CANADIAN MECHANICS MAGAZINE AND PATENT OFFICE RECORD

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MORE TECHNICAL EDUCATION REQUIRED IN OUR PUBLIC SCHOOLS.

WE have only to refer to the testimony afforded in the reports published by different institutions and universities in the United States, to evince the necessity of making some reform in the curriculum of our public schools which will prove of more utility in the sphere of life so many of the scholars will be called upon to fill in after-life. Why we particularly allude to the United States as a reference and a guide, is because an affinity and similarity exists between that country, its people and its customs, with ourselves.

It is obvious from the reports we have read that the instruction given in public schools should have a direct bearing upon the common avocations of life; and so strongly is this felt in the United States, that a new class of higher institutions of learning are springing up throughout the country. This new class consists of technical schools and technical universities, whose aim it is to prepare young men to direct, with skill and economy, the great industries of the country which are every day assuming vaster proportions.

The number of the institutions, and the attendance upon them, it is presumed, must continue to increase, until they who seek to enjoy benefits therefrom will form no inconsiderable portion of those who leave the public schools for more advanced instruction. Hence it is essential that the work done in public schools should have a direct bearing upon the more advanced instruction of the technical universities. But it is also to be observed that the elementary instruction which is specially essential to advanced instruction, has a direct bearing upon the common avocations of life, and so is doubly entitled to be given in the public schools.

The fundamental study, the one above all on which technical instruction must rest, is Industrial Drawing. Hardly any department of technical instruction can get on at all, and none can get on well, without this. Therefore, it is not surprising to find those in charge of technical universities in the United States urging the teaching of Industrial Drawing in the public and other elementary schools. One eminent authority on this point says that a student entering a technical school with such a knowledge of drawing as ought to be imparted to all in the public schools, would have a whole year's advantage of him who had not received such training.

The elements of drawing should be taught in every public school, and every school teacher should be trained to teach the art. A knowledge of forms, which is an important agent in all industrial education, can only be learned by the study of drawing; the time required to lay the proper foundation for future special application need not be disproportionate to that devoted to other studies. In many of our public schools, in cities, free-hand drawing is taught, but seldom in the common schools of the country. Now, the teaching of so important an art should not be confined to cities. It is a branch of art training most essential to all young mechanics as a training both to eye and hand.

We address, particularly, all Educational Boards with the hope that they will earnestly advocate reform in public education, and give more consideration to what should be taught at our primary grammar and high schools, so far as relates to a technical education; for it must be remembered that the public schools have a direct bearing upon the occupation and welfare of the whole people. We want to modify the teaching of public schools of all grades, so that it shall have a much more direct and telling influence upon the common needs of practical life. We want that when boys leave school they shall carry with them those elements of knowledge, taste and skill that will prove of the most direct and essential service in the various pursuits in which nearly all of them must engage; and these elements of a technical education, once mastered, further progress becomes very easy in case any, after leaving the public schools, will feel a desire to continue their studies in that branch of education which they will need most in their sphere of life.

Many of us have felt the disadvantages a boy labours under, who, in going to a new school, is put into a class whose studies are in advance of what he has learned, and the struggle he has to keep up with that class from the difficulty of understanding rules which depended on preceding ones to demonstrate, and which he had never been taught; and this desire to push on a boy before he is thoroughly grounded in the rudiments of education, a feeling often felt by both master and parents, is most detrimental to the acquirement of knowledge.

The common school elementary public education, which comprised a knowledge of reading, writing and arithmetic, is not sufficient for the masses in the present day, whatever it may have been thirty years ago. The common occupations of life have so increased, and the conditions of it have so changed within that period, and science and mechanics have made such startling and rapid advances, that progressive education is absolutely necessary if we would hold our own in the competition and rivalry for excellence that is going on in the world. Not many years ago manufactures in this country, and even in the United States, were hardly known. The housewife did the spinning and the weaving; and we can remember, in our own day, when the itinerant shoemaker went on his annual round. The representatives of many vast machine shops and foundries on this continent were but cross-roads' smithies, and the draughtsman and architect had scarcely then made their appearance. The cultivation of the soil in those days was done nearly altogether by mere muscular strength, and the products of the mechanics—such as the shoemaker, blacksmith, fitter, waggon-maker and carpenter—could boast only of rough strength and durability. There were no workers of skill and taste then displayed, and a simple education was enough to qualify for ordinary avocations. But not so in the present day: although the progress of education in our public schools has made even wonderful progress of late, still it has not advanced in ratio with the requirements of the times. Every year now muscle counts for less, and intelligence and skill for more. The few small and rude manufactures of the past have grown to vast dimensions, and the whole character of construction has become changed. In the cultivation of the soil, intelligence takes the place of muscle and brute force, and scientific knowledge and mental discipline, acquired by the proper study of science, become more essential to success in manufactured articles of every description; and the attainment of success has been rendered more difficult by the novel machinery employed, by the adoption of more delicate scientific processes and by the growing taste of the people.

As the result of new discoveries in science, and of new inventions and industry, occupations have so greatly increased that even the products of the earth have become more diversified, and manufactures so multiplied in variety, as well as in extent, that they give employment to one-fourth of the population of the whole country; and, therefore, to make a country equally progressive with those around her, there must be an ever-growing demand for more technical knowledge, for greater deftness of hand, and for finer taste on the part of the producer.

The effect of the great improvement in machinery has been to elevate the character and increase the field of the workmen, and with the possession of knowledge, taste has become enlarged. It has been urged by some that the excellency arrived at in the construction of machinery has so reduced the number of operatives heretofore required as to act materially to their disadvantage. This is a very mistaken idea. The number of operatives in this country alone has increased to a very great extent during the last decade, and in the United States much greater in proportion to their population. It was the extraordinary demand made upon manufacturers and tillers of the soil during the civil war in the States that gave an abnormal impetus to manufactures and agricultural labor-saving implements, far beyond the average requirements of a steadily growing country, and the mistake rested with those young men who were tempted from the home of their fathers and from cultivating the soil, which was their hereditary avocation, to following handicrafts in cities and at a time of unusual requirements. Had they, after the demand for labour had ceased, again taken up the plough, they would now have been producers and buyers in place of being a drag upon the community.

For this state of affairs many of our manufacturers are themselves to blame for encouraging an inferior class of workmen, because they worked cheap—and who would have been better off by tilling the soil—and not encouraging sufficiently skilled mechanics. Such men, from the want of education and knowledge, can have neither taste, skill nor ambition, and thus a vast quantity of inferior goods is manufactured for our home market which ill contrasts with similar goods of other countries.

But although mechanics are now suffering from the depression of business, and the over-manufacturing of goods beyond the requirements of the country, it must be observed that the field for the exercise of taste, and the demand for its products, are practically unlimited. If hitherto the great object has been to increase the quantity of our manufactures, in future we must strive to improve their quality and thus raise their commercial value. In this work our only reliance must be upon the æsthetic taste which can lend a charm to every object produced by man, and which, fortunately, is the result of education.

The subject of "More Technical Education," we consider, is of such importance that we shall continue it in the next number of the MAGAZINE.

A Really Indelible Ink.—The ordinary so-called "indelible" inks are prepared from salts of silver, and the writing done with them can be removed by soaking the linen with a solution of cyanide of potassium (exceedingly poisonous, it should be remembered) or of hyposulphite of soda, or by moistening with a solution of bichloride of copper and then washing with aqua ammonia. A really indelible ink, that is, one that cannot be removed by chemical agents, may be made from aniline dyes according to to the following recipe:—

Dissolve 8½ grs. of bi-chloride of copper in 30 grs. of distilled water, then add 10 grs. of common salt and 9½ grs. of aqua ammonia. A separate solution is made of 30 grs. of hydrochlorate of aniline in 20 grs of distilled water, which is then added to 20 grs. of a solution of gum-arabic, containing 2 parts of water, 1 part of gum-arabic, and lastly 10 grs. of glycerine. Four parts of the aniline solution thus prepared are mixed with part of the copper solution.

The fluid thus prepared has a greenish color, but becomes black in a few days after being used for marking, or at once by the application of a hot iron or on being otherwise heated. A steel pen may be used for writing with it. If the cloth after being marked is put into tepid soap-suds, the writing acquires a fine bluish tint.

The ink should be perfectly limpid, so as to penetrate the fabric; and the solutions should be mixed only when they are to be used.—*Boston Journal of Chemistry*, xii. 76.

BOSTON SPA CHURCH.

DESIGN FOR A CHURCH.

We copy from the London *Builder* a design for a church and school-room :

BOSTON SPA CONGREGATIONAL CHURCH.

It consists of a nave with small transepts, porch, lobbies, and tower, and will seat 260 persons. The length of the nave internally is 53ft., its width 34ft., the whole roofed in one span, with open timbers, and boarded. Its acoustic properties are described as satisfactory. The seats are open benches, and the walls are lined to a height of 3ft. with wood.

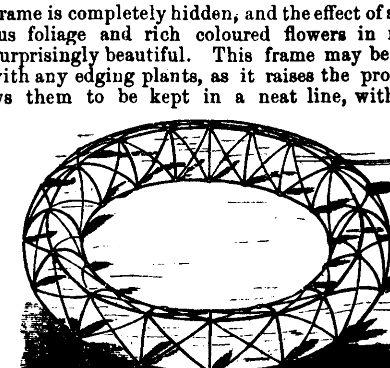
The tower, which is intended to form a staircase to give access to an end gallery to be added at some future date, is 50ft. high, and has a slated spire, the total height to the top of the finial being about 90ft. The total cost was about £3,000, of which amount £372 were paid for the land, much less than it would cost in Canada.

Behind the church, and on the same level, is a school-room, 30ft. by 25ft., with separate entrance, class-room, minister's vestry, and lavatory.

Civil and Mechanical Engineers' Society.—On Saturday last, the 6th inst., the members of this society paid their last visit to works for the present session. The gasworks in the Old Kent-road were selected for the visit. Much interest was manifested in the gas holders and tanks, the largest holder, 180 ft. diameter with a capacity of 2,200,000 cubic feet, being constructed without any internal trusses or bracing, the cover or crown, when empty, being supported on a timber staging erected in the tank ; but the most remarkable feature is the tank, 184ft. diameter, 47ft. deep, constructed entirely of concrete, without either brick lining or puddle backing. Another striking example of the use of concrete was seen in the new retort houses in course of construction, the floor being raised 10ft. above the level of the ground, was carried by piers and concrete arches 21ft. span, rising 1ft. 9in. centre, 18in. thick at the crown. The next session of the society for the reading and discussion of engineering papers will commence in December.

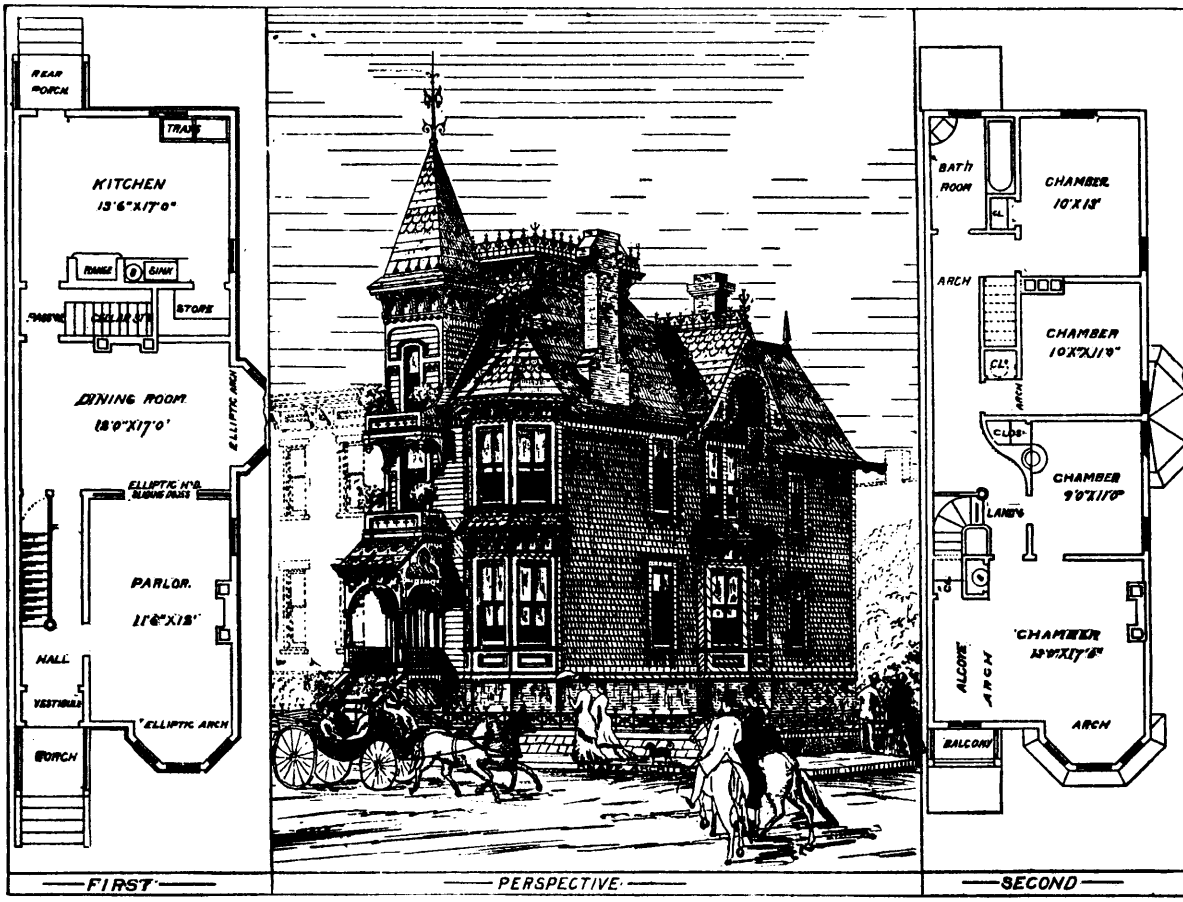
A NEW EDGING TO FLOWER BEDS.

Numerous plants are used as edging to flower beds, but we do not often see those that are altogether satisfactory. Where the edging is made by numerous plants set closely together, the failure of one or more from any cause, leaves an unsightly gap, and one that is very difficult to fill. A circular galvanized wire-frame, of which a cross-section is a semi-circle, is made of a proper size for the bed, if a small one, or in segments, if for a large bed ; this frame, which has wires crossing it to form a coarse basket-work, is placed around the bed, where the honeysuckle or creeping vine plants have been previously set, and as the plants grow, their shoots are worked into this wire frame. In a short time the frame is completely hidden, and the effect of such a circle of gorgeous foliage and rich coloured flowers in neatly kept grass, is surprisingly beautiful. This frame may be used to advantage with any edging plants, as it raises the prostrate ones, and allows them to be kept in a neat line, with very little trouble.



WIRE FRAME FOR EDGINGS.

Judging from the number of patents taken out, it would seem that the long pent-up talent of the Germans is expending itself on new inventions. The number of patents granted in German States, from the 1st of January to the 30th of June, 1877, is given in *Trade Marks*, so far as is known, as follows :—For Prussia, 566 ; Bavaria, 124 ; Saxony, 256 ; Wurtemburg, 113 ; Baden, 147 ; Hesse, 48 ; Brunswick, 57 ; Saxe-Meiningen, 16 ; Saxe Altenburg, 16 ; Saxe-Coburg-Gotha, 18 ; Anhalt, 22 ; Schwarzburg-Sondershausen, 14 ; Schwarzburg-Rudolstadt, 13 ; Waldek and Pyrmont, 8 ; Reuss Old-line, 15 ; Schaumburg Lippe, 9 ; and Lippe, 10.



DESIGN FOR CITY RESIDENCE, COSTING $2,800.

City Cottage.

Description of Cottage.—The first and second floor plans show the internal arrangement. On the first floor are parlor, dining-room, and kitchen. The parlor and dining-room each contain a fine semi-octagonal bay-window; that of the parlor affording a view through the street in either direction, and that of the dining-room giving the latter an exposure to the front street as well as in other directions. Under the main stairs is the dining-room china-closet, and the pantry dividing the dining-room from the kitchen contains the stairs to the cellar, A capacious kitchen store-room is provided, and wash-trays are fitted up in the kitchen, the dimensions of the latter affording ample room for laundry as well as for culinary purposes. The kitchen is fitted up with range, boiler and sink, and the several fire-places of the first floor are placed in the best positions for utility and effect. The sliding doors dividing the parlor and dining-room are finished with elliptical head, and trussed arches of the same form span the bay-windows.

The second floor contains four sleeping-rooms and a bath-room, the former being each provided with closet and wash-basin. The bath-room is fitted up with bath-tub and water-closet, cased and trimmed up in hard wood. A close flight of stairs leads to the attic, which is very spacious, is well floored, and would afford fine bedrooms.

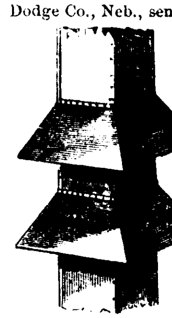
The slopes of the roofs are covered with Chapman roofing slates, with ornamental courses of colored slates in cut butts, as shown. The deck roof, valleys, and gutters are tinned. The house is finished in a manner far superior to brick filling, the materials and workmanship the very best, and many novel details have been introduced which it is not practicable here to show.

THE FORMATION OF MINERAL VEINS.—Meunier has communicated to the French Academy of Sciences some observations on the formation of mineral veins, based on the fact that the native sulphids effect the reduction of metals from their solutions. Galena placed in a solution of chlorid of gold is at once covered with gilding, and in a solution of nitrate of silver arborescent growths are formed. Other sulphids, including those which are most commonly associated in veins, iron and copper pyrites, blende, cinnabar, stibene, and even the sulphid of soda found in mineral waters, produce similar effects. Nor is the action confined to the sulphids. Some selenids, antimonids, arsenids, and tellurids also behave in the same way. Meunier therefore points out that if sea-water, which always contains silver, filters into a vein of galena, all the silver will be reduced and concentrated in the vein, and this action explains the presence of the native silver so often found in galena. When this has taken place, and the liberated sulphur does not recombine with the silver, we have the super-sulphuretted galena, sometimes so rich as to take fire in a flame. But commonly the silver is transformed into a sulphid.

ADULTERATION OF BREAD.—A baker in London, England, was recently arrested for selling bread adulterated with alum so as to be injurious to health. The defendant plead guilty, but urged that the adulteration was not like water added to milk, made to increase the bulk—that the alum made no difference in the bulk of the loaf. The court however called his attention to the fact that the charge was that of adulteration to the injury of health. Although the defendant said he "did not mind taking alum in his," he was fined forty shillings and costs.

Ventilator for a Cess-Pool.

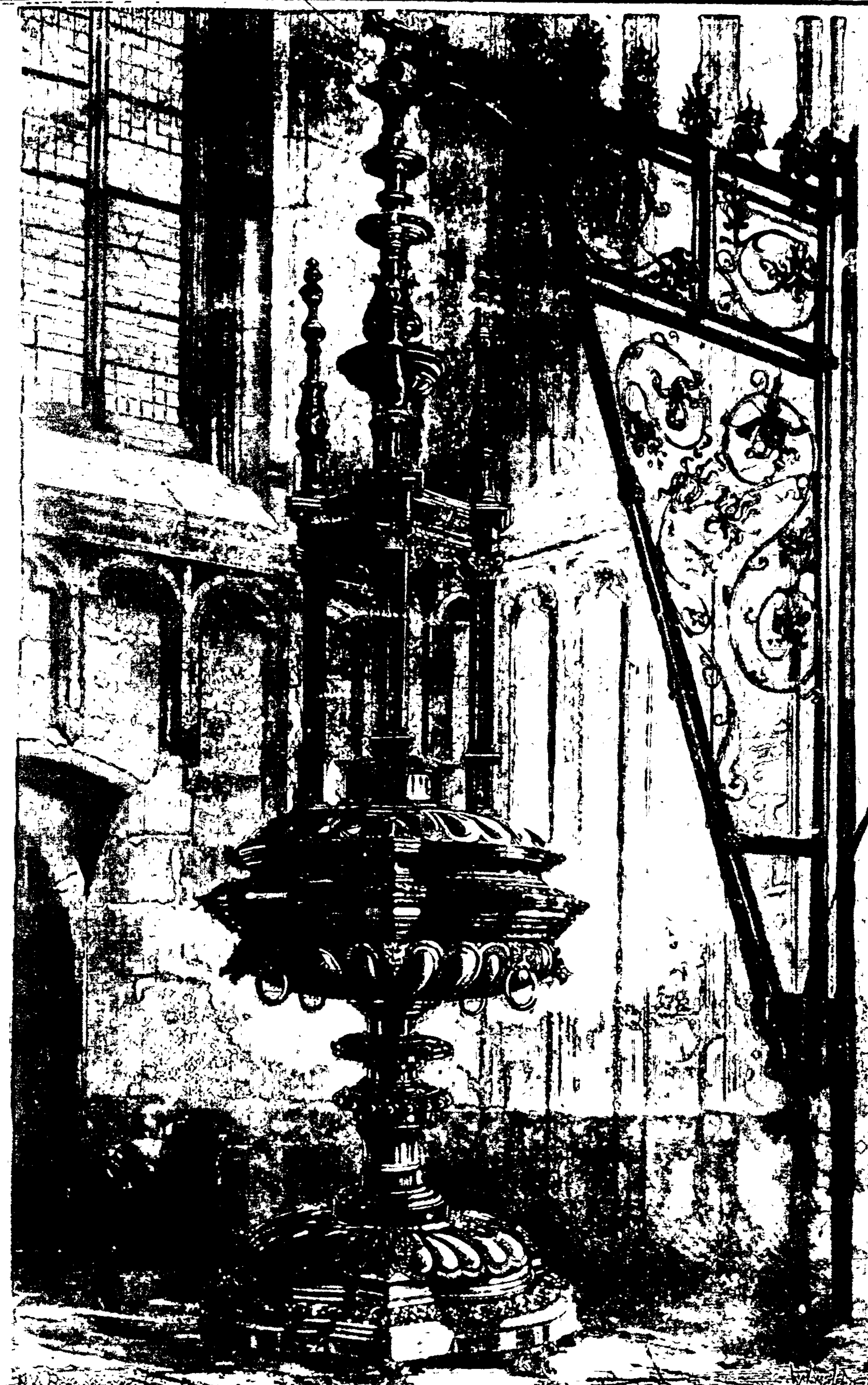
A correspondent from Dodge Co., Neb., sends a sketch and description of a ventilator for a cess-pool. It consists of a square wooden pipe, sufficiently high to catch the wind and reaching down into the vault. To cause a draft upwards through the pipe, caps of tin, sheet iron or wood, are placed as shown in the engraving, beneath which there are several holes through which the draft passes into the pipe. The draft starts and keeps up a current of air, which carries off the noxious gases from the vault.



VENTILATOR.

GOOD FOR THE FUTURE. — The American *Manufacturer* says: At no time has so much attention been given to the rearing of young men for fitness in special branches of trade. Our scientific institutions are furnishing us with young men of excellent technical education, who enter their profession with a valuable stock of knowledge, which enables them to at once become useful and indispensable aids in the prosecution of our great industrial enterprises.

TO KEEP TOOLS CLEAN.— When tools are clean and bright, they may be kept so by wiping, before putting them away, with a cloth dipped in melted paraffine. If they are rusted they may be cleaned by soaking in kerosene oil, and then rubbing with an oily rag dipped in fine emery powder.



FONT IN THE PROTESTANT CHURCH, BREDA, HOLLAND. SIXTEENTH CENTURY.

Automatic Compound Fire Annihilator.

