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CANADIAN MECHANICS' MAGAZINE AND PATENT OFFICE RECORD

Vol. 6. JANUARY, 1878. No. 1.

PROSPECTUS FOR 1878.

IN commencing the sixth volume of the CANADIAN MECHANICS' MAGAZINE, we beg to assure our readers, and all those interested in Science and Technical information, that, so far from being discouraged by the depression of the times, it is our intention to make great improvements in this volume—particularly in an appropriate selection of such subjects as will be found of real utility to all interested. The price of the CANADIAN MECHANICS' MAGAZINE is very low for a Scientific Illustrated Journal containing such practical information for the benefit of architects, engineers, builders, carpenters, plumbers, painters, and all the various trades and professions; but the price has been made small to enable it to reach the masses, which makes it still more deserving of general support.

We have in previous articles stated that, from year to year, it would be our interest and main object to preserve in it such features as have shown themselves valuable; to strike out those not particularly suitable for the country; and to add, in place thereof, such other subjects as would be of more utility to the reader. Having this object in view, it will be perceived that we have given fewer illustrations of an unimportant character and more letter-press in lieu thereof. We have, also, now adopted the plan of placing the letter-press, descriptive of an illustration, on the same page with it. We have further arranged our sheets so that on particular pages those connected with mechanical trades will find out at once that which particularly relates to their own business. We purpose also opening a page for describing, monthly, those Canadian inventions in the PATENT OFFICE RECORD, which appear to us desirable to bring before the notice of the public, and the back of the cover will be entirely devoted to a Business Mechanical Directory which will be found of much use to country subscribers.

We shall particularly, this year, solicit discussions in our columns on topics which come within our general scope, and will endeavor through our "Queries and Answers" department to answer all questions propounded.

Another feature of improvement will be an increased attention to the building interests of the country, for which we specially invite architects and builders, everywhere, to send us all matter that is deserving of notice in this publication. A page of Designs for Architecture will be given in each number, and we hope our architects will contribute thereto.

It is much to be desired that the manufacturing interests of the country should receive more particular notice through a recognized channel, and there is none more suitable for it than this Magazine. Every manufacturer in the Dominion should be a subscriber.

The importance of supporting a Technical Journal (and this is the only one published in the Provinces) is so great to comparatively a new country, that it cannot be too highly estimated, not only by scientists, manufacturers and the mechanical trades, but by a large portion of the mercantile community, whose prosperity is always in ratio with that of the people who are connected with manufactures and mechanical pursuits; and this is an opportune time to urge upon all who are interested in the increased development of our crude resources, to endeavor to lend a helping hand to assist our manufacturers and mechanics, so that our factories may soon be again in full blast and new industries created and opened out to the world's wide market. To do this and to maintain an even degree of prosperity, it is most essential that the technical education of young men intended for mechanical trades should receive more public attention, particularly in our public schools. We cannot be blind to the fact that we are, as a body, much behind our neighbors across the line, and also the mechanics of Great Britain, in technical education and practical experience. For this no blame can be attached to the people. In intelligence and handicraft, when properly instructed, they are inferior to neither—they simply want instruction and training. In the United States great encouragement has always been held out by men of wealth and the Government of the country to the arts and sciences and the mechanical trades — and the latter have always held a higher position there than in Canada. The result of such encouragement has created a national taste for technical instruction, which, year by year, under the fostering care of public instructors and the advantages of free libraries in so many of her cities—polytechnic institutions and public lecture rooms—have become more perfected, and scarcely a month elapses without there appearing in some of her illustrated papers or periodicals the portrait of some self-made man, who raised himself to wealth and position and benefitted his country by the efforts of his mechanical genius, which, without the advantages of a technical education, whether acquired at a public school or self-taught and perfected through knowledge obtained through the various channels of information which are so multifarious in the States, would have remained dormant, or at least never have developed itself to perfection. Doubtless, we have many amongst us within whose brains lie dormant the germs of genius and talent from the sheer want of education to develop them.

The skilled workman of Great Britain, although not so fertile in resources or in the same favorable position with respect to education and encouragement he may receive from his employer, is still far in advance of us in the details of particular branches of his trade, because he has become skilled in some particular line of work from the fact that in England he must serve a long apprenticeship to his trade. Unfortunately for Canada, a young man is seldom bound by any obligations of the sort, and often starts on his own account when he has barely learned to properly use the most ordinary tools of his trade, therefore at the point of information he had arrived at, at the time he left his master's workshop, at that he remains all his life-time, making no advance, in fact frequently retrograding. The number of *botch* mechanics we have in the city of Montreal, particularly in the plumber's trade, who foist themselves off upon people as good workmen, until tried and found out, is a disgrace to the trade they profess to belong to; a great deal of the unhealthiness of this city has arisen from employing these inefficient workmen.

As this is the only scientific journal published in the Dominion, there is no reason why we should not make it, in time, equal to any published in other countries, and in fact all that is really wanted to do so is a more general support. Therefore, at the commencement of a new year we most urgently appeal to the public for that support to enable us to continue our improvements.

Although from the present title of the MAGAZINE (which we contemplate changing) many may suppose that it is purely a mechanical journal, we can assure the reader that its contents are varied and such as will be found highly instructive in almost every household. We believe that the programme for the coming year submitted to us by our Editor, and the inducements he contemplates offering to subscribers, which will appear in our next number, will largely increase our subscription list.

ICE WATER AT THE BOTTOM OF THE SEA.

THE "CHALLENGER" DISCOVERIES.

At the last meeting af the Liverpool Geological Society, Mr. T. Mellard Reade read a paper in which he pointed out the geological bearings of the information gathered by the *Challenger* expedition by deep-sea soundings and dredgings. As is well known from these physical observations, the basins of the great oceans are occupied in their lower depths with ice-cold water extending over the whole northern and southern latitudes, and consequently under the equator. This Mr. Reade considered to be a remarkable physical fact, and proved that the secular cooling of the earth must be exceedingly slow, as the heat of the earth, apparently, did not influence the temperature of these vast ocean tracks, which are fed with cold water from the poles. It was also pointed out that the temperature of the ocean, decreasing with the depth, was the opposite to that of the solid earth, in which observations in mines and wells prove a general but varying increase of temperature downwards, so that at a zone 3,000 fathoms from the surface the temperature of the water is at freezing point; while on the land, in cases where the increase is 1° per 60 feet, on the same zone the temperature would be considerably above that of boiling water. Not the least interesting of the discoveries announced is that of the oceans bottoms below 2,000 fathoms being occupied generally —nay, almost universally—with a deposit of red clay containing pieces of pumice and nodules of peroxide of manganese, together with sharks' teeth and ear and other bones of whales; while the depths not exceeding 2,000 fathoms are largely occupied with foraminiferal ooze. These facts, it was considered, truly inferred a very great age for the present oceans, as, from a calculation which cannot be detailed here, Mr. Reade considers it will take a minimum of 20,000 years for a deposit of foraminiferal ooze of an average depth of one foot to accumulate over the whole of the area occupied by it; while the red clay, the result of decomposition of volcanic products, must be an exceedingly slow accumulation, probably not at the rate of one-tenth that of the ooze, but this rate is at present difficult to calculate.

JAPANESE INGENUITY.

A correspondent writing from Tokio on the prospects of a trade with that country in American manufactures, says:

"During and after the Philadelphia Exhibition, the Japanese Commission bought a large quantity of agricultural implements, and so anxious were the dealers to open a trade with Japan that they sold these sample articles at less than wholesale figures. In due course of time the things arrived here, and the sharp-eyed mechanics went to work to copy them. They are now making cast-iron plows just as cheaply as we can make them in America, and at less price than it would cost to deliver them here. Harrows, cultivators, seed sowers, and similar simple implements they are copying to perfection; they may buy a few now and then in America, but it will be solely that they may use them as models. With reapers, mowers, and similar intricate constructions, they have not succeeded as yet, but are confident of doing so in time, and, in any event, the character of the country and its agriculture, and the low price of labor, will prevent a large demand for this sort of labor-saving machinery. Hoes, shovels, and other hand tools they have not attempted to any great extent, and thus far they have not been able to get the peculiar strength and flexibility which is the boast of the American maker. The Japanese laborer is a conservative being, and will not readily surrender the implements of his ancestors. Doubtless he may do so in time, and when he does he will purchase our productions, provided, in the meanwhile, a home-made article of equal excellence does not come to light. There are no patent laws in Japan, and the inventor has no protection if the native mechanics can succeed in copying what he has created. A young American came here recently with fond hopes of making a fortune out of a refrigerator, the invention of an enterprising countryman. But he found in the first place that the Japanese made no use of the article he brought; and, second, they would copy them."

PRINTING PICTURES FROM PRINTS.—The page or picture is first soaked in a solution of potash and then in one of tartaric acid. This produces a perfect diffusion of crystals of bitartrate of potash through the texture of the unprinted part of the paper. As this salt resists oil, the ink roller may now be passed over the surface, without transferring any ink except to the printed part.

MISCELLANEOUS.

ANOTHER IMPROVEMENT PROJECTED.—It is well known that the main stream of the Nile is supplied by the great equatorial lakes of Africa, and that the annual inundations are caused by the inrush of torrent water laden with soil from the fertile slopes of the Abyssinian plateau in July, August and September. This silt is now for the most part being deposited in the bed of the Mediterranean, where it is gradually forming a new delta similar to the delta already formed at the river's mouth. Sir Samuel Baker has written to the *Times* suggesting a plan by which not only water of the Nile, but the mud which it now deposits wastefully in the sea, may be turned to good account as a fertilizer of the deserts of Nubia, Libya, and the Soudan. He proposes by suitable engineering works to divert a portion of the Nile flood-water into these deserts, where it can deposit its rich sediment on the sands, and also irrigate them so as to transform them from a desert into "cotton-fields that would render England independent of America." This could be effected by having suitable dams and sluices at different points of the Nile, say at the Cataracts. These dams and sluices, by enabling craft to pass the Cataracts, would also render the Nile navigable from the Mediterranean to Gondokoro, a space of 29 deg. of lat.—*Telegraph Journal.*

IMPORTANCE OF BREAD.—Bread is the foundation of human nourishment, and any attempt at improvement should begin there. Hundreds of years ago the importance of this was seen in France, and a society of physicians was organized, under the auspices of the government, "to improve the art of making bread," at first more especially for the patients in the hospitals, and afterward for the people at large as a matter of public hygiene. The labors were attended with good results, and from that time down to the present the knowledge became general, and the nation has uninterruptedly eaten good bread. Vienna bakers also furnish an excellent bread. What is sold in New York as French bread in most of the American hotels and restaurants is not much better than the American baker's bread, and bears no resemblance to French bread, as made in France, in taste, texture, or nutritive qualities. Through the inferiority of the bread made here, it is not as much eaten as it would be if better made. It is, when properly prepared, superior to any of the other vegetable products in nutritive qualities, and on it probably depends more than on any other aliment the mental and physical health of our people.

RULES FOR ASCERTAINING REVOLUTIONS OF GEARING.—To ascertain the revolutions of gearing: *Rule:* Multiply the number of cogs in the driver, by its number of revolutions, and divide the product by the number of cogs in the driven; the quotient will be the number of revolutions of the driven.

To ascertain the number of cogs in the driver, the number of its revolutions, and the number of cogs and revolutions of the driven being known: *Rule:* Multiply the number of cogs in the driven by the number of its revolutions, and divide the product by the number of revolutions of the driver; the quotient will be the number of cogs in the driver. So, *vice versa*, to find the number of cogs in the driven, its required revolutions being given.

To ascertain the diameter of cog gearing: *Rule:* Multiply the number of cogs by the number of thirty-seconds of an inch in the pitch—Example: A pitch of two inches has sixty-four thirty-seconds of an inch; say the wheel has 120 cogs, 120 x 64 gives 76.80 (seventy-six inches and eighty-hundredths of an inch) inches, the exact diameter on the pitch line.

IMITATION TERRA COTTA.—The *Magasin Pittoresque* gives the following original recipe by which it is stated plaster casts may be made to imitate terra cotta ware with great fidelity. The following colors are necessary: brick red, lamp black, zinc white, and yellow ochre, all in powder. The object to be treated is first carefully rubbed over with "00" sand-paper, so as to remove all roughness of the surface or ridges indicating where the parts of the mould have been joined. The mixed color consists of yellow ochre 2 parts, brick red 2 parts, and black 1 part. These are well rubbed together. Then 3 parts of zinc white are separately mixed with a little milk to a paste. All the ingredients are then combined in a mortar with 8 or 10 parts of milk, and the resulting mixture is passed through a fine sieve to relieve any particles of the white. A soft brush is then used to spread the stain over the object, care being taken to lay it on evenly. After 24 hours' drying a second coat is applied. When the article is completely dry, rubbing with the finger will eliminate brush marks.

NEW METHOD OF PRESERVING FISH.—The flesh of fresh fish, either raw or boiled, is cut in thin slices and plunged in a bath of water strongly acidulated with citric acid. After two or three hours' soaking, the fish is removed and dried, either in the air or under moderate heat. In the latter case one hour is sufficient; in the former there should be an exposure of five or six days. M. D'Amelie states that fish thus treated will keep anywhere for an indefinite period, and that it becomes as hard as wood. To prepare it for use three or four days' soaking in fresh water is necessary.

