defervesce. This is due to a want of promptness in the regulatory arrangements.

The question of the increased production of body-heat to meet great loss of heat has been much disputed. Liebermeister, Roehrig, and Zuntz maintain that such is the case, while Winternitz and Senator dispute it. There can be no doubt that the enormous amounts of fat devoured by the Esquimaux are consumed and go to the production of body-heat. For, however much, by the use of furs, &c., he may reduce the loss of heat by the skin, there is still the loss entailed by respiration, by the hot expired air, to be accounted for.

On exposure to cold, the skin ordinarily becomes cool and marbly, from contraction of the cutaneous vessels; so the loss of heat is checked, and the blood is kept in the internal parts, the heat-producing area. A cold bath, or exposure to cold, often causes a rise of temperature in the internal parts and Liebermeister found that, in a cold bath, not only the loss, but also the production of heat, is increased, the production being in inverse proportion to the temperature of the bath. The amount of blood on the skin, the cooling surface, is diminished on exposure to cold, and so the bulk of blood in the heat-producing area is increased, and, by this combined action, a sufficient body-temperature is obtained.

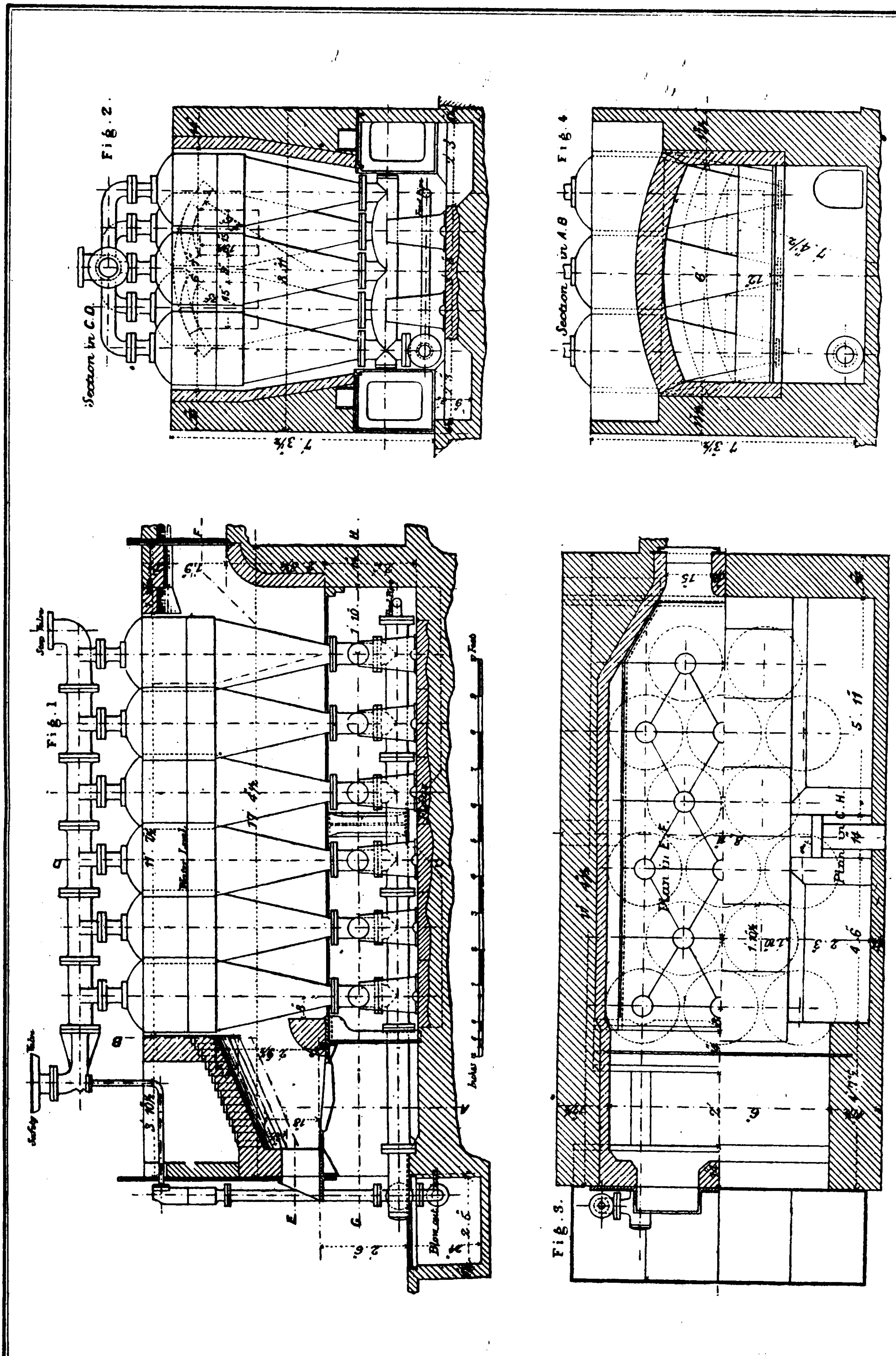
Where there are an increased loss and an increased production of heat simultaneously, they neutralise each other. Where there is much muscular exercise, there is perspiration; where there is much loss of heat, there is increased production of heat. In those inured to exposure, an immediate increase in the production of heat probably exists. In others, a lack of promptness in the heat-producing process occurs, a delay indeed, and then the chill and lowered temperature are followed by a time of increased production of heat, and a feverish condition results. Instead of the evolution of heat being instituted at the time of the excessive loss of heat, it comes on slowly and forms a reactionary disturbance—an oscillation of the balance; being much depressed, it rocks to an equal extent in the opposite direction. Habit endows the system with an educated power of maintaining the balance; disuse lessens the power. The more people take care, in the common way, against cold, the more susceptible they become and the less exposure is sufficient to disturb their more mobile body-balance.

Instead of feeling any surprise that a chill is followed by subsequent fever, it is what we might, *a priori*, expect.

It does not follow, however, that, because there is great loss of heat, there is also keen sensation of cold. In fact, the large flow of warm blood to the skin, or extremities, prevents the sensation of cold; which sensation is often acute when the internal temperature is normal, or even higher. Compare the cold hands of the snow-baller; and yet, surely there is more actual loss of heat with the latter than with the former? Some people assert that it is impossible that they could have caught cold, as their hands and feet were warm. Precisely so; to maintain the temperature of the extremities the body temperature generally was lowered. On the other hand, a frost-bitten limb may be the price of a life. If the warm blood had not retreated to the central area, death from general loss of temperature might have resulted; the maintenance of the temperature of the periphery would probably have lowered the body-heat beyond the danger point.