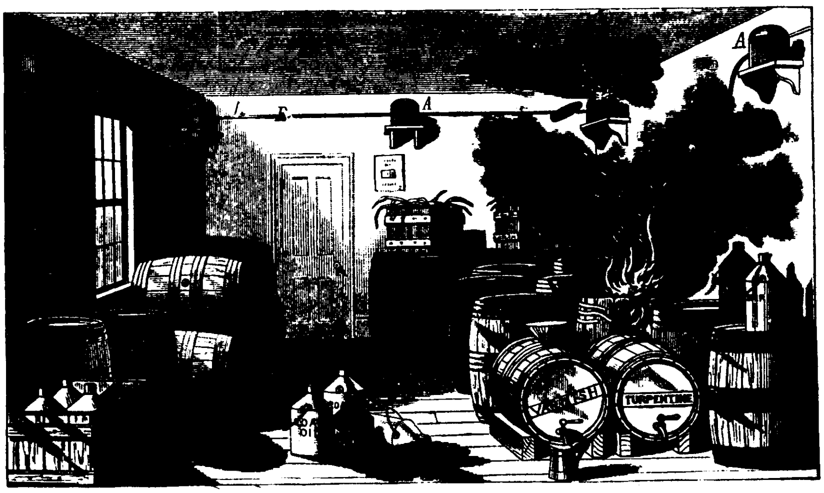
The inadequacy of all means thus far used for extinguishing fires, proceeds chiefly from the difficulty of their immediate application, and also that the very means now used to extinguish fires frequently involve great damage to merchandise and other property, by the volume of water used in putting out the fire itself. It is often the case, where fires are actually extinguished, that the damage through this cause exceeds that of the fire loss. Scientific and thinking minds have for years been engaged in solving the problem of subduing fires in their earliest stages by some process that, while it should extinguish the fire, should not involve great loss through the means employed. A Professor of Chemistry at the University of Leipsic, Germany, at last succeeded in filling this long-felt deficiency in the modern means of preventing conflagrations. He produced a dry chemical compound, which, on being ignited evolved volumes of gases antagonistic to fire. His invention was subjected to the severest practical tests, and then adopted, on its merits, by the leading governments of Europe.

After the success of his process became known, it was introduced into the United States through being patented first and afterward exhibited to the municipal authorities of the leading cities. Its success here is none the less marvelous than attended its introduction in Europe. During the short time it has been known in this country rapid progress has been made in its application to use in manufactories, dwellings, depot warehouses, and shipping. It is put up in strong metallic boxes holding from 5 to 50 pounds each. A slow match or fuse is attached to the box, and in case of fire, is ignited with a match and thrown into the room on fire. The compound then burns slowly, creating gases that are absolutely antagonistic to fire, thus putting out the fire and damaging nothing else. It cannot explode, and its gases being fumigatious and disinfecting in their nature, injure nothing, while they smother effectually all fires, whether from wood, textile fabrics, spirits, kerosene oil, benzin, or any other violent inflammable material. Its cheapness, portability, ease of application, and efficiency make it the most acceptable thing for the purpose known. Without desiring to reflect upon other extinguishers, we are led to suggest that no child or woman can handle and apply for the extinguishing of fire any machine weighing 40 pounds and upwards, or work a force-pump in addition thereto, or in the excitement of a sudden fire have the courage to stand and fight a fire with any of the chemical extinguishers now in general use. With this new compound no skill or strength is required in using it, but is simply to be ignited and thrown into the fire, the doors and windows closed, and it will do its work without further human assistance. Other and important advantages of this compound are, that it will not freeze or deteriorate, and is always ready. Its automatic principle consists in this: Placed upon a shelf or bracket, with the fuse exposed or extended along the room, a fire occurring will ignite it, an' it will act itself, suppressing fire without human [illegible] or this alone it is invaluable. On shipboard i[illegible] is a want never before supplied. The horrors of a ship on fire have appalled the stoutest hearts, because nothing heretofore invented could reach and extinguish a fire between decks among the cargo. This compound, emitting gases that smother fire, will penetrate to the remotest part and accomplish that which has, up to this time, baffled the ingenuity of man.

We have no doubt that when the merits of this compound are known, no one who has property at stake will longer remain without it, and no ship or steamer will undertake a voyage without a supply.

We adjoin a representation of the inside of a storeroom of painters' supplies, containing the most combustible material, and where a barrel of turpentine has taken fire, and where some of the above described packages containing the compound have been arranged along the top of the room in such a way as to cause the incipient fire to ignite the fuse which connects the boxes, and thus to communicate the fire to one or more of them, which then at once will commence to burn slowly and emit so much gas as to completely fill the room with gases, and smother the fire, the only conditions being that the windows and doors of the room must be kept shut when unguarded, so as not to allow the gases evolved to escape or fresh air to enter.

We have before us a number of testimonials which place the effectiveness beyond doubt, and emphatically recommend it to oil refiners, candle-makers, varnish manufacturers, and all others who handle materials which water will not extinguish. For them this is the only reliable thing to use.



PRACTICAL APPLICATION OF THE COMPOUND.

We have seen the experiment tried in a wooden shanty nearly filled with wood saturated with benzin, tar, etc., and then ignited and apparently under full headway, so that no fire-engine could have extinguished it with water; a single box thrown in and the window closed ended the fire in a few minutes, leaving the interior blackened—that was all.

Light in Railway Cars.—The *Railway Age* pleads for light in our railway cars, and more especially as the season of early darkness has now set in and the need is daily growing more apparent, particularly in those composing the suburban trains whose passengers do not take their daily ride for pleasure, but simply to reach business or home as comfortably as possible. It is now too late to say that railway cars cannot be well lighted. In the modern Pullman cars, and in the ordinary coaches of some roads, lamps suspended from the ceiling, with porcelain shades or burnished reflectors, diffuse throughout a mild, clear light by which the finest type can be read with ease. In cars thus lighted cheerfulness and good humor prevail, and in reading or in animated conversation the trip appears short, and the travellers leave the train with a warm and grateful feeling toward the liberal management that has done so much for their comfort. On the other hand, fifty or sixty people sitting in a car lighted only by the ghastly reflection from three candles—as may be seen on several of our roads—become a silent, discontented crowd, almost dangerous to accost by the dim, irreligious light of the dip.

Violet Ink for Rubber Stamps.—Mix and dissolve the following: Aniline violet, two to four drachms; alcohol 15 ozs.; glycerine, 15 ozs. The solution is to be poured on a cushion and rubbed in with a brush.

Concrete Bridge.—At Seaton, Eng., a three-arch bridge is being built of concrete, on a new principle invented by Mr. Brannon of London. The idea of the inventor is that concrete would, for such work, prove far more enduring than stone. The toll-house at the end of the bridge is being built on arches. Mr. Brannon suggests that by building cottages on arches, instead of on solid ground, all fear of fever caused by exhalations from the soil would be avoided.

The Perils of the Foundry.

Few appreciate the dangers which many mechanics have to face, or give them proper credit for bravery. We read of an accident in Pittsburg, Pa., which happened as follows: A number of men were casting a chilled roll. Nearly two tons of iron were required to make the casting, and the services of twenty men were needed to handle it. While they were pouring the molten metal into the mold there was a sudden and terrific report, which was closely followed by a shower of liquid iron. The red-hot metal flew in every direction, and dropped upon and about the workmen. They ran to escape the shower, in their terror dropping the ladle which yet contained most of the metal. The ladle was overturned, and immediately great streams shot out in quick pursuit of the flying laborers. Two of the workmen, closely followed by streams of the red-hot iron, fell into adjoining pits and the metal ran in upon them, burning their flesh to a crisp in many places. One man's face was burned to a crisp and his eyes burnt out of his head, and in their places the sockets were filled with chunks of chilled metal. The other man's eyes were also burnt from their sockets, and his face, breast, arms and hands were burnt to a crisp at different places. Here and there the red-hot metal had actually eaten its way to his bones. The cause of the explosion was attributed to a "damp cave;" in other words, the sand with which the mold had been packed was not properly dried, and perhaps, too, not properly grooved, so that the steam generated could not escape.

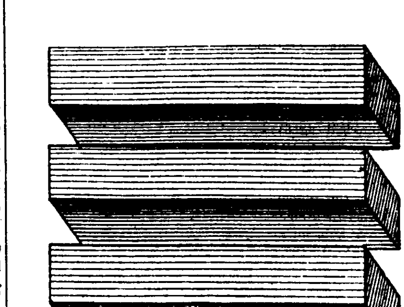
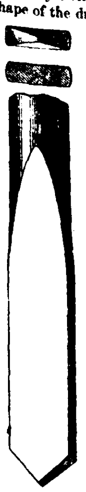


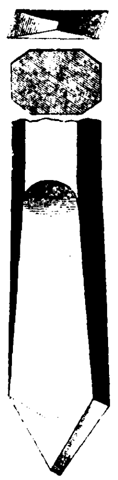
Fig. 2.—Section of Blind.

(See page 64.)

CONCERNING FLAT DRILLS.*

What a drill is for is to bore easily in metal, a clear smooth hole that shall be round and parallel, and of a definite and desired size. A good many drills produce work that is three-sided or oblong, tapered, ridgy, crooked, and out of size, and take much time and power. This is generally owing (except when in lead or copper) to the shape of the drill.





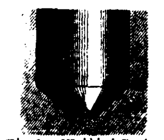


Fig. 3.—Wabbled Centre.

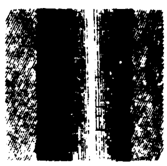


Fig. 1.—Good. *Fig. 2.—Bad.* *Fig. 4.—Ridged Hole.*

Taking an ordinary flat steel bar with thin pointed end, this end having slight bevel or clearance on back edge, we get a drill that will do tolerably straight smooth work, but drive somewhat hard, and bruise its chips and clog with them. It always bores the same sized hole, no matter how often the point is sharpened. Making the cutting edges square makes them cut equally from point to corner, all parts working at equal speed; slightly rounding the parallel edges of this drill-bit makes it run easier, because there will be less friction against the sides of the hole, and the chips escape more easily (See Fig. 1). If the bar were thicker at the butt than at the point, the chips would be impeded in progress. If the bar were of octagonal section (that is the edges beveled instead of rounded off) the borings would be bruised and broken. If the bar be wider at the point than at the butt, there will be some easement for the passage of the chips (unless it have a greater butt thickness, to increase the area of its section). But with a spreading point every grinding makes it cut a smaller hole (see fig. 2). If the point be thick it cuts unevenly; there is liability of the point wabbling and cutting around a cone centre in the bottom of the hole (see fig. 3); in this case it will cut a *ridgy*, untrue hole (fig. 4). It will consume a great deal of power, and be likely, if it has any fair rate of feed, to become hot and lose its temper.

If we take a slight groove immediately off the cutting face, so as to lessen its cutting angle, we make it more eager in cutting, but easier dulled; so that we find this form, or "lipped" drill (fig. 5), best only for long holes, in which case its heavy borings are less likely to clog than if finer. Raising the back part of the cutting edge too high is like grinding a cold chisel to the acute bevel of a wood-turner's chisel.

One form of drill, which is used so often as a cutter or for counter-boring, as to be often called a counter-bore, is the pin-drill (fig. 6); having a flat bar tapering in neither width nor thickness, and, at right angles to its length and sides, a slightly beveled cutting face, having projecting from its middle a guide pin, central with the drill axis, and for the guidance of which a small straight hole, with very little clearance, must have been first bored. If the first hole be crooked, the larger hole will follow its direction. If the guide-pin have too much play in the guide-hole, the drill will cut wabbling and out of round. If rightly made the pin-drill will curl out great chips with comparatively little power. The pin must of course be straight and true. If the end face of the pin be formed into a tiny milling tool (as in fig. 7), it is an advantage, as any slight defect of round or straightening in the guide hole is remedied by the milling action of the pin, and the guide-hole is cut true, ahead of the action of the drill-faces proper. The guide-pin may also be cut so as to form a rose bit, and the guide-hole in this case may be a trifle smaller than the pin. The pin-drill is a costly tool to make and keep in order. A development of this contrivance is used for boring flue-sheets; in this case, where the circle to be cut is much larger than that intended for the ordinary pin-drill, it would be a great waste of time and power to cut into borings, all the metal in the hole. Instead of cutting with the whole end

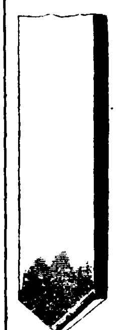


Fig. 5.—Lipped.

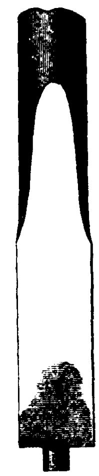


Fig. 6.—Pin Drill.

Fig. 7.—Milling Pin Drill.

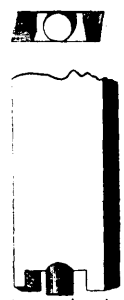


Fig. 8.—Flue Sheet Cutter.

face of the drill around the guide-pin, the cutting faces are cut out in a wide ring around the guide-pin; leaving only a cutting ring at the extreme periphery of the end-face (see fig. 8). This tool thus cuts away a ring and leaves a hollow core between this ring and the guide-hole. It is even more expensive to make and maintain, than the ordinary pin-drill; the spaces between pin and cutters being hard to cut out in a lathe. If however, (see fig. 9), a cutter is made from a round steel ball, having drilled in its axis a hole the size of the guide-pin, and having its flat end cut into radiating teeth so as to form a milling tool, the central non-cutting spaces may be readily removed with it. It may also be used for making and repairing ordinary pin-drills. Another flat drill, not nearly so good as t e pin-drill, is the tit-drill or centre-drill (fig. 10); having instead of a cylindrical guide-pi , working in a previously drilled hole, a triangular center-tit, intended to do cutting work. This tit, which requires to be carefully filed up in the vise, is very bothersome in tempering, on account of the small quantity of metal therein; rendering it apt to be either too hard and brittle, or too soft and dull.

The principal beauty of the best flat metal drills is that they have similar cutting edges on both sides, giving even and equal pressure on both sides of the hole, and not wasting any power in side-strains.

If there is any one particular nuisance in a machine shop it is square-tapered drill shanks (fig. 11), no two the same length, thickness, or bevel. A square tapered shank is likely to be untrue; its square-tapered socket more so. Hence this kind of a shank is liable to cause wabbling and untrue work. A round-tapered shank is more

Fig. 9.—Rose Cutter for Pin Drill.

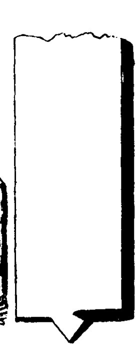


Fig. 10.—Tit Drill

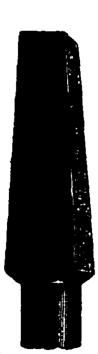


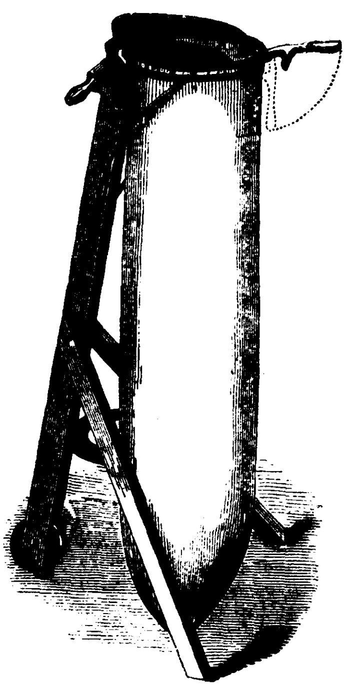
Fig. 11.—Square Tapered Shank.

Fig. 12.—Round Parallel Shank.

expensive than the square-taper; is hard to draw out and apt to be injured in drawing. In common with the square-taper shank, it cannot be extended in case a drill is a trifle to short too reach or bottom its work. A straight round shank (fig. 12) is apt to be true; so is its socket; it is less likely to jam and to be injured in drawing; it can be "set out" by slipping a block in the socket. It is, too, easier to have standard sized shanks and sockets; the saving in the time bill alone on this score, is important. G.

A Combined Bag-Holder and Truck.

Being recently at a railroad depot, where a good deal of grain is received, we were much interested in a man filling some bags with wheat from a car, and trundling them away to a store-house. He used a bag-holder, which served also as a truck, upon which the filled bag could be wheeled away. We quickly sketched the bag-holder in our note-book, as a good thing to make known to our readers, not knowing then the name of the maker of it; but on our way home discovered in a catalogue of the Higganum Manufacturing Company, of Higganum, Conn., an illustration of the same holder and truck. We give our illustration here, which shows for itself the character of the bag-holder, and the method of using it. For use in grist-mills, and barns or granaries, this handy contrivance would be found to save considerable labor and time, as when the bag is filled, it may be wheeled away by taking hold of the handles at the top, and



BAG-HOLDER AND TRUCK.

making a one-wheeled truck of the machine; the bag rests between the projecting legs.

Experiments with the Turkish Bath.—Some interesting observations were related at the last meeting of the British Medical Association, by William James Fleming, M. B. (Glasgow). These experiments were performed by the author upon himself, and consisted of observations on the effect of the Turkish bath at temperatures of from 130° Fah. to 170° Fah., upon the weight, temperature, pulse, respiration and secretions. The results showed that the immersion of the body in hot, dry air, produced loss of weight to an extent considerably greater than normal, amounting, on the average, to the rate of about 40 ounces an hour. This was accompanied by an increase in the temperature of the body and a rise in the pulse rate, with at first a fall and then a rise in the rapidity of respiration. The amount of solids secreted by the kidneys was increased and coincidently the amount of urea. The sweat contained a quantity of solid matter in solution and among other things a considerable amount of urea. The most important effect of the bath was the stimulation of the emunctory action of the skin. By this means the tissues could, as it were, be washed by passing water through them from within out. The increased temperature and pulse rate pointed to the necessity of caution in the use of the bath when the circulatory system was diseased.

"PARAGON" SCREW STOCK AND DIES.

Remembering the proverbial saying that "A jack of all trades is master of none," we are apt to regard with some distrust those wonderful tool combinations by the aid of which it is stated that any and every mechanical operation may be performed. At the same time we are ready to welcome any shop appliance in which the number of parts is reduced, provided there be no sacrifice of efficiency. Recently, at Birmingham, some improved stocks and dies were brought under our notice, which are not only capable of cutting a given range of sizes with a less number of dies, none of which need be loose, but which also perform the duty of a tap wrench, thus saving the weight and cost of the latter.

The ordinary screw stock is too well known to need description, but it is well to remember that each size of screw requires a pair of dies, from two to four of which accompany each size of stock, and that only one pair of dies can be contained in the stock at the same time. There are, therefore, at least two, and frequently six, loose pieces liable to loss and injury; while a separate piece, of nearly the same size as the stock, is required for turning the taps. Messrs. John Wright and Co. in their "Paragon" avoid keeping any dies loose from the stock at any time, and dispense with the separate tap wrench altogether, by arranging three sizes of screw cutters and one half diamond on the four sides of their dies, as shown at fig. 1, while the stock is also made more simple and symmetrical. Fig. 2 shows the dies separately; fig. 3 a set of dies for cutting four sizes of screws; and fig. 4, a pair of dies to serve as the tap-wrench, required in this latter case.

It will be observed that a lock nut on the stock prevents the adjustable arm from coming unscrewed. It is also obvious that the sizes can be changed with much greater facility than in the old form of stock. It will be remembered that the usual tap wrench is not constructed with a great amount of accuracy; indeed, the square hole, like too many of the spanners in an engineering shop, fits the tap heads so badly that they are soon spoilt for an accurately fitting wrench; with the hardened tap die of the "Paragon," no such difficulty can occur. Again, length, weight, and cost are all in favour of the new arrangement.

The well-known firm of Tangye Brothers, after having had these stocks and dies in use at their works for some time, have expressed approval of their simplicity and efficacy.—*Iron.*

WHY A BELT RUNS ON THE HIGHER PULLEY.—This problem is explained by J. H. Cooper in his new book on "The use of Belting" as follows: "That end of the belt which is towards the larger end of the cone is more rapidly drawn than the other edge; in consequence of this the advancing part of the belt is thrown in the direction of the larger part of the cone, which obliquity of advance towards the cone must lead the belt on its higher part. It may here be observed that this very provision—the rounding of the face of the pulley—which keeps the belt in its place so long as the machinery is in proper action, tends to throw it off whenever the resistance becomes so great as to cause a slipping. To maintain a belt in position on a pulley, it is necessary to have advancing part in the plane of the wheel's rotation."

TECHNICAL EDUCATION.—The Executive Committee of the Livery-Companies of London, formed to promote the establishment of a Technical University, met last week to consider the reports which had been drawn up for their guidance. At the last meeting of the committee it had been determined to procure reports from qualified persons as to the best means of utilising the funds available in the promotion of technical education. These reports were taken into consideration by the committee, and it was decided to meet again for their further discussion.

A FRENCHMAN, who has lived in America for several years, says: "When they build a railroad, the first thing they do is to break ground. This is done with great ceremony. Then they break the stockholders. This is done without ceremony."

IN France, the average salary of workmen (without board or lodging) is sixty-eight cents; in Germany, Italy, and Switzerland, thirty-eight cents; in England, eighty-three cents, living being thirty per cent. dearer than in France.

IRON or steel articles placed in the following mixture maintained at boiling temperature will, says the *Scientific American*, take a fine blue tint: Dissolve 4 oz. hyposulphite of soda in 1½ pints of water, and then add a solution of 1 oz. acetate of lead in 1 oz. of water.

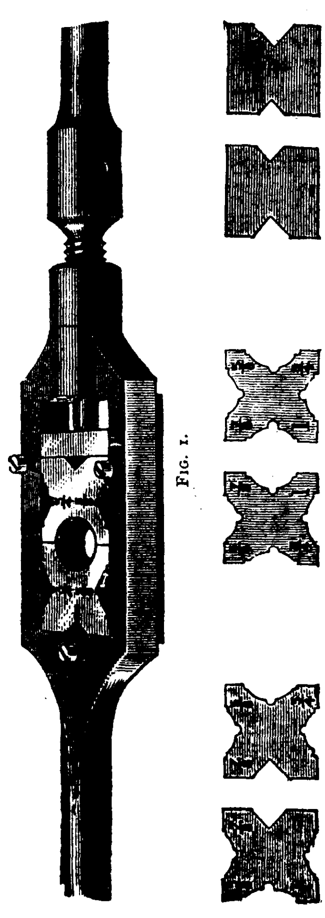


FIG. 1. FIG. 2. FIG. 3. FIG. 4.

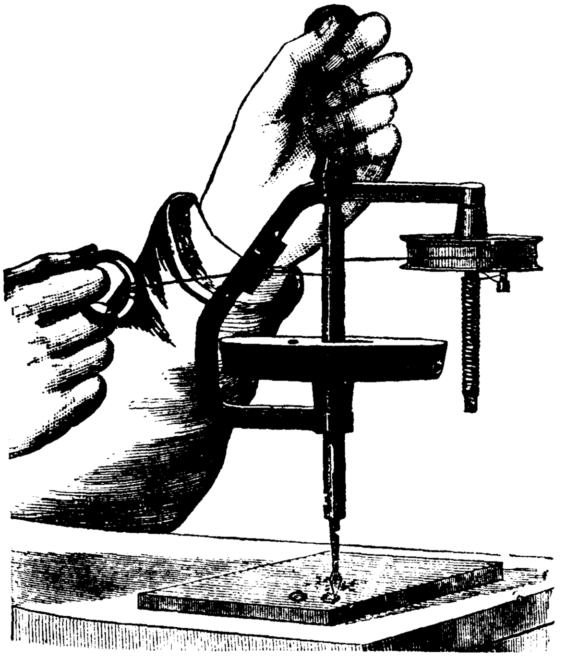
NOTICE TO PATENTEES.

Inventors who are desirous of disposing of their patents would find it greatly to their advantge to have them illustrated in the CANADIAN MECHANICS' MAGAZINE. We are prepared to get up first-class engravings of inventions of merit, and publish them in the CANADIAN MECHANICS' MAGAZINE on very reasonable terms.

We shall be pleased to make estimates as to cost of engravings on receipt of photographs, sketches, or copies of patents. After publication, the cuts become the property of the person ordering them, and will be found of value for circulars and for publication in other papers. Apply to the Editor.

NOBLE ILLUSTRATION.—Lord Carnarvon, in addressing the people of Birmingham, used the following illustration: "Travellers tell us that in some of the Eastern seas, where those wonderful coral islands exist, the insects that form the coral within the reefs, where they are under the shelter of protecting rocks, out the reach of wind and wave, work quicker, and their work is apparently sound and good. But on the other hand, those little workers who work outside those reefs, in the foam and dash of waves, are fortified and hardened, and their work is firmer and more enduring. And so I believe it is with men. The more their minds are braced up by the conflict, by the necessity of forming opinions on difficult subjects, the better they will be qualified to go through the hard wear and tear of the world, the better they will be able to hold their own in that conflict of opinion which after all it is man's duty to meet."