EMERY BOARD.—Emery paper is considerably employed for cleaning and polishing metals, but all the kinds in use hitherto have the great disadvantage of not retaining an equal efficiency. The fresh parts bite too much, and the paper itself soon gets worn through in places. Emery on linen has been tried, but without much success. The emery paper recommended herewith is not a pasteboard with emery on both sides, but a board in which emery enters as a constituent part. Fine and uniform cardboard pulp must be procured, and from one-third to one-half its weight of emery-powder thoroughly mixed with it, so that the emery may be equally distributed. The mass is then poured out into cakes of from 1 to 10 inches in thickness. They must not be pressed hard, however, but allowed to retain a medium pliability. This paper will adapt itself to the forms of the articles, and will serve until completely worn out.

BUTTER PACKING FOR TRANSPORTATION.—At the commencement of the present century, Appert devised his well-known method of "bottling" butter. It answered admirably, but for some reason or other has completely fallen into disuse. Then M. Beon adopted the plan of covering butter packed in tins with a thin layer of water acidulated with tartaric acid, or with a solution of six grammes of tartaric acid and the same quantity of bicarbonate of soda in a liter of water, and soldering up the cases. This process, too, gave excellent results, and is still practiced by some large houses in Italy and by the Grande Compagnie de Copenhague.

ANCIENT LIGHTNING-RODS.—Dr. Munke quotes a passage from the "Talmud," written in the fourth or fifth century of our era, permitting the use of iron "as a protection from lightning and thunder." Wiederman, in an editorial note, says that the Egyptians seemed to have employed gilded masts "for warding off the bad weather coming from heaven."—*Annalen der Physik und Chemie.*

CARBOLIC ACID ON METAL CUTTING TOOLS.—The *Papier Zeitung* mentions that a Herr J. Asby strongly recommends the use of carbolic acid for moistening the tools with which metals are worked. The duty of the grindstone is even said to be increased by the use of the acid. The dark and impure acid can be used for this purpose.

HOW A BOY HELPED THE GROWTH OF THE STEAM ENGINE.—The steam-engine has now assumed a form that somewhat resembles the modern machine.

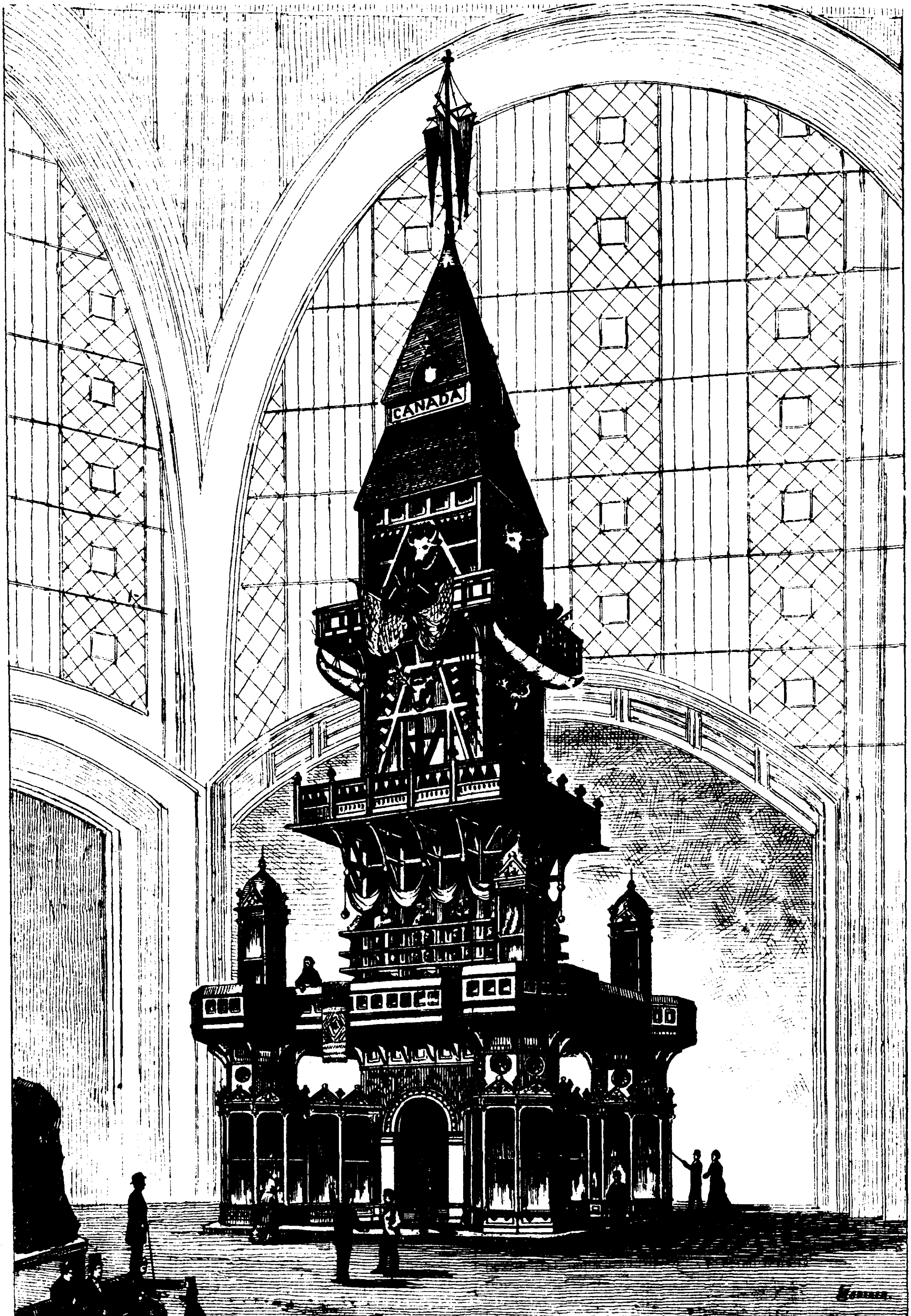
An important defect still existed in the necessity of keeping an attendant by the engine to open and shut the cocks. A bright boy, however, Humphrey Potter, to whom was assigned this duty on a Newcomen engine in 1713, contrived what he called a *scoggan*—a catch rigged with a cord from the beam overhead—which performed the work for him.

The boy, thus making the operation of the valve-gear automatic, increased the speed of the engine to fifteen or sixteen strokes a minute, and gave it a regularity and certainty of action that could only be obtained by such an adjustment of its valves.

This ingenious young mechanic afterward became a skilful workman and an excellent engineer, and went abroad on the Continent, where he erected several fine engines.

Potter's rude valve-gear was soon improved by Henry Beighton, and the new device was applied to an engine which that talented engineer erected at Newcastle-on-Tyne, in 1718, in which engine he substituted substantial materials for Potter's unmechanical arrangement of cords.—*Prof. Thurston, in Popular Science Monthly for December.*

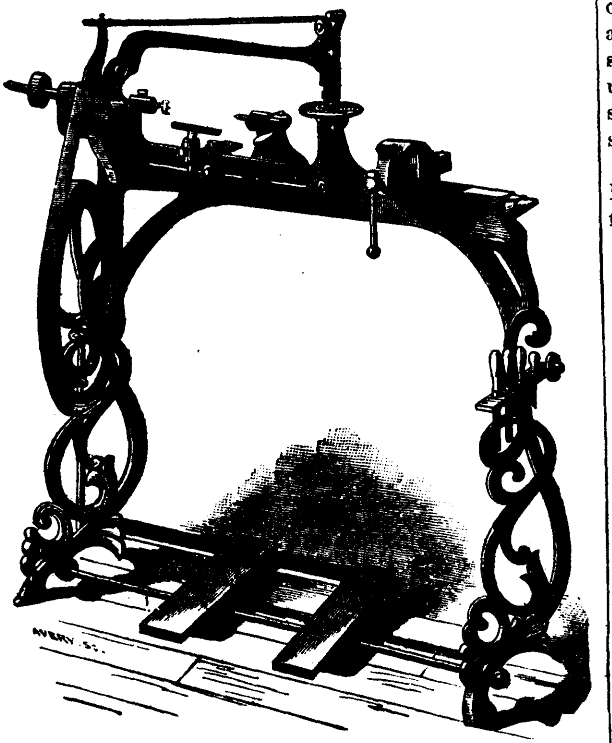
COLOURED INKS FOR STAMPING.—The following are commended for the colours most frequently wanted for stamping purposes.—Red: Dissolve ¼oz. of carmine in 2oz. of strong water of ammonia, and add 1 drachm of glycerine and ¾oz. of dextrin. Blue: Rub 1oz. of Prussian blue with enough water to make a perfectly smooth paste; then add 1oz. of dextrin, incorporate it well, and finally add sufficient water to bring it to the proper consistence.



CANADIAN TROPHY AT THE PARIS EXHIBITION.

COMBINATION LATHE, SCROLL SAW, ETC.

The machine illustrated herewith is a combined foot power drill and turning lathe, scroll saw, grinding wheel, vise,



and anvil, in the construction of which many novel features are embodied. The body and legs are cast iron, the treadles wood, the belts leather, the wrench iron, the fixed screws polished iron, the set screws casehardened, the finish black japan with ornamental paintings. The lathe will turn work four inches by nine long. It is suitable to hand turning, has a press lever for drilling, and is furnished with steel spur and pointed centers. The rest has all the adjustments common to large turning lathes. The scroll saw plays vertically through the center of an iron table, which may be tipped on an angle for inlaid work. The saw is held by means of iron clamps and thumbscrews, said clamps being attached, each to the end of a leather band, which bands pass over friction pulleys and are hung to pins on the ends of the vibrating lever, which is driven by an eccentric on the lathe spindle. There are several pin holes in the upper band to adjust the strain to saws of varying lengths. An arm projecting over the table serves as a presser foot to hold the work down while sawing, and adjusts itself to varying thickness in boards. When the saw is disconnected to enter holes, said arm may be raised to admit the board, or it may be swung over to leave all clear above the lathe if desired. This machine swings fifteen inches under the arm, and the motion of the saw is in a straight line.

In carrying out this principle of operating the jig saw on a large machine, the saw is hung in sliding guides as usual, but the bands for reaching any distance on the work and the vibrating lever are the same as here shown.

It is claimed that no perceptible jar is fëlt in running a sixteen inch saw that will reach the center of work up to ten feet radius. This steadiness is caused by the vibrating lever being very short and well balanced, and by the cushioning effect of the inertia of the bands. The lever need not be over six inches radius to give the saw four inches stroke.

The vise and anvil are permanent attachments to the machine. The emery wheel on the spindle is heavy, and serves as a fly wheel to the lathe and saw. In the outer end of the spindle is a drill for bracket work. When desired, the manufacturer furnishes tools and extra parts with the machine, such as face plates for chucking, a drill plate, a circular saw, and table, turning gouges, chisels, etc.

Patent pending. For further particulars see Business and Personal column, or address W. X. Stevens, East Brookfield, Mass.

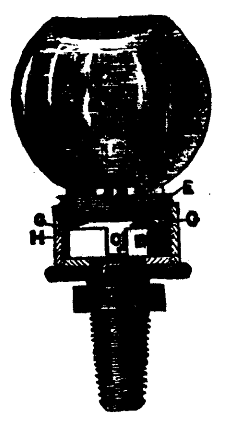
The Delicacy of the Telephone Circuit.

In a recent lecture before the Society of Telegraph Engineers in England, Professor Bell called attention to the remarkably slight earth connection which is needed to establish a circuit for the telephone. In describing an experiment showing this, he stated that while an assistant made connection at his end of the line by standing on a grass plot, he himself stood upon a wooden board. On trying the telephone Professor Bell was very much surprised to hear a continuous musical note uttered by his coadjutor, and on looking for the cause he found that a single blade of grass was bent over the edge of the board and that his feet touched it. The removal of the grass was followed by a cessation of sound from the telephone, but the sound became again audible whenever the Professor touched even the petal of a daisy with his foot.

AUTOMATIC SHAFT OILER.

The annexed cut represents a new and simple shaft oiler, by means of which it is claimed that the difficulty experienced in making an air-tight joint between the glass globe and its brass socket, and in regulating the flow of oil, is avoided.

A is a glass globe with grooved neck, B, the end of which is ground smooth to form a tight joint against a cork washer.



A threaded brass ring with a projection, C, to prevent turning, slips over the neck, and is retained by a soft brass ring to the groove above B. The feed is regulated by a hole in slotted screw, D, with air-tight packing, E. The slot in screw is parallel with the hole, and will show the amount of fuel like a cock. A new glass is easily replaced by removing the soft brass ring from the groove, and the feed regulated without removing the cup.

By the use of these cups, waste in oiling machinery is claimed to be avoided, as it is stated that a cupful of oil will keep machinery well lubricated for many months.

For further particulars address F. Lunkenheimer, Cincinnati Brass Works, Cincinnati, Ohio, sole owner and manufacturer.