Alcohol has been abandoned in Arctic regions. It dilates the cutaneous vessels and increases the loss of body-heat. The drunken man perishes of cold, when the abstainer survives.

When the exposure follows a long continued warmth, the cutaneous vessels do not contract, but become dilated or paralysed, and then a large bulk of warm blood courses



SHEPHERD'S SECTIONAL BOILER.

through the cooling surface, and a great loss of body-heat is entailed. Not only so, but the current of chilled blood passes inwards to the right heart and the lungs. Inflammations of the lungs are common along with severe colds, and this is possibly the explanation. Such inflammation is specially liable to occur if at the same time cold air be inspired. The cold respired air and the current of chilled blood together produce those vaso-motor disturbances in the lungs which, in the graver aspects, are known as pneumonia

The practical considerations which are the outcomes of this review of the pathology of cold are these. Never to wear wet clothes after active muscular exertion has ceased, but to change them at once; to meet the loss of the body-heat by warm fluids and dry clothes, to avoid long sustained loss of heat which is not met by increased production of heat; to increase the tonicity of the vessels of the skin by cold baths, &c., so educating them to contract readily on exposure — by a partial adoption, indeed, of the "hardening plan; to avoid too warm and debilitating rooms and temperatures, to take especial care against too great a loss of heat when the skin is glowing; and to prevent the inspiration of cold air by the mouth by some protecting agent, as a respirator We can readily understand how a respirator should be an effective protection against winter bronchitis in those so disposed

THE FALL OF THE LEAF.

The phenomenon of the "fall of the leaf," common as it is is very difficult to explain satisfactorily. The following, according to the *Farmer*, are the facts so far as we understand them, which are exceedingly interesting and instructive. It seems that Nature begins the provision for separation almost as soon as the leaf is born in spring. When first put forth into the atmosphere the stalk of the leaf, supposing one to be present, is continuous with the stem. As the leaf and its stem grow, however, an interruption between their tissues (fibrous and cellular) occurs at the base of the leaf-stalk, by means of which a more or less complete articulation or joint is gradually and ultimately formed. This articulation is produced by the continuation of the growth of the stem after the leaf has attained its full growth, which it generally does in a few weeks. The growth of the leaf being completed, the base of its petiole, or foot-stalk, is no longer able to adapt itself to the increasing diameter of the stem, and a fracture between the base and the stem necessarily ensues; the excision advances from without inwards, until it finally reaches the bundles of woody fibre, which form the main support of the leaf. While, however, Nature is forming a wound, she is at the same time making provisions to heal it, for the cuticle or epidermis of the stem is seen to grow over the surface of the scar, so that, when the leaf is detached, the tree does not suffer from the effects of an open wound. The provision for separation being thus completed, the leaf is parted from the stem by the growth of the bud at the base, the force of the wind, or even by its own weight. Therefore, as soon as the glorious colours of the autumn leaves begin to fade, this provision for separation is completed, and the winds sing their death dirge as they carry them away from their summer's home on the branches of the trees, and scatter them in countless numbers upon the ground. The fall of the leaf is, therefore, the result of a regular vital process, which commences with the first formation of the leaf, and is only completed when it is no longer useful to the tree. There is no denying, however, that the frosts of autumn, by suddenly contracting the tissues at the base of the leaf-stalk, accelerate the fall of the leaves. All must have noticed, on a frosty morning in autumn, that the slightest breath of air moving among the decayed and drying leaves will bring them in complete showers from the trees to the ground. The leaves of the beech, hornbeam, and oak die in autumn, but frequently remain attached to these trees throughout the winter months, provided that the trees are not so situated as to be exposed to violent winds. Such leaves, when examined, will be found to be continuous with the stem, and therefore without that articulation or joint which so naturally assists in the separation of the leaf from the tree. These dead leaves fall off when the new leaves are put forth in spring, they are, in fact, pushed off by the expansion of the stem when the growth of the season commences. The leaves of evergreen trees and shrubs, and of coniferous plants, as the pine and fir, do not fall in autumn, but in spring, when the growth of the season is proceeding, and as this annual leaf-fall is only partial, consisting of one-half or one third at a time, there is always a sufficient number of leaves left on such trees to keep them clothed with perpetual verdure. Hence it is that their foliage consists of leaves which have been attached to the stem from one to three or five successive years.

RECIPES.

Removing Ink Stains from Mahogany.—Put a few drops of spirits of niter in a teaspoonful of water, touch the spots with a feather dipped in the mixture, and on the ink disappearing rub it over immediately with a rag wetted in cold water, or there will be a white mark which will not be easily effaced.

Adhesive Labels.—Dissolve 1½ ozs common glue, which has lain a day in cold water, with some candy sugar and ¾ oz. gum arabic, in 6 ozs. hot water, stirring constantly until the whole is homogeneous. If this paste is applied to labels with a brush and allowed to dry, they will then be ready for use on merely moistening with the tongue.

New Method of Cleaning Woollen Goods.—It is well known that wool, when first taken from the sheep, contains an unctuous secretion from the skin of the sheep called "yolk." This soapy substance contains potash, and can be washed out with water, with which it forms a sort of lather. In Elbœuf this yolk is employed with advantage as a substitute for fuller's-earth in cleaning woollens. The raw wool is put in a large vat, and covered with water. Here it is left for three hours; then the water is let out into a second vat, and afterwards pumped back into the first vat for two hours longer. The operation is repeated two or three times, and then the wool is taken out of the vat freed of water. New wool is now put in the vat and manipulated as above, until the water is sufficiently soapy. The cloth is put in the fulling-machine with a sufficient quantity of this liquor, and fulled for two or three hours. After washing it is found to be perfectly clean

Painting Old Buildings.—An inexpensive but durable method of painting old buildings is as follows. First give them a coat of crude petroleum which is the oil as it comes from the wells, and which can be procured for four or five dollars per barrel. Then mix one pound of "metallic paint," which is brown or red hematite iron finely ground, to one quart of linseed oil, and apply this over the petroleum coat. The petroleum sinks into the wood and makes a ground work for the iron and oil paint. The color of the iron paint is a dark reddish brown and is not at all disagreeable, it is very durable, and is fire-proof.