SAFETY LAMPS, of an ordinary construction, are used by the night policemen and watchmen of Paris. A small glass vial holds a piece of phosphorous as large as a pea, upon which is poured boiling olive oil sufficient to fill about one-third of the vial. The latter is then closely stopped by a cork. In use, the stopper is released for a moment, so as to permit the entrance of air to the phosphorous. The vacant inner space is thereupon lit up, diffusing a clear, and, of course, perfectly harmless light. When the light fades, it will hold good for six months without renewal.



THE HAND-POWER ROCK-DRILL.

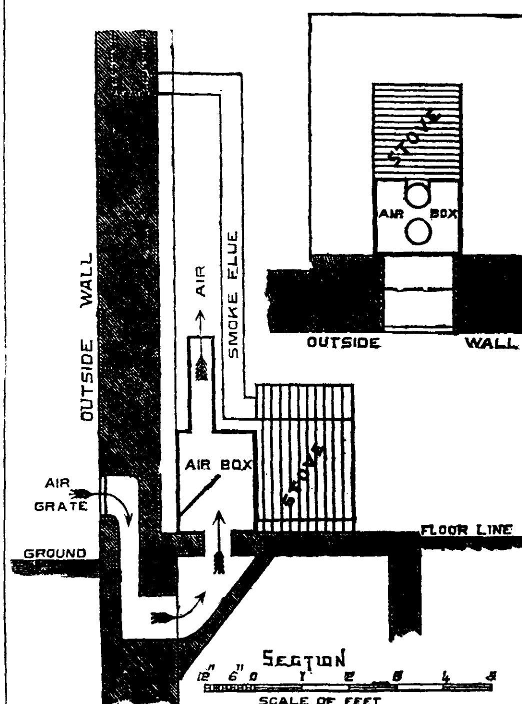
Various forms of percussive rock-drills are constantly being invented; but never before we believe has a hand-worked machine been offered to the mining public. This drill is not intended to compete, in the amount of work done, with the larger appliances driven by steam or compressed air as ordinarily used from a reservoir; but it is destined to afford a cheap and portable means of boring holes for blasting, whereby manual power may be turned to better account than in the primitive methods of "jumping" and driving with drill and sledge, without the necessity of a heavy expenditure for plant.

We were invited to a trial of this new borer on Wednesday last, at the works of the makers, Messrs. Glover and Hobson, where the results achieved were highly satisfactory in themselves, under conditions which were most unfavourable to the machine. In the space of one minute, 1¼-inch holes were drilled 6½ inches deep in hard Portland stone, 3 inches deep in Aberdeen granite, and 5½ inches in sandstone; at least that was the rate at which the last hole was bored, but the sleeping of the stone put a stop to this particular trial. In the other two trials, it was evident that the blows of the drill on the stone were cushioned, owing to the soil beneath not being sufficiently firm, so that a still better result may be looked for in the solid rock of a mine or quarry.

The upper cover of the cylinder is air-tight; but air is admitted through ports at the lower end, and passes round the piston, when at the lowest part of its stroke, to supply any leakage. In the upward stroke this air is compressed, so as to give a smart blow on the next downward stroke. The piston connected to the drill-bar is raised, so as to compress the air, by a double cam on a shaft, turned by a couple of men with winch handles, so that two blows of the chisel are made for each revolution. The cams are so formed that, after raising the drill-bar by means of a thrust block, they release it suddenly for giving the blow. As the thrust block is cylindrical and the cams strike it on the end, they cause it to make a partial revolution. A form of drill like two gouges united, so as to make a cutting edge like the letter S, is found to give the best results, never striking twice in the same place. The upper end of the drill-bar is screwed, and works in a long phosphor-bronze nut. When this nut is clamped so as to be fast, the revolution of the drill-bar is to be fed down; but by turning the nut, by means of a small handle and bevel pinions, the drill-bar can be hand fed, or raised and lowered at the rate of a foot a minute. It will thus be seen that a simpler machine, or one with fewer working parts, it would be difficult to design, while the method of working the piston is mechanical and direct, without the intervention of any valve whatever.

Though the working parts are the same, there are three classes of the machine, for sinking shafts, quarrying, and driving adits, each of which has its special form of stand or frame. We observed, however, that the range of boring in each was amply sufficient for its individual requirements. We defer a more detailed description of the drill and its carriages to accompany the drawings, which we shall shortly reproduce.

The Royal Cornwall Polytechnic Society awarded a silver medal this year to the hand-power rock-drill, which, on account of its efficiency, simplicity, compactness and low cost, deserves the attention of all engaged in mining operations. It is the invention of Messrs. Thos. B. Jordan and Son, who act as managers to the Hand-Power Rock-Drill Company (Limited).—*Iron.*



VENTILATION.

(*To the Editor of the Builder.*)

Sir,—A simple and effectual method of supplying fresh air without draft to a school-room, may perhaps be thought worth notice in the pages of the *Builder*. The details will be seen on reference to the accompanying small plan and section. It may be described as an air-box made of sheet-iron, and placed behind an ordinary Gill stove. The box is connected by an air-shaft with the outside wall, and has an inlet-pipe above, which admits the fresh air into the room. In passing through the "box" the air becomes slightly warmed in winter, when there is a fire in the stove, and it is a good ventilating shaft in summer. It is most effective when it is most required, *i.e.*, when other openings, doors or windows, are closed. Its advantage over the old plan of a simple opening under the stove, is that there is no danger of dirt or ashes falling into it and filling it up. I may add that I designed it twelve months ago, for a Board School in Leicester, where it has been found to work admirably.

[We have frequently urged the necessity of a similar method of supplying warm and pure air to public and private buildings, for the latter particularly.—*Ed. C. M. M.*]

Fire-Proof Joist.—An ingenious kind of fire-proof joist, recently introduced, consists of a slip of wood five inches wide, by five-eighths of an inch thick, belted between two flanged strips of quarter-inch iron, making a beam quite as strong as those of wood ordinarily employed. The iron sides, in addition to affording strength, it is claimed, render the joist substantially fireproof, while the centre of wood affords the means of putting down floors and nailing on laths in the usual manner. The impediment to the manufacture of these joists heretofore has been the difficulty of rolling the flanged iron sides, but this has now been successfully overcome.

THE ELECTRIC LIGHT.

No. I.

Not many years have elapsed since the production of light by electricity ranked only as a lecture experiment. In this stage the electric light possessed no commercial value whatever. It is not our purpose now to trace the history of the discovery that electricity could be made to produce light. It will be enough to say that the labours of various inventors have so far developed the lecture experiment, that the electric light can now be used with great advantage for numerous purposes, such as the illumination of lighthouses, forts, ships of war, public rooms, railway stations, and factories. For the last purpose it is now extensively employed in France, and its use is extending in this direction. We propose in this and succeeding articles to explain briefly what the electric light is, how it is produced commercially, and how it can be employed to the most advantage by those who possess workshops, foundries, shipyards, or factories; and we shall endeavour to make all we have to say on the subject as simple and intelligible as possible, so that no difficulty may be found in applying to a practical purpose such information as we are in a position to communicate to our readers. In carrying out this object we shall avail ourselves largely of a very excellent work—*Eclairage à l'Electricité, Renseignements Pratiques*, by M. Hippolyte Fontaine, recently published in Paris by Baudry.

There are three methods by which light may be produced by electricity—putting on one side as having nothing to do with our present purpose the heating of a platinum wire white hot. The first consists in the employment, as conductors of a current of electricity, of two rods of carbon, held a short distance apart, between the extremities of which play a series of brilliant sparks, which form a species of flame known as the "voltaic arc." The second consists in rendering luminous a rod of carbon interposed between two carbon conductors of a section much greater than that of the rod. The third consists in the production of a peculiar, faintly luminous, flame in tubes from which the air has been exhausted. To this last we shall not refer further, except to say that its use for mining purposes has been more than once suggested, nor shall we speak just now of the second device; we shall confine our attention entirely to the first system, as that may be regarded as the only method of producing the electric light which at present possesses any commercial importance.

The electric lamp, then, consists of a pair of carbon rods called "electrodes," why so called we need not stop to explain, seeing that almost every author writing on electricity thinks it his duty to tell us the old story of the "amber" and its Greek name. If two rods of carbon be placed with their ends in proximity, and a current of electricity of sufficient power be sent through them, an intense light will be produced. The amount of the light will depend on the intensity of the current, the nature of the electrodes—for other materials than carbon can be used—and the medium which surrounds them. The colour of the light varies with the material of which the electrodes are composed or according to the presence of various metals. The appearance of the electric flame varies with the form of the electrodes. Thus if a coke point is attached to the positive wire and opposed to a plate of platinum, the flame takes the form of a cone, while between two carbon points it has the shape of an egg. The length of the flame depends more on the intensity of the current than on anything else. Thus Davy, who may be said to have discovered the electric light in 1813, obtained with 2000 pairs of zinc and copper plates a light 0·11m. long. Despretz made, in 1850, a series of experiments which showed that the length of the flame increases more rapidly than the intensity of the current. Thus, the flame produced by 100 Bunsen cells is nearly four times as long as that produced by fifty cells. It will not be out of place to state here that for commercial purposes batteries are never used now, electricity being obtained in a far cheaper way. But the fact remains that considerable advantage accrues as regards the quantity of light given by augmenting the intensity of the current, no matter how that current is obtained.

Although electrodes of very various materials may be made to produce the electric light, in practice carbon points only are employed. It will be readily understood that these play so important a part that it is necessary great care should be taken in preparing them. Several patents have been taken out with the object of producing good carbon electrodes. Thus, in 1846, Messrs. Staite and Edwards patented a process of making electrodes of sugar and powdered coke, mixed, moulded to shape, pressed, and burned. In 1849 M. Le Molt patented electrodes made of two parts animal charcoal, two parts wood charcoal, and one part of pitch. Various improvements have been effected recently, and among the best made are those of Carré, Archereau, and Gaudoin. Those who require further information on this subject we must refer to M. Fontaine's book, to which we have already called attention.

It is now time to say something more in detail of the curious phenomena which, taking place between the ends of the two carbon electrodes, supply the electric light. Fig. 1 is a diagram, showing the position of the electrodes as ordinarily employed.

The two sticks of carbon, usually round and about ⅜in. in diameter, are fixed in two supports, with their points at a small distance apart, and are united with the source of electricity by two wires. Fig. 1, it must be understood, is intended simply to show the principle involved. The electric lamp is in practice a much more elaborate apparatus, as will be seen further on.

Fig. 2, copied from M. Fontaine's work, shows, full size, the electric light as far as it can be shown on paper. The light results from the incandescence of a jet of particles detached from the electrodes and projected in all directions. The projection, however, mainly takes place from one electrode toward the other, and more especially from the positive to the negative pole. The positive electrode always has a temperature much higher than that of the negative electrode, and thus while the latter is heated only to a dull red at a small distance from the point, the positive electrode is at a white heat for a considerable way up. Both electrodes waste away, as may be imagined, but the positive electrode is dissipated twice as fast as its fellow. The light resembles a trembling, or vibrating flame, of an egg shape. From time to time we

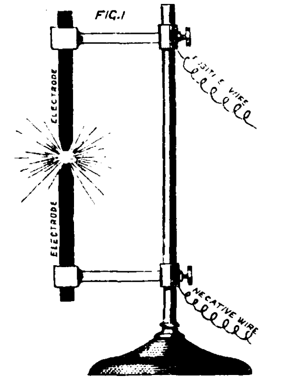


DIAGRAM OF ELECTRIC LAMP

may see a brilliant spark cast from one electrode to the other. Upon each of the carbons may be noticed little liquid incandescent globules *g*, showing that some mineral particles present in the carbons are fused by the heat. These are never seen when the carbon is pure. It will be understood that in observing the electric light darkened

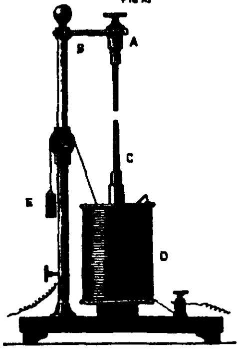
FIG. 2

THE ELECTRIC LIGHT—FULL SIZE.

glasses must be used, for the unprotected eye could not endure the glare.

"The voltaic arc," says M. Fontaine, "is a portion of the electric circuit, possessing all the characteristics of other portions of the circuit. The molecules entrained constitute between the two points a movable chain, possessing more or less conductivity, and more or less heated, according to

FIG. 3



ARCHEREAU'S LAMP.

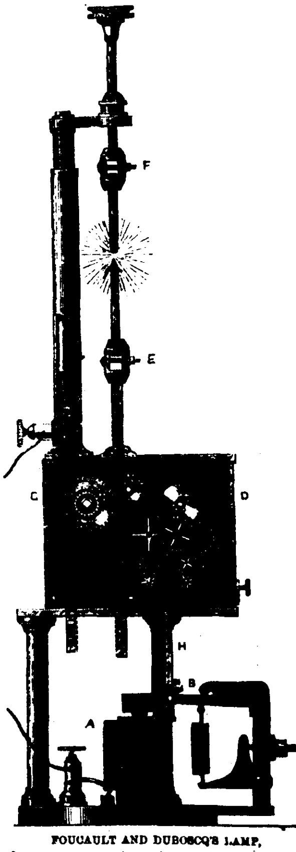
the intensity of the current on the one hand, and the nature and the distance apart of the electrodes on the other. What occurs is precisely as though the electrodes were united by a wire or a carbon rod of very small section; and thus it may be said that the light produced by the voltaic arc and that produced by incandescence are results of the same cause, namely, the heating of a bad conductor interposed in the circuit."

As regards the quality of the electric light, a remarkable similarity exists between it and that of the sun. Thus it excites the combination of chlorine and hydrogen. It effects changes of colour in certain salts; it possesses the property of imparting phosphorescence. It can be used by the photographer and the dyer.

To sum up, then, it is to be understood that the electric light is produced when two carbon points are placed close to each other, and a strong current of electricity is sent through them. The current breaks off, as it were, particles of carbon, which, momentarily suspended between the two electrodes or carbon rods, are raised to a dazzling white heat. Why this should be so, it forms no part of our purpose to explain here. The explanation may be sought in any good work on electricity, in so far as it can be supplied at all. When we have stated that the production of light from electricity is a result of a change in the manifestation of a form of energy, we have said almost all that need be or can be said briefly on the subject.

We now come to a very important department of our subject. In order that an apparatus for producing light may be serviceable in factories or workshops, it is essential that it should give a continuous illumination, the intensity of which should vary but little. As will be seen further on when we come to speak of the machinery employed to supply electricity, this supply can be rendered as constant in amount and intensity as may be desired. The producing apparatus, so to speak, will give little trouble in this respect; but the using apparatus—that is to say, the lamp—behaves very differently. It has

FIG. 4



FOUCAULT AND DUBOSCQ'S LAMP.

always been a source of trouble, and it is not too much to say that this trouble has only been barely disposed of. We have explained that the carbon electrodes waste away, but it is necessary to the production of the light that the points should remain constantly at an all but invariable distance from each other. We have seen that the positive electrode wastes twice as fast as the negative electrode. If this were not so, and all the carbon which one electrode lost went to its fellow, little harm would be done, one electrode losing as much as the other gained. In practice this does not take place, and the distance between the electrodes increases continually until it becomes so great that the current will no longer leap over it. Then the lamp is extinguished, and to re-light it the points must be brought again into contact, and once more separated to the proper distance. In such a lamp as that shown at Fig. 1, this operation would have to be performed every few minutes. It is not surprising, then, that measures were taken at a very early period in the history of the electric light to render the lamp automatic in the sense that it would of itself adjust the position of the carbons. The ordinary spring candle lamp used with carriages affords an example of the automatic adjustment of a *locus* of incandescence in a given place. Of course the same means could not be used to obtain the required end with the electric lamp; but the idea involved is much the same, and springs have been and are used for the adjustment of electrodes. Some of the many devices which have been tried are extremely complex in appearance or in reality. We illustrate in Fig. 3 the electric lamp of M. Archereau, because it is the most simple of all, and will serve admirably to render the nature of the problem to be solved quite clear. It consists of a hollow copper bobbin, on which is wound copper wire insulated by having a silk thread spun closely round it; of a suitable stand; of two " porte carbons," or electrode holders, and of a counterweight. The upper electrode is carried by a tube A, which can slide on and turn in a projecting copper arm B, at the top of the apparatus. This arm is insulated, and connected with the *negative* wire. The lower electrode C rests on a small cylinder, half of copper, half of iron, which can rise or fall inside the hollow bobbin D. The positive wire is attached to one of the ends of the wire wound on D, and the other end of the wire wound on D is fixed to the hollow core of the bobbin. The lower electrode is thus put in direct communication with the positive wire, because the cylinder on which the electrode rests always touches the walls of the core of D in some place. A counterweight E balances the gravity of C and its carrying cylinder. The frictional resistance is very small, and but little force is required to cause C to rise or fall. We have said that the upper part of the suspended cylinder inside D is of iron, the lower part of copper. When the current passes it produces a magnetic action, which causes the descent of the cylinder and the rise of the counterweight E. When the current ceases to flow, E descends again and pulls up C.

To put the apparatus in action it suffices, the current being ready, to touch the two carbons, and then to remove them gently to a small distance, the light will at once be produced, the cylinder remains fixed inside the bobbin D, and the counterweight is motionless. But a moment arrives when the carbons, having been dissipated, the distance between them becomes too great to allow the electricity to pass. Then the bobbin D no longer exerts any influence over the cylinder within it. No longer held down, this rises obedient to the pull of E; but the instant it rises the current is re-established in full force between the electrodes, and C is retained in its proper place until the carbon points are once more too far separated, when the operation is renewed. This apparatus is not now in use, as practical difficulties were met with in its employment.

In Fig. 4 is shown a Foucault and Duboscq lamp, which enjoys a very high reputation in France. Its construction will be readily understood by those who have followed us thus far. An electro-magnet is placed at the lower part of the apparatus; above the magnet A is fitted a lever B, controlled by a helical spring, which can be regulated by a thumb-screw in a way which will be understood without further description. The electro-magnet pulls against this spring. Above the magnet will be seen a box D containing a clockwork movement which actuates the porte carbons E F, which are fitted with racks as shown, which gear with the wheels G, one of which is larger than the other, because the carbons waste at different rates. The armature B carries a vertical rod H, which rises within the box D and stops the movement of the clockwork when the current is just what it should be and the light satisfactory; but the moment the distance between the carbon points becomes too great the resistance to the current augments, the armature is drawn away from the magnet, and the movement of the rod H sets the clockwork free to run until the carbon points are brought close enough for the light to be re-established, when the armature resumes its original position, and the wheel-work is stopped. Two trains of mechanism are used, and either can be set free while the other is at rest; one, as we have seen, brings the electrodes together, while the other separates them. The only attention required is to wind up the lamp every day, and to supply new electrodes when required—that is to say, about every four or five hours—an operation which does not occupy more than two or three minutes. All the details are very ingenious and carefully worked out.

Hints for the Workshop.

A grindstone is very seldom kept in good working order; generally it is "out of true," as it is

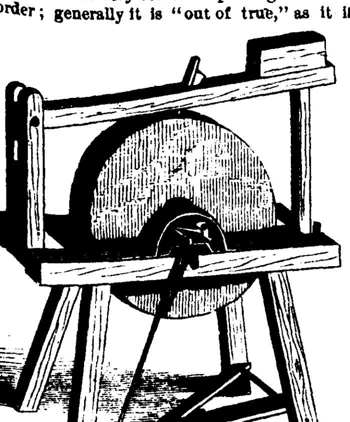


Fig. 1.—TRUEING A GRINDSTONE.

called, or worn out of a perfectly circular shape. A new stone is frequently hung so that it does not run "true," and the longer it is used, the worse it becomes. When this is the case, it may be brought into a circular shape by turning it down with a worn-out mill-file. It is very difficult to do this perfectly by hand, but it is easily done by the use of the contrivance shown in figure 1. A post, slotted at the upper part, is bolted to the frame. A piece of hard wood, long enough to reach over the frame, is pivoted in the slot. This should be made two inches wider than the stone, and be pivoted, so that an opening can be made in the middle of it, of the same width as the stone. This opening is made with sloping ends, so that a broad mill-file may be wedged into it in the same manner as a plane-iron is set in a plane. At the opposite end of the frame a second post is bolted to it. A long

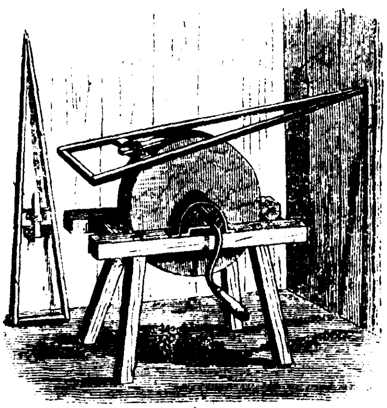
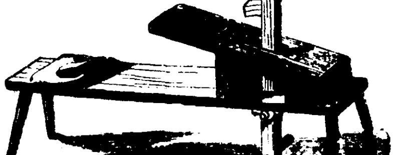


Fig. 2.—HOLDER FOR TOOLS.

slot, or a series of holes is made in the lower part of this post, so that it may be raised or lowered at pleasure by sliding it up or down upon the bolt. If a slot is made, a washer is used with the bolt; this will make it easy to set the post at any desired hight. It should be placed so that the upper piece of wood may rest upon it, exactly in the same position in which the file will be brought into contact with the stone. A weight is laid upon the upper piece to keep it down, and hold the cutter upon the stone. When the stone is turned around slowly, the uneven parts are cut away, while those which do not project beyond the proper line of the circumference, are not touched.

In reply to several inquiries for a shaving-horse, or a machine for holding shingles, or other articles that require to be worked with the drawing-knife,



A SHAVING-HORSE.

we give the accompanying engraving of one in common use. It consists of a strong stool, made of hard wood plank, four feet long and a foot wide, with four legs, which are eighteen inches long. Upon one end of the stool is fixed a bench, nearly two feet long, sloping a little from the front backwards, to make it more convenient in use. This bench may be supported upon four posts, or two walls of plank, being then open underneath at each end. A slot is cut in the bench, to admit the end of a lever, which is pivoted in a similar slot in the plank beneath. A stout peg, similar in shape to a rung of a ladder, is fixed in the bottom of the lever, and projects about six inches on each side. The lever is sawed out of a piece of tough white-oak plank, and a carriage bolt is passed through the jaw, at the upper part, in order to strengthen it. When in use, the workman bestrides the stool, using a cushion if desired, setting with the bench in front of him, and his feet upon the peg beneath it. By pushing with the feet, the jaw of the lever is pressed down very firmly upon whatever work may be placed upon the bench. The slope at which the bench is placed, should be such that the drawing motion will be as easy as possible to the workman.

The Future of America.

Rev. Joseph Cook recently delivered a lecture in New York City on "Ultimate America." Of our continent's field for progress in the future he said:

It is not commonly known that the amount of arable soil in North and South America is greater than that in Europe, Asia and Africa put together, and can therefore sustain more lives. This is no rash conclusion. I speak from a scientific basis. The remnant of productive soil (as the scholars say, I do not assert it on my own authority), is 10,000,000 square miles in the Old World, and 11,000,000 in the New. Thus bursts upon us in all the light of scientific truth the fact that America can sustain a greater population than the Old World, and if she can, it is unquestionable that she some day will. In this circumstance I hear the echoes of fate, with whose footfalls it is fitting that the centuries should keep step. Some of us who are not yet very old have seen our population increase from 27,000,000 to 40,000,000. Some have seen it increase from 8,00,000 to 40,000,000.

Suppose that there are 100,000,000 persons in all America in the year 2000. This is surely a moderate estimate, for now there are 84,000,000. Suppose that after the year 2000 our increase is one per cent. a year, or less than the present increase in England and Germany. It is said that the imagination is audacious, but the reason is more so. On this basis what do we find the future of America to be? Its population in the year 2600 would be 6,400,000,000. The "Encyclopedia Britannica" affirms that North and South America can furnish sustenance for 3,600,000,000. Europe has an average population of 80 persons to the square mile. We have an area of 15,000,000 square miles. If we conclude (and why may we not?) that we shall some day have as large an average, our population will be 1,200,000,000. Before such a stupendous future we should remember that America has been twice washed in blood because past generations have been poor rudders. In this view of the case, the age has, therefore, not ceased to be a crisis.