HARDENING STEEL.—The risk of cracking steel when hardening is much reduced by surrounding the article, when in the fire, by shreads of leather, bone, &c., or by covering it with the prussiate of potash as soon as it gets to a dull red heat; then it may be heated to the proper temperature for hardening. If the piece to be hardened is of moderate size I should heat it as above, with leather, &c., and at a good red heat immerse it vertically in a mixture of oil, tallow, &c., the proportions of which were given some two months ago.

SANITARY SCIENCE AND PRACTICE.*

(See page 22.)

Abstract treatises innumerable have appeared on the laws of health, and public attention is now becoming aroused to the necessity of fresh air and a pure water supply, with the innocuous removal of the waste matters of a population. Still, practice and theory, somehow or other, have hitherto not been coincident; and those who talk and write freely about sanitary matters have sometimes been, unconsciously perhaps, themselves offenders against the laws of health, in their own houses.

A little work has been brought before our notice which professes to deal, in a common-sense and practical manner, with the sanitary condition of our houses; and, as the company who publish it undertake to carry out practically the reforms they advocate, we will, instead of reviewing the book in the ordinary way, endeavour to extract and condense as much of its contents as is possible in the space at our disposal, making use of some of the woodcuts which illustrate its pages.

A sufficient quantity of pure air is a vital necessity; and those who are shut up all day in offices or workshops are apt to blame the long hours of work for the depression they feel, whereas it may really be the vitiated air breathed which chiefly affects them. It is said that air containing more than one-thousandth part of its bulk of carbonic-acid gas is injurious to health; but in bed or sitting-rooms, where the doors and windows have been kept close for some time, the air often contains two or three times the quantity named of this poisonous gas. If a fire and light are burning at the same time, the oxygen of the air is also consumed very rapidly; it is said that an ordinary gas-burner requires as much air as four or five people, while the products of its combustion are known to be exceedingly deleterious. The air in the chamber should therefore be constantly renewed—not by means of a draught under the door, keeping the feet at an icy temperature—but by a constant, equable and regular supply of sufficient volume, without appreciable current. The method recommended for securing this desideratum is the system of vertical tubes, which we have before described and illustrated.† We will remark, however, that in addition to the system of water trays, on which the fresh air is deflected, for depriving it of impurities, another and cheaper method of filtration has been devised for offices, and wherever the keeping of the trays regularly supplied with water is at all likely to be neglected. A pyramidal frame of tinned iron wire, covered with fine canvas, is inserted in the tube for arresting the particles of carbon, &c., and has been found to answer admirably. The canvas can be taken off and washed, from time to time, as required. Owing, however, to the filtering area obtained by this arrangement being about 500 square inches, it only requires cleaning occasionally; whereas, with a layer of cotton wool or canvas stretched across the tube, the filtering area is limited to the section of the tube, and would very soon be clogged.

As it has been determined that disease in its simple, as well as in some of its more dangerous forms, is introduced into the system by the agency of water, the importance of securing purity in this necessary fluid cannot be too strongly insisted upon. It is also ascertained that water readily absorbs impure gases, and that it also both decomposes and dissolves various substances injurious to health, which are held either in solution or suspension. With proper care, however, these may, in a great measure, be got rid of, or their injurious effect neutralised. In London and other large towns, where the supply is not derived from a pure source, it is impossible for the water companies to remove all the impurities by means of their filtering beds; and when the supply is intermittent, there is the further danger of the water becoming contaminated in cisterns—not cleaned out, perhaps, for years together. It is recommended, therefore, that the house cistern be so placed as to be readily accessible for cleaning and examination; and that a separate tank be provided for the water-closets, perfectly unconnected with the cistern for general household purposes. The interior of the latter, if not lined with zinc, or constructed of galvanized iron, should be lime-washed about once a year. The company have devised a special self-cleansing cistern, shown in vertical section at fig. 1. The waste-pipe (perforated with holes near the top to serve for this purpose) acts also as a plug, and, on this being raised by means of the handle, A, whatever sediment has collected is carried freely away. A self-cleansing and aerating filter, shown both in vertical and horizontal section in the same figure, is also added. As the water enters the tank, being led by means of the pipe, E, to an opening in the annular space, B, it rushes entirely round the surface of the filtering ring, C, which is composed of fine mineral carbon in a compressed state, and so keeps it free from deposit, the accumulation of one day being washed away the next. The pipe, D, serves for aerating the filtering medium, and, by attaching an indiarubber tube to this pipe, and reversing the flow of water, the granular material in the body of the filter may be cleansed when necessary. As this filter is being continually cleansed, and the cylindrical surface affords a large filtering area, the quantity of water which can be passed through it is considerable.

If some such arrangement as the above be not adopted for the general household supply, at any rate the water used for drinking should be filtered; and the selection of a filter is an important matter. Eminent authorities have stated that the old-fashioned appliances for this purpose, provided with vegetable charcoal, sand and sponge, are not only useless for the proper purification of water, but worse than useless. Vegetable charcoal possesses very limited purifying qualities; and sand and sponge only act as strainers to arrest the grosser particles. Animal charcoal is now being largely used as a filtering medium; but although this substance, when fresh, exerts great power in arresting and absorbing impurities of all kinds, it has been authoritatively determined to become a source of danger when remaining in use for too long a period, owing to the property, which it is said to possess in a high degree, of favouring the growth of low forms of organic life. What was required to ensure perfect filtration was a substance possessing powerful oxidising and purifying properties without these drawbacks, and this has been found in a mineral carbon of peculiar nature, and prepared in a special manner. The oxygenation of the water, or of the filtering medium through which the water passes, is another point which must not be neglected. Filters should be so arranged that, as water is drawn off, air is drawn in through the filtering substance; in fact, the filter should *breathe*, and thus continually renew its chemically purifying properties. The company have had a filter specially constructed on this principle, and so arranged that the whole of the filtering medium may be cleaned or replaced. This is shown in vertical section at fig. 2, and consists of an earthenware receptacle, a movable pan having a cake of mineral carbon for preliminary filtration, and a perforated plate below, on which rests a deep layer of granular mineral carbon for the second filtration. When water is drawn, it runs more rapidly out of the tap than through the carbon block, consequently, air and water are together drawn through the filtering medium, and this aeration and revivification are constantly going on. All other filters of this class have an air-tube at the side; but in this case the air is made to pass through the filtering substance itself, in the direction shown by the arrows. The object of making the perforated plate of the form shown is to afford a portion of the area in which the column of water shall exert a less pressure than on the rest, and thus give way to the air displaced by the water as it descends into the lower receptacle.

Although the heating of rooms by hot-water pipes and stoves may be a convenient and advantageous arrangement under certain conditions and in special cases, the open fireplace, besides being preferred in this country on account of its cheerful appearance, has the great advantage of assisting ventilation by effecting or encouraging the rapid changing of air in a room. The company advocate the principle adopted in what are termed slow-combustion stoves, and to which we referred in a recent article, viz., the use of firebrick for the sides, back and bottom of the grate; but the latter is, in their case, provided with perforations capable of being closed by a damper. This grate is shown in elevation and vertical section at fig. 3, in which will be seen the mechanism for closing and opening the damper. The register may also be regulated from the outside, as shown. The combustion is not so irregular as in iron grates, because, with so large a body of heated firebrick the fuel is kept in a constant glow; and when fresh coal is put on, the heated bricks at once assist combustion. Not only is the amount of heat thrown out while the fire is burning very great, but heat is also radiated from the hot bricks for a long time after the fire is extinguished. A saving of about 30 per cent. of fuel has been ascertained to have been effected, owing to the more perfect combustion. The object of making the bottom with interstices capable of being closed, is that the draught may be adjusted to suit the description of coal burnt; and, besides, a draught at the bottom greatly assists the lighting of the fire. Another improvement consists in inclining inwards the front bars, which are flat in section, thus allowing more of the fire to be seen, and preventing the fall of coal or cinders on the hearth.

The constant variation in the pressure of gas acts prejudi-

* "Health and Healthy Homes." London: Published by the Sanitary Engineering and Ventilation Company, 115 Victoria Street, Westminster.
† See *Iron*, of 19th August, 1876, vol. viii., p. 229.

cially in several ways; in addition to the trouble of having frequently to regulate the flame at the burners, a large amount of gas passes through them unconsumed, whereby the quality or illuminating power of the light is impaired, and the atmosphere of the room made unhealthy, besides causing the meter to work irregularly. A simple governor, called the Imperial Regulator, which may be screwed on to any meter, has been especially designed to equalise the flow of gas, and so put an end to the above-named difficulties. It governs the pressure of the gas so perfectly, that the cocks of the burners may be turned full on when the gas is lighted, not requiring any subsequent adjustment; and whether one light or fifty be in use, a quiet, steady light with full even flame is maintained, while a saving of from 15 to 20 per cent. is effected. Fig. 4 shows a dry meter, and fig. 5, a wet meter fitted with the governor, an enlarged section of which is given at fig. 6. It will be observed that the orifice is conical, and that the plug or valve working in it is so arranged that the greater the pressure of gas on the diaphragm, the smaller is the annular orifice allowed for its passage.—*Iron.*

A LOCOMOTIVE SET UP IN THREE HOURS.

The days of deliberate and long considered labor are departing and the substitute is work at lightning speed. The most remarkable feat on record in connection with locomotive building has been performed at the shops of the Michigan Central Railroad at Jackson, Mich., where, it is alleged, two new engines were completely put together and set in motion in a few minutes less than three hours from the moment the naked boilers were hauled into the shop.

Thursday evening, November 15th, there stood in the Michigan Central yard at Jackson two locomotive boilers, complete in all respects, upon trucks, while within the shops were the levers, the valves, the cylinders, the connecting rods, the bolts, the nuts, the wheels, the frames, and all the other pieces of machinery required to construct two perfect locomotives, all finished and ready for use, but not one of which had ever been fitted to its neighbour or subjected to any test or measurement other than those applied to every similar piece before being pronounced good and fit for service. A notice was given that these parts were going to be combined in two harmonious wholes, and that those persons who desired to see a locomotive put together in the shortest possible time were invited to be present on Friday morning.

At seven o'clock to the minute the shop doors were opened, the boilers hauled in and the two gangs of 14 men each sprang to their work. The spectators, numbering about 200 men, stood far enough away not to interfere with the workers, and the contest went on.

The jacks were applied, the huge boilers were raised and bolted on their frames, then they were placed on their wheels with all possible expedition, while simultaneously work was progressing on every portion of the machines, which were rapidly assuming perfect form. Water was let into the boilers, and even while the men were working at the grates the fires were kindled and the "infants" began to warm up for their work. All this time not an unnecessary word was spoken and every man worked as though his very existence hung upon the uninterrupted prosecution and speedy completion of his task. Great drops of sweat gathered on their heated faces and trickled down in streams; but no thought of rest suggested itself to a man, and a feeling of anxious pride pervaded all alike, workmen, shopmates, officers and spectators. At last one of them is ready for the smoke-stack, and is pulled along the track until she stops beneath the one designed for her, which hangs above her. A few moments more and the last screw is turned, the last bolt is fastened, the engineer stands in his place, and in just two hours and fifty-five minutes from the time the signal to commence was given, the throttle is pulled and the first of the twins moves off completed, followed a moment later by her mate, amid the cheers of all who have been fortunate enough to witness the most wonderful feat ever known in the history of locomotive building.

In considering this extraordinary achievement, it must not be forgotten that the most wonderful feature of the whole, is that no mistake of any kind was made, and that every portion was so perfect that there was not the delay of a second in fitting or adjusting.

We read also that the Pennsylvania railroad shops, upper and lower, at Altoona employ 3,000 hands. With the facilities at hand an eight-wheeled hopper-bottom car can be constructed in an hour, and recently 112 of this class were turned out in a week of ten hours a day. An eight-wheeled box-car can be made in nine hours, including one coat of paint, and a passenger car can be built in two days.

PROF. HUXLEY ON TECHNICAL EDUCATION.

Professor Huxley has recently delivered a lecture on Technical Education before an English workingmen's association, in the course of which he gives his views as to what working men should know. He defines technical education as the teaching of handicrafts, and the requirements thereof he sums up to be reading, writing, and ciphering, a taste for one's calling, an acquaintance with the elements of physical science, a knowledge of a foreign language, and the scrupulous avoidance of the practice known as "cramming."

As to the means for carrying out this ideal education, Professor Huxley strongly advocates the more extended teaching of natural science in the public schools, and he thinks that the mode of instruction should be especially practical and experimental. He also recommends some special means for utilizing in the public interest unusual talent or genius found in schools.

It was Edward Everett, we believe, who regarded anyone who could read, write, and cipher as well educated, and if to that a knowledge of a foreign language was added, the education he considered fine. Professor Huxley goes a step beyond this, it would seem; and besides his recommendations, while excellent, appear rather too general to be susceptible of ready practical application.

TAR WATER FOR INSECTS.