Preservation of Fruit.—The following method for the preservation of fruit has been patented in England. The fruit is placed in a vertical vessel in layers, separated by layers of pulverized white sugar, and is then covered with alcohol of 80° Gay Lussac. After twelve hours the closed vessel is inverted and the maceration allowed to continue from twelve to seventy-two hours, according to the nature of the fruit, which is then removed and allowed to drain and dry About two pounds of sugar and two pounds of alcohol are recommended for [illegible] pounds of fruit.

To Keep Meat Fresh.—As soon as the animal heat is out of the meat, slice it up ready for cooking. Prepare a large jar by scalding it well with hot salt and water. Mix salt and pulverized saltpetre. Cover the bottom of the jar with a sprinkling of salt and pepper. Put down a layer of meat, sprinkle with salt and pepper the same as if it was just going to the table, and continue in this manner until the jar is full. Fold a cloth or towel and wet it in strong salt and water in which a little of the saltpetre is dissolved. Press the cloth closely over the meat and set it in a cool place. Be sure and press the cloth in tightly as each layer is removed, and your meat will keep for months. Then drain off all the blood that oozes from it. It will be necessary to change the cloth occasionally, or take it off and wash it first in cold water, then scald in salt and water as at first. In this way farmers can have fresh meat all the year round. Beef that was killed the 12th of Feb. and has been kept thus packed in the same way kept six weeks during the dog days.

MISCELLANEA

The coal product of Nova Scotia for 1874 was as follows:— Cumberland county, 49,599 tons, Pictou county, 357,920 tons; Cape Breton county 337,020 tons, other counties, 4588 tons; total, 749,127 tons. The destination of the coal was as follows:— Nova Scotia, 214,965 tons; Quebec, 162,269 tons; New Brunswick, 78,841 tons; Newfoundland, 55 696 tons; Prince Edward Island, 41,948 tons; United States, 138,335 tons; West Indies, 47,844 tons, South America, 5077 tons, and to Europe, 4152 tons.

Is the patient really dead or not? is at times a very anxious question A medical practitioner of Cremona proposes a simple method by which the question may be answered with certainty. It is to inject a drop of ammonia beneath the skin, when if death be present, no effect or next to none, is produced, but if there be life, then a red spot appears at the place of the injection A test so easily applied as this should remove all apprehensions of being buried alive.

Slate for Engravers.—As a matter of interest to wood-engravers, the discovery is worth noting that plates of polished slate may be used as substitutes for box-wood engraving It is stated that such engraved plates will furnish 100,000 impressions without loss of detail, and are not affected by oil or water. One drawback which they possess, is that they are readily scratched, an objection from which wood is almost free.

Marking tools.—Much trouble can often be saved by marking tools with their owners' names, which can easily be done in the following manner: Coat over the tools with a thin layer of wax or hard tallow, by first warming the steel and rubbing on the wax warm until it flows, and let it cool. When hard, mark the name through the wax with a graver, and apply nitric acid; after a few moments wash off the acid, and wipe it with a soft rag, when the letters will be etched into the steel.

Talc has been recommended by MM. Vigier and Aragon for the prevention of incrustation in boilers. It is used on the Paris and Lyons Railway, and it is stated that the quantity of talc introduced into the boiler is about one-tenth of the weight of deposit accumulated between two consecutive blow-offs. It is stated not only to prevent but to loosen and remove old incrustation.

Strength of Glued Joints.—The absolute strength of a well glued joint is given as follows:—

	Pounds per square inch. Across the grain, end to end.	With the grain.
Beech	2133	1095
Elm............	1436	1124
Oak............	1735	568
White wood.....	1493	341
Maple..........	1422	896

It is customary to take from one-sixth to one-tenth of the above values, to calculate the resistance which surfaces joined with glue can permanently sustain with safety

Some interesting particulars were given in the course of the Schiller inquiry of the life in the Bishop Lighthouse, which is, in the winter months, cut off from communication with the world for long periods of time. The sea dashes sand right to the top, though it is 110ft. above high-water mark, and the ordinary way of embarking and disembarking from a boat is to make fast the boat by a grapnel and then let a man down by a rope, or hoist him up in a similar way to the door of the house. In a storm the tower trembles so much that plates and cups fall from the shelves and the glasses of the light break According to *The Navy*, this part of the evidence was given in court, but not from the witness-box, and it does not all appear in the notes.

The Best Time to Cut Timber—Dr. Hartig, who has made numerous experiments to determine the point, states that March and April are the best months in which to cut timber for building purposes, as it then contains its lowest per cent. of moisture, which he states to be forty-seven per cent. During the three previous months it has fifty-one per cent., and the three following ones forty-eight. He further states that properly-seasoned timber should not contain more than from twenty to twenty-five per cent. of moisture, and never less than ten per cent If the moisture is removed to a still greater extent the wood loses strength and becomes brittle. Another authority states that if trees are felled as soon as they are in full leaf, and allowed to remain undisturbed until the leaves dry up and fall off, the timber will be found well seasoned, the leaves having exhausted all the moisture.

Paper Buckets—The real possibility and advantage of the varied and extending uses of paper pulp are illustrated in the manufacture of such articles as water-pails, which are now made in large numbers of this material, as well as of wooden staves In the old way of making pails, the separate parts or staves are cut, one at a time, from a log of wood, and in making them, all the chips and smaller pieces are wasted, so far as the real object of manufacture is concerned In making a paper pail, however, the fibrous material is wholly utilized, and if the original stock is wood, as in part it may be, then that which would be wasted in chips and in fag ends is entirely saved. These who make paper tell us that thus far they have barely entered on some of their new lines of product.