To Straighten Warped Woods.—Of all the trials and vexations that beset the beginner there are none more annoying than the tendency of his wood to warp. He sends to his dealer for a small assortment of fine woods, and expects to receive them perfectly true and flat. Perhaps the woods are flat when they leave the dealer, but in transit they are very likely to twist out of shape, reaching their destination badly warped. The expressman may not be aware of the subtle nature of these woods, and in not a very gentle manner lays the package on a damp, cold floor. The dry wood sucks in the moisture on one side, swells and curls. It should not be a difficult matter to cure this. If the wood is in a large piece the convex or hollow side should be steamed or moistened a little, and then laid upon a dry floor, holding it down with a smooth, flat board, upon which weights are placed. When quite dry it will be found to have regained its original shape. If the wood is in small pieces it can be easily straightened by gently steaming the convex side over a teakettle, and then holding the other side towards the heat until it becomes straight, when it can be left in a press or under weights for a few hours. Almost any warped woods will yield under this treatment.

To Make Ropes Durable.—To prolong the duration of ropes and retard their decay, steep them in a solution of sulphate of copper, an ounce to a quart of water, and then either tar them or immerse them in soapsuds, four ounces of soap per quart of water. In the latter case there is no smell.

TO OUR READERS.

In reply to a suggestion from a subscriber that it would be gratifying to many to have the Patent Laws of Canada printed in this MAGAZINE, we beg to say that a summary of the Patent Laws of Canada and the United States was published in Vol. 4—1876—and that any subscriber not having that volume can obtain it by enclosing $2 to this office.—ED. CANADIAN MECHANICS' MAGAZINE.

MACHINES THAT HEAR AND WRITE.

The propagation of sound in air is excellently illustrated in the ingenious apparatus devised by Professor Tyndall and represented in Fig. 1. A is a stem passing through the upright, B, to which a shock can be sent from a ball, C, through a spring to another ball, thence through another spring to another ball, and so on until at last the shock reaches the last ball, which is projected against the india rubber pad at the end, D, placed there to represent in a rude mechanical way the drum of the ear. When the stem, A, is pressed, the ball, C, only moves to and fro, yet it sends a kind of pulse, *f*, *e*, *e*, *f*, which travels along the line and ultimately causes the last ball to give a smart stroke on the pad, D. That this represents what takes place in air, when sound is propagated through that medium, is shown by the apparatus represented in Fig. 2. A tube 11 feet long and 4 inches wide has its ends closed with thin india rubber. Against the rubber at one end there presses a cork, *a*, with which is connected a hammer, *b*, which is in contact with the bell, *c*. If now a pulse be sent from the other end of the tube, the india rubber will drive away the cork and will cause the hammer to strike the bell. It will thus be evident that, when vibrations are caused in the air of a tube closed by a membrane, that those vibrations will be transmitted to the membrane. In the ear, as we have stated, the auditory nerves take the vibrations from the membrane to the brain, and the latter influences other nerves and muscles which cause us to write down what we hear. The problem to be solved in the phonograph is to find a mechanical substitute for auditory nerves, brain, and muscles, or, in other words, to connect some device with the body thrown into vibration by the sound, which shall register the movements of that body. The simplest and most direct method of recording vibratory movements is by Lissajou's apparatus, by which the vibratory motions of two sounding bodies may be compared without the aid of the ear. This method, which depends on the persistence of visual sensations on the retina of the eye, consists in fixing a small mirror on the vibrating body, so as to vibrate with it, and to impart to a luminous ray a vibratory motion similar to its own. The bodies used are tuning forks, and in Fig. 3 is represented the optical combination of two rectangular vibratory motions, the figure being projected on a screen. A large number of curves are produced, which are more complex when the ratios or the numbers of vibrations of the bodies are less simple; and as each curve or variation corresponds to a definite condition of the forks (pitch, etc.) it is evident that, while it is a graphic representation of the vibrations which take place in the bodies, it also represents the sound resulting from such vibrations. If the beam of light producing

FIG. 1.

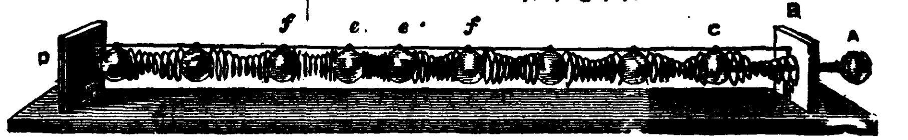
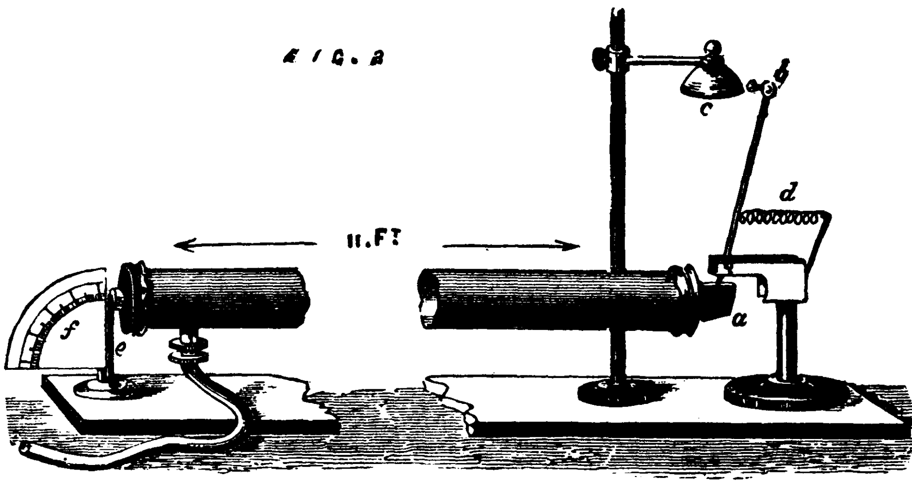


FIG. 2



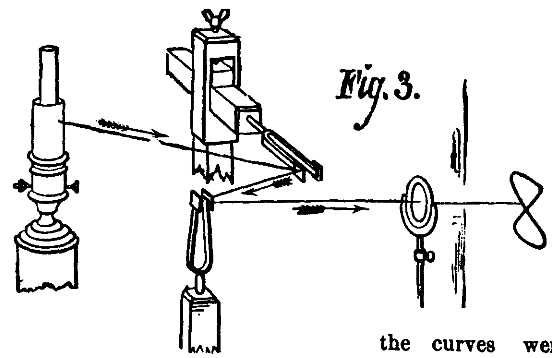
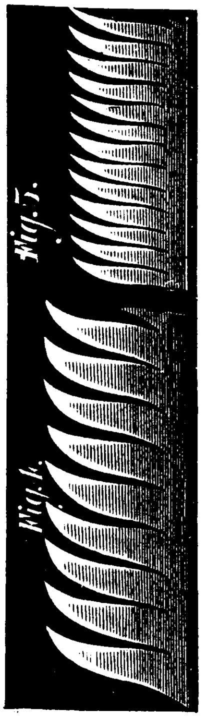


Fig. 3.

Fig. 7.

the curves were projected upon a sensitized surface, then the curve would be photographed, and consequently we should have a graphic representation of the sound.

König's manometric flames furnish a very delicate mode of graphically showing the nature of sounds. The apparatus used consists of a metallic capsule divided into two compartments by a thin membrane of rubber. The tube on one side of the capsule connects with a mouthpiece; the space on the other side is connected with a gas burner, the supply pipe of which also enters said space, so that on one side of the membrane is air and on the other gas. When the sound waves enter the capsule by the mouthpiece and tube, the membrane yielding to the condensation and rarefaction of the air waves, the gas in the compartment on the opposite side of the membrane is alternately contracted and expanded, and hence are produced alternations in the length of the flame, which are, however, scarcely perceptible when the flame is observed directly. But to render them distinct they are received on a mirror with four faces, which is rotated on a vertical axis. As long as the flame burns steadily there appears in the mirror, when turned, a continuous band of light. But if the capsule is connected with a sounding tube for example, yielding the fundamental note, the image of the flame takes the form represented in Fig. 4, and that of Fig. 5 if the sound yields the octave. For different sounds produced before the capsule the flame assumes widely differing appearances. It would not be impossible to photograph the representation of the flame in the mirror, and thus permanent graphic records of sounds might be obtained.



We now come to purely mechanical means of registering sound, to which class belong the Edison and other phonographs. In Fig. 6 is represented Leon Scott's phonautograph, which consists of an ellipsoidal cask, A, of plaster of Paris, and about 1½ feet long. The end, A, is open; that at B is closed by a solid bottom having an orifice, in which is a bent brass tube, *a*, which carries a ring on which is affixed a thin membrane. Near the center of the latter is a very light style; and in order that this style may not be at a node, the membrane stretching ring carries a movable piece, *i*, which is termed a subdivide, and which, being made to touch the membrane first at one point and then at another, enables the experimenter to alter the arrangements of the nodal lines at will. It follows that, when a sound is produced near the apparatus, the air in the ellipsoid, the membrane and the style will vibrate in unison with it, and it only remains to trace on a sensitive surface the vibrations of the style and to fix them. For this purpose a rotating copper cylinder, *c* is covered with lampblacked paper and the style is brought in contact with the latter, so that, when the cylinder is rotating and the style vibrating, a sinuous line is produced, the nature of which depends upon the sound. Thus in Fig. 7 is represented the trace of the sound produced jointly by two pipes, whose notes differ by an octave. This arrangement of rotating cylinder is also employed in connection with tuning forks, a style being arranged on one arm of the fork. On a note being sounded in unison with which the fork is tuned, the fork vibrates and consequently a sinuous line showing the nature and velocity of the vibrations is made upon the paper of the cylinder.

In April, 1873, Mr. W. H. Barlow read before the Royal Society a paper on the "Logograph," an invention of his own for recording sound, which consists of a small speaking trumpet about 4 inches long, having an ordinary mouthpiece connected to one end of a tube of ½ an inch in diameter, whose other end is broadened out so as to form an aperture of 2½ inches diameter, which aperture is

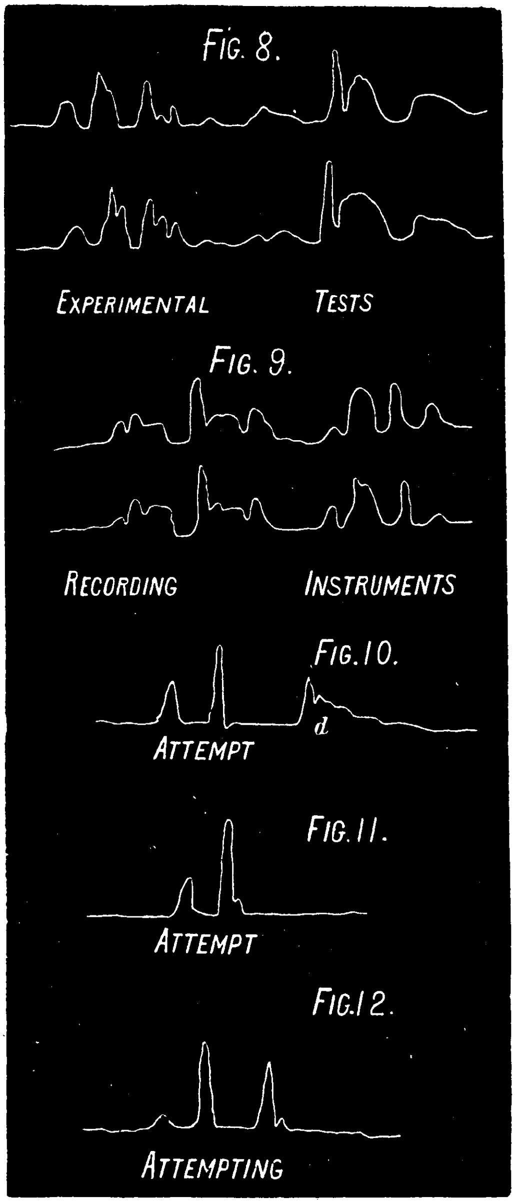
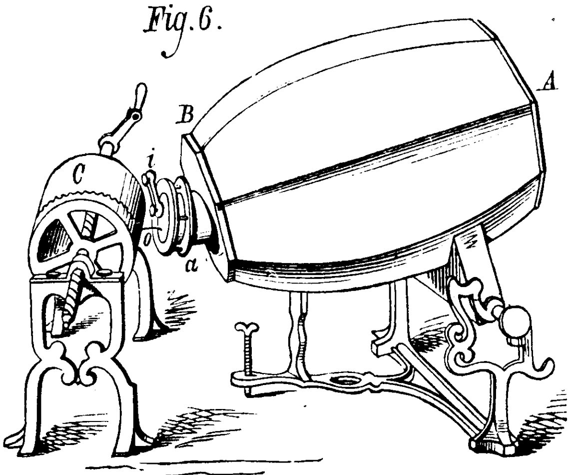
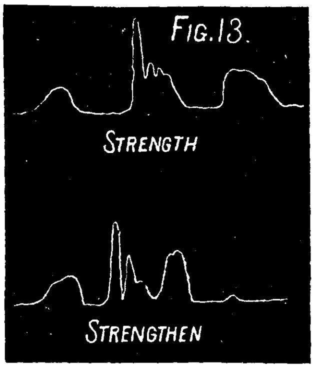


Fig. 6.



stopped by a membrane of goldbeater's skin or thin gutta percha. Against this membrane a spring presses lightly and has connected to it a light arm of aluminum, which carries a marker consisting of a very fine sable hair pencil, projecting from the lower end of a glass tube containing coloring material, the tube and pencil together forming a kind of fountain marker,



as the coloring material gradually oozes out and keeps the pencil continually moist and supplied with color. Under this marker a continuous strip of paper is made to pass, in in the same manner as the strip of paper in the register of the Morse telegraph, and the whole is so arranged that when the membrane occupies its normal position the marker makes a simple, straight line, as the strip of paper passes beneath it, but any force acting on the membrane will cause the marker to move, and a crooked line will be the result, the deviation from a straight line depending on the amount of force exerted on the membrane.

To provide for the escape of the air passing through the trumpet a small orifice is made in the side of the tube, so that the pressure exerted upon the membrane and its spring is that due to the difference arising from the quantity of air forced into the trumpet and that which can escape through the orifice in a given time. The pressure of the spring and the size of the orifice have to be so proportioned to each other as to admit of the movement of the marker with the slightest pressure of the breath, and yet it must not move so easily as to pass over the edge of the paper under the greatest pressure which the breath is capable of producing. By this apparatus, when, properly adjusted, the various sounds produced by speaking will act on the membrane, causing it to move the marker correspondingly to the force exerted by the differing tones of the voice, and thus a series of irregular lines will be produced, exhibiting remarkable uniformity when the same phrases are repeated, as is shown by the diagrams in Figs. 8 and 9, made by the instrument when the words under them were pronounced by the same speaker successively.

One of the first peculiarities manifested in using the instrument was the action produced by the silent discharge of air from the mouth after a word was pronounced. This silent discharge appeared to depend on the force required in the last syllable, and was most developed in those syllables terminating with the consonents termed "explodents," whether with or without the silent vowel E after them. This effect is shown in Fig. 10, in which the part marked *d* is the silent discharge, and its appearance in the diagram is under the control of the will, for by holding the breath immediately after pronouncing the word, this part of the diagram can be altered as shown in Fig. 11. If, instead of terminating with an explodent, another syllable be added to the word, making it terminate with a consonant of softer sound, the air which would have been silently discharged is used to form the syllable added, and the subsequent silent discharge is very much diminished, as at Fig. 12.

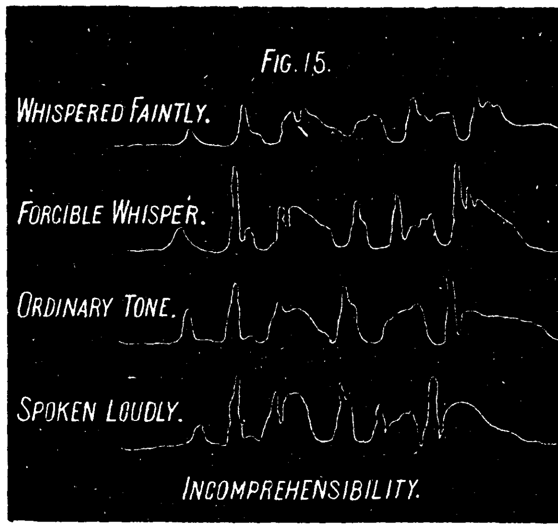
Some words appeared shorter when a syllable was added, as, for instance, the word "strength" and "strengthen," the mark made by sounding the latter being considerably shorter than when the former was spoken, as may be seen by comparing the diagram of the two words in Fig. 13.

To test the rapidity of the action of the instrument, the old nursery line "Peter Piper picked a peck of pickled pepper" was repeated at the rate of six syllables per second, and the diagram shown in Fig. 14 was the result.

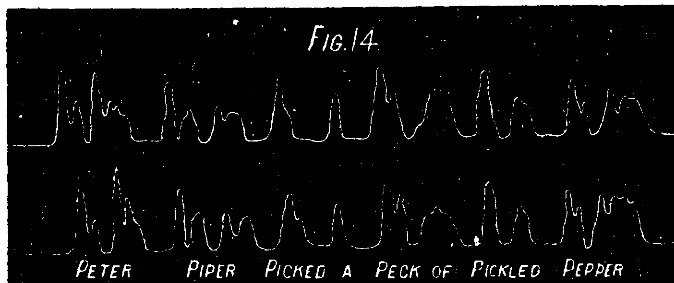
In Fig. 15 may be seen the diagrams made when the word "Incomprehensibility" was spoken in different tones, showing that, although a certain amount of variation due to the energy occurs, yet each sound preserves the same specific character.

Fig. 16 shows the diagrams made by repeating the well-known stanza from "Hohenlinden."

From the above it would appear that sooner or later we may expect to see the desks of our popular preachers provided with reporting instruments something on the same principle as Mr. Barlow's logograph, only much more deli-



cate, so that each discourse may be taken verbatim, as it would seem that it would be comparatively easy to learn to translate the logographic diagrams (or logograms, if we may be allowed to coin a word) into plain English writing. It may be more difficult, however, to report the speakers at a public-meeting in this manner, as, so far, we know of no means of separating from the discourse the various noises that indicate the applause or dissatisfaction of the audience,



and which would, when operating in conjunction with it, produce a strange jumble of marks that would puzzle not only a Philadelphia lawyer, but a dozen of them, to decipher. (*Scientific American.*) 18

FIRE-PROOF CONSTRUCTION.

The great danger in our present system of construction lies in the inflammable nature of our building materials, and in the opportunity given by the arrangement of partition walls and floors, unchecked, unseen, and out of reach. It is best, if possible, to build outer walls of brick, and, with a judicious treatment and at moderate expense, they can be made to look attractive, even i· the country. By making a projection or offset inside at each floor, an effectual stop can be put to any passage of fire up the inside surfaces; or, if hollow or vaulted walls are used, the plaster can be put directly on the brick without using any wood. But if the outside walls are of wood, the spread of fire can be greatly checked by filling them full, between the joints and against the outside boarding, with brick and mortar, or concrete, or any such incombustible material; or, if that expense is too great, they may be filled at each floor, and for a short distance above. Then, by treating the partitions in the same way, there will be an unobstructed channel or flue for flame only one story high, and stopped tight at top and bottom. The wood will hold well and burn very slowly, even when only partially protected in this way. In war times, soldiers used to build chimneys with a cob-house construction, of small sticks plastered inside and out with clay; and these frail structures would endure the heat of roaring wood fires, simply because the flame could not reach to envelop the wood. Protect a piece of joist on two sides with plaster, and it will be very hard to make the exposed flat surface burn long, and the charred wood soon furnishes a sort of check to further combustion. And this is the correct principle to apply to the protection of wooden houses. Cover the wood so far as possible, with mortar, and stop all circulation of air. Having pugged the walls and partitions thoroughly, and treated the stairway in a similar manner, by filling in between the supporting stringers or carriages with coarse mortar, we must next make the opening around the chimney tight, where it passes through the floor, by a filling in of mortar, or by turning trimmer arches against the surrounding timbers on the four sides.

The next vulnerable point is the floor. In France it is often the custom to cross-lathe the ceilings with lathes considerably thicker than ours, and then to put a flat surface of rough boards a short distance below the under surface of these lathes (supporting it by a staging), and to pour in from above a mixture of plaster of Paris, which hardens into a solid mass between the floor timbers and above and below the lathing. When the whole is sufficiently set, the staging is removed and the ceiling smooth finished from below.

All these precautions against fire are also useful to make the house warmer, to deaden sound, and to help to stop leaks. And they are all in one sense economical, they may save expense in insurance. It is a good maxim in war to do what your enemy least wishes you to do. The fire fiend craves light woodwork, loosely arranged and full of draft channels. Let him find everything pugged solid with mortar. Make him dig for every inch of wood he seeks to devour; check him, hold him, worry him, cramp him in close quarters. Then with a little presence of mind, a strong arm or two, and a few homely weapons, you can drive him to a corner and finally destroy him altogether.—*J. A. F, in the Boston Journal of Chemistry.*

The power of a horse is said to vary from five to eleven times that of a man...A new item of commerce—coffins—from Norway......Copper is believed to exist in the human blood... Portable iron huts are in use by the Russian army; they use condensed forage.

CAUSE OF DECAYED TEETH.

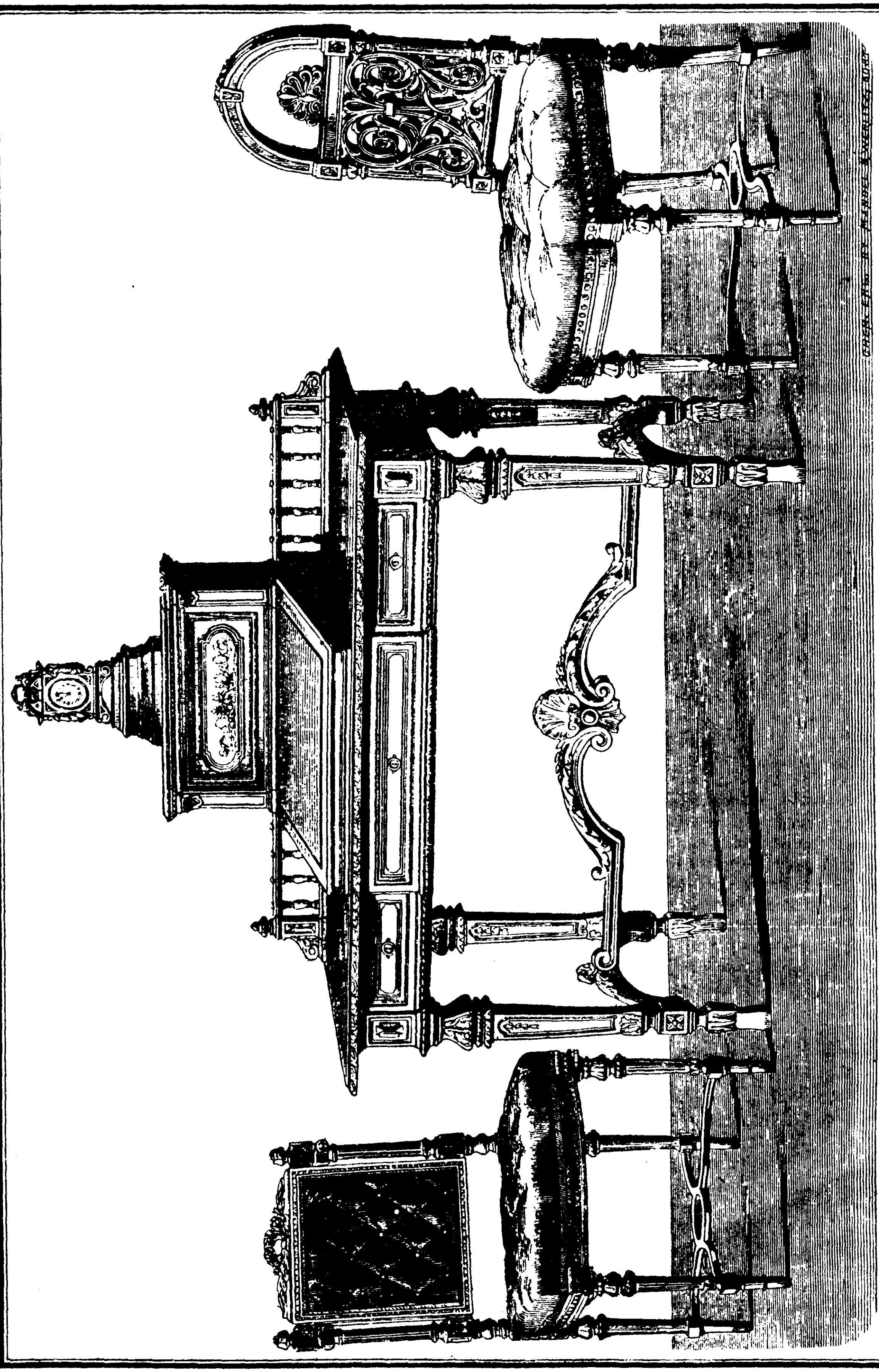
A writer in the *British Medical Journal* gives some valuable suggestions on the preservation of the teeth: The general prevalence of dental caries is chiefly owing to food remaining on and between the teeth after meals—from breakfast time till the following morning—when, according to custom, the teeth are brushed; brushed, but probably not cleaned, as the brush is more often used to polish the surface merely than to assist in removing what has acumulated between them., Experiments have been referred to that prove the solvent action of weak acids on the teeth; and I think it will be conceded without proof that, were portions of our ordinary food, mixed and moistened as in mastication, kept during the night at the high temperature of the mouth, the compound would be sour. It follows that dental caries must continue to prevail as now, while it is the custom to allow the food to remain in contact with the teeth all night.