For the last five years I have not lost a cucumber or melon, vine or cabbage plant. Get a barrel, with a few gallons of gas tar in it; pour water on the tar; always have it ready when needed, and when the bugs appear give them a liberal drink of the tar-water from a garden sprinkler, or otherwise, and if the rain washes it off and they return, repeat the dose. It will also destroy the Colorado potato beetle, and frighten the old long potato bug worse than a thrashing with a brush. Five years ago this summer, both kinds appeared on my late potatoes, and I watered with the tar-water. The next day all Colorados that had not been well protected from the sprinkling were dead, and the others, though their name was legion, were all gone, and I have never seen one of them on my farm since. I am aware that many will look upon this with indifference, because it is so cheap and simple a remedy. Such should always feel both their own and their neighbors' bugs, as they frequently do.—*Chicago Tribune.*

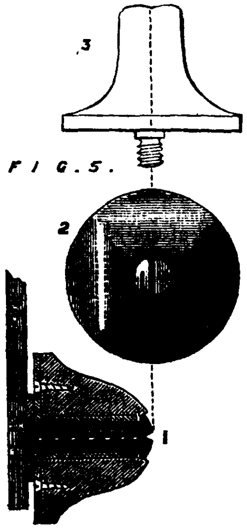
Fatal Parasitic Worms in Dogs.—The New York *Independent* condenses from Chinese newspapers an account of a discovery why dogs in China are liable to sudden and apparently unaccountable death. This is often found to be due to the plugging of the pulmonary artery, or to mechanical interference with the action of the valves of the heart, by a mass of filariæ, or worms, occupying the artery and cavities on the right sider. On opening the heart the worms are found massed together in a bundle, like a coil of thick cat-gut that has been some time steeping in water. The few sluggish movements they exhibit after the death of the dog form a striking contrast to the liveliness of their minute progeny, which wriggle about in the neighborhood and in the blood throughout the system. On unraveling and extending the parent worms, they can be separated into two kinds. One sort, the larger and plumper, measure from 8 to 13 inches in length by 1·30 of an inch in diameter; the other, the smaller, five to seven inches in length by 1·40 of an inch in diameter. Their progeny are about 1·100 of an inch in length by 1·3,000 of an inch in breadth. A similar disease to this is known in America, France, Italy and other countries. Dr. Manson, in his report on these Hematozoa, is inclined to believe that the great frequency of aortic aneurism among Europeans in China might possibly be traceable to the existence of these worms in the heart and blood-vessels. With the practice he has acquired in the detection of these worms in the blood of the dog, he searched for them in man. No selection was made of cases; but the first patient or healthy person who presented himself and was willing to have his fingers pricked was examined, six slides of blood, at least, being carefully searched. In this way he of 190 cases found the worms in 15 or about 8 per cent.

Varnish Putty, for filling the pores of the wood after the first coat of priming, is made of quick-drying varnish and Paris white; the addition of a little ochre improves it for rubbing down. First-class varnishes stain more easily than the inferior grades. Slight stains may be removed by rubbing the spot with rotten stone and water, and, after thoroughly drying the part, rubbing it with sweet oil, applied by the hand.

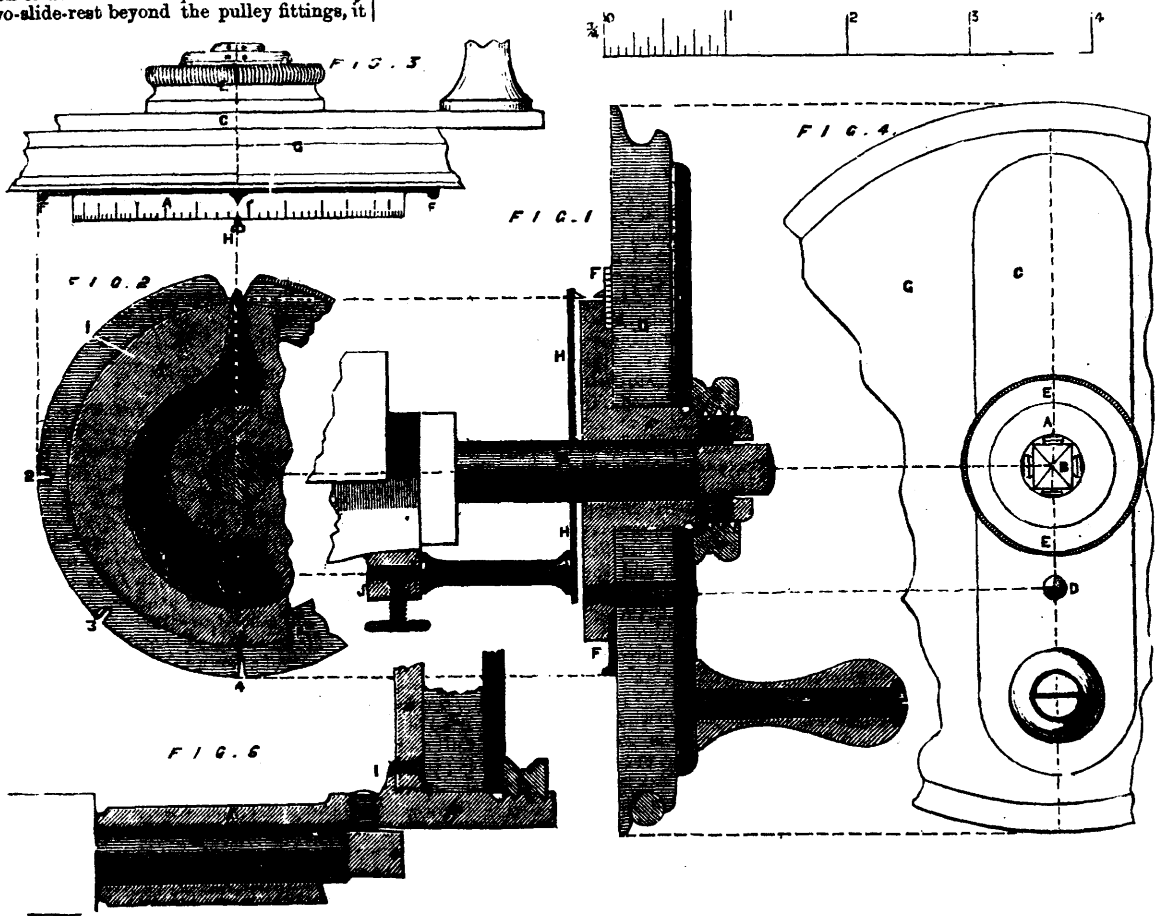
This being the first number of the CANADIAN MECHANICS' MAGAZINE for 1878, we particularly desire to call the attention of our readers to the improvements held forth in our Prospectus, which will be found on the first page, and hope that they will kindly assist us all they can by renewing their subscriptions, accompanied with a remittance for the same.

COMBINATION PULLEY-HANDLE FOR SLIDE-REST.

THE accompanying drawing represents a combination of handle, pulley, and adjustable index for the slide-rest. It was suggested bit by bit to meet the requirements of an overhead, which is almost always in use when the the lathe is running, it being as handy for sliding either traverse of the rest, with or without back-gear, as it is for screw-cutting, drilling from back-centre, cutter-driving, &c.; and as no addition or alteration is required to the ordinary two-slide-rest beyond the pulley fittings, it



be taken off or replaced at a moment's notice without disturbing the centring. Practically, however, there is seldom any occasion to move the bush at all; but as the general workman must be prepared for every possible contingency, it is desirable to have a quick and ready method of doing this if it should be required; and none can be much quicker or simpler than loosening two set screws. This will be better understood when the drawing has been explained; but these remarks are made as a preface to show the reason for the general arrangement. It may also be added that, while the particular object of carrying the handle-plate right across the pulley was to back it up well, and tie all firmly together, this has also the general advantage of balancing the handle well, and so avoids that disagreeable shaking down which so often occurs with the ordinary handle on a radial arm without any counterpoise, unless the collar of the slide-rest screw be tightened up to an extent which causes it to work with unpleasant stiffness. With the handle-plate now shown, the weight of the handle itself can, if necessary, be exactly balanced by simply screwing on a leaden button of the



was worth while to make these as efficient and complete as possible. But even where the pulley is not wanted, the general principle here shown is, perhaps, as simple as any for mounting an adjustable index counter. It is necessary to the correct action of the index that there should not be the slightest shake in its fitting, and, therefore, some kind of set screw would be essential in any case; while anything like a wobble when running is very offensive to the eye. So the first trouble of making the four set screws for the four faces of the squared part of the slide-rest screw-shank is, perhaps, most satisfactory in the end, as they can be used to centre the bush and pulley to run with perfect accuracy, while they bind the fittings firmly to the screw-shank, and also furnish a stop by which the exact position of this adjustable fitting is secured. If two of the squared faces of this shank and the places of two of the four screws in the bush be marked to correspond, so that only the same two screws (being, of course, two at right angles to each other) may be moved, then the fitting may always same weight at the opposite end of the plate. But I have not found that this is required where a wooden handle is used.

The adjustable index was, in my own case, first adopted for the special purpose of screw-cutting; but it would be quite impossible to say too much about the utility and convenience of the arrangement for general practice. Indeed, there is hardly a stage of any job where these indices (I have one on each handle) are not in constant use, from chucking the rough casting truly to graduating a finished counter by the division plate. They dispense entirely with recording readings, and to a great extent with reading the numbers at all. Being always ready for use, gauges may be secured with accuracy to 001in. at one reading, whether on the outside or inside of the work, or at the bottom of a deep bore; and the tool can always be replaced with the greatest certainty after withdrawing for the purposes of fitting or gauging. They are invaluable for finishing out cuts to exact gauge in sharp corners, or securing exactly the same gauge when the tool has to pass over swells or flanges on the work. In short, to describe all the cases where the adjustable index is sure to be used, if once on the slide-rest handle, would be to describe nearly every operation of accuracy that can be done in the lathe.

Referring now to the illustration, Fig. 1 is a section of the side elevation, showing the several parts. Figs. 2 and 4 are, respectively, front and back views, giving so much as is necessary to explain Fig. 1, from which they are both projected. In the same way Fig. 3 is a plan view, projected from Fig. 2. In every case the same letters are used to denote the same parts, and these are connected by dotted lines. The scale is ¾in. size from the fitting on the traversing or parallel slide of my own rest. Fig. 5 shows a substitute for the ordinary form of handle, which is rather more convenient for this slide in a case like my own, where the overhead is always in use if there be only an inch of work to slide. Fig. 6 shows so much of the fitting for the surfacing, or transverse slide, as proved necessary in my case; where the end of the slide-rest screw was so short, and so much overlapped by the slide-plate when brought out to the full extent of its traverse, that the index and pulley could not have been attached as shown in Fig. 1, without sacrificing nearly an inch of range. A, in each figure is the flanged bush of cast iron, brass, or gun metal. This must be bored to fit the round part of the slide-rest screw very accurately at B, the flange end of the bore. The outside of the barrel end is screwed as far as shown, to take the nut E, which binds all together. The thread should be about 1-12in. pitch, as only two or three strong threads are wanted, and these should run easy, so that the nut may be at all times loosened or tightened by the fingers alone. As it is desirable to keep everything as close as possible on the handle side of the fitting, the set-screws (two shown in Fig. 1, and the ends of all four in Fig. 4) are tapped through the thread on the end of the bush, being of course sunk clear of the bottom of the thread. The set screws may be of ¼in. or 5-16in. diameter. The way in which two of the square panes of the slide-rest screw, and the two corresponding parts at the end of the barrel may be marked, is suggested in Figs. 1, 3, and 6 by the dots on these parts. It is, of course, necessary to provide a stop of some kind so that the bush may always set up to the same spot on the slide-rest screw-shank, and bring the two indices to the right distance from each other. Where the shank of the slide-rest screw admits of it, the squaring of the four faces and the set-screws will provide the necessary stop in the simplest way. Otherwise there should be a little ring or collar fastened to the round part of the slide-rest screw-shank at B. The inside face of the flange must be rebated out as shown, to take the flat brass ring, F F, which carries the adjustable index. It must revolve easily but firmly in the groove formed by this rebate and the pulley behind it. However the ring may be made, it should fit (laterally) rather too easy than otherwise at first, when the ring is flat and dead true. A very slight cast with the fingers will secure the right stiffness for working; but if the (lateral) fit were made too true the ring might box. The nattiest way of making the ring is to have a casting made with a bead, which can be afterwards milled, as suggested by the little piece on the right of the index at F in Fig. 2. But an equally efficient ring may be made with less trouble and expense from sheet brass (about 1-32in. thick), turned out to fit and revolve accurately on the axle, supplied by the rebate in the flange. A tongue can be cut down out of the edge of this, turned over and finished up into the pointer, as shown at H, Figs. 2 and 3; and to supply the place of the milled bead, little ears can be thrown up for the finger to catch when turning the ring round to adjust the index. The simplest way of doing this is to drill small holes at the required distances, and having cut down with a fret saw *to one side of them* (see Fig. 2., F 1), then turn up the ear and finish off with file, as at 2, 3, and 4, in the same figure. Of course, the tongue for the index (at H, Figs. 2 and 3) could be cut out and turned down without breaking the continuity of the edge of the ring, and I did this at first. But, in sliding into close quarters with the overhead, I found it safer to look at the index as it revolved on the pulley than at the tool itself, as the guide for pulling the striking gear. It was, therefore, well to mark the place of the index as distinctly as possible; so I purposely cut away the edge, as shown at H, and blackened it and the index. I now find I can slide with safety to within ·01 of a shoulder before using the striking gear, which leaves a mere trifle to take out by hand.