An Arithmetical Curiosity.—The *Athenæum* contains the following curious arrangement of figures:

16	3	2	13
5	10	11	8
9	6	7	12
4	15	14	1

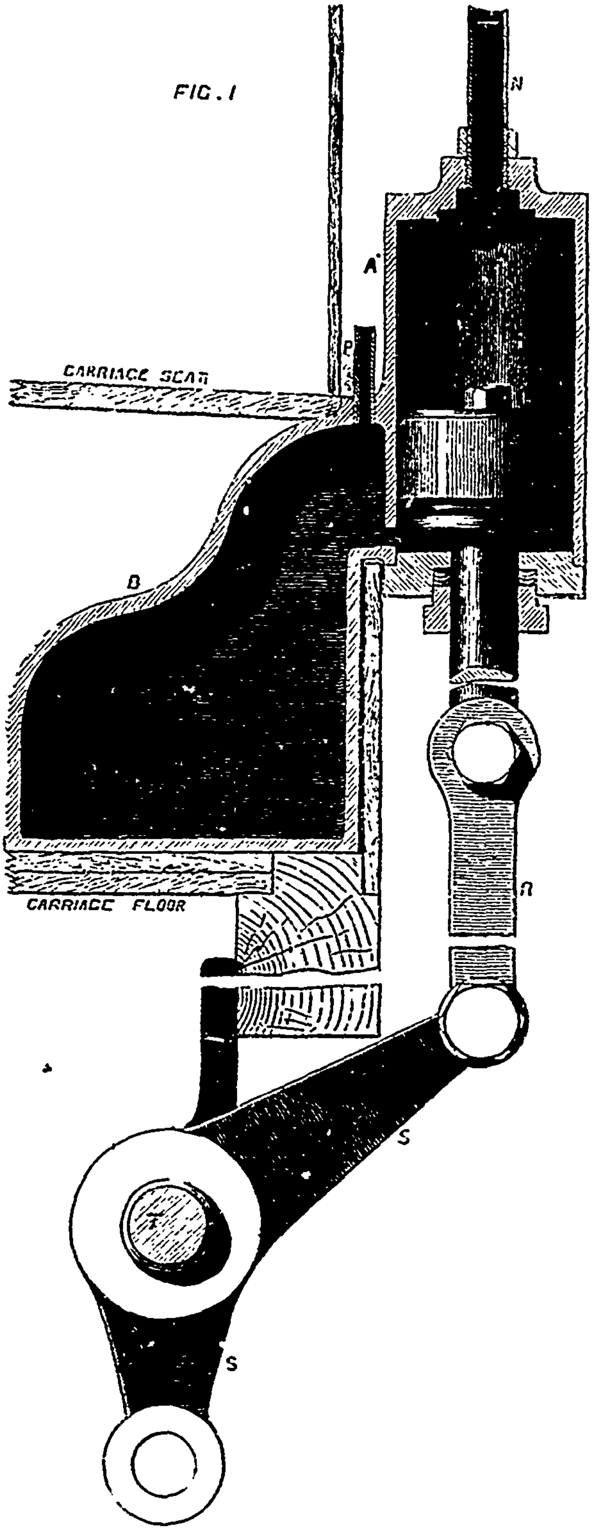
It will be seen that the sum of each line, each column, and each diagonal is 34 The four corner figures, 34. The corner figures of any square of four figures (of which there are four in the larger square)—34 The four figures of the central square 34 The four figures of each corner of the whole square, 34 Making altogether twenty different ways in which 34 may be reckoned The other sums of 34 may be obtained by taking the figures which stands next to the corner figure, going round from left to right, thus, 3, 8, 14, 9—34. Then take the figures which stand to the left of the corner figures, going the other way round, 2, 5, 15, 12—34.

While Dr Priestly was a minister at Leeds, Mass, a poor woman who labored under the delusion that she was possessed by a devil, applied to him to take away the evil spirit which tormented her The doctor attentively listened to her statement and endeavored to convince her that she was mistaken. All his efforts proving unavailing, he desired her to call the next day, and in the meantime he would consider her case. On the morrow the unhappy woman was punctual in her attendance. His electrical apparatus being in readiness, with great gravity he desired the woman to stand upon a stool with glass legs, at the same time putting into her hand a brass chain connected with the conductor, and having charged her plentifully with electricity he told her very seriously to take particular notice of what he did. He took up a discharger and applied it to her arm, when the escape of the electricity gave her a pretty strong shock "There," she said, "the devil's gone, I saw him go off in that blue flame, and he gave me such a jerk as he went off I have at last got rid of him, and I am now quite comfortable"

It has been ascertained that the American wild rice makes first-rate paper—white, tough, and flexible, and it is estimated that 100,000 tons of this material can be obtained from the Canadian lakes alone each year

Mr. Gerald C. Brown, of Perth, has leased 1,500 acres of phosphate lands in the township of Buckingham, county of Ottawa, Quebec, and intends developing them at once. The lease extends over a period of 50 years.

Fourteen thousand four hundred tons of coal were shipped at Pictou in one week The carrying of coal from Pictou is now almost exclusively done by steamers, very few large sailing vessels having taken cargoes this summer.