The following observations show the dependence of caries on food remaining in contact with the teeth. When the teeth are wide apart food is not retained, and they generally remain free from caries. The lower front teeth are seldom attacked by caries when, as is generally the case, the spaces between are closed to the entrance of food by tartar. The backs of all the teeth, upper and lower, being kept free from food, by the tongue, are seldom affected by caries. Lodgment of food takes place between the bicuspids, between the molars, in the depressions on the masticating surface of these teeth, and on the buccal walls of these molars, and these are the chief seats of caries. While mastication is performed by the molars and bicuspids, the upper front teeth remain free from food and from caries; but, when they themselves are made to do the work of diseased molars, and the food gets between them, caries is certain to follow before long. Further proof cannot be required that, if no food remained in contact with the teeth after eating, they would be free from caries, unless acted upon by acidity from other sources. The only indications, therefore, for the prevention of dental caries are the neutralization of acid applied to the teeth and the removal of food before it has become acid. The food should be removed after every meal, and all who have not the opportunity of doing so should not fail to remove it every night at bedtime by rinsing, as the brush cannot be trusted to remove the food from between the teeth.

WHOLESOME WATER.

At a recent meeting of the New York Academy of Science, Prof. A. R. Leeds read a paper on the relation between fish and plant life and the probability of drinking water. The subject of the wholesomeness of drinking waters was brought prominently before the public of this section by the excessive mortality of the fish in the Passaic river during last June. This appeared of such importance to the Professor that he made two visits to Paterson to collect information. No naturalist appears to have examined into the nature of the disease. Its external indication was the formation of a soft spot on the side of the fish, and death speedily followed the rapid growth of this. That the refuse of factories was not the cause was plain from the fact that the fish had died in great numbers above the falls, even in the tributaries of the Passaic, and also in isolated bodies of water like Rockland lake. Mr. John Roe, one of the fish wardens, stated that the water was unusually low during the epidemic and the weather had been excessively hot. Where the disease was most prevalent, the depth of water varied from three to eight feet. It appeared also that at this time an unusual amount of acquatic plants of a low order had invaded the stream. The following inferences may be drawn: 1. That the rapid development of vegetable growth may be attended with the production of spores or gemmicles forming a specific poison to fish life. 2. That the organic impurities arising from the action of the sun upon shallow water and the gases evolved may originate disease. 3. The supply of oxygen might fall below the point requisite to the support of life by being consumed in the oxidation of vegetable matter; by the partial exclusion of the air from the water by the crust of floating algæ; and by diminution in the supply of highly ærated water from levels by reasons of the drouth. A very heavy rain put an end to the epidemic. The third hypothesis seems the strongest.

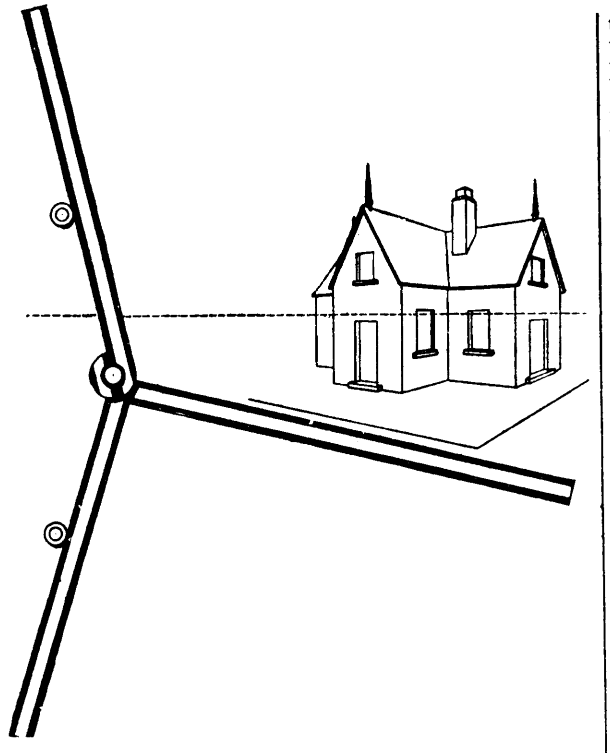
The Hayden Geographical Survey parties are preparing their reports of last season's expeditions......The Patent Bar Association of Washington has proposed amendments to the Patent Laws.



WRITING TABLE AND CHAIRS, Designed by F. SCHŒNTHALER, Vienna.

CHURCH FURNITURE.

EXAMPLES OF POLISHED BRASS EAGLE LECTERNS AND CARVED WOODEN LECTERNS.



A NEW PERSPECTIVE DRAWING TOOL.

In perspective drawing it is necessary to draw lines from a distant point at one side, called the "vanishing point." This point is frequently at such a distance as to require a very long drawing-board and straight-edge to produce the vanishing lines. The simple instrument represented in our engraving, called the "Perspective Linead," will accomplish this in the most perfect manner without requiring long boards or rules, and is therefore indispensable to all draughtsmen and artists who have to make perspective drawings.

This instrument consists of a long rule upon which are jointed two arms by a thumb-screw in such a manner that they may be set at any required angle. It will be observed on reference to the engraving that one edge of the rule and one edge of each arm come in line with the axis of the rule. In this position the instrument is adapted to produce vanishing lines from the left-hand side of the drawing only; to draw those of the right-hand side another instrument of the same kind is required, both forming a pair.

In drawing with the perspective linead the arms are pressed continually against two studs, which are fastened at a distance apart upon the edge of the drawing-board. One method for setting the perspective linead for use, which is the manner recommended, is as follows: After drawing the horizontal line for the intended perspective drawing, which is generally done by the T-square, a vertical line has to be drawn at right angles to it, up the side of the drawing-board, from which the vanishing lines are wished to be produced. Upon this line, at equal distances—generally about eight inches—from each side of the horizontal line, are to be placed the two studs, which are intended for the arms of the linead to slide against. These studs are fixed in position by pressing down the pin, which projects from the under side in the point of distance set off on the line. The upper or axial edge of the rule of the perspective linead is then placed along the horizontal line, and the arms (the screws of which have been previously loosened) are each brought to one of the studs, allowing the arms to take about the angle to each other thought to be required to produce the desired distance of vanishing point; in this position the arms are to be clamped. It is then necessary to try if the linead will correspond with the line which forms the top of the building, or other object intended to be placed in perspective, which is either sketched by judgment or drawn according to the rule of perspective. This is done by moving the rule up from the horizontal line, always keeping the arms in contact with and sliding against the studs. Should the vanishing point that would be given by the perspective linead, as now set, appear too near, it will be necessary to put the rule back on the horizontal line, from which it has always to be set, unclamp the screws of the arms, and press the rule back against the studs, keeping it still on the horizontal line, so as to flatten the angle of the arms the amount thought to be required; then clamp the arms again and make another trial.

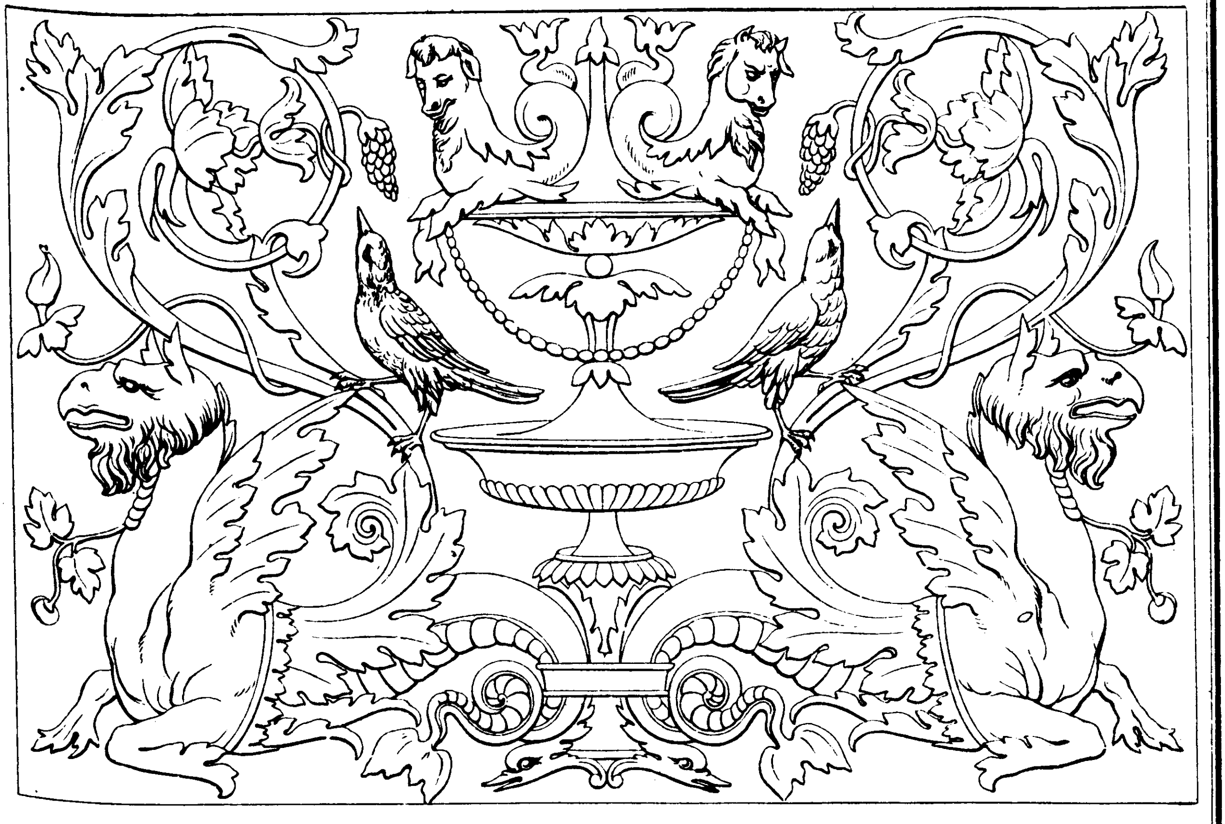
If the vanishing point appears too far, the arms will require setting at a more acute angle. It is best in all instance to make a mark at the side of the end of the linead to show its position before alteration, to insure having about the distance from the last setting thought to be required. When the instrument is once set, it is right for all the vanishing lines from one side.

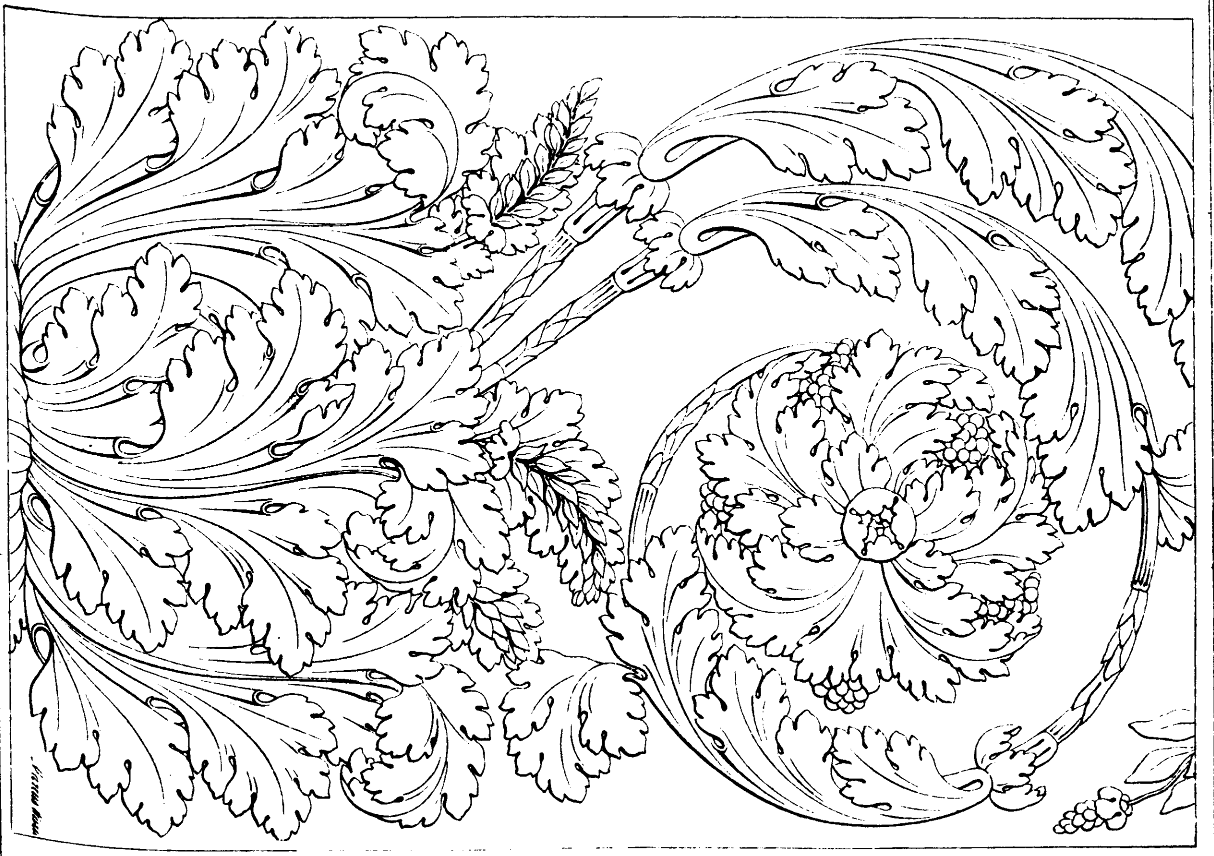
The above description may perhaps convey the impression that the instrument is difficult to use, but in fact it is quite easy in practice, as, after using the linead for a few perspective drawings, the angle at which the arms should be set for any particular drawing becomes so familiar that it may be judged sufficiently near for the first trial, or a slight alteration of this, to suffice.

Varnish for White Wood.—Copal Varnish: Take of copal, liquefied, 3oz.; essence of turpentine, 20oz. Place the mattrass containing the oil in a balneum mariæ, and when the water boils add the pulverized copal in small doses. Keep stirring the mixture, and add no more copal till the former be incorporated with the oil. If the oil, in consequence of its particular disposition, can take up 3ozs. of it, add a little more, but stop if the liquor becomes nebulous; then leave the varnish at rest. If it be too thick, dilute it with a little warm essence, after having heated it in the balneum mariæ. When cold, filter it through cotton, and preserve it in a clean bottle. This varnish has a good consistence, and is as free from colour as the best alcoholic varnish. When extended in one stratum over smooth wood which has undergone no preparation it forms a very brilliant glazing, which, in the course of two days in summer, acquires all the solidity that may be required. The facility which attends the preparation of this varnish by the new method here indicated will admit of its being applied to all coloured grounds which require solidity, pure whites alone excepted. Painted boxes, therefore, and all small articles, coloured and not coloured, where it is required to make the veins appear in all the richness of their tones, call for the application of this varnish, which produces the most beautiful effect, and which is more durable than turpentine varnishes.

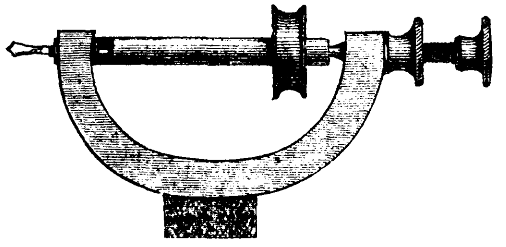
Edge-Laid Belt.—A better plan of making a broad belt than the usual American *double* leather belting sewn together, is made with the greatest ease, of any thickness or width, perfectly equal in texture throughout, and alike on both sides. It is made by cutting up the hides into strips of the width of the intended thickness of the belt, and setting them on edge. These strips have holes punched through them about one-eighth of an inch in diameter and one inch apart. Nails, made of round wire, clinched up at one end for a head and flattened at the other, are used for fastening the leather strips together. Each nail is half the width of the intended belt, and after the strips are all built upon the nails, the ends of the latter are turned down and driven into the leather, thus making a firm strap, without any kind of cement or splicings. When the strap is required to be tightened, it is only necessary to take it asunder at the step lines of the splice, cut off from one end of the strap at each step what is required, and piece up again with wire nails or laces, going entirely through the strap.—*E. Leigh.*

Preserving Wood by the Application of Lime.—The method of preserving wood by the application of lime, as pursued by M. Svostal, is published in the French journals. He piles the planks in a tank, and puts over all a layer of quick-lime, which is gradually slaked with water. Timber for mines require about a week to be thoroughly impregnated, and other wood more or less time according to its thickness. The material acquires remarkable consistence and hardness on being subjected to this simple process, and, it is alleged, will never rot. Beech-wood has been prepared in this way for hammers and other tools for iron works, and is said to become as hard as oak without parting with any of its well-known elasticity or toughness, and to last much longer than when not thus prepared.



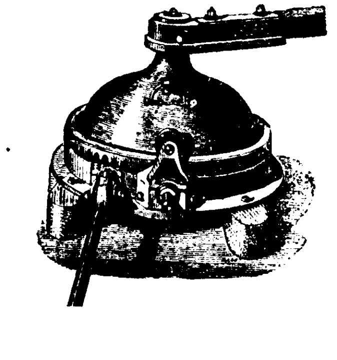


Specimens of Panel Ornaments for Students in Free-Hand Drawing.



COHEN'S SMALL DRILLING APPARATUS.

The above illustration represents a small drilling machine manufactured by Mr. M. Cohen, of Kirkgate, Leeds, which may be used by fastening it in a vice, or in a wood block, or attached to a small lathe in the ordinary way. It is a well-made and nicely-finished little tool, and is one which will be found very useful for a variety of purposes, and especially useful to amateurs. Its construction, as will be seen from the illustration, is an improvement upon those hitherto made. Each machine is provided with six small drills, and its remarkable cheapness, and evident usefulness, should secure for it a large sale. Our readers will hardly credit that they can receive it post free for one shilling sterling.



IMPROVED PATENT PONY AND HORSE GEAR.

A useful improvement on the common means of transmitting power has been patented by Messrs. John Williams & Son, of the Phœnix Iron Works, Rhuddlan, near Rhyl. It will be shown, with other productions of the firm, at the forthcoming Agricultural Show, at Islington. The general shape of the machine is shown in the annexed cut. It is described by the makers as a new patent pony gear with dome wheel and intermediate motion encased inside of same, making it a very safe and compact implement, and it is said to be well adapted for driving small food-preparing machines, churns, pumps, &c. The diameter of the driving wheel is 2 feet 5 inches, a larger size being 2 feet 8 inches in diameter. The gear is fitted with two speeds, each making six-and-thirty revolutions to one of the pony. In days like these, when the necessity of using appliances for economising manual labor is so universally felt, owners of farm stock will doubtless find it to be true economy, though it may seem costly at first, to possess themselves of machines like this, the action of which, if kept in good working order, is uniform, and may therefore be depended upon.

We may note that the chaff and turnip cutters of these makers —described in our columns some time ago—have been very successful in this year's competition. Silver medals at Preston and gold medals at Antwerp, with a special medal for chaff-cutters at Edinburgh, last July, are honors worthily conferred upon a firm which always aims at keeping up the high character long ago obtained by sound and good work.

CUCA AS A STRENGTH SUSTAINER.

In many callings it is occasionally necessary for a man to put forth extra exertion for protracted periods of time; as, for example, a sailor during a storm, a soldier on a forced march, an engineer in case of accident or impending disaster. Frequently, at such times, it is impossible to procure or to prepare suitable food for the increased demands of the system, or to obtain the sleep which both body and mind require. Yet it is desirable, perhaps imperative, that both body and mind shall be kept up to their best working capacity. In every part of the world and in all stages of civilization, men have discovered means more or less efficient, more or less harmful, for meeting such emergencies; and one of the hardest lessons of human life and experience has been to learn how to use such aids to endurance without abusing them. Even the most useful and least harmful of them—tea, coffee, wine, tobacco, and the rest—are mischievous if not worse when used habitually or in excess; while others, like the various alcoholic beverages, are apt to disturb what is so essential in critical emergencies, the proper action of the brain. It is natural and proper, therefore, that those who recognize the practical need of the race for what may be called special foods, should take a lively interest in the demonstration of means for securing the good results aimed at by all of them, with the least possible physical and mental risk. The latest claimant for this responsible position is the leaf so long used by the mountaineers of South America—*cuca*; and perhaps the most instructive test of its virtues thus far made is to be credited to the Toronto Lacrosse Club, a company of intelligent gentlemen, most of them occupying high social and professional positions, and all of sedentary occupation. The latter point is important, since men of indoor life are not the most favorable subjects for occasionally putting forth violent and protracted physical effort; while the matter of intelligence is not less important in determining the value of their estimate of the aid received by the use of cuca.

In the spring of 1876 several of the members of the club began to use cuca as a strength-sustainer, with results so satisfactory that nearly all the " first twelve " used the leaves during all their important matches. There were ten in number, and some of them lasted for several hours. The club, it will be remembered, held the championship of the world and maintained it throughout against all comers, Indians as well as whites.

Their practice was to serve out to each man at the beginning of a match about a drachm or a drachm and a half of the cuca leaves, to be chewed in small portions during the progress of the game, the saliva to be swallowed. The effect, the experimenters report, was a sensible increase in muscular force and an almost entire exemption from fatigue. The pulse was increased in frequency, and perspiration was augmented; but no mental effect was observed beyond the natural exhilaration of contest and vigorous exercise. There were no subsequent disagreeable effects; and no alkaline matter was used with the leaves, as is the practice in Peru.

On one occasion, in midsummer, the thermometer marking 110° in the sun, a match was played with a club of mechanics and other out-door workers, of sturdy build and in fine condition. The cuca chewers came out of the game as elastic and apparently as free from fatigue as when they began, while their opponents were thoroughly exhausted.

The experience of the past season, so far as reported, substantially confirms that of the preceding year. Nearly every member of the club is confident that the cuca has been of great assistance in sustaining strength. Two or three are doubtful; not one finds it injurious. It is proper to add that among the South American natives, by whom cuca is used with lime and to excess, its effect is often disastrous, imbecility being a common result of its protracted use.

Improved Carmine Ink.—The *English Mechanic* says: The solubility of carmine lake in caustic aqua ammonia is attended with this disadvantage: that in consequence of the alkaline properties of ammonia, the cochineal pigment will, in time, form a basic compound, which in contact with a steel pen no longer produces the intense red, but rather a blackish color. To avoid this evil, prepare the ink as follows: Saturate 1 gramme of pure carmine with 15 grammes of acetate of ammonia solution and an equal quantity of distilled water in a porcelain mortar, and allow the whole to stand for some time. In this way a portion of the alumnia which is combined with the carmine dye, is taken up by the acetic acid of the ammonia salt, and separates as precipitate, while the pure pigment of the cochinal remains dissolved in half saturated ammonia. It is now filtered, and a few drops of pure white syrup added to thicken it. In this way an excellent red drawing ink is obtained, which holds its color for a long time. A solution of gum arabic cannot be employed to thicken this ink, as it still contains some acetic acid, which would coagulate the bassorine which is one of the natural constituents of gum arabic.