The pulley, G, is a plain disc of wood, bored to fit the barrel of A accurately, and drilled for the pin, D, which acts as dog for it and for the handle-plate, C. The flange of the groove furthest from the hand should be rather higher than that nearest, as the band can then be thrown in mechanically, without even looking at the pulley. Where accurate time is an object the pulley-groove should on no account be V-shaped, but half round, and the working contact should not be deeper than is sufficient to take the band up to half its diameter. Of course, any desired size or form of pulley can be taken by this arrangement, and the shift made in a moment by unscrewing the single nut, E. But it is well to adopt a standard thickness for the pulleys, and ½in. will be found convenient for gut band of ¼in. diameter. The handle-plate, C (Figs. 1 and 4), is conveniently made from coach hoop-iron of the right width (which may be a trifle less than the diameter of the nut E). I have found a thickness of ⅛in. or 3-16in. amply strong enough for all a 5in. centre back-geared lathe can do. The nut, E, may be made of iron or brass, and the edge milled. The fitting for the fixed index is a matter of considerable latitude; but the plan shown at H, in Figs. 1, 2, and 3, is neat and compact. The upright part, H H, carrying the pointer, is made from sheet brass 1-16in. thick, turned out to pass over the slide-rest screw-shank, and finished off to shape outside, as shown in Fig. 2. There is often a little lump just under the middle of the rest, and where there is, it forms a very convenient fixing for the arm carrying the upright which carries the index (see J, Fig. 2). 1, 2, and 3, Fig. 5, are different views of a finger-knob which is rather more convenient than the ordinary handle where the overhead is always at work, as in my case. There was only one case in which I found the handle in the way when casting the cord on or off—viz., in boring, when the pulley happened to stand just over the bed of the lathe, and the handle happened to stop at the very bottom of the pulley. It was not a very serious inconvenience, but as it chanced to happen several times running one day, I fitted another handle-plate, C², Fig. 5, and after trying knobs of several shapes, found that that given proved the handiest. Since then it has quite superseded the ordinary handle on the parallel slide at all times and for all work, except when the mandrel is being driven (through the overhead) by the slide-rest handle, while the fly-wheel is driving the cutters independently, and then the ordinary style of handle is preferable.

1 is a section of the knob, showing bush and washer. 2 is the view looking down on the top after the sides have been rasped and filed out, and 3 is the end view of the knob after this flattening of the sides.

In Fig. 6 (the fitting for the surfacing slide) the only difference is in the way the flange, A, is mounted, and in its size. The pulley and counter cannot now interfere with anything so long as they do not stand above the top of the upper slide-plate, and there is therefore a double advantage in making the counter as large in diameter as possible. In my own case the diameter of A on this slide is 5in., which brings the readings well up into the light, and, with a leading screw of ⅛in. pitch, gives each graduation for ·001 in a space of over $\frac{1}{16}$in. As the barrel for mounting A must now be of the construction shown in Fig. 6 (subject, of course, to the same consideration of a good fit at B), in order to lengthen the handle the set screws are put in on the other side of the flange, as at I; and the barrel having been turned with a small shoulder, as shown near the same letter, I, is threaded on the handle side, so that the larger flange, A, may be screwed on and pinned to the shoulder with a small screw, also shown at I. In this case, to lighten the flange, it is made as a wheel, instead of being solid, and the pin, D (Fig. 1), is screwed into one of the spokes. If the same distance from the centre be observed as in Fig. 1, the pulleys and handle-plates may all be exchangeable if need be. It is of course well to take all the distance that can be got between the end of the barrel abutting against the collar of the slide-rest screw at B and the set screws at I. The fixed index is mounted in the same way as in Fig. 1. The graduation on the edge of the flanges will, of course, depend on the pitch of the slide-rest screw. My own being ⅛in. pitch, 125 divisions give readings to one-thousandth part of an inch, which work admirably with vernier callipers. Say, for example, that it is required to turn a cylinder of ½in. diameter, or ·500. Having worked down very close with ordinary callipers, then gauge with the vernier. If the reading prove to be, say, ·525, there is ·024 to come off. On the parallel slide the adjustable index would be set on 24 divisions, but on the surfacing slide only 12, as the reduction of the work is, of course, double the direct motion of this slide. But in either case it is now only necessary to work on until the adjustable index coincides with the fixed index, and the exact gauge will have been secured by the one reading and adjustments without the trouble of recording any numbers. It is, of course, necessary to take care that there is no back-lash in the slides when the adjustable index is set, and to draw the tool so far clear that all back-lash may be taken out before the adjustable index can again coincide with the fixed pointer.

In conclusion, there may appear to be a great deal of work in these fittings, but I can only say that I do not think I ever made any addition to my lathe, which has paid so well in constant and general utility whenever the slide-rest is at work for any purpose whatever.

D. H. G.

THE NEW GERMAN PATENT LAW.

The New German Patent Law which went into force on July 1, 1877, possesses some points of interest not only to such of our readers as are the patentees or manufacturers of mill machinery, but also the whole milling fraternity, as it may show how some of the defects of our present law may be remedied. Until last July the greatest confusion existed in Germany in regard to patents, there being twenty-one States of the Empire which granted patents of their own. All this disorder is now at an end, and one law now governs all the States of the Empire, the same as in this country. The following is a brief synopsis of the principal points of the new law :—

1. Pharmaceutical compounds, medicines, alimentary preparations and chemical products cannot be patented, although the process by which they are obtained is patentable.
2. New inventions are defined as being those not publicly known or worked within the realm, or described in printed works to such an extent as to enable any one to work the invention therefrom.
3. The operation of a patent is to restrain others from manufacturing, trading in, or importing the article, or using the process patented.
4. Any one who has already used the invention in Germany before the date of application for the patent, can continue to use it, even though such prior use has been kept secret.
5. The Imperial and State Governments have a right to use the invention patented for Imperial or State purposes, but the patentee can claim compensation for such use.
6. The original cost of a patent, including agency charges, will be from $60 to $75.
7. Patents will be granted for fifteen years, and will be subject to a tax of 50 marks ($11.90) at the end of the first year, 100 marks at the end of the second year, and an increase of 50 marks each succeeding year, making the total cost of a patent for fifteen years about $1.260.
8. Patents of addition can be obtained at the same cost as the original patent, 50 marks ($11.90), although they are not subject to the annual tax, they being considered as incorporated in the original.
9. Failures to pay the annual tax within a reasonable time, forfeits the patent, although in the cases of poor patentees, the tax may be postponed or altogether remitted.
10. A patentee is bound to work his patent in Germany within three years of the date thereof, on pain of forfeiture, and should licenses be required for the public interest, the patantee is bound to grant them at a reasonable royalty.
11. Persons not residing in Germany can only apply for a patent through a duly qualified agent or proxy residing in Germany.
12. The Patent Office is situated in Berlin, and its staff is composed of examiners appointed by the Imperial Chancellor and Federal Council who have power to call in experts.
13. The inventor must thoroughly explain the invention, by specification, and drawings, types, models, and patterns, as may be required to make it clear. These are examined by the examiners, and, if objected to, the applicant or his agent can alter them to suit before being published. If the examiner approves of the description, it is immediately published, unless the Imperial Government reserves it for State purposes.
14. Any one can, during the ensuing eight weeks, oppose the grant of the patent on the grounds of fraud or want of novelty. All interested parties, in case of opposition, have a right of hearing at the Patent Office. Should no opposition take place, the patent is officially granted.
15. The decision of the Patent Office may be appealed against at the Supreme Imperial Tribunal of Commerce.
16. Deliberately infringing a patent is a criminal offense, and the infringer is liable to a fine of not exceeding 10,000 marks (or $2,380), or imprisonment for one year at most, besides damages to the injured party.
17. In criminal cases the injured party is entitled to publish the sentence at the cost of the condemned party, and in all cases may, besides the penalty, demand an amercement of $5,000 at most from the condemned party in lieu of damages.
18. No action can be brought for any infringement that took place more than three years before the date of the action.
19. A fine of 150 marks, or $35.70, or imprisonment, will be inflicted on any one falsely representing a thing to be patented, or by marking the cases, advertising, or otherwise doing anything to induce people to believe that an unpatented article is patented.
20. All existing German patents are exempt from this law, and continue in force as heretofore.
21. During the existence, however, of any German patent, the owner has the option of getting it transferred to the Imperial Patent Office, and making it operative over the whole of Germany.
22. In such cases the Imperial patent will be dated, and held in every respect as if applied for at the date of the earliest dated individual State patent for the same invention.
23. After a patent is granted, a short specification will be published in the *Patent Journal*.
24. Before the lapse of a patent, notice will be given to the inventor, and a proper time allowed him to fulfil the requirements of the law.

It will be seen from a survey of the above points that ample protection is afforded the patentee, while care likewise is taken to protect the public. The taxing of patents is a wise provision and is well calculated to weed out worthless patents in a few years after they are granted. Another sensible point is the fixing of a limit to the time when a patentee can bring suit for infringement, and compelling the patentee to work his patent within a stated time under pain of forfeiture. These three points, taken together, would be quite effectual in preventing the extortions practiced by the patentees of machines which never have and never could be put into use.

TAMING MALICIOUS HORSES BY ELECTRICITY.

There is now in California a mottled gray thorough-bred stallion called Cognac, born in Normandy, France, of a most symmetrical and powerful mold. At his native home he was docile, and was worked at the plough. He was imported to the United States two years ago, being then five years old, and became the property of a man in Illinois. One day his owner put a halter on him, the style of which he took as a mortal affront, and he became refractory. All attempts to subdue him were in vain. He was so terribly beaten about the head that for some weeks he was but little better than a dead horse. He recovered, and has ever since exhibited a deadly hostility toward man, and was therefore called the "man-eating horse," though perfectly harmless to animals of his own species.

The way of taming horses by electricity, of which we have before spoken, is now practiced in San Francisco by Prof. Tapp, and this gentleman undertook to tame Cognac in this way, and did it at a public exhibition of his method. Some two or three hundred spectators assembled to see how the animal would conduct himself under the electrifying effects of a galvanic battery. The novelty of the experiment and the fame of the tamer and of the horse attracted the spectators. The ring inclosure was about seven feet high, and the seats for spectators were elevated still over this, so that they were presumably out of the reach of Cognac. Notwithstanding this, he came very near making a square meal of a wholesome citizen who was unwarily leaning over the temporary rail that surmounted the ring inclosure.

The horse was running at his freedom in the ring, and charged with a wild fury at every person who approached the railing, although they were above his head. He seized the gentleman in question by the coat lappel, taking also his vest, shirt and undershirt in his teeth, and, being an immensely powerful animal, it was with the greatest difficulty that the man was kept from being dragged into the ring and killed. As it was the horse got away with a large piece of broadcloth coat and a hearty mouthful of vest, shirt, and red flannel under-garment, and the man's breast was discolored as if he had received a very heavy blow. This was before the audience had assembled or the horse-tamer had come in.

At two o'clock the work of securing Cognac began, and by a little manœuvring two ropes were made fast to the headstall he wore. This was accomplished by the Professor and an assistant, who stood on the outside of the entrance door, which was opened sufficiently to admit a man's harm ; Cognac keeping his nose thrust close to the opening in the apparent hope of getting a nip at somebody. One of the ropes was then passed up along the corridor in front of the seats and made fast to an upright post. Then the trainer entered the ring and secured the other rope to the tent-pole. Thus Cognac found himself unable to follow the bent of his inclination any further.

Prof. Tapp then retired from the ring, and in a few moments returned armed, as he expressed it. He had on an overcoat and buckskin gloves. In the inside pockets of the overcoat he had two small electro-galvanic batteries, one on each side. These were connected by an insulated wire that passed behind his back. A wire ran from each battery, one being positive and the other negative, passing down inside the sleeve to his gloves and connected with a small metallic plate covering the ball of the thumb. He had also a bridle-bit, with long reins attached. The bit was wound with coil of copper wire, which extended along each strap to a small button. With a little difficulty he got the bit in the horse's mouth, the bridle being put over his head piecemeal.

During this process Cognac fought with his mouth and fore-feet as best he could, but he did not show any disposition to use his hind feet. The Professor then took the reins, one in each hand; he kept the thumb of his left hand constantly on the button of the strap; his right thumb he held over the other button, but not in contact with it, except when he wanted to give the horse a dose of lightning. When all was ready, he dropped his right thumb on the positive button, giving at first but a light charge. Cognac started as if he had been struck by a bullet. As the shocks were increased in strength the animal plunged and reared as much as his strong fastenings would permit. At length the side rope was loosened, and he had the full circuit of the ring. Tapp let on the electric fluid, and Cognac reared high in the air, endeavoring to plunge at his tormentor, but the Professor kept his eye on him, and by the slightest movement of his thumb created a wall which the horse could not cross.

It was a magnificent sight—the horse, covered with foam, fretting, chafing and panting, reared and attempted to throw himself forward upon the Professor, but the brute strength and fierceness paled before the behest of science, and Cognac was powerless to do harm. The experiment continued about twenty minutes, when the Professor concluded to test the docility of the animal. He said that the principal thing to be overcome was Cognac's disposition to bite. Tapp approached him, stroked him on the body, then on the head, and took hold of his nose. The horse having become convinced that he had found his master, permitted this, and even showed the same docility toward the Professor's assistant.