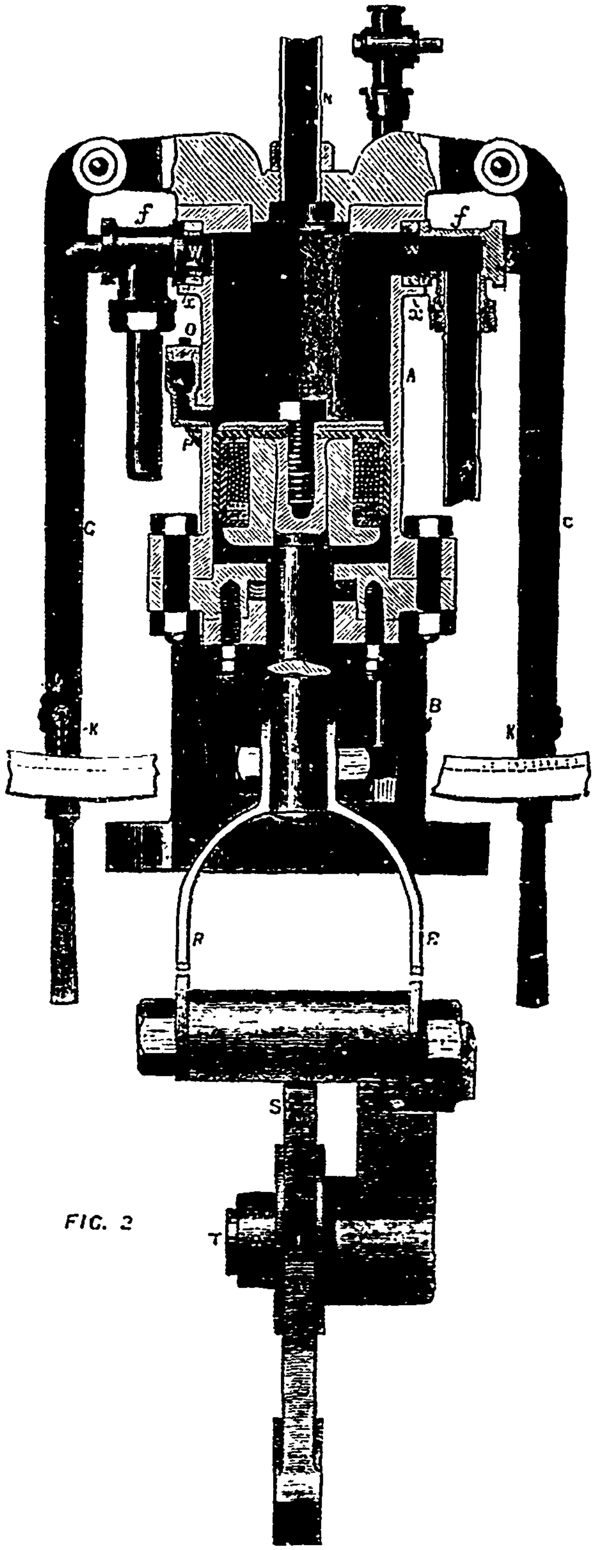
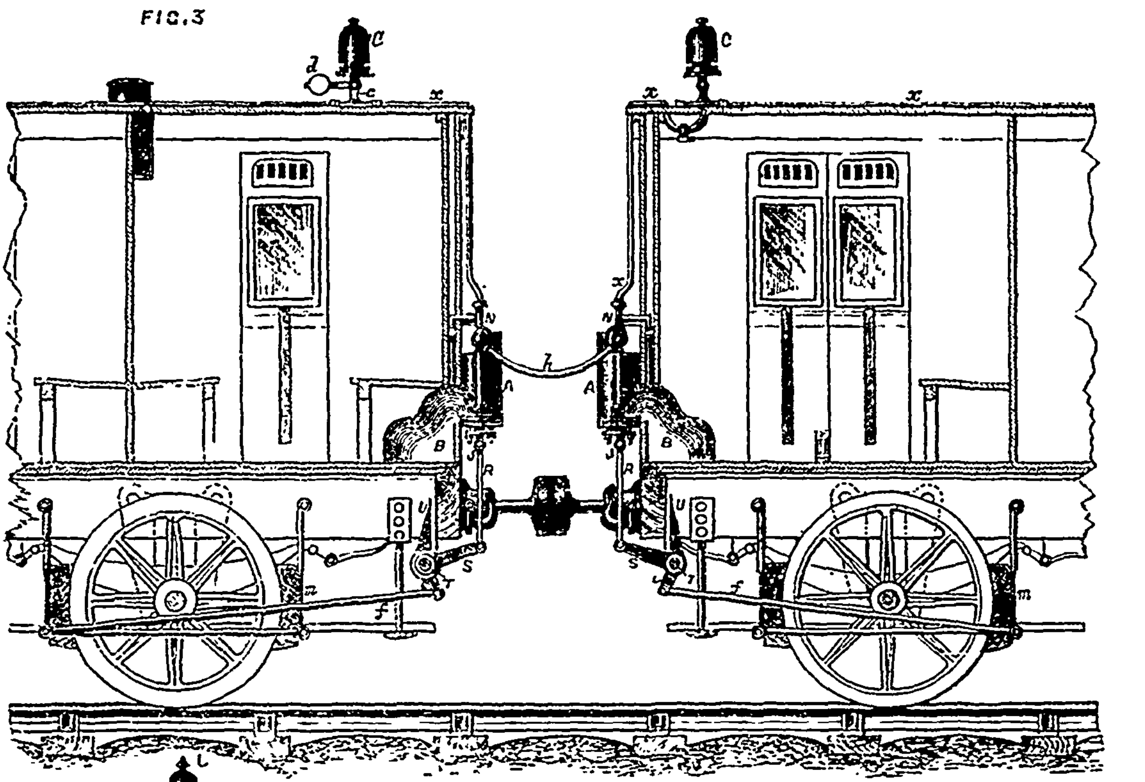


FIG. 2

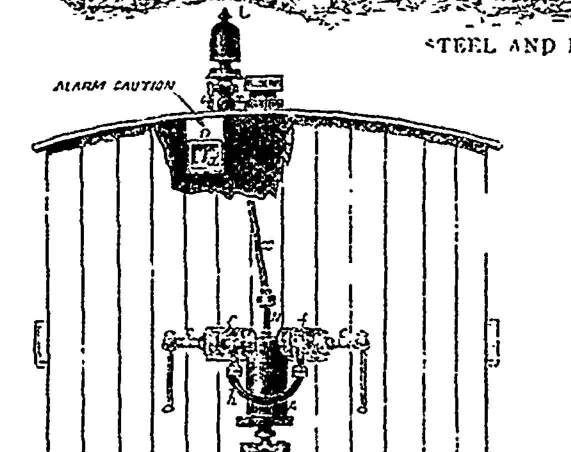
STEEL AND McINNESS BRAKE.

We illustrate on these two pages, the Steel and McInnes brake fitted to the Caledonian train tested during the recent brake competition. Two methods of securing the hose to the cylinders were used on the train, but the second, which is regarded as the latest and best, is shown in the enlarged views Figs. 1 and 2 For the following description of the brake we are mainly indebted to a paper read before the Society of Engineers, by Mr. St. John Vincent Day, of Glasgow.

This is a compressed air brake, and is in regular operation on the Caledonian Railway. The communication from the air reservoir throughout the whole apparatus is clear, the only valves being a simple clack on each brake cylinder. This brake is applied under two different arrangements :—



STEEL AND McINNESS BRAKE.



(*a*) That in which the cylinders are placed at the end of each carriage, in which case two brake cylinders are employed for each vehicle: (*b*) That in which the cylinder is placed at the centre of the carriage, in which case one cylinder is employed for each vehicle.

The air compressing engine mounted on the locomotive consists of steam engine and air pump. A double piston valve is used for the admission and exhaust of steam to and from the steam cylinder, and the air pump is provided with four bevel-seated valves, two below having strainers through which the air is drawn in, the two others being at the top, their boxes being coupled by a pipe and back-pressure valve leading to the reservoir beneath the footplate. The pump, as at first constructed, had the valve spindles completely contained within the valve-casing, and the striking of these against the ends of the casing when working was productive of a succession of sharp sounding blows, which were quite an unnecessary addition to the endless noises which offend the ear under the roof of a railway station. The spindles of the valve have now been made longer, and are brought through stuffing boxes, beyond which is a plate resting upon a cushion, and by which the sharpness of the blows is silenced.