The Coal Production of the World.—The coal production of the world would appear to have increased to a surprising extent during the last thirty years. In 1845, Great Btitain extracted 31,500,000 tons. In 1874 she raised 125,043,300 tons. Belgium extracted 4,960,077 tons in 1845, and 14,669,000 tons in 1874. The production of the United States in 1845 was 4,400,000 tons; in 1874 it had grown to 42,423,900 tons. France produced 4,141,617 tons in 1845, and 16,949,000 tons in 1874. Prussia extracted 3,500,000 tons in 1845, and 41,754,600 tons in 1874. Finally, Austria and Hungary produced 709,700 in 1845, and 12,810,900 tons in 1874. The combined production of the six countries will be seen to have risen from 49,211,400 tons in 1845, to 253,650,700 tons in 1874.—*Am. Manufacturer.*

About Broken Bottles.—What becomes of all the broken bottles? may well be asked. Thousands of tons of bottles are broken every year in London alone, and the difference between the sound and the broken bottle must be something very considerable. Broken "wines" and broken "sodas" are converted to many useful purposes, the latter especially. The best soda-water bottles come from Yorkshire, and the "gingers" from Derbyshire. The sodas are no longer sent to the metropolis packed in crates, as formerly. In the crate they were pilfered to a very great extent *en route to their* destination, and the cost of carriage was higher. They are now transmitted in bags made of coarse canvas, and packed in layers of straw. Each bag holds eight dozen. The broken bottles are subsequently utilized for manufacture of cheap jewelry, chimney ornaments, and inferior household glass for the manufacturing districts. They are also used for the manufacture of emery powder, glass paper, etc. Some idea of the number of "sodas" broken in the processes of filling, corking, cleaning, and distributing, may be gathered from the circumstance that one of the London mineral water manufacturers sold last year 100 tons. The value of the "metal," as it is styled, is somewhere about 10s. per ton, but it varies according to the demand.—*British Trade Journal.*

CHEMISTRY, PHYSICS AND TECHNOLOGY.

Two Processes for Preserving Fish from decay were detailed in a recent communication to the Paris Academy of Science by R. M. d'Amelio. The first process was as follows: The fish, whether raw or cooked, is immersed in a strong solution of citric acid in water. After two or three hours, the fish is taken from the bath and dried in the open air, or by artificial heat, the latter course being preferable. Fish so prepared will keep fresh anywhere for years. To restore its original flexibility it must be steeped in fresh water four or five days. The other method consists in the employment of a bath of silicate of potash and glycerine, in equal quantities. The fish, the intestines having first been removed, is steeped in this bath for a day or two, washed in fresh water, and dried slowly. By the use of this process the author has succeeded in preserving intact the color of the fishes and the eyes.—*P. S. M.*, vii, 384.

Caoutchouc Making on the Amazon.—Narrow paths lead from the hut through the thick underbrush to the solitary trunks of the India rubber trees; and as soon as the dry season allows, the woodman goes into the seringal with a hatchet, in order to cut small holes in the bark, or rather in the wood of the caoutchouc tree, from which a milky white sap begins to flow through an earthenware spout fastened to the wound. Below is a piece of bamboo which is cut into the shape of a bucket. In this way he goes from tree to tree until, upon his return, in order to carry the material more conveniently, he begins to empty the bamboo buckets into a large calabash. The contents of this are poured into one of those great turtle-shells, which on the Amazon are used for every kind of purpose. He at once sets to work on the smoking process, since, if left to stand long, the gummy particles separate, and the quality of the India rubber is hurt. This consists in subjecting the sap, when spread out thin, to the smoke from nuts of the Urucury or Uauassa palm which, strange to say, is ths only thing that will turn it solid at once. An earthenware "bowl without bottom," whose neck has been drawn together like that of a bottle, forms a kind of chimney when placed over a heap of red-hot nuts, so that the white smoke escapes from the top in thick clouds. The workman pours a small quantity of the white, rich, milk-like liquid over a kind of light wooden shovel, which he turns with quickness, in order to separate the sap as much as possible. Then he passes it quickly through the dense smoke above the little chimney, turns it about several times, and at once perceives the milk take on a grayish yellow color and turn solid. In this way he lays on skin after skin until the India rubber on each side is two or three centimeters thick and he considers the plancha done. It is then cut upon one side, peeled off the shovel, and hung up to dry, since much water has got in between the layers which should dry out if possible. The color of the plancha, which is at first a bright silver gray, becomes more and more yellow, and at last turns into the brown of caoutchouc, as it is known in commerce. A good workman can finish, in this way, five or six pounds an hour. —*Scribner's Magazine.*

A New Car Brake, devised by Jacob J. Anthony, of Sharon Springs, N. Y., comprises a cylinder containing pistons, which are forced apart by steam, water, or air, under pressure. By this means levers are moved so as to force the brake shoes against all the wheels simultaneously, and with an equal pressure on both sides of each wheel.—*C. R. Rev.*

PRACTICAL GEOMETRY—APPLIED.

BY J. MANGNALL.

THE CONSTRUCTION OF SCALES

SCALES.—The scale is so called from a Greek word, which signifies a wooden measure of length, and is a mathematical instrument consisting of various lines drawn on wood, ivory, brass, &c., variously divided according to the purpose it is intended to serve, and is used for measuring straight lines, and laying down distances. Scales are denominated, according to their uses, as the plain scale, diagonal scale, plotting scale, vernier scale, &c.

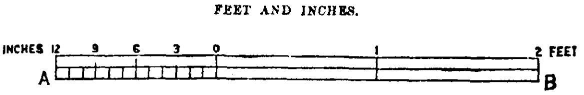
The most useful scales for mechanical drawing are the plain scale and diagonal scale, and to the construction of these scales we confine ourselves in this part of the series.

PLAIN SCALES.—Plain scales consist of any number of equal divisions and subdivisions, laid down with such accuracy that any drawing constructed by them shall be in exact proportion in all its details.

In the construction of scales, the subdivisions should be carried to as low a denomination as is likely to be required. Thus, for a drawing of limited extent, the subdivisions may be inches, and the primaries feet, but, for a drawing of large area, these subdivisions may each represent one mile, or one chain, or one foot, &c.; and the primaries so many tens of miles, or of chains, or of feet, &c. Therefore, the graduation of the scale must be determined by the natural size or extent of the object or area, and the space or surface to be occupied by the delineation.

NOTE.—In copying plans and drawings, it is often requisite to transfer a series of different lengths on one straight line, from the one plan to the other. This may be easily done with the compasses or scale, but, in practice, the following more expeditious and convenient method is preferred:—Place a thin strip of paper—with one edge cut accurately straight, and of sufficient length—along the line to be copied, and mark upon it the several divisions with a finely-pointed pencil; then, by placing the same upon the other line, the divisions may be transferred with great facility, and with sufficient accuracy for most practical purposes.

PROBLEM 104.—TO MAKE A SCALE OF ONE FOOT TO AN INCH TO SHOW FEET AND INCHES.



1.—Draw a straight line, **A B**, of any convenient length, suitable for the required drawing.

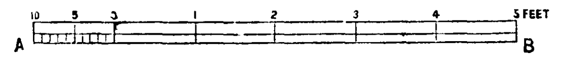
2.—From the point **A**, set off, on **A B**, equal distances of one inch in length, and, to make the points of division more conspicuous, raise small perpendiculars from each of them: these divisions each represent one foot, and are called the primary divisions; mark these divisions with figures, commencing at the second division, **1, 2,** &c., according to the length of the scale, and mark the first **A 0.**

3.—Divide the first division, **A 0,** into twelve equal parts, for inches (see Prob. 8), and figure every third division or inch as **3, 6, 9, 12,** counting the opposite way from **0,** to that of the feet. These divisions are called subdivisions.

To take a measurement of 2 feet 6 inches, from this scale, place one leg of the compasses on **2 B**, and the other on **6** (the sixth subdivision). Other dimensions are taken in a similar manner.

NOTE.—In subdividing a line, the operation may be performed with the greatest accuracy and least trouble, by using a sort of compasses called Hair-dividers; but, in cases where the divisions are so very small (as in the above case), a sort of dividers called Spring-compasses are preferable. This instrument has, from its principle of construction, a steadiness and firmness which cannot be surpassed, and its points can be adjusted to the smallest portion of space with an ease and nicety unattainable by any other form of compasses.

PROBLEM 105.—TO MAKE A SCALE OF TWO FEET TO AN INCH TO SHOW FEET AND INCHES.



1.—Draw the straight line **A B**, as before, and on it set off the required number of distances, each equal to half an inch in length.

2.—Figure these points or divisions, commencing at the second division, **1, 2, 3,** &c., according to the length of the scale, and mark the first **A 0.**

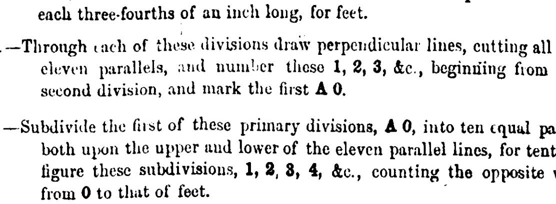
3.—Divide the first division, **A 0,** into ten equal parts, to represent tenths of feet, and figure the fifth and tenth division, counting the opposite from **0** to that of feet.

To take a measurement of 3.5, or 3 feet 5 tenths, place one leg of the compasses on **3**, in the larger or primary divisions, and the other on **5**, in the smaller or subdivisions.

DIAGONAL SCALE.—More minute subdivisions are frequently required than those obtained from a simply-divided scale, which give only two denominations—primaries and tenths or twelfths—so that any distance which is less than a tenth of a primary division cannot be accurately taken from them; but by means of a diagonal scale, the parts of any distance, which are the hundredths of the primary division, are correctly attained.

A diagonal scale consists of a number of primary divisions, one which is divided into tenths, and subdivided into hundredths, by diagonal lines.

PROBLEM 106.—TO MAKE A DIAGONAL SCALE OF THREE-FOURTHS OF AN INCH TO THE FOOT, TO SHOW FEET, TENTHS OF FEET, AND HUNDREDTHS OF FEET.



1.—Draw eleven parallel equidistant lines.

2.—Set off, on **A B**, the lower of these lines, a number of equal distances, each three-fourths of an inch long, for feet.

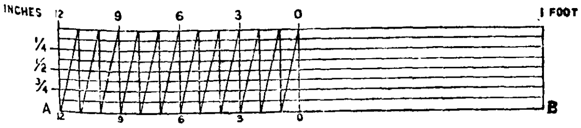
3.—Through each of these divisions draw perpendicular lines, cutting all the eleven parallels, and number these **1, 2, 3,** &c., beginning from the second division, and mark the first **A 0.**

4.—Subdivide the first of these primary divisions, **A 0,** into ten equal parts, both upon the upper and lower of the eleven parallel lines, for tenths; figure these subdivisions, **1, 2, 3, 4,** &c., counting the opposite way from **0** to that of feet.

5.—Draw the diagonal lines from the ninth subdivision above to the tenth below; from the eighth above to the ninth below, and so on. These lines divide each tenth again into ten equal parts at points in the horizontal lines, or one-hundredths of the extent of a primary division.

To take a measurement of 2.68—that is, 2 feet, 6 tenths, 8 hundredths—place one leg of the compasses on the primary **2**, and carry it down to the ninth parallel line, and then extend the other leg of the compasses to the intersection of the diagonal, which falls from the subdivision **6**, with the parallel that measures the eighth-hundredth part; or, on the parallel indicated by the third figure, measure from the diagonal indicated by the second figure to the vertical indicated by the first.

PROBLEM 107.—To make a Diagonal Scale of one and a-half inches to the foot, to show feet, inches, and eighths of inches, or the ninety-sixth part of a foot.



1.—Draw nine parallel equidistant lines.

2.—Set off, on **A B**, the lower of these lines, a number of equal distances, each one and a-half inches long.

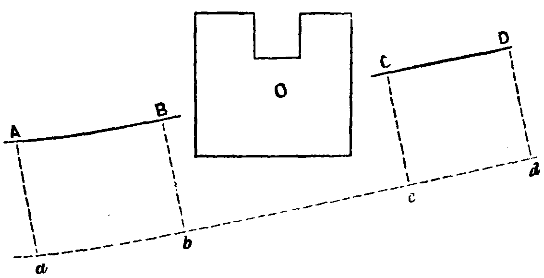
3.—Through each of these divisions draw perpendiculars, cutting all the nine parallel lines, and figure these **1**, **2**, &c., commencing always from the second division, and mark the first **A 0**.

4.—Subdivide the first of these primary divisions, **A 0**, into twelve equal parts, both upon the upper and lower of the nine parallel lines; figure every third division as **3**, **6**, **9**, **12**, counting the opposite way from **0** to that of feet.

5.—Draw the diagonal lines from the eleventh division above to the twelfth below, from the tenth above to the eleventh below, and so on, till you get from zero above to 1 below.

These lines divide each twelfth in eight equal parts at points in the horizontal lines, or one ninety-sixth of the extent of a primary division.

PROBLEM 108.—To produce a Given Straight Line beyond an obstacle which prevents the appliance of the usual means by which Straight Lines are drawn.



Let **A B** be the given straight line, terminated by an obstacle **O**, but required to be continued on the other side of the obstacle, as **C D**.

1.—Take any two points in **A B**, and from them erect perpendiculars to **A B**, and equal to one another, as **A** *a*, **B** *b*, and of such a length that *a b* produced will clear the obstacle.

2.—In *a b* produced, take two other points, *c*, *d*, beyond the obstacle, and draw *c* **C** and *d* **D** perpendicular to *a b* produced, and make each of them equal in length to *a* **A** or *b* **B**.

3.—Join **C D**, which is the line required.

Another Method.

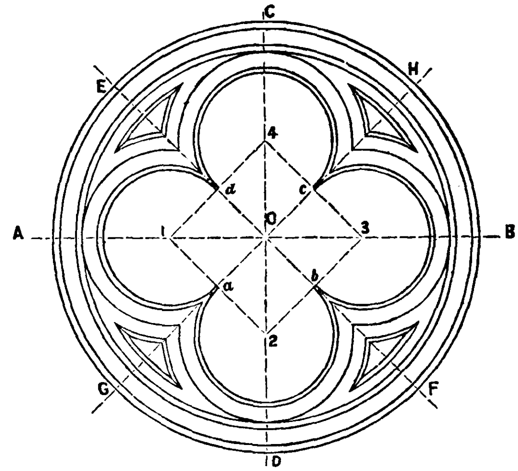
If the obstacle **O** be such, that two points in **A B**, as **A** and **B**, are visible from **C** and **D** (as in case of ponds or bogs), the proper position of **C** and **D** will be easily determined by placing the eye at **A**, so as to see **B**; and then an assistant, on the other side of the obstacle, places two marks or poles, **C** and **D**, moving them either to the right or left, until all four are in one straight line. In this case, **C D** being joined, will be the line required—that is, it will be in the same straight line with **A B**.

Note.—This Problem is very useful in Land Surveying, when you meet with buildings, bogs, ponds, &c., on a chain line.

QUATREFOIL.

A Quatrefoil is a piercing or panel formed by cusps or foliations into four leaves or lobes. It is much used in Gothic architecture, in the tracery of window panels, &c.

PROBLEM 109.—To construct the Quatrefoil.



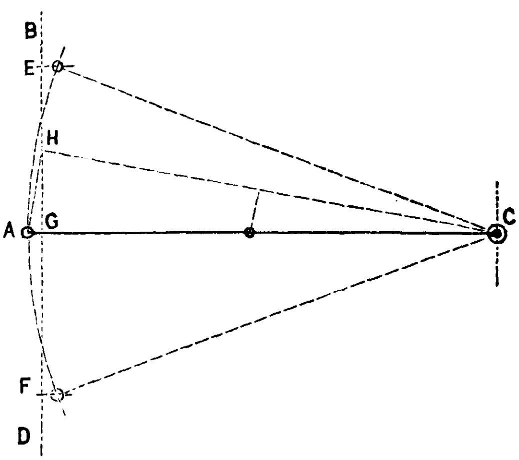
1.—Draw the lines **A B** and **C D** at right angles to each other, intersecting in the point **O**.

2.—About the centre **O** construct the square **1, 2, 3, 4**, having for its diagonals a part of the straight lines **A B** and **C D**.

3.—Bisect the sides of the square by the lines **H G** and **E F**, cutting the sides in the points *a*, *b*, *c*, and *d*.

4.—From the corners of the square, **1, 2, 3**, and **4**, as centres, with **1 a**, **1 d**, or half the side of the square, as radius, draw the arcs *a d*, *d c*, *c b*, and *b a*, and those concentric with them: the rest of the circles are drawn from the centre **O**.

PROBLEM 129.—Given the Line of Stroke of the Piston Rod, the length of the Stroke, and the Centre of the Walking-Beam or Lever, to find the Radius of the Lever, so that the End Centre will deviate equally on each side of the Line of Stroke.



Let **C** be the centre of the walking-beam, **B D** the line of the stroke, and **E F** the length of the stroke.

1.—Draw the straight line **C A**, indefinitely, and from **C** set off **C G**, the distance of the line of stroke of the piston rod from the centre of the walking-beam.

2.—Through **G** draw the straight line **B G D** at right angles to **A C**.

3.—And from **G** set off **G H**, a distance equal to one quarter of the stroke, and join **C H**.

4.—From **H** draw **H A** perpendicular to **C H**, cutting the line **C A** in the point **A**. **C A** will be the required radius.

(To be continued.)

Dry Earth and Earth Closets.

Probably no invention, or rather application, of so much importance was ever so neglected as that of the use of dry earth in the management of what, for the want of a better name, we call "night soil." The application of earth to this purpose is as old as the days of Moses; the invention consists in the apparatus for applying it, and for this, and for his efforts to popularize its use, the Rev. M. Moule, of England, is one of the world's benefactors. If the deposits which nature requires all to make, were simply unpleasant, and on this account were to be put out of the way as soon as possible, the use of dry earth would be an important one; but when it has been proven, as clearly as can be, that these deposits can cause and communicate disease, and that sickness and death may be traced directly to them in a neglected state, the matter becomes one of vital importance, and one which cannot be too often, or too earnestly, presented to the heads of every household. Col. Waring, who has given much attention to sanitary matters, has several times presented this matter in his articles, where they are more likely to meet the eye of the house-father than of the house-mother, and letters we receive asking for explanations, show that the subject is far from being generally understood by housekeepers. Let one travel among the rural population in any part of the country, and it will oftener than otherwise be found that the one neglected place on the premises is the privy; houses where the interior and mode of living of their occupants indicate comfortable means, refinement, and luxury, will often have for this most important out-building an affair which is repulsive to every sense, and a standing menace to those who must visit or pass near it. The necessity for a reform in this matter is too glaring to require argument; to neglect that which concerns both comfort and health, would be wrong were the better way difficult and expensive, but where, as in this case, the reform is easy and inexpensive, the neglect is doubly wrong. The principle is simply to cover the deposit with dry earth, and is not patented or patentable · various contrivances for accomplishing this, some of them very ingenious and useful, are patented, and where one can afford them, are desirable. But the absence of these need not deter any one from using the dry earth; the requirements are: a receptacle, dry earth, and some means of placing the earth on the deposit; this may be done by an automatic machine or by a simple scoop or paddle. The essential thing is the dry earth or its equivalent; sand will not answer so well; road-dust of a stiff, clayey, loamy kind, or similar earth scraped up from the surface of a field or garden, during a dry time, dried still further on some boards, sifted and stored under cover, is the best; the next best, and nearly as good, is fine coal-ashes, a material that every one who burns coal is desirous to be rid of. An ordinary outbuilding can be cleaned out, the vault filled up, and a box provided which has sled-runners, so that it may be hauled away when full; inside of the building should be a box of the earth or ashes, with a scoop or some kind of shovel; then if every member of the family *will use the earth* at each visit, the inexpensive arrangement will be as effective as the most elaborate; still those who can afford them will find the fixtures made for the purpose, in which the earth is thrown down by the weight of the person, much more sure and convenient. *Note.* The throwing of slops of all kinds into this or any other earth closet must be *absolutely prohibited*. Dry earth so completely absorbs all odors and emanations that a portable closet may be used in any convenient place in the house, and for invalids it is one of the greatest comforts imaginable. If one wishes to save expense, the matter may be greatly simplified. Provide a box to contain a receptacle, fitted with a seat and cover, also a smaller box, to hold the earth, tight, or lined with paper, to prevent sifting, with cover and scoop, these complete the affair. These may be made as ornamental as desired, or be provided with movable drapery. Several companies now make very excellent commodes in which there is a receptacle for the earth, which is let down by a pull as in an ordinary water-closet.

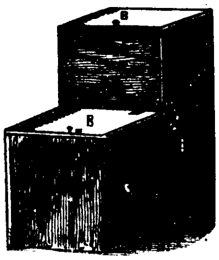


Fig. 1.—EARTH COMMODE.

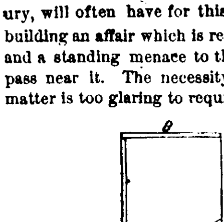


Fig 2. SECTION OF COMMODE.

Fig. 3.—EARTH DISTRIBUTER.

A Self-Acting Device for Shutting Gates.

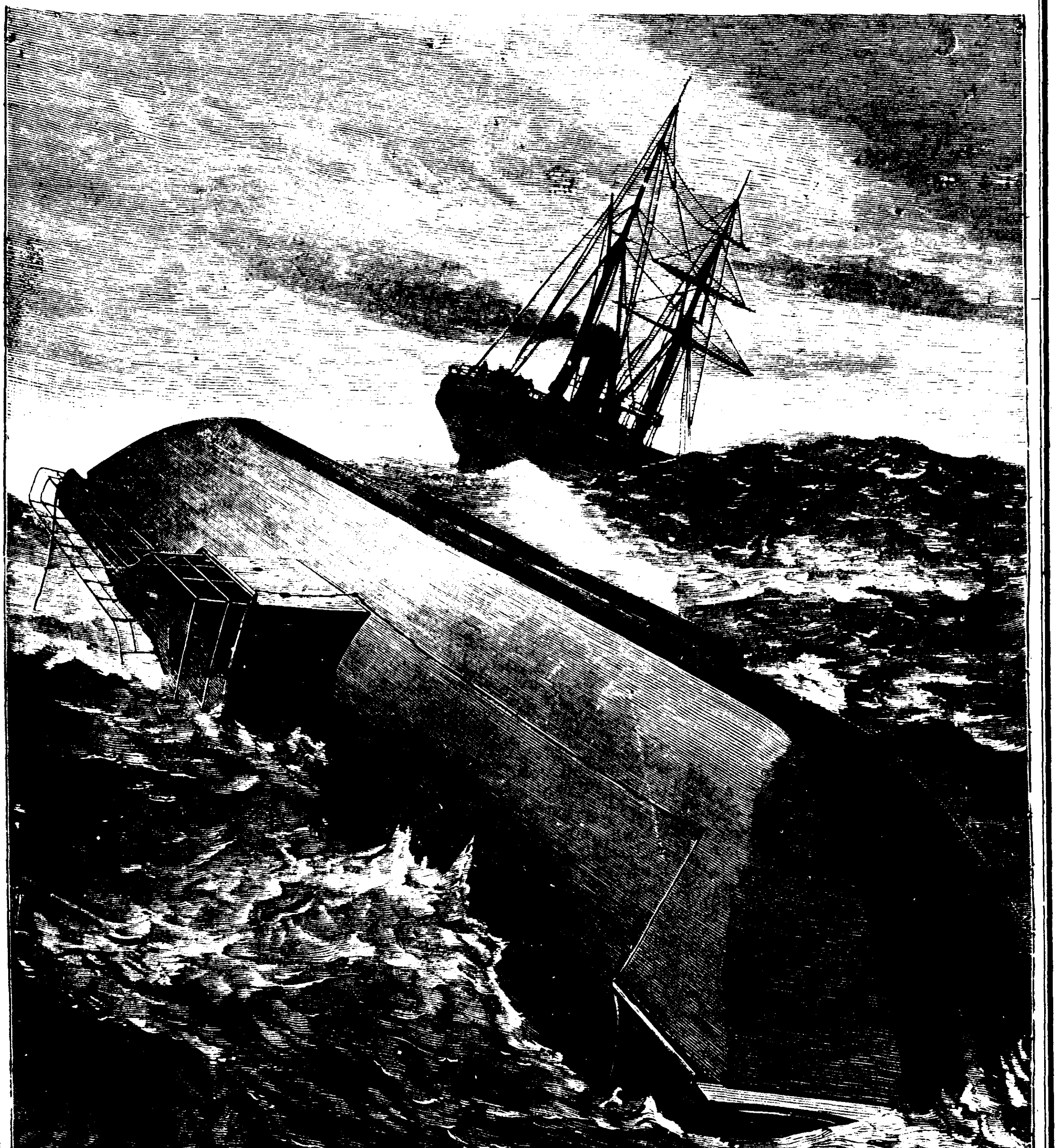
The following description, accompanied by a very neat drawing of a self-acting gate-closer, has We consider this more valuable than many of the patented appliances for gates, and expect it will be widely used.