Prof. Tapp thinks the galvanic treatment a success, and in this he was concurred with by a number of horsemen in the audience, although others thought differently, as the animal exhibited his usual viciousness toward any others who approached him.

Before Cognac was taken from the ring he would come and go back at his trainer's command, and in many respects act like a good tempered horse. At last Prof. Tapp hitched Cognac up in a buggy, and the gates having been thrown open, he drove several blocks and returned. There were a great many people watching to see how the horse would acquit himself in harness; he behaved just like any other horse, and but for the fact that the "man-eater" was followed by a large crowd, no one would have suspected that he was the distinguished animal that so much had been heard about.—*San Francisco Call.*

FIREPROOF DRESS.

Mr. Oestberg, a Swede, has been conducting some sensational experiments in various parts of the Continent with his fireproof suit. This is made in two layers, the inner one of India rubber, the outer of English leather, the head being protected by a helmet resembling that worn by divers. At the girdle is fixed a piece of hose, which serves both for air and water. The air pipe, fed from two blowers, is placed inside the water pipe, and brings the air, after being cooled by the surrounding water, into the inner part of the dress. The air inflates the costume, passing away through the two small openings made for eye pieces. The current of air not only keeps the enclosed body cool, but drives smoke and flame away from the eyes. At the back the water pipe divides, one branch serving as an extinguisher, the other passing into the outer coating of the dress, the stream being distributed over the whole outer surface. With the apparatus on, the experimenter stood in the middle of a pile of burning shavings and logs without taking the least harm. If a continued use of this apparatus shows similar results, it is likely to be a useful invention.

EDUCATION, as defined by Aristotle, means an agency for the implanting of sound and virtuous habits. Nothing else would satisfy him for a moment.

CONCLUSIVE.—Lodger: "I detect rather a disagreeable smell in the house, Mrs. Jones. Are you sure the drains—" Welsh landlady: "Oh, it can't be the drains, sir, whatever. There are none, sir!"—*Punch.*

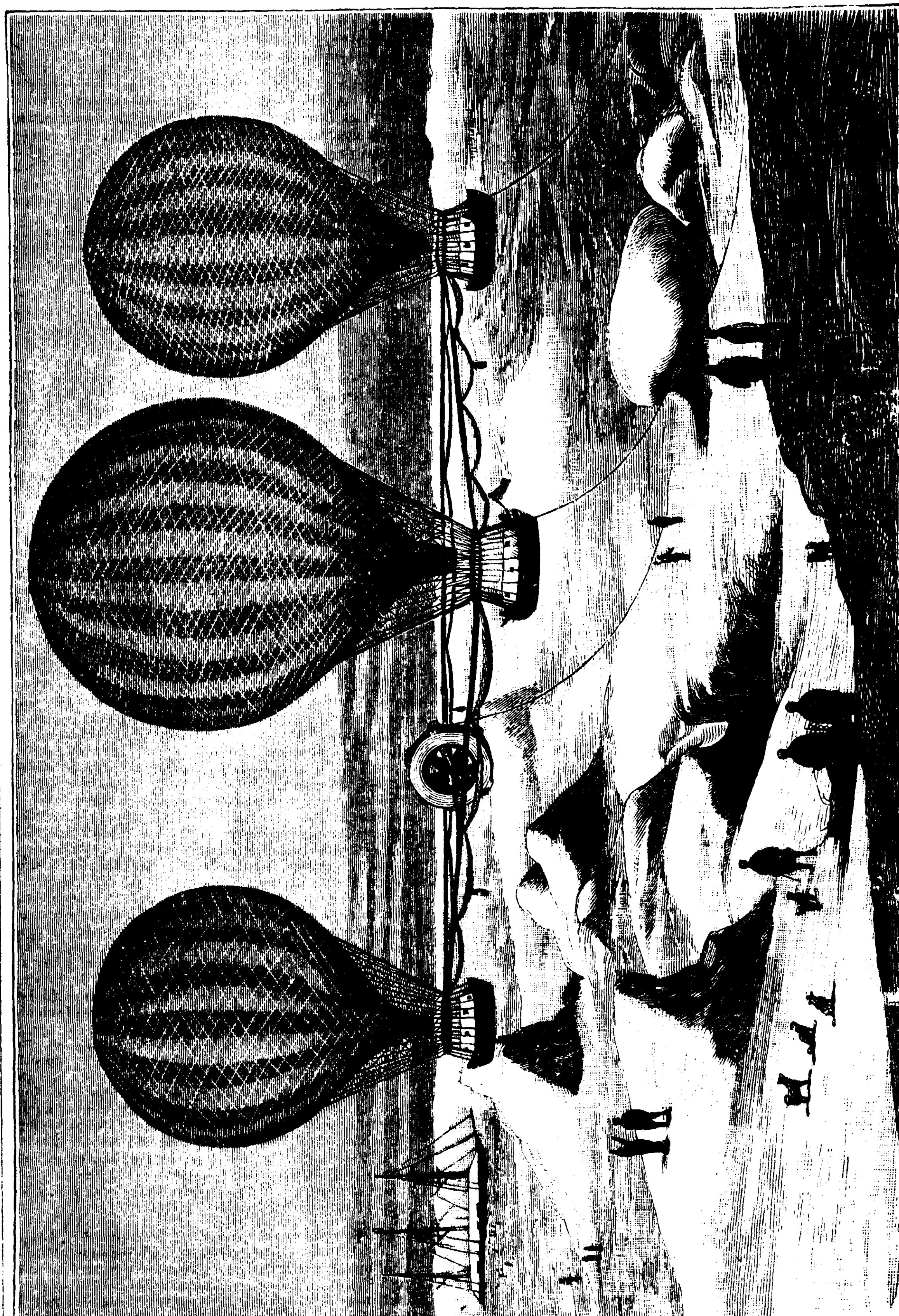
IMITATION OF WOOD MOSAICS.

Hugo Riha describes the following neat method of imitating mosaics in wood:—The smooth pine board is painted with three or four coats of dull white for a ground. When dry it is ground with *ossa sepiæ*, well dried with a piece of buckskin and left a day standing. A thin liquid paint is made by grinding the finest ivory black with turpentine on a glass plate, very fine, and mixing thoroughly with a mixture consisting of three parts of ordinary copal varnish and one part turpentine. This is applied evenly, with not too stiff a brush, upon the white tablet, and graded down very fine and delicately with a badger's hair grader. After two hours the paint dries so solid that work may be begun on it. The tablet is placed on an inclined position and the drawing of the design, the outlines of which have been pricked through the paper with a needle, is laid upon it, and reproduced on the black surface by striking it gently with a bag filled with finely ground chalk, and after removing the paper the outlines will be found in white upon the black background. The design is next painted over with a solution of calcined soda. In two or three minutes afterwards the painted part is washed with a piece of sponge, dipped in water, with a circulatory motion of the hand and arm. With a little rubbing the black paint is removed from the portions where the soda was applied. The washing with clean water and sponge is repeated until the design appears in white. This, of course, is the white ground that was under the black. This surface is then dried with a piece of buckskin. By this process the white portion is depressed while the black portion which did not come in contact with the soda remains raised. The colors are now applied to the white portion to imitate the different kinds of wood; and where two kinds of wood are to be matched together, a strip of adhesive paper is pasted along the line where they are to meet, and one kind of paint applied up to the paper. When dry the paper is removed and placed over the painted part and the other colour applied. When the design is completed it may be varnished and polished. As the paint applied does not form a thicker coat than the black which surrounds it, the work has the appearance of natural wood mosaic inlaid in a black groundwork, instead of being raised from it as in the usual method.—*Scientific American.*

HOW TO MAKE HOMES HEALTHY.—Most cases of infectious diseases have, in addition to the common epidemic influence, a direct exciting cause. This will be found, when contagion is excluded, to be poisonous emanations of some kind in the house, or on the premises, or in the drinking water; in cities generally sewer gas. Dr. Chapman, of Brooklyn, to whom we refer in another article, after experiments, has settled on the following plan as a sure relief from sewer gas: The soil pipe running from the cellar passes through the house and opens into the kitchen flue at the top story. The pipe should be four inches in diameter. It will be freely ventilated by the draft of the flue. Into this soil pipe or ventilator, the waterclosets and basins on the different floors empty through traps. The water from the upper closet, running past the opening of the lower closet, would be apt to suck its trap dry, and to prevent this a separate ventilating pipe is run from the traps of the lower closets to a point in the ventilator above the upper closet. In this manner all foul gases at once pass upwards and empty at the top of the house. In several houses where malarial disease had been frequent, since the introduction of this plan the residents have been free from all disease due to blood poisoning.

CLEANING ENGRAVINGS.—Put the engraving on a smooth board, cover it thinly with common salt finely powdered; squeeze lemon juice upon the salt so as to dissolve a considerable portion of it; elevate one end of the board, so that it may form an angle of about 45 or 50 degrees with the horizon. Pour on the engraving boiling water from a tea-kettle until the salt and lemon juice be all washed off; the engraving will then be perfectly clean and free from stains. It must be dried on the board, or on some smooth surface, gradually. If dried by the fire or sun, it will be tinged with a yellow color.

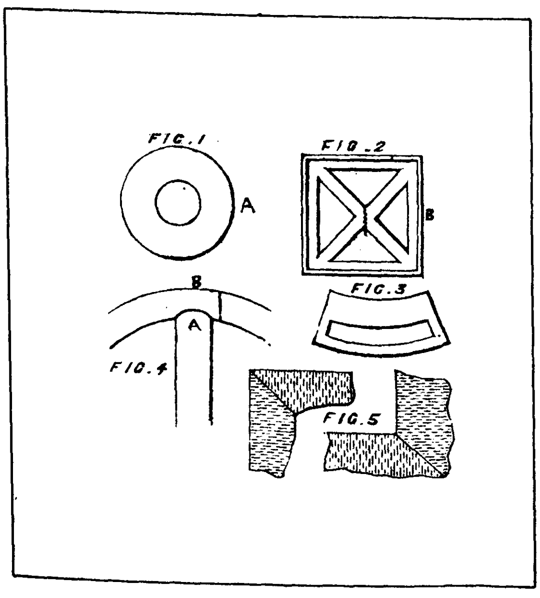
THE famine in India has quadrupled the death rate in the city of Madras. The death rate in July was 1,150 weekly. During the week ending August 17th, 1,051,000 persons were receiving relief in the Madras presidency. In thirteen affected districts the death rate in the week was equal to 483 per 1,000, signifying that if this rate continued for a year, scarcely more than half the population would survive.



PROPOSED BALLOON VOYAGE TO THE NORTH POLE.

PROPOSED BALLOON VOYAGE TO THE NORTH POLE.

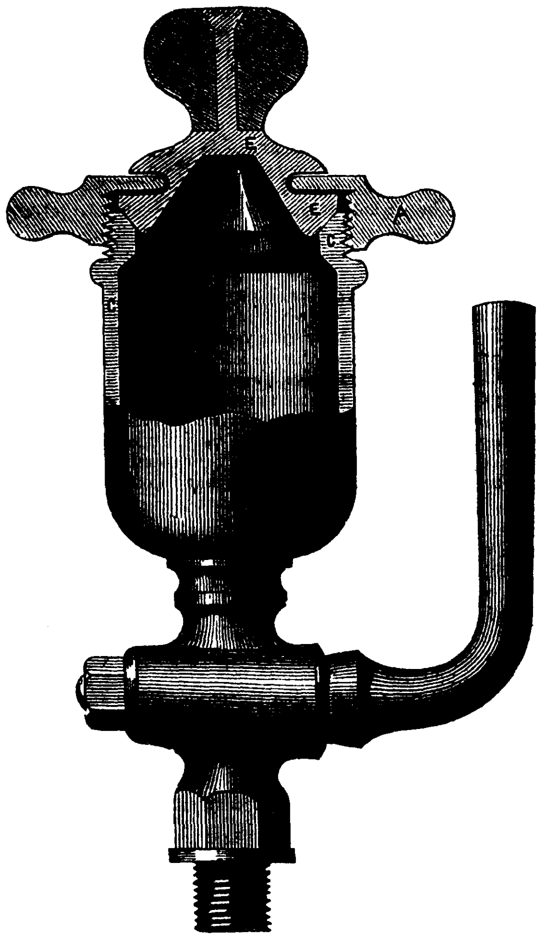
We find in the London *Graphic* the annexed engraving of an arrangement of balloons proposed by Mr. Henry Coxwell of England as a means of crossing the Palæocrystic Sea and so reaching the north pole. Our contemporary attributes to Commander Cheyne, R.N., the origination of the idea of using balloons for this purpose. It is believed that the three balloons connected in the manner shown in our engraving would carry six men, besides three tons weight of gear, boat cars, stores, provisions, tents, sledges, dogs, compressed gas, and ballast. The triangular framework connecting the balloons would be fitted with foot ropes, so that the occupants could go from one balloon to another in the same manner as sailors lie out upon the yards of a ship, and the balloons would be equipoised by means of bags of ballast suspended from this framework, and hauled to the required position by ropes. Trail ropes would be attached to the balloons, so as to prevent their ascent above a certain height (about 500 feet), at which elevation they would be balanced in the air, the spare ends of the ropes trailing over teorological observations conducted on board the vessel, and at two observatories some thirty miles distant in opposite directions. It is estimated that, with a knowledge of the diameter of the wind circle, and the known distance from the Pole, the balloons could be landed within at least twenty miles of the long wished-for goal. There the balloons would be securely moored; and when the necessary observations at the Pole had been carried out, a return wind would be secured for their return, the requisite full inflation having been made by means of the surplus gas taken out in a compressed condition. The returning voyagers would arrest their course to the southward on the parallel of latitude on which they left their ship, and the remainder of their journey, east or west, would be performed by means of the dogs and sledges conveyed in the balloons.