A reducing valve is placed in the pipe leading from the reservoir to the brakes throughout the train, and a cock is also provided by which the air is admitted at once at full pressure to the upper end of the tender brake cylinder. In the tender brake there is nothing particular, it consists simply of a vertical cylinder, fitted with a piston packed by a cup leather, and a piston-rod rough from the forge connects it to the brake levers. The brake lever is also provided with a slotted end, in which the nut of the ordinary hand brake engages, so that either the hand or air brake may be used as described.

Fig. 1 is a section of a brake cylinder arranged on this system for a 10-ton carriage. The cylinder A and receivers B, are in one casting, the capacity of the receiver being about five or six times that of the cylinder. The cylinder has a movable cover at one end only, and this has a stuffing-box, through which the piston rod passes, this being coupled by the links R, directly to the brake levers S, on the shaft T The connections for the couplings are also cast with the cylinder. The couplings consist of simple T pieces, two arms of the T being hollow, and constituting the passage, whilst the other is solid. One of such pieces is attached to either end of a length of flexible hose, and being pressed by the levers G, against the elastic faces X on the cylinders, the communication throughout the apparatus is at once effected. Two coupling pipes are used between each pair of cylinders, and, in the event of one of these rupturing, the brake is rendered not inoperative, for in such a case all that is necessary is to turn the solid end of the T piece against the coupling face o the cylinder and press that in by the levers, so as to close the openings on that side, the communication being kept up by the unbroken pipe. In any case, either to replace a broken pipe by a new one or to reverse the couplings, is an operation of but a few seconds only. The pistons used in the cylinders consist of two cup leathers, one inverted and inside the other. To insure a perfectly tight fit these are expanded by light steel springs, and the space between them and the body of the piston is filled with shot, the weight of which bears evenly on all parts of the cup leathers and prevents any risk of air escaping through it. In practice these pistons have, it is stated, not needed attention, the moisture due to the compression of the air being found sufficient to keep them soft and in working condition, the cylinders being oiled about once a week only.

The action of this brake is as follows :—When the air is let out through the pipes from the reservoir, it enters the upper end of each cylinder, escapes through the valve or clack *x*, in each, and by the pipe connected therewith into the receiver Instantly then the pressure per square inch of area on both sides of the pistons is in equilibrio, but by virtue of the area of the upper side of the piston being greater than that of the underside by a quantity represented by the area of a cross section of the piston rod, the pressure on the upper side preponderates by that amount, and this together with the weight of the brake gear, immediately causes the pistons to descend to the bottoms of the cylinders, in which position the brakes are off. The air is kept constantly on, and to apply the brakes, it is only necessary to open any one of the valves or cocks in the air pipes, which can be done either by the driver, guards, or passengers, in either of which cases the air escapes from the upper sides of the pistons, and that on the underside not being able to escape—its pressure closing the valve by which it entered—immediately expanding lifts the pistons and applies the brakes.

As the normal condition of these brakes is to be " on " for purposes of shunting, disconnecting, &c, " each receiver is provided with a cock, by turning which the air escapes and the weight of the apparatus causes the brakes to come off the wheels. In the event of a train breaking up, the air escapes from the upper parts of all the cylinders and the brakes are instantly applied to each part of the train. To enable the passengers to communicate by signal, the carriages are fitted with a valve box communicating with a large whistle, the escaping air sounds the whistle; but instead of a whistle, Messrs Steel & McInnes are now using a pair of trumpets constructed after the manner of fog horns, which not only are very cheap as compared to the large whistles, but it is stated by Mr. Day, will make sufficient noise at all times of wind and weather to ensure the signal being heard.—*Engineering.*

SAW SHARPENING AND SETTING.

Although machines have been contrived by means of which the gullet-teeth of circular and other large saws can be ground on an artificial emery-wheel, yet such appliances fail when employed for saws with angular teeth; so that, hitherto, the sawyer has had to depend chiefly on his file, and on his manual skill. To sharpen a saw to cut well, it should be clamped between two parallel strips of wood nearly as long as the saw, the whole being firmly retained between the jaws of a bench-vice. Should the saw be a bow-saw, it must be removed from its frame previous to being set. In all cases the strips of wood should clench the blade so near the teeth as only just to allow of the play of the file between them. Things being thus adjusted, a three-square file, known as a saw-file, is chosen and removed, *pro tempore*, from its handle. In order to insure equality in the length of the teeth, the file held parallel to the blade of the saw, is passed along the tops of the teeth for a few times.

The operator then proceeds to sharpen tooth No. 1 nearest to him, which he does by working the file crosswise in the groove before the first tooth, keeping the file nearly level, but slightly pointing to his right shoulder. In the same manner he sharpens the 3rd, 5th, 7th, &c., teeth, always skipping one until he arrives at the end of the saw. He then removes his saw from the vices, and proceeds to place it in the contrary direction. Again he takes the file in his hand and operates on the remaining teeth, viz., 2nd, 4th, 6th, &c. In this mode the cutting edges of the teeth are alternately sharpened.

But were the saw employed in this state, it would be found to bind or cling to the work in a most tiresome manner, owing to the " kerf" or width of cut, being the same as the thickness of the blade of the saw, the latter therefore finding much resistance in its passage through the cut portions. To remedy this defect the saw requires " setting," and to effect this, every alternate tooth is slightly bent out of the straight line in opposite directions. Sawmakers set their saw by striking the alternate teeth with a narrow-headed hammer on a smooth anvil, to which a proper inclination is given, then turning the saw over, the untouched teeth are bent in the opposite direction. This is, undoubtedly, the best mode of setting a saw, but sawyers generally, who are not sawmakers, are content with bending the alternate teeth in contrary directions with a slotted steel plate somewhat resembling a key with wards. Several contrivances have lately been brought forward under the name of patented saw sets, by means of which the amount of bend given to each tooth becomes a fixed and invariable quantity. If a saw be properly set, a needle placed between the first teeth, will run from end to end on tilting the saw

THE ARCTIC EXPEDITION.

On page 256 will be found a chart of the circumpolar regions which will be useful for reference to our readers and for which we are indebted to the *Graphic*.

The centre is of course the northern axis of the earth, the vertical line is the meridian of Greenwich to the pole, and the 180th degree of east and west longitude on the other side of it, all the radiating lines are meridians of longitude (slightly distorted by the curvature of the earth), whilst the circular ones are parallels of latitude. It will also be readily understood that what is generally meant by the north-west passage is any passage or channel of water that may exist between Davis Strait and Baffin Bay to the east, and Behring Strait on the west, whilst the north-east passage is that which, passing round Norway, Lapland, and Russia, finds its outlet in Behring Strait.