CHANCE OF DEATH BY TRAVEL.—It takes the French to get up statistics. One of their learned men, skilled in that line, has demonstrated the great improvement which has taken place in the safety of travel in modern times. He says that in the old diligence days a man had one chance of being killed in 300,000 trips and one chance of being injured in 30,000. On the railway, between 1835 and 1855, there was one chance of being killed in 2,000,000 journeys and one chance of being injured in 500,000. From 1855 to 1875, one chance of being killed in making 6,000,000 journeys and one chance of being injured in 600,000. Now the chances of being killed are as one to 45,000,000 and of being injured one to 1,000,000. Consequently, a person traveling 10 hours a day at the rate of 40 miles an hour, would, in the first period, have a chance of escaping destruction during 321 years, during the second period during 1,014 years, and between 1872 and 1875 during 7,439 years.

DOSE FOR RATS.—A writer to the *Rural New Yorker* says: My method of ridding myself of rats in the cellar, or about the house, is to take a quantity of fined potash, (I use Babbit's) partially pulverize it, moisten it with water, so that it will form a sort of paste, and daub this about the bottoms of their holes and run-ways, so that they are compelled to step in it, in entering the premises. I have practiced this method for several years, with very satisfactory results. If the first application is not sufficient, it can, of course, be repeated with but little trouble or expense, and I am confident of favorable results. Such, at least, has uniformly been my experience since I first adopted the method, many years since. The theory is, the rats step in the moistened potash while entering. Its caustic nature produces a smarting sensation in the feet. He at once proceeds to lick his feet to alleviate the pain. The consequence is, a not-very agreeable sensation in the mouth. He is compelled to renew the application in going out—result, he does not care to renew his visit, and probably imparts good counsel to his associates, and the rat nuisance is at once abated. I prefer this method to the use of phosphorus, or any of the "rat poisons" recommended, as it is not always safe to have the latter around.

The Way To Make a Cheap Book-Case.

I HAVE just been making a cheap and neat book-case, which has cost only a few dollars. The case consists of two end pieces and two shelves, with movable shelves between the two rigid ones. The two end pieces are one and a quarter inches thick, eight inches wide and four feet high. Four inches from the lower ends, a shelf eight inches wide is neatly fitted into gains in the end pieces, and six inches below the upper ends, the top shelf is held in by other gains. Instead of nails, two large three-inch wood-screws were driven through the end pieces into the end of each shelf. The shelves are eight feet long. Between the two end uprights, two other upright pieces eight inches wide are fitted between the two rigid shelves, thus dividing the space between the upper and lower shelves into three equal spaces or divisions. Screws are put through the shelves into the ends of the middle upright pieces. Those sixteen screws hold the parts together with desirable firmness. The advantage of using screws instead of nails is, that in case it were necessary to transport the book-case, the screws could be taken out, the parts tied together firmly, and the book-case would occupy but little space, and the varnish would be marred less. Before the parts were screwed together, gains were cut in all the upright pieces to receive the ends of the shelves. I employed a joiner's dado to cut the gains. A dado consists of a small plane somewhat like a rabbet plane, with which a gain can be cut true and neatly, in about a minute. I made gains two inches apart in the upright pieces, so that the shelves between the bottom and top shelves can be adjusted to suit large books and small ones. After it was finished, the surface was sand-papered, after which a heavy coat of boiled linseed oil was laid on evenly. After a few days, the surface was again sand-papered, and two coats of shellac varnish were laid on, which gave the wood a beautiful and glossy straw-color. The lumber employed was white pine, but boards of any other timber, such as chestnut, butternut, tulip, basswood, sugar maple, or oak of any sort, would look beautifully if sand-papered and varnished with shellac. Such varnish can be procured at most paint stores. In case shellac cannot be procured conveniently, use any other good varnish. I procured three boards about eight inches wide, and one board sixteen inches wide, or as nearly that width as could be found, all sixteen feet in length. Hence the waste in making was small. I purchased fifty-five square feet, at five cents per foot, $2.75. Sixteen wood screws, 16 cents. Oil and varnish, 30 cents. The labor, nothing, as the case was made when I would have been doing nothing else. A book-case with glass doors, that would contain as many books as this cheap affair, would cost sixty to eighty dollars. How much more economical to provide a neat and cheap system of shelves and spend one's money for desirable books to fill it, than to appropriate a large sum for an expensive book-case, and then fill it with papers, pamphlets, and patent-office reports, because money is lacking to purchase books.



THE ABANDONMENT OF THE CLEOPATRA AT SEA.

In the annexed illustration is represented the scene of the abandonment of the obelisk vessel at sea in the Bay of Biscay during a severe storm. A heavy sea struck the craft, broke some of her rail ballast adrift, and left her with a strong list to starboard. Fearing that another sea would swamp the vessel altogether, her captain signalled for assistance and a boat's crew was sent to her, but the boat and all on board were lost. Further efforts were then made to take the Cleopatra's crew from their perilous position, which in the end proved successful, and the towing steamer "Olga" left the obelisk to its fate.

Within two days' time the "Fitzmaurice," a vessel bound from Middlesborough for Valencia, sighted the wanderer in lat. 44° 53′ N., long. 7° 52′ W., took her in tow and carried her to Ferrol, Spain.

It appears to be a very difficult question to decide where the obelisk shall be placed, and the advantages and disadvantages of different proposed sites for the Egyptian monolithe are being freely discussed by architects in England.

A SELF-ACTING DEVICE FOR SHUTTING GATES.

THE CHARACTER OF GOOD LIME MORTAR.

I.—*Its Constituents.* These, it is well known, are sand and lime. A word should be said upon each.

1st. *Sand*, as generally found, is silex—in other words, finely broken flint stone. It is found in beds, where it has been deposited by natural causes. Silex is one of the hardest and most indestructible of minerals. The sand of some beds appears under the microscope, very smooth, as though the particles had been recently rolled about in water. In other beds it is rough and angular. This last is the best for mortar, and is called *sharp* sand. The cleaner sand is the better, since clay or muck mixed with it unfits it to combine closely with lime. Its sharpness moreover enables it to adhere to the lime more firmly.

2d. *Lime.* Solid limestone rock makes a very durable material for building. But if we use blocks of it, or of rough stone or brick, we need something to cement the separate pieces together, so as to give firmness and beauty to the work. For this purpose we use lime and sand mortar more commonly than anything else. Pulverized limestone would not do this. We, therefore, burn the lime; this drives off the carbonic acid, which had before constituted the particles of lime into a solid rock. Adding water to freshly burnt lime, in the proportion of about one part of water to three of lime, slakes it, so that it falls into a fine powder, called hydrate of lime. This hydrate of lime very readily absorbs corbonic acid, and returns to a condition resembling pulverized limestone, when it is entirely unfit for mortar. Lime should therefore be used soon after being slaked.

II.—*The Preparation of Mortar.*

1st. Sharp, clear sand and fresh burnt lime being at hand, the first question is the proportion of each.

2d. The principle here involved is that no more lime should be used than is just sufficient to cement the single particles of sand into a solid mass. Mortar which is thus proportioned will grow hard quicker, and cause brick or stone work to stand firmer than that which has a larger proportion of lime.

3d. The reason is obvious. Mortar (beyond its mere drying in the air) hardens by the re-absorption of carbonic acid into the solid mass, where it gradually reaches each particle of lime, converting it into limestone. Well-made mortar, properly hardened by lime, thus becomes a sort of silicated limestone. The mortar as it dries rapidly, becomes porous, to the extent that it was once filled with water. The gradual absorption of carbonic acid by the lime, fills up these pores, constituting the whole into a sort of stone, as already observed. A native of Prussia once informed the writer that some fortress, built by the Knights of St. John, at the city of Thorn, presents this singular spectacle The bricks of which they are built have gradually disintegrated, especially at the corners, leaving the mortar like a honey-comb of rock, and so firm that persons are able to climb up by the insertion of the fingers and toes in the interstices once occupied by the bricks.

Poor mortar, as the masons sometimes call it, thus makes the firmest work, if the whole be done with care.

4th. Of the mixing of mortar, but a word need to be said. If the foregoing principles are correct, the mixing should be very thorough. It should be worked over and over again with the hoe, crin, or mortar mill, so that each particle of sand may be brought into contact with its necessary surrounding of lime.

May it not be inferred, also, that no more mortar should be put between wall faced stone and brick than is just sufficient to make them adhere, since a small portion will more readily harden by the absorbtion of carbonic acid than a large one.

Where lime is cheap, and there is no great need of firmness and durability in the structure which is being erected, lime may be used more freely, the mortar made more hastily, and the sand be less select than above directed. A large proportion of lime constitutes a mortar that is readily used, even when made in a very hasty manner.

The record of falling buildings shows, alas, that too many have been built under the spur of cheapness and haste, with the risk of the durability of the structure and the life of its occupants.

American petroleum is distributed to all parts of the world as the cheapest illuminator......The lamented Agassiz, located the oldest part of the world at the Trenton Falls, New York...... It would take four million years to distribute meteoric dust over the earth's surface in a layer as thick as this paper......

BUILDING IN CONCRETE.—Mr. S. W. Lincoln, an architect of Hartford, has been writing to the *Times*, of that city, about a house built of *beton*, at Port Chester, N. Y. Mr. Ward, a wealthy and enterprising manufacturer, decided about two years ago to have a house that would not burn readily, and he has succeeded in building it. The walls, partitions, floors stairs, cornices, columns, dormers, roofs, and balconies weighing nearly four tons, projecting four feet from the building, are all one solid indestructible mass. Iron girders, encased in beton, are used in the floors and roofs, forming deeply coffered ceilings; but Mr. Embler would ignore the use of iron entirely were he to repeat the work, as he deems the composition sufficiently strong for all practical purposes; and it is evident at a glance that he is correct. The iron beams used are in no case nearer than seven and a half feet between centres. A floor of eighteen feet span sustains a weight of thirty tons of cement, in barrels, without showing the least deflection. (This any one may see who may visit the building.) The roofs are the finest specimens of plastic construction ever seen in this country. A splendid circular colonnade, after the Tuscan order, is a noticeable and striking feature.

The building is two stories high, surmounted with a Mansard roof, with elegant dormer windows. There are two towers, the main one being nearly seventy feet high, and both in the Norman style, with heavy battlements. The reader must bear in mind that this is a structure of elegant and substantial proportions, with heavy medallion cornices, projecting balconies, tower battlements, gargoyles, and all the various forms of thorough construction demanded by good taste; but nothing is overdone, as solidity and simplicity are the prevailing characteristics throughout.

The outer walls are two feet thick, with circular flues running up and connecting with the spaces between floors and ceilings. All the main partitions are constructed in the same manner; and the design is to heat the building by radiation from the partition floors, and ceilings, as the heated air from the furnace is to pass up the partitions and form a general circulation through the air spaces, and return back to the furnace room without directly entering the rooms. This is an experiment, and if successful, will give the speculators upon heat and ventilation something to talk about. Ventilating ducts are carried up in the walls and partitions. Massive chimney pieces are to be constructed of the same material. There are partitions thirteen feet in height, one and two inches thick, firm as a rock. There has been but one thoroughly skilled workman besides the superintendent on the work from the start. This man has had charge of all moulds and forms for cornices, columns, etc. The cost, thus far, is one-half less than if built of cut stone, brick, and mortar.

No insurance will be needed; and this a solution of a vexed question. It will be asked, how has such a work been done? The answer is a simple one. Portland cement, clean sharp sand from Long Island, broken stone, carefully screened, mixed with water—and *brains.* That is about all there is to say, further than that there is no patent, as the materials are not stuck together with gum Arabic, as in the case of some patent stones. The entire substance of the building is nearly as hard as granite, and will take a polish quite like it, as the experiment has been tried.

Heat and Force Produced by the Explosion of Nitro-Glycerine.—The temperature developed by the explosion of nitro-glycerine, has not as yet been determined with accuracy; but as the combustion in the case of gun powder is nearly perfect, the elevation of temperature produced by the explosion of the former is certainly much greater than that of the latter, perhaps more than twice as great.

A volume of gun powder produces, at the ordinary temperature, 190 volumes of gas. Owing to the heat produced, this gas occupies about four times the above mentioned volume, or about 760 volumes of gas are produced immediately after the explosion. A volume of nitro-glycerine produces 1,300 volumes of gas at the ordinary temperature, and admitting that the heat produced by the explosion is two and one-half times that produced by gun powder, this volume would be increased to 13,000 volumes. The force of nitro-glycerine is nearly thirteen times as great as that of gun powder, but on account of the energy of the combustion, the action is still further increased. —*Revue Industrielle*, viii. 458.

A Diamond Drill is to be started on the 1,000-foot level of the California mine. The object is to find out what lies to the eastward. The east clay wall has never been found anywhere beyond a point 200 feet north of the south line. The

THE SHORT-HORNED COW TENTH DUCHESS OF GENEVA.

We copy from the London *Graphic* a fine portrait of a celebrated shorthorn cow, Tenth Duchess of Geneva, whose personal and family history is somewhat remarkable. Tradition ascribes the origin of the family to a breed of cattle possessed for centuries by the family of the Duke of Northumberland, but the actual records commence in the last century, when an ancestress of this cow passed into the possession of Mr. C. Colling, of Ketton, Durham, who was one of the founders of the short horn as a distinct and highly improved breed. In 1804 Mr. T. Bates, of Kirklevington, Yorkshire, purchased one of the Duchess cows, and recognizing in her excellence and that of her male offspring the superiority of her family over the shorthorns he had previously owned, he determined to secure more of her sort; and at Mr. Colling's great sale, in 1810, when forty-seven animals of both sexes and all ages, from eleven years downward, made the then unprecedented average of $832.84, he gave $929.64 for the two year old young heifer Young Duchess, afterwards called First Duchess, a daughter of Comet (sold on the same occasion for $5,080), and grand-daughter of the cow he had first purchased. From that heifer, to the female line direct, sprang those Duchesses which have at different periods won the chief honors of the Royal Agricultural Society of England, and for many years past have commanded the highest prices at public and private sales. Mr. Bates, while practicing to a considerable extent the system of in-and-in-breeding, crossed his Duchesses at different times with other approved shorthorn families, notably with those of Mr. Colling's Red Rose and Princess, thus combining what he considered three of the oldest and best shorthorn families in the kingdom. In 1853, at the Totworth sale (after the death of Earl Ducie), Sixty-sixth Duchess was bought by Messrs. Becar and Morris, of New York, for $3,557.40.

Her descendants, having changed owners in America, were finally disposed of by auction in 1873, when Tenth Duchess of Geneva was bought by Mr. Berwick for the Earl of Bective at $35,000. She had bred in America the bulls Third Duke of Oneida, Sixth Duke of Oneida, and the heifer Eighth Duchess of Oneida, bought also for Lord Bective, at the same sale, for $15,000. In this country she has produced the bull Duke of Underley and the heifers Duchess of Underley and Duchess of Lancaster, all of which, with Eighth Duchess of Oneida, are now in the herd at Underley Hall, Westmoreland. The Tenth Duchess of Geneva died in January last, and in the same month the Earl of Bective had the misfortune to lose his old bull Second Duke of Tregunter.

THE BANDED CHERSYDRUS.

The achrocord or banded chersydrus is a curious aquatic serpent found in the bottoms of marine creeks and mouths of rivers on the borders of the sea, in the vicinity of Malacca, the bay of Manilla, Coromandel, Java, Sumatra, New Guinea, and generally along the coast of southern Asia. The fishermen frequently catch them on their lines, not willingly, as the fangs of the reptile are provided with a deadly poison. It is distinguished from other serpents by being almost entirely free of scales. The body is covered with grain-like particles inserted in the thin and wrinkled skin. Those on the back project slightly in the center, and those on the stomach are pointed. The median line is marked out by two or three ranges of scales placed at angles. The nostrils can be closed with a membraneous fold. The tail is flat and compressed, resembling an oar blade. The body is generally banded with black and white oval rings, the tail is spotted with white, and the small head is brownish. Some specimens have yellow or brown bands. They are classed by some among the sea serpents, and by others among boas.

TEMPERING THIN TOOLS.—To temper files, ratchets, etc., the best method is to heat them to a red heat, according to the nature and quality of the steel, on a small iron shovel, and to turn the piece on to a plate of steel or iron, which is at least a centimeter in thickness; then cover quickly with another plate of the same thickness. If the operation is well performed a very good tempering will be obtained.

ACCORDING to letters received in Valparaiso, there has been a grand discovery made at a place a few leagues from Arequipa. The discovery consists of a rich vein of gold and silver ores. It is said the vein is some seventy metres in length, and broader than any vein of metal yet discovered in the world. The lay of the ore is four ounces to the cajon, and according to assays made in Copiapo of samples remitted there, some of it reaches fifty ounces. Seventy-one quintals of the metal sold in Arequipa are said to have produced 20,000 soles.

TO REMOVE rust from steel, cover the metal with sweet oil well rubbed in; 48 hours after rub with finely pulverized unslaked line.

TO COAT iron with emery, give the metal a good coat of oil and white lead; when this gets dry and hard, apply a mixture of glue and emery.

FONT IN THE PROTESTANT CHURCH, BREDA, HOLLAND.

(See page 37.)

We have from time to time had occasion to mention the Protestant church, formerly the cathedral, of Breda, in North Brabant. It is not our intention now to give any descriptive account of this edifice, but simply to call the attention of our readers to the remarkable font which forms such a beautiful feature in this very interesting church. This font, as will be seen from our illustration, is a fine example of the Early Renaissance style of the Low Countries. It is entirely composed of brass, and is gilt both over its external surface and in the interior of the bowl. The workmanship is remarkably delicate, and the arabesques of the pilasters are worthy of an Italian. There can, however, be no doubt but that it is a work of that splendid school of architects and workmen who produced the stalls at Dortrecht, the side screens at Bois-le-duc, the high altar at Venloo, and other works of a similar character.—*Builder*.

PLAUSIBLE THEORY OF STEAM BOILER EXPLOSIONS.—At the meeting of the National Academy of Science, an apparatus was exhibited at work which proved that steam might be decomposed by simple heat, into the constituent gases of water—oxygen and hydrogen. The heat employed was a little over ordinary redness, but did not reach whiteness. This experiment is of the highest value, as illustrating a possible cause of boiler explosions. The apparatus was beautifully simple—a flask in which water was heated, a tube conveying the steam into a closed platinum crucible, where it was again heated by a spirit lamp, and a tube thence carrying the super-heated steam and the liberated gases to an ordinary pneumatic trough, where the mixed gases were collected in a test tube, while the steam was absorbed. At the conclusion of the experiment, the gases thus collected were exploded by a lighted match, showing beyond question that they were the components of water. The experiment indicates that this explosive mixture of gases may be found in a steam boiler. But it can only result from the most culpable carelessness. The boiler must, at least in part, be raised to a full red heat. Then cold water must be injected, for so long as steam and the gases are mixed the latter cannot explode. The injection of water must condense the steam in the boiler before it cools the red-hot iron. All these conditions being fulfilled, an explosion of the gases may take place. Whether an engineer, on trial for homicide, caused by the explosion of a boiler under his care, will ever allege such a set of circumstances in excuse for the accident remains to be seen. It would need a shrewd lawyer to make a jury believe that such an explosion was an unavoidable accident.

STORKS EATING YOUNG RABBITS.

Our engraving represents a hungry stork making his breakfast off of an unfortunate young rabbit. It is not often that the bird captures such large prey, but probably, while searching the thick grass with its bill partly open, as is its curious habit, it encountered the rabbit and pounced upon without stopping to consider the difference between young rabbits and field mice. The latter, together with snakes, toads, frogs, and large insects, constitute the stork's ordinary food. The unhappy victim is not gorged instantly, but is carried off to the margin of some pond where its captor shakes it and beats it with its bill until it is reduced to a proper condition for easy swallowing. Then the meal is dispatched in a gulp or two, and the bird, which possesses an enormous appetite, resumes its hunting. The stork's favorite food is eels, which it captures with great dexterity. No spear in common use for taking that fish can more effectually secure it between its barbs than can the stork's mandibles. A small eel, despite its lightning movements, has no chance of escaping when once aroused from its lurking place by a stork.

In Europe the stork attaches itself to man and his habitations, building huge nests on tops of houses, and tamely walking round the streets. It especially parades about fish markets, where it finds no lack of subsistence in the offal.

CHEAP FUEL.

The recent rise in coal has caused considerable excitement among steam users, and the old question comes up again, "What can we use to reduce the price of fuel?" The *American Manufacturer* says: Coal screenings are becoming more in use, and with a small mixture of bituminous coal can now be burnt without using a blast under boilers set with the Jarvis furnace. For years attempts have been made to utilize immense fields of peat in the New England and Middle States. To do this it was necessary to carefully cut it in squares and dry it. Machinery was invented to do this, but the cost of cutting and drying was so large, especially the long time required in drying, that at the present time the matter has been generally abandoned. Recent experiments have been made with fresh dug peat wet from the meadow, without even cutting in squares or drying, and it has been found that with a small mixture of coal screenings or soft coal this can be used under boilers set with the Jarvis patent furnace without using a blast. It makes an immense heat with very little smoke. Before, in burning dry peat it was found that the gases would fill up the flues, but in the Jarvis furnaces these are fully utilized by the hot air supplied on the top of the fires, and the flame varies from white to a clear green colour.

Swiss Patents.—The *Public Ledger* says in an article upon the subject of patents in Switzerland, that public sentiment in Switzerland is beginning to look with favor upon patent laws, and a loss of a good deal of their watch-making trade, mainly because a Swiss inventor could not be protected, has caused a considerable feeling on the subject. Federal Councillor Droz has prepared a bill for a patent law, which has been published in the Swiss journals, and is thus presented to the people. Patents of importation will be granted to inventors living abroad only on the principle of reciprocity. The maximum duration of a patent is to be 15 years. An application fee of 30 francs will be charged, and an annual fee of 30 francs each for the second and third years. Every subsequent year a surcharge will be levied at the rate of 20 francs more than the amount paid in the preceding year. If the inventor refuses to admit the use of his invention by voluntary agreement, the question may be submitted to the Federal Tribunal. The Federal Patent Office may, under certain conditions and circumstances, declare a patent void or withdraw it. The Patent Office is to be composed of three permanent members, elected by the Federal Council for six years, and several examiners. The Patent Office must transmit the appeal of an applicant who gives serious reasons for impugning the decision by which his invention was refused a patent, to a court composed of at least three examiners, among whom must be none who made the first examinations. The applicant may appeal from this court to the Federal Tribunal, which, hearing fresh experts chosen from Switzerland and abroad, gives the final judgment. No additional fee is charged for an appeal against a first decision. The judgment of the Federal Tribunal is always accompanied with the costs of the appeal.

GRAFTING.

What is Grafting?—Almost every one knows that a cutting, or piece of the stem, of many plants, if placed in the soil, will take root, grow, and become a new plant. In grafting, we take a piece of a stem, and instead of putting it in the soil, we plant it in the branch of another tree. Let us saw off a branch of an apple tree, and take a twig, say as large as a lead-pencil from another apple tree, whittle the lower end of it to a chamfer, or half of a wedge, for an inch or more, then carefully, by means of a wedge, push the bark of the branch away from the wood, and slip the twig with its cut part innermost, between the bark and wood, cover all the cut parts with some kind of an air-tight plaster, we shall essentially plant the twig on the branch. It will not take root, but wood will form and unite the two, putting the twig in communication with the roots of the tree. This is one kind of grafting, but a kind not suited to general use, though it illustrates the principle.