SHRINKAGE OF IRON CASTINGS.—(See page 15.)

HUNT'S LUBRICATOR.

We give, below, an engraving of a form of suet lubricator now being made by Messrs. James Hunt and Co., of the Crown Brass Works, Birmingham, the special feature in the arrangement being the form of joint between the body of the lubricator and the cover. This joint is arranged to give a clear opening the full diameter of the cup, and at the same time to dispense with the use of india-rubber or soft metal to secure tightness. Referring to



the engraving it will be seen that the lid A is screwed directly on to the cup C, the lid bringing down with it the valve E, and this having a ground surface fitting a corresponding surface on the cup, and making a steam-tight joint. The valve E is free on the lid, so that it can rotate either way, and all the attention that is required is to wipe the faces before screwing down. Horns are provided to screw it down by, and an ebony knob to remove the lid when hot if necessary, and care has been taken to encase the valve in the lid, so that the face may not get indented in either removing or affixing. Valves or taps are affixed at bottom according to the requirements. The joint when worn can be ground in its place by merely relieving the lid from the valve.

A Great Oil Pipe Line.—A new oil pipe, known as the seaboard pipe line, is soon to be laid from Butler county, Pa., to Baltimore, a distance of 230 miles. The transporting capacity will be 6,000 barrels of oil per day, and the flow will be incessant. It is expected to bring into Baltimore annually about two million barrels of crude oil, about equal to the quantity now carried there by two railroads.

RECEIPTS, &c.

Driving Fleas Away.—Take 1 tablespoonful of crude carbolic soap, dissolve it in ½ pint of boiling water, then add ½ pint of cold water; use an ordinary paint-brush and wash the parts effectually. It is sure death to all insects. Pets require to be washed often, and one half the above solution is all that is requisite. Rinse after washing.

Removing Warts.—Take a tough stick, sharpen the point, and run it through a cork into a bottle of turpentine. By wetting the warts with what turpentine will adhere to the point of the stick from 10 to 15 times a day—being careful not to spread the turpentine over the skin—will cause the warts to grow out in about two or three weeks. I have entirely cleaned the warts from my hands in this way, and have never been troubled with them since.

Cleaning and Polishing Metals.—When steel is rusty the rust may be removed and the metal cleaned by diluted sulphuric acid; the film of oxid on brass is removed by a solution of oxalic acid; and the brown sulphuret deposit on silver by a solution of hyposulphite of soda. For polishing use first fine emery, and then Paris rouge or electro-silicon. If cheapness is an object, you may make the Paris rouge by calcinating green vitriol in the fire. This is a sulphate of iron, from which, by heat, the sulphuric acid is driven off, when an oxid of iron remains behind. The latter is in a very finely divided condition, and as such is called Paris rouge. The main point in polishing powders is to have the particles very hard, sharp, and gritty, but at the same time so fine that not a single coarse particle can produce any scratch. A less gritty substance is Paris white, which is nothing but very fine chalk; it has very little sharpness and is rather soft, but its fineness makes it very appropriate for a last finish when other polishing powders have done the roughest work.

Oil for Sewing Machines.—Do not use any animal or vegetable oil, such as lard oil, whale oil, or sweet oil; they all become rancid and gummy, and if you do not use your machine for a few months it will stick fast, and you will have to take it apart to clean it (by the way, the best cleaner is benzin). The lubricating oil for sewing-machines, and all kinds of small machinery, is crude filtered petroleum of the heavy and thick kind, such as is found in Western Virginia. The heavy petroleum obtained by high temperature distillation, after the kerosene has been driven off, is not so good, but is better than vegetable or animal oils, and is sometimes added to the latter to prevent them from becoming so soon rancid, acid, or gummy. It improves them, but after all nothing is better than the crude heavy petroleum purified by simple filtration through animal charcoal.

Liquid Glue.—To produce a good and cheap liquid glue, dissolve, in a pan heated by boiling water or steam, from 4½ to 5 pounds of soda in 20 to 25 pounds of boiling water, then add to it, stirring well at the time, 30 pounds of powdered resin, keeping the whole continually boiling until the resin is perfectly dissolved. The soda-resin composition, dissolved in the proportion of 1 pound of resin to from 30 to 40 pounds of water, is to be well mixed together with a glue solution, made by dissolving 10 lbs. of glue in about 30 to 40 pounds of water; then boil both solutions together for about 10 minutes, after which run it through a fine sieve or filter, and it is then ready for use. The best proportions for mixing have been found to be for 1½ parts resin 1 part glue.

Cleansing Feathers of their Animal Oil.—The following recipe gained a premium from the Society of Arts in Paris: For every gallon of clean water take one pound of quick-lime, mix them well together, and when the undissolved lime is precipitated in fine powder, pour off the clean lime water for use. Put the feathers to be cleaned into another tub, and add to them a quantity of clean lime water, sufficient to cover them about 3 inches; when well immersed stir about therein. The feathers, when thoroughly moistened, will sink, and should remain in the lime-water three or four days, after which the foul liquor should be separated from them by laying them in a sieve. The feathers should afterwards be well washed in clean water and dried upon nets, the meshes of which may be about the fineness of cabbage-nets. The feathers must, from time to time, be shaken on the nets, and as they get dry will fall through the meshes, and are to be collected for use. The admission of air will be serviceable in drying. The process will be completed in three weeks; and after being thus prepared, the feathers will only require to be beaten to get rid of the dust.

Gilding with Gold Leaf.—There are various methods applicable, according to the various circumstances and the variety of objects to be gilded. Bookbinders use the gold leaf in two ways—to gild on the edge and to place gold letters on the binding. To gild on the edge, the edge is smoothly cut, put in a strong press, scraped so as make it solid, and the well beaten white of an egg or albumen put on thinly; the gold leaf is then put on before the albumen is dry; it is pressed down with cotton, and when dry polished with an agate polisher. To put on the lettering, the place where the letters are to appear is coated with albumen, and after it is dry, the type to be used heated to about the boiling point of water, the gold leaf put on, either on the book or on the type, and then pressed on the place where the lettering is desired, when the gold leaf will adhere by the heat of the type, while the excess of gold leaf loosely around is rubbed off with a tuft of cotton. To do printing with gold leaf, the sheet to be printed upon is pinned to the timpan of a hand-press, and it is first printed with ink of any colour, or with varnish, then the type is covered with a large sheet of paper, the gold leaf laid on, and the tympan laid down again, slowly and carefully, so as not to disturb the gold leaf by motions of the air; then the pressure is again applied, when the gold leaf will stick to the printed sheet, and the surplus can be rubbed off with a tuft of cotton. In gilding picture-frames with gold leaf there are two methods; one with the ordinary gold size, and the other with varnish. The latter method does not allow polishing, but is water-proof; the former is not. The main point is to have a well prepared ground-work of say white lead and drying oil, smoothed down properly; then follow several coats of calcined white lead in linseed oil and turpentine, with intervals of at least 24 hours between each coat, which must be carefully smoothed off with pumice-stone and fine emery-paper. Then the gold size is applied, which may be made from the sediment that collects at the bottom of the pot in which painters wash their brushes; this is thoroughly ground and strained. When the gold size coat is sufficiently dry so as to be still a little sticky, apply the gold leaf and press it on with cotton or a soft brush; after a few days' hardening it is varnished with spirits or oil varnish. This gives a water-proof gilding, but ordinary picture frames are gilded with a gold size containing no oil. It is made of finely ground sal ammoniac, to which is added a very little beef suet; this is mixed with a pallet-knife, with parchment size dissolved in water, so as to flow from the knife when hot. The frame may be prepared first with a few coats of Paris white and glue water, rubbed down smoothly, and finally apply the size, which must not be too thick, as then it will chip off, and if too thin it will not have sufficient body. The most difficult part in all these operations of gold leaf gilding, is the application of the gold leaf, which requires much practice, judgment, and great care, but with some attention to little details it can be easily learned. There ought to be no draught at the place of operation, and the operator ought to avoid allowing his breath to blow upon the gold leaves, as they are so thin and light that the least breath of air causes them to fly about—worse than feathers. Turn the gold leaves—one at a time—out of the book upon the leather cushion; with the gilding knife you may lift any leaf and carry it to a convenient place to cut it into the sizes required. Blow gently on the centre of the leaf and it will at once spread out and lie flat without any wrinkles, then cut it by passing the edge of the knife over it until divided. Place the work to be gilded as near as practicable in a horizontal position, and with a long camel's hair pencil, dipped in a mixture of water with a little brandy, go over as much surface as the piece of gold is to cover; then take up the gold from the cushion with a tip. Drawing it over the forehead and cheek will dampen it sufficiently to make the gold adhere. This must then be carefully transferred to its place on the work, and by gently breathing on it, it will adhere. Take care that the part to which it is to be applied be sufficiently wet, so that the gold leaf will not crack. Proceed in this way a little at a time, not attempting to cover too much at once. If any cracks or flaws appear, immediately apply another piece of gold leaf over it—large enough to cover the crack. If occasionally the gold does not appear to adhere, on account of the ground having become too dry, run a wet pencil close to the edge of the gold, so as to allow water to penetrate under the gold leaf. When the work is dry (say in 10 or 12 hours), it may be burnished with an agate tool, taking care to first remove all dust from the tool as well as from the gilded surface.

Gelatine moulds for plaster of Paris are made of good glue dissolved in hot water containing from five to fifteen per cent. of glycerine. Glue thus made, on cooling, gelatinizes, but does not dry or harden.

SHRINKAGE OF IRON CASTINGS.

(See page 12.)

The chief trouble with iron castings is their liability to have internal strains put upon them in cooling, in consequence of their shrinking. The amount of this shrinkage varies with the quality of the metal and with the size of the casting and its comparative thickness. Thus locomotive cylinders shrink only about 1-16″ per foot (1-192 = ·0052), while heavy pipe castings and girders shrink 1-10″ (1.20 = ·0083) or even 1/8″ per foot (1-96 = ·0104). While small wheels shrink only 1 25″ per foot (1-350 = ·0033), large and heavy ones contract 1-10″ per foot 1-120 = ·0083). (The "shrink-rule" is employed by pattern-makers to relieve them of the labor of calculating these excesses of ·00520·083, &c., the scales being graduated to inches, &c., which are ·0052, ·0083, &c., too long.) Now, if thick metal, proportionately, shrinks more than thin, we must expect any casting not absolutely symmetrical in every direction to change its form or proportion. (A cubic or spheric mould yields a cube or a sphere as a casting; but a mould say of the proportions of 100 x 5 x 1, shrinking differently according to dimensions, gives a casting not only less in size, but in somewhat different proportion.) In many cases we still find them strained and twisted. Those parts which cool first get their final proportions, and the later cooling portions strain the earlier, the resistance of which to deformation puts strains on those cooling. This initial strain may, of itself, break the casting, and if not will weaken it. Castings of excessive or varying thickness, and of complicated form are most in danger from internal strain. This strain is gradually lessened in time by the molecules "giving." In a casting such as A (Fig. 1), in the figure—say a thick press cylinder—the outer layers solidify and shrink first, and as the inner layers contract after the outer ones have "set," there is compression of the outer layers and tension of the inner. Such a cylinder will, if subjected to internal pressure, be weak, because there is already in the inner layers a force tending to expand them. The cylinder would be stronger if these layers were braced to resist extension, or in other words, were already in compression. If we cool the interior first, by artificial means, while delaying the cooling of the exterior layers, we have these layers braced to receive gradual or sudden pressure, and this is especially desirable in cannon. In a panel like B, Fig. 2, with a thin but rigid flange, the diagonals shrink more slowly than the rim, and a crack is likely to appear. A casting like that in Fig. 3, would solidify on the thin side first, and when the thick side shrank it would curve the bar and compress the thick part, and put the thin part in tension. Wheel and pulley castings are especially troublesome. The latter have a thin, rigid rim, which cools before the arms, and when the latter cool they are very apt to break by tension along the line A (Fig. 4). If the arms set first, they are apt to break the rim as at A B, as they make a rigid abutment, which resists the rim-contraction, bending the iron and breaking it from within outwards. In the cooling of castings the particles range themselves in crystals perpendicular to the cooling surface, hence we may expect to find weak points at sharp corners, as in Fig. 5. The remedy for this is to round off all angles.—*Polytechnic Review.*

REMARKABLE MARKMANSHIP.—Captain Bogardus, a well known marksman, recently accomplished in New York the remarkable feat of breaking 5,000 glass balls inside of as many consecutive minutes, the missiles being shot from a double-barreled gun. The balls were thown up from spring traps and were shattered in the air. The feat was accomplished with a margin of 19 minutes and 25 seconds to spare. It is stated that the weapon, weighing ten pounds, was lifted and aimed 5,300 times, which work is equivalent to 318 foot pounds per minute, accomplished by the arms alone and continued for over 8 hours. This must be added to the brain work involved in aiming the gun, in order to perceive the nature of the remarkable skill and endurance of the marksman.