With this simple description of the nature of our map, we will point out what has been done in that which may be called modern times. In the year 1818 the extent of our knowledge of the geography between Davis Strait and Behring Strait was limited to the coast line immediately in the vicinity of the Coppermine and the Mackenzie rivers, and between Behring Strait and Icy Cape—and with the exception of that portion which within the last few years has been added to our chart by the American discoverers, Kane, Hayes, and Hall—the whole of the vast coast line between the points indicated, and the whole of the mass of islands lying to the north of it, is due to British energy.

The actual accomplishment of the north-west passage is still to be effected, but that water communication exists is established both by the voyages of Sir John Franklin and that of Sir Robert Maclure The former sealed the discovery with his life, whilst the latter connected the communication by passing over the ice-covered strait, and returning to England by the strait he had not entered by. The tracks of these two discoverers are clearly delineated on our map, as also are those of Sir Leopold McClintock in the " Fox.'

ORNAMENTATION OF COPPER AND BRONZE.—A new mode of ornamenting bronze or copper work is described as follows: After the object has received the desired form, the drawings are made with water colors, the body of which is white-lead. Those portions of the surface which are not painted are covered with varnish. The article is then placed in dilute nitric acid, whereby the paint is dissolved, and the surface of the metal is etched to a certain depth The article is then washed with water and immediately placed in a silver or gold bath, and a layer of the precious metal deposited by electricity on the exposed portions. When the latter operation is finished the varnish is removed, and the whole surface ground or polished, so that the ornamented portion is just even with the rest of the surface A specially fine effect is obtained by producing a black bronze of sulphuret of copper on portions of the surface between the silver ornaments. A copper vase then has three colours, black and white drawings on a red-brown ground of suboxide of copper.

Mr. J Williams, in a paper before the Chemical Society of London, proposes to substitute the freezing and boiling points of mercury for those of water, and to divide the scale into a thousand parts.

HOME AND THE FARM.

Soap for Removing Grease Spots.—Dissolve in half a pint of water half a pound of washing soda, put in two pounds of good hard soap cut in slices, and boil until a homogeneous mass is formed, then add alcohol, camphor, ether, and liquid ammonia, half an ounce of each, and mold it into cakes.

Cochineal Red on Wool.—Boil the wool for an hour in a bath prepared in a copper (or, better, a tin) vessel, with soft water, with the addition of half a poun of oxalic acid, half a pound of tin-salt, and one pound of cochineal, for ten pounds of stuff. The bath may be repeatedly used, after clearing it, and the proportion given may be varied, when an economical effect of the cochineal will be apparent. It is suggested by Geyer that the addition of yellow would render the colour more fiery, without adding practically to the cost.

Corns.—"Those annoyed by corns, warts on hand or head should apply acetic acid. Rub a little oil round the corn or wart, to prevent the acid touching the skin, and then fold a narrow strip of linen three or four times at one end, to form a small pad. Dip this pad in the acid, lay it on the corn or wart, and wrap the rest of the strip round the toe or hand to keep it in its place. Three or four applications will kill the corn, and it comes off bodily I have known a large wart on the hand removed by the daily application of the inside of a broad-bean pod."

Keeping Sausage Meat.—After trying several methods, we have found one which will keep the meat in perfect condition for several months. In cold weather there is no difficulty but as soon as it becomes warm, it will spoil unless the air be perfectly excluded. As soon as the sausage meat is made, we make up into cakes that which is to be kept, and cook it the same as for the table; the fried cakes are then placed in a stone jar, and the fat which comes from them is poured over them, and as this is not enough, more lard is melted and added, to thoroughly cover the cakes. They should not be pressed against the sides of the jar, but so placed that each will be completely surrounded by the fat. When needed they require only to be warmed through, and they are ready for the table We do not know how long the meat will keep in this way, but the writer has kept it perfectly well until the middle of June, not caring for sausage in warm weather, we do not know how long the meat will keep in this way, but the writer has kept it perfectly well until the middle of June.

Red Marking-Ink for Clothing.—A red ink for marking clothes, which is not attacked by soap, alkalies, or acids, is prepared as follows. Enough finely pulverized cinnabar to form a moderately thick liquid is very intimately mixed with egg albumen previously diluted with an equal bulk of water, beaten to a froth, and filtered through fine linen. Marks formed on cloth with this liquid, by means of a quill, are fixed after they have become dry, by pressing the cloth on the other side with a hot iron. The ink will keep in well-closed bottles for a long time without separation of the suspended cinnabar.