Why do we Graft?—To plant twigs of a kind of fruit that we know and want, upon the roots of a kind that we know nothing about, or of an undesirable kind. In the nursery, seeds of unknown kinds of apples, pears, etc., are sown; if these were allowed to grow up, they would in ten or more years bear fruit, but very likely poor fruit, and each seedling different. The nurseryman takes up these young trees, cuts them off nearly to the root, and grafts, or plants on them a twig of a well tested and valuable kind. This is the usual way of making apple trees in the nurseries. If the seedling tree is allowed to grow up and branch, then a graft may be put in each branch, all the rest of the tree being cut away, allowing one growth from the grafts to form the head.

What is needed in Grafting?—Several things. *1st*, Something to graft upon, which is called the *stock*, whether it is a year-old seedling, or tree 20 or 30 years old. *2nd*, The graft, or cion, which should be of a desirable kind of fruit. *3rd*, Some air and water-proof material, to cover the wounds that must be made, until they heal over. *4th*, The tools for doing the work, and, *5th*, the knowledge and skill to use the tools. Let us notice each separately:

The Stock.—At this time we will notice only the grafting of old trees, or those that have reached a considerable size. A tree that is only one or two inches through, may be cut square off and grafted, at the hight of 3 or 4 feet from the ground. Large trees must not be renewed all at once, but the operation extend over two or three years, grafting the branches near the centre first. Select branches with a space free from knots, and from 1 to 4 inches thick.

The Cions are best cut in early winter, but may be taken at any time before the buds swell, keeping them cool in damp sawdust or sand, until wanted. They should be straight, healthy twigs, of the previous season's growth.

Covering Material.—Several kinds are used; we give that which we have found to be the best and least trouble, which is waxed cloth. Melt together beeswax, 3 parts; rosin, 2 parts, and tallow, 2 parts, in an iron skillet kept for the purpose. Melt very gradually over a slow fire, and stir together thoroughly. Some old muslin or calico will be needed, an old dress or sheet will answer, if so much worn that it will tear easily. Tear this into strips ½ to ¾ inch wide, for small work, up to an inch for larger, or the strips may be two or more inches wide, to be torn smaller, as needed; they may be as long as the material will allow. Wind the strips on a stick, as seen in figure 1, laying it on regularly, and removing any loose threads, as the winding proceeds.

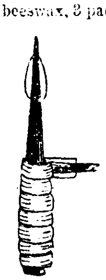


Fig. 1.

When one strip is wound on, take another, putting its end *under* that of the first strip, as seen in figure 1; this saves much trouble in unwinding. When the roll is of convenient size, about 2½ inches through, fasten the end of the last strip with a pin. Furnish the end of the stick with a wire, to hang it by. Have the melted wax ready and put in the roll of cloth, keeping the wax hot enough to be liquid and penetrate every part of the roll. When the roll is thoroughly soaked through, hang it up over or near the stove, and allow it to drain, catching the drops in the vessel. When it no longer drips, hang it away to cool. Prepare what rolls may be needed, as, if kept away from the dust, the waxed strips will keep for some months. Also keep the wax in the skillet covered.

The Tools required are: a saw with fine teeth, set rather wide; a strong knife, and a smaller one, both very sharp, a wedge of iron or hard wood, a wooden mallet, and, if much work is to be done, a grafting knife or chisel, fig. 2. This has a thin blade and a

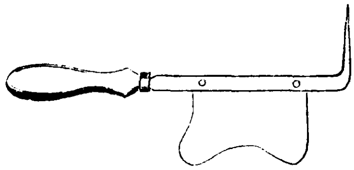


Fig. 2.—GRAFTING KNIFE.

strong back, the end of which turns up to form a wedge; the use of this knife will be shown presently. The wax strips, a lump of tallow, and some old cloths, for wiping the hands, may be included, which can be carried in a basket, unless one has *An Orchard Box*, which will be found very convenient to hold all the implements required in

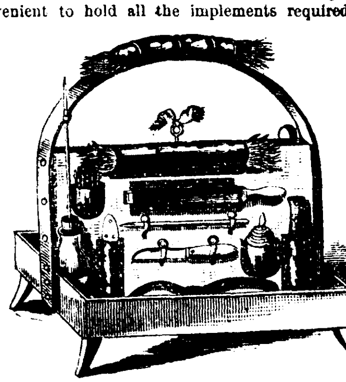


Fig. 3.—ORCHARD BOX.

working among trees and vines in the orchard or fruit garden. Figure 3 shows a box, from a drawing sent several years ago, by a very ingenious correspondent in Pennsylvania, and holds all the appliances required in pruning, grafting, budding, and the like. It is a shallow box on legs, with an upright partition under the handle. Some pouches and loops of leather and springs of hard wood keep the things in place. This box shows a lot of bass-strips, wrapped in oil-cloth, on the handle; on the partition is another case of strings, a pouch of grafts, a bottle of shellac varnish, (see notes for last month,) a heavy knife, and two smaller, with a hone to sharpen them, a roll of waxed strips, a pencil, etc. The saw, mallet, grafting chisel, labels, and other needed articles may be put in the bottom of the box. We have found a shallow basket, fitted with partitions, very useful in the garden, and any handy person can fit up a box or basket, according to his work, that will save much running for and search after tools.

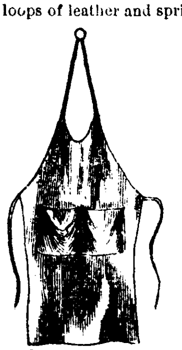


Fig. 4.—APRON.

An Apron will be useful; figure 4 gives a pattern for one, with pockets at the breast, which will come handy when working in the tops of trees. The stick of waxed strips may be hung from a button above one of the pockets.

When to Graft.—The best time is when the stock is just starting into growth, as shown by the swelling buds. If grafts are set before this, they are exposed to drying winds long before any union can take place with the stock. Peaches at the North do not succeed well when grafted. Plums do so fairly, when done very early. Apples and pears may be grafted from now up to blossoming time, but great care is required in later working.

The Kinds of Grafting are many, some curious kinds being given in the French works on the subject. We can now give only the two most in use, one for small, and the other for large stems.

Budding differs from grafting in being done with a single bud, instead of a cion with several buds, and late in the season, when the buds have formed.

The essential point in grafting is to bring the inner barks of stock and cion into as perfect contact as possible. The growth of woody stems takes place between the wood and the bark; the wood increasing by layers on its outside, the bark by new layers on its inside; here then is the place where the work is going on, and new wood is formed to unite the cion with the stock. In every style of grafting, this part of the cion must touch somewhere — and the more the better—a similar part in the stock.

Fig. 5.

Splice and Whip Grafting.—If the cion and stock are of precisely the same size, and each is cut with the same slope, (fig. 5,) and the cut surfaces put together and bound, it is evident that the growing parts of both will have a wide contact, and be very sure to grow. The difficulty with this, the "splice graft," is, that the parts are easily displaced. After cutting the slopes, as in figure 5, split each cut surface, as in the right hand of figure 6, then put them together, as shown at the left hand, and we have the "whip graft," one of the most servicable kinds for small work. The notches not only help to hold the parts firmly, but increase the surfaces in contact, and will rarely fail. If the stock is larger than the cion, if the parts on one side are carefully brought together, it will succeed, and may be practised on stocks even an inch thick. Only a sharp knife is needed for this.

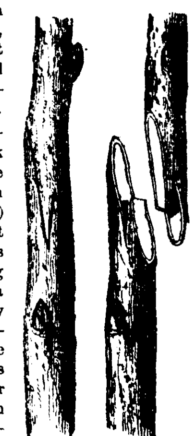


Fig. 6.

To Wax this Graft.—Tear off a piece from the waxed strip, and, beginning well below the cut, wrap each layer slightly lapping the one below, as seen in figure 7, putting on the cloth so that it will adhere closely to the bark and to itself; after winding, slightly grease the thumb and finger, and smooth the waxed strip, rubbing in the direction of the turns, this will blend the whole into a perfectly water-tight and air-tight covering. But most frequently we have the stock larger than the cion, especially in grafting over old trees, and then use the oldest kind of grafting.

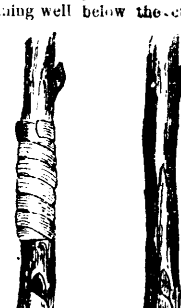


Fig. 7.

The "Cleft-graft."—Saw off the branch of the stock, being careful not to tear the bark; pare the cut surface smooth with a strong knife. If the stock is an inch or less in diameter, cut away about half with a slope as in figure 8. Then, by means of a strong, thin knife, or the grafting knife, and a blow of the mallet, make a split across this slope. Prepare the cion, which may have 2 to 4 buds, by whittling it to a long even wedge, as in figure 9, beginning at a bud (*A*) and tapering to an edge, making one side of the wedge somewhat thicker than the other, as seen in the section at *B*. Open the split in figure 8 with the point of a knife or a wedge, and insert the cion, as seen in figure 10, taking care that the vital parts, as before, come in contact, leaving the bud, *A*, just above the top of the stock. This bud is not absolutely necessary, but it is a center of active growth, and increases the chances of success. The slope in the stock is made because it will become covered with new wood and bark, and heal more completely than a cross-cut. When the stock is two or more inches across, two cions may be put in; the stock being sawed square across and trimmed, is split as in figure 11, with the grafting knife (fig. 2), the curved edge of which cuts the bark before the wood. The cleft is sprung open by means of the chisel point of the knife, while the cions are being inserted, and when they are in place (fig. 12), this is taken away, and the springing together of the cleft holds them firmly.

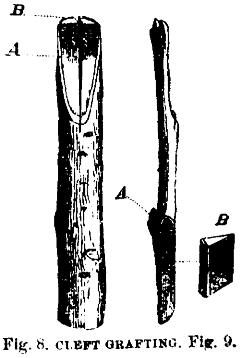


Fig. 8. CLEFT GRAFTING. Fig. 9.

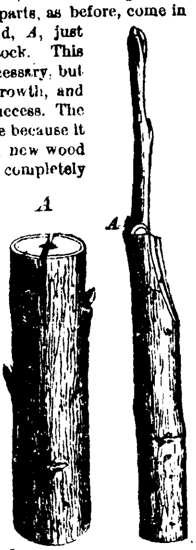


Fig. 11. CLEFT. Fig. 10. CLEFT GRAFTING.

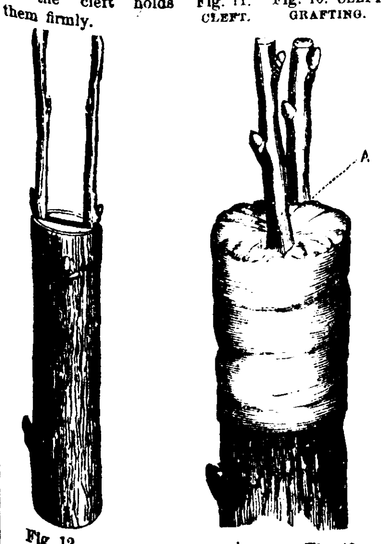


Fig. 12. TWO GRAFTS. Fig. 13.

To wax this graft, take a strip of the waxed cloth an inch or more wide, begin below the cleft, and in two or three turns bring the edge sufficiently above the stock to lap over and cover the cut surface; having the part around the stock closely applied, bend in the free edge to cover the top, tearing it if need be, to fit around the cions; if any portion of the cut surface of either stock or cion is exposed, tear off small bits of the cloth to cover every part; finally, smooth and blend the covering together by passing over it the greased thumb and finger. When finished it will appear somewhat as in figure 13. It is well to put a bit of waxed cloth on the top of the cions, to prevent the cut surface from dying.

The Wholesomeness of the Orange

Julia Colman, Superintendent of the New York cooking school, gives the *Phrenological Journal* the following: Not a few of those who wish to be careful as to the quality of their food have doubted the wholesomeness of the orange as it is found in the markets. A fruit, they have said, which is picked so green and kept so long can not be very desirable food. These queries, however, have mostly died away before the experimental proofs of its wholesomeness. Invalids and all sorts of well people eat of it freely without known ill effects. Many have gone to the other extreme and attributed to it health-giving properties, which they deem almost marvelous. For example, it is said to be a sort of insurance against disease to eat two oranges before breakfast for three months in the spring, say from March to May inclusive. We admit that such a course, if generally pursued, might turn many doctors out of employment.

Another prescribed use is to cure a longing for alcoholic drinks. The sufferer must eat an orange the first thing in the morning. We have faith in the remedy, so far as it goes, but to make it effective the subject must earnestly desire to give up the drink, be determined to do so, and then the orange will be a natural help to quench thirst, to aid in healing the stomach and to induce a wholesome tendency in the system generally. This much ought to be understood to prevent any one from supposing that it acts like a charm or philter to take away the unnatural craving. That will return again and again for some days, and if the subject understands this, instead of being discouraged, he will take another orange, and calling all the moral and social aid he can command to his help, he will be much more likely to succeed.

If in hot, unhealthy countries generally, men would eat an orange in place of drinking a glass of gin, brandy or other alcoholic liquor, the result would be most advantageous. And if some juicy fruit were eaten always in place of taking unwholesome water or any other drink whatever, the malaria of the worst localities might become almost harmless. If the water be wholesome, oranges or other fruit juice mingled with it makes it very much more satisfactory, both in taste and results. If we took half the pains to provide ourselves with fruits that we do to provide ourselves with alcoholic drinks, we should soon see a beneficial change on the face of affairs.

A SUBSTITUTE FOR TIN.—It is stated that columbium has been found in large quantities in Marion, U. S., and in the Amazon stone of Colorado. In color it stands midway between nickel and tin. It can be applied to the surface of other metals like the two just named, and the *Manufacturer and Builder* prophesies that we shall soon hear of columbium-plating. It is slightly lighter than tin, and in its chemical properties, while somewhat similar to the latter, are more nearly allied to those of bismuth and antimony. At present there is little immediate prospect of its becoming an article of commerce. But we must remember that aluminium was not many years ago as little known and rarely seen as columbium, *alias* niobium.

LOST FREIGHT.—The item of lost freight in rail road affairs amounts to a good deal in the course of a year. The Pittsburg, Fort Wayne and Chicago road employs four clerks to look after lost freight. Much of it is found and restored to owners, but the losses in one year to the road amount to about $20,000. This includes goods of all kinds, principally boots, shoes, and the finer grades of dry goods.

DOSE FOR RODENTS.—The following cheap and simple method is said to be used in Germany: A mixture of two parts of well-bruised common squills and three parts of finely-chopped bacon is made into a stiff mass, with as much meal as may be required, and then baked into small cakes which are put down for the rats to eat. Several correspondents of the *German Agricultural Gazette* write to announce the complete extirpation of rats and mice from their cow-stalls and piggeries since the adoption of this simple plan.

MATHEMATICS AND MEDICINE.—Mark Twain, in *Atlantic* for November, says: Among other talks to-day, it came out that whale ships carry no doctors. The Captain adds the doctorship to his own duties. He not only gives medicines, but sets broken limbs after notions of his own, or saws them off and sears the stump.

The Pernicious Habit of Drinking.

An English physician, Dr. Duckworth, writes as follows: "Medical men may fairly tell the healthy, robust, well-fed and well-housed to give up stimulants if they fully maintain their health without them. Total abstainers are generally large eaters, and the ultimate textural effects of excess in eating or drinking, if any, may not be very dissimilar. I think it is proved that the addition of a little alcoholic food to a meal secures a more moderate ingestion of solids, and where it agrees, which it does not always, promotes a more satisfactory digestion of them. But a large number of persons suffering chiefly from dyspepsia or insomnia are better without stimulants of any kind. A daily allowance of alcohol is manifestly wrong; more to-day and less to-morrow may be needed or instinctively called for. The rational individual must honestly and conscientiously find out for himself what the special needs of his system are, and where a right-minded christian individual is in earnest in such a matter and has a proper control over his appetite, he is not likely to go far wrong in the matter of stimulants.

"Medical men should urge teetotalism upon the nervous classes of drunkards, persons who are careless and self-indulgent or who by their lives or callings are much in the way of drink. Stimulants should be always taken at meal times, and only then.

"I am confident that, as a body, our profession is unanimous in condemning the modern American habit of taking odd glasses of stimulants at all hours and laments the grievous multiplication of the means of gratifying this mischievous custom, for truly the conduct of masses of young business men in our cities and large towns in this respect is becoming disgraceful and the practice is fast gaining in other circles and communities. Our countrymen of these classes have no excuse for this, for they are well-fed and have liquors with their meals in addition to their hourly drams, while Americans, who are notoriously the worst dietitians in the civilized world, are water-drinkers at meal time."

SOLDER AS AN AID TO CHUCKING.—Prof. Sweet in his last talk on lathe working in the *Polytechnic Review* gives the following hint: Very few machinists appreciate the advantages gained by the use of a little solder. Often irregular pieces can be soldered to a block or casting, and chucked easily; and after finishing, a little heat melts it loose. I have seen various straps, bolts and clamps put around the two halves of a brass box to hold them for boring out, when the application of a little solder would have held them together like a solid box. It is well enough to remember that if you have a piece of work which you can neither chuck on the lathe nor hold in the vise, to solder it to a piece you can hold. In setting work in a four-jawed chuck, much time is saved in adjusting it first in one direction, that is by adjusting the first and third screws, entirely disregarding the other two; then when the piece is true in one direction, turn to the second and fourth screws and adjust these in like manner.

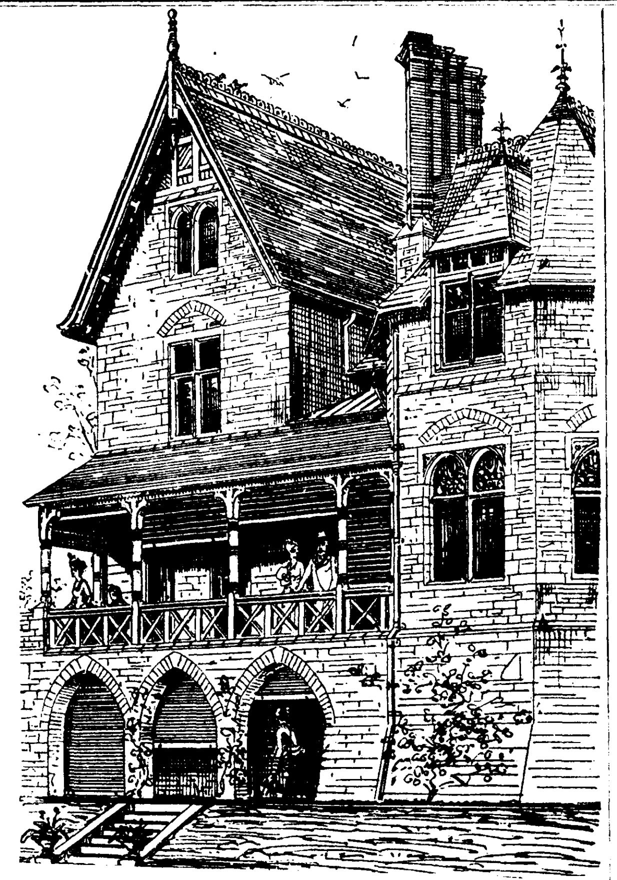


Fig. 1.—Application of the Self-Coiling Venetian Shutters.

SELF-COILING VENETIAN SHUTTERS.

(FOR FIG. 2, SEE PAGE 38.)

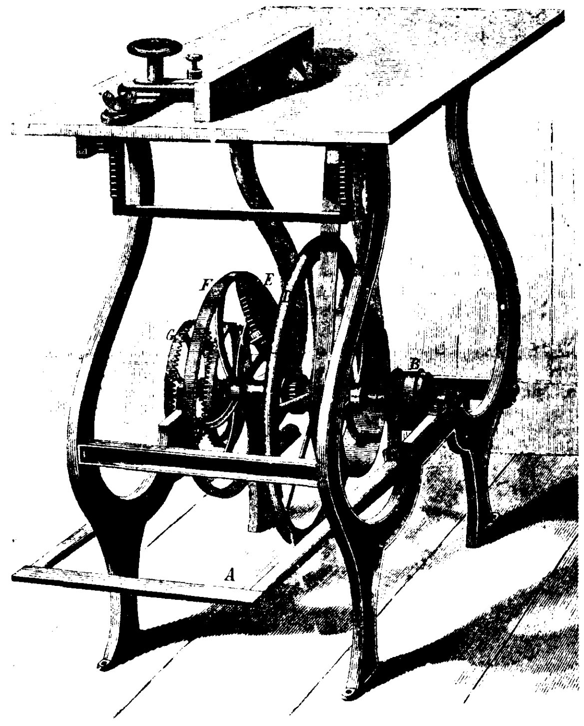
The engraving (Fig. 1) which accompanies this article represents a solidly built summer residence, the piazza of which is provided with Wilson's self-coiling and rolling Venetian shutters intended to show the great advantage to be derived from such an arrangement, as it enables one at once to convert the piazza into a private room, keeping out sunshine, heat, and winter cold, and at the same time perfectly safe against burglars.

The slats of these shutters are ⅝ of an inch thick ; for inside blinds ⅜ of an inch is sufficient, as for these such great strength and durability are not required as for outside blinds. It will also be seen how the basement door and windows may be provided with similar blinds.

These blinds, of which we represent a section in Fig 2, are an admirable substitute for those more ordinarily in use for windows, vestibule doors and piazzas, and are as elegant as useful. They adorn a dwelling-house, and are of no mean effectiveness as an obstacle to burglars. They are durable, simple in action, and are operated with ease and rapidity. They are composed of diamond-shaped slats, strung together on metal wire or bands, leaving a space between each slat, so that the air and light can penetrate freely. They coil on spring rollers, above or below, can be fitted inside or outside, and can in either case be worked from within. It is often a trying experience to close the average outside blinds in a driving rain or snow storm. All such difficulties are obviated by the use of these rolling blinds. When drawn down and fastened, they cannot be opened without violence from the outside, forming an effective protection against sneak thieves.

We need not add that if made of steel, they offer the utmost protection possible against burglary and fire, and we only wonder that more persons able to pay for such improvements do not apply them to residences and stores. But we are convinced that the advantages have only to be made known to them to cause the demand they deserve, and we gladly contribute our share in diffusing this knowledge.

They are manufactured by Messrs. Wilson & James, 68 Beckman street, New York.



FOOT-POWER CIRCULAR-SAWS.

The adjoined engraving represents one of the most effective circular-saw machines that can be driven by simple foot-power. The table can be raised and lowered so as to make the circular-saw project more or less over its surface, which contains the usual movable guide. A smooth fly-wheel D, moving with great velocity, secures a considerable momentum, and so becomes a store of power able to overcome temporary resistances. The treadle A is connected with the axis by means of a short piece of belt running over a pulley B ; one end of this belt is attached to the treadle and the other end to the pulley. The pulley turns loose on the axis, but has a pull and ratchet, so as to turn in one direction only, and a weight to pull the pulley back and the treadle upward, so that without the latter it always causes a forward motion of the axle and fly-wheel, and has no dead point. The shaft runs loose through the centre of the fly-wheel and is connected with the gearing F, which works the oblique wheel E, and this the small cog-wheel attached to the fly-wheel, which runs thus with a far greater velocity than the pulley B. The belt running over another pulley runs the saw, as seen in the engraving. By this arrangement the saw makes 102 revolutions for one of the shaft. The motion of an eight-inch saw is 102 for one of the treadle, so that 40 steps per minute give 4,080 revolutions in that time. High speed gives better, square, well-lined, and smoother cuts, as all experts know.

There is no doubt that this combination economizes the power applied, and that this saw is especially adapted for light work, and by raising the top properly for rebating, grooving, etc., with certainty and dispatch.

The cross-cut and miter gauges are pronounced very superior and perfect. The size of the table is 27 x 42 inches, the weight of the machine 360 pounds, and the price, with two saws, $110. The cross-cut and miter gauge is extra, and costs $15, while a boring apparatus, costing $10, may be easily attached.

For further details, address L. C. Chelsea, Elizabeth Avenue, Elizabeth, N. J.