COMPARATIVE STRENGTH OF WOOD AND CAST IRON.—Herr Hirn has been conducting a series of experiments in Germany, on the comparative strength of wood and cast iron in their different applications, and finds that in a great number of cases the former has the advantage. Professor Hirn finds the strength of wood to be in direct ratio to its density, and this strength is increased by immersing the pieces of wood in linseed oil, heated from 185 deg. to 212 deg. Fah., and letting the wood, thus immersed, remain for two or three days, or until partially saturated. —*The Engineer*, lxiv. 318.

ENGINEERING CALCULATIONS.

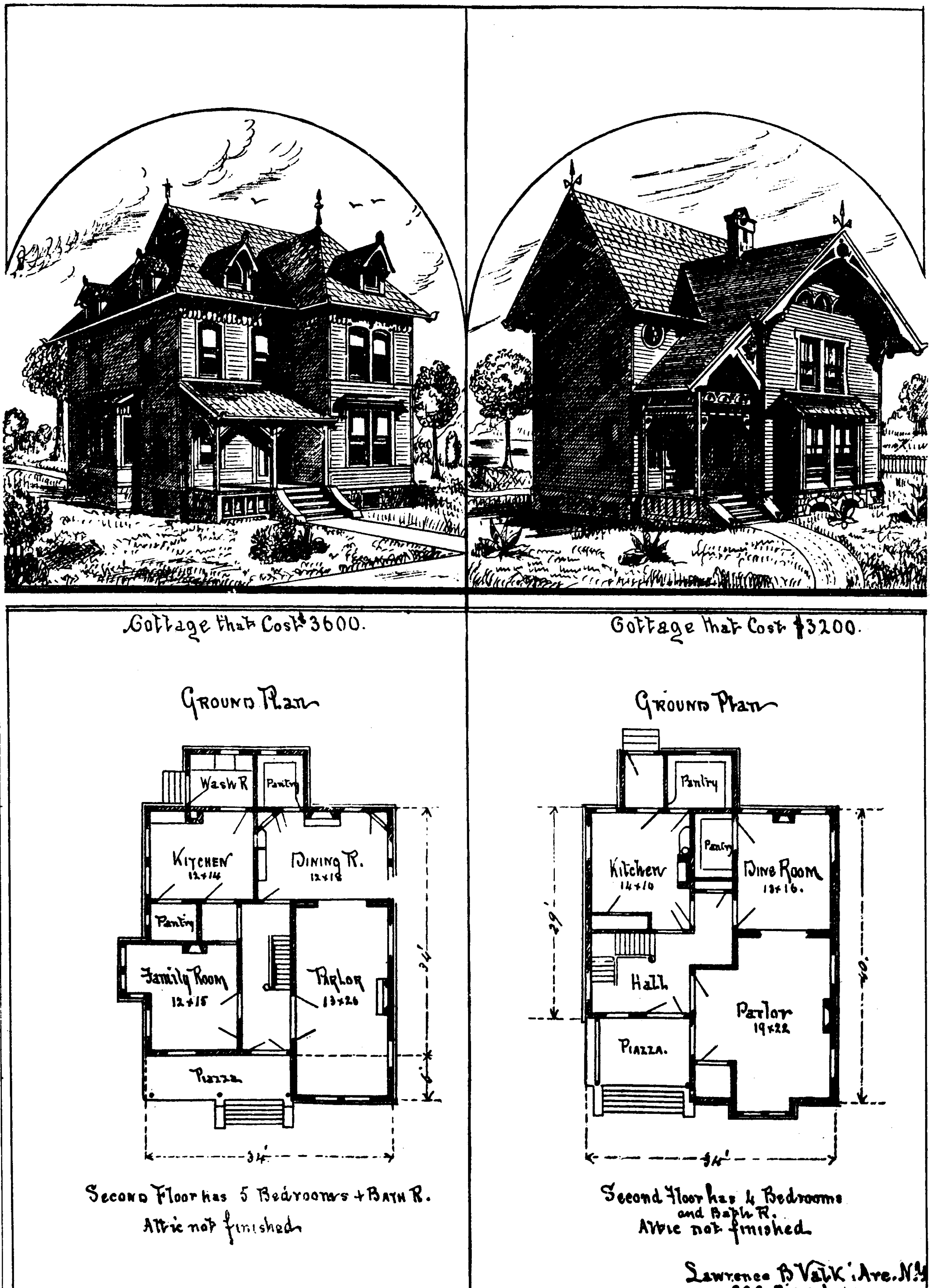
A whole treatise, useful enough and by no means small, might be written on the questions, "When to calculate and how to calculate," in their applications to engineering matters. If such a work ever did appear, moreover, and treated its somewhat comprehensive subject in a really rational manner, it might certainly do good service both to the calculators and the anti-calculators, if we may coin a word. It would show reason for lowering the pretensions of those who believe that mathematics can do everything, while it would at the same time greatly enlighten those who still refuse to believe that mathematics can do *anything* in the solution of our professional problems.

As to the "when" of calculation in our every-day work, it is no doubt possible and right to take a middle course between the "always" and the "never" of the two conflicting schools just mentioned. An obvious rule for procedure in the matter is supplied by remembering that calculations can only be of value when data exist upon which to found them. But a bare statement of this kind, distinct as it may appear at first sight, does not after all help much in practice. It is no doubt true enough, but it only leaves us, in each particular case, face to face with another question, namely, whether the data do or do not exist, and this is not always easily settled. The problems of engineering practice—whether they bear upon the quantity of steam used in an engine, the dimensions of a girder or of a beam, the diameter of a crankshaft, or what not—are in almost every case of great perplexity. Their solution, in other words, is influenced by a large number of different factors. Starting, then, with the assumption (which we shall not here discuss) that a calculated result is a thing to be desired if it can be obtained, it is necessary first to find out, as completely as possible, the whole conditions under which our problem lies. Of some of these conditions it may be recognized at once that they connot sensibly affect the question; but even after eliminating these, sufficient often remain to render the problem complex enough. It happens but seldom, in the case of such problems as we have mentioned, that the data exist for calculating a solution which really takes into account *all* the elements of the case. The algebraic formulæ most applicable to it are based on assumptions which are by no means really fulfilled by it; the experimental results most nearly resembling it have been obtained under circumstances only approximately the same as those with which we have actually to deal.

The question, therefore, whether the data for calculation really exist in any particular case becomes rather a question of degree than one to which a positive Yes or No can be returned. The important point is that in every case it should be distinctly realized which conditions are, and which are not covered by the data at our disposal. It may be readily admitted that there are too many cases in which this has not been done, and it is probably the publication of imperfect results of this kind that has led to the strong prejudice which still exists largely enough against all calculation. It is only too easy, after spending a good deal of valuable time, to say nothing of ink and foolscap, in working out results by the aid of a complex formula, to forget at the end what was known at starting—that the formula only partially represents the real circumstances of the case. The result upon which so much labor has been spent is not a real solution of the problem, but a solution only of some much simpler one, more or less closely resembling it. It is useful—very possibly extremely valuable—as a first step towards a complete solution, but it is this only in the hands of those who know its real meaning. In the hands of any one who forgets or is ignorant of the fact that it is only an approximation, as well as of the extent to which it is an approximation, and of the bearing of the modifying circumstances on it, it is not only not useful, but often absurd and sometimes even dangerous.

It is easy enough to sneer at all this, and plenty of capital has been made out of it, from time to time, by those who believe, or affect to believe, that all calculation is useless. It is impossible, however, to do without calculation in some form now-a-days, and the only alternative to calculation proper seems to be the use of "Rules." A rule is, of course, just a formula under another name; and it may present in an epitomised form the result of close reasoning or of elaborate experimenting. In such a case it is worthy of all respect, and may be of great convenience. In the hands, however, of those who have not themselves gone through the reasoning or followed out the experiments, it is liable to every bit as great abuse as its more formidable-looking brother in a mathematical or physical text-book. But such "rules" as this are not the most common. The most popular rules are those short statements contained, generally, in "pocket-books," in

(Continued on page 18.)

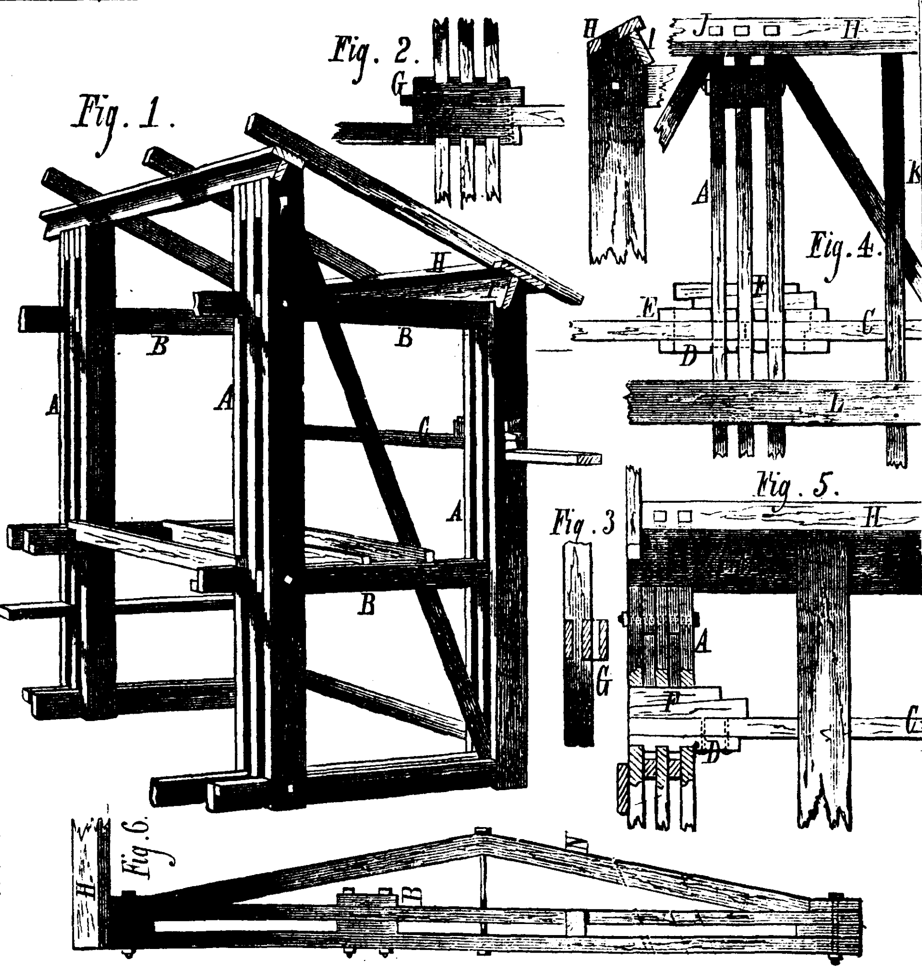


TWO DESIGNS FOR COTTAGES.

IMPROVED CONSTRUCTION OF PORTABLE FRAME BUILDINGS.

We illustrate herewith an improved method of erecting frame buildings by the use of planks of suitable length, and thickness, from which the posts, beams, joists, etc., are formed, so that the structure may be erected with much saving of timber and by unskilled persons. It also may be taken down and packed in small compass for shipment from place to place.

The supporting posts, A, are made of two or more planks according to the size of the edifice to be erected. The planks are placed at some distance from each other, and are firmly bolted to the beams, B, Fig. 1, which are made of several planks interposed between the post planks, the whole forming a strong and rigid construction. The lateral posts connecting girders, C, are passed through mortises of the plank



posts, and are rigidly secured at their meeting ends by a recessed key D, Figs. 4 and 5, which is first passed through the mortises of the post and then placed in position. The girder ends, after being inserted, are connected with a second recessed top key, E, of less width. Both keys are spiked to the girder ends in order to unite them. The keys and girder joints are finally locked to the mortises of the plank post by two wedge keys, F, introduced at relatively opposite directions.

The girders, C, are also connected to the posts by a similarly recessed key or girder, G, Figs. 2 and 3, that is inserted as above described, bolted and finally locked by wedge keys.

The rafters are seated by their recessed ends on the rafter-bearing plates, H, Figs. 1 and 4, which are supported by pieces I, set at right angles to the plates and fitted to the recessed ends of the posts to which they are spiked. The top ends of the posts have tenons, J, Fig. 4, that enter mortises in the rafter plates, H, so as to cause the rigid interlocking of said plates with the posts. Vertical siding strips, K, Fig. 4, are nailed to rafters, girders, &c., so as to receive the horizontal siding boards, L. A horizontal siding strip, M, runs below the rafter plate. In some cases posts are required that are not tied to the building by a girder or beam, in which case the post, constructed as already described, is strengthened