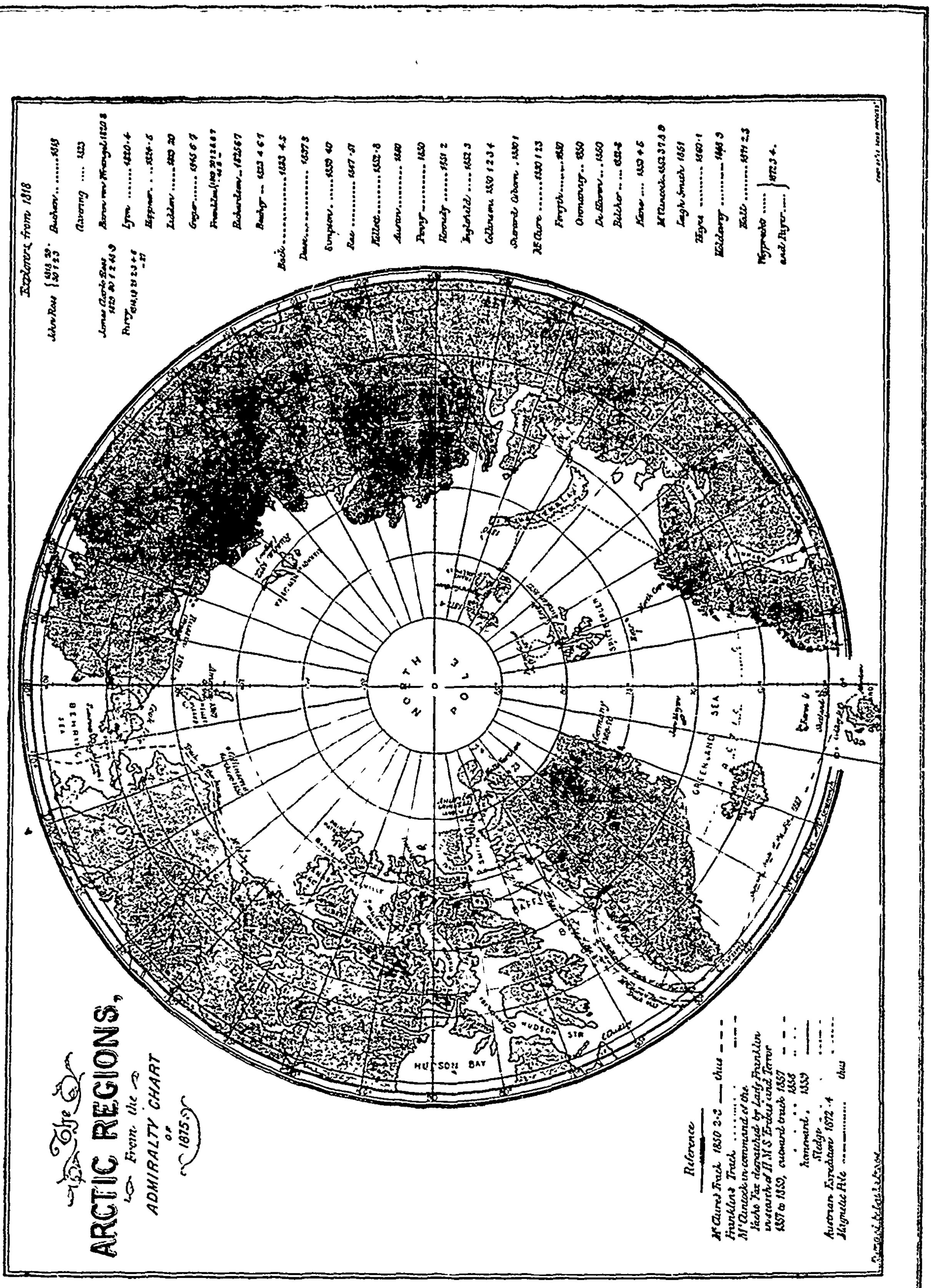
Remedy against Bed-Bugs.—There are several remedies' some better than others; many people simply use kerosene or turpentine, which they drop into the fissures. Recently a solution of sulphurous acid gas in water has been recommended as the best of all; but considering that all volatile substances disappear and give no safety for the future, it is better to use a solut on of corrosive sublimate, which not only destroys the existing insect, but also makes the spots where it is applied uninhabitable for other insects afterward.

Windows for Dark Rooms.—To light a dark room looking out on a narrow yard or street, let the glass be roughly ground on the outside, and set flush with the outer wall. The light from the whole of the visible sky, and from the remotest parts of the opposite wall, will be introduced into the apartment, reflected from the inumerable faces or facets, which the rough grinding has produced. The whole window will appear as if the sky were behind it, and from every point of this luminous surface light will radiate the room. The common window let into the wall takes only the reflection from opposite buildings.

Slitting down the Bark of Fruit Trees in Early Summer.—The writer remembers his father's doing this when he was a boy. Sachs, in his Text Book, speaks of this as having been long ago advantageously employed in horticulture. Is the custom still kept up by orchardists?—It is well known to those familiar with the microscopical structure of wood, that the outer part of each year's layer, or, that is, the portion formed later in the season, consists of smaller wood-cells, and all flattened parallel with the bark. Now Sachs, (who likes to explain things mechanically), conjectures that this must be owing to the pressure of the bark on the cambium or forming wood, which would increase as the growth of the season goes on. And in his last edition he states that DeVries has proved that it is so by experiment. So that this old practice ought to be useful, by enabling the trunk of a growing fruit tree to produce a greater amount of vigorous wood than it otherwise would do; and no harm is done when the slit heals promptly.

Cheap Substitute for Double Windows.—Dr. Oidtman of Linnich, in a pamphlet on sanitary measures, suggests that double grooved window-glazing should be used, instead of double windows, by which, as he says, great expense may be saved. This is done in the following manner: two grooves are channelled in the frame for receiving the panes, an outer and an inner one, and in both of them panes are then put in and puttied. A space of about three-sixteenths to three-eighths of an inch is thus formed, containing a dry atmosphere, cut off from the air both in the room and from without. As it cannot perceptibly contract or expand, the outer panes repel the cold of the outer air, and the inner the warmth of the room. For such a double grooved window-glazing good hard glass (poor in potash) must be selected, so that, especially in southern aspects, the rays of the sun will not decompose and render dull the facing sides of the panes, which naturally can not be cleaned. In putting the panes in, therefore, care must be taken not only that the facing sides are scrupulously cleaned of all dust and dirt, but also that the air between the panes be dry. The glazing of the windows should therefore take place only in dry weather Their increased cost will be covered the first year by saving in fuel This method acts also as a protector in summer against the troublesome heat of the direct rays of the sun. A room provided with double-glazed windows, at a temperature of about 90° F. will be 9° F. cooler than one with ordinary windows. The method may also be applied to hot-beds, for which it has proved efficient, and for large areas of glass and green-houses, double glazing might be likewise very advantageously employed.

Milk Cans.—Reports concerning the use of deep cans seem to be increasing month by month, and, considering the imperfect way in which the experiments are made, the results are often better than I should have expected. It seems to be generally thought that the great point is to set the milk in deep cans, and to keep the cans in a room with a low temperature. This is not sufficient for the full benefit desired. Air, even though kept almost at the temperature of melting ice, will not withdraw the heat of the milk, so rapidly as water will, and this rapid withdrawal of heat is the important point. All who propose to experiment in this matter should provide themselves with cans not too large, (8 inches in diameter is better than a larger size), and should float them in cool water, if possible not much above 60°. Even less than 50° would probably be advantageous, but I cannot speak on this point from experience. The possible danger in having the temperature too low would be that the heat would be withdrawn too rapidly, that is, before the volatile odors of the milk, which often affect the taste of the butter, have been driven off. Very sudden cooling, as in passing the milk through a coil of pipe surrounded with ice, has the effect of fixing these volatile matters, to the certain destruction of flavor in the product. Too high a temperature, especially in the summer time, allows the milk to curdle, or to become loppered, or stringy, before all the cream has had time to rise. Much further experimenting will be necessary before the precise point that is best for ordinary milk can be determined, but my own experience (with Jersey cows), which has been constant for the past four years, winter and summer, shows that in my case a perfectly satisfactory result, including the securing of *all* the cream, is attained with a temperature of the water of about 54°.—*American Agriculturist.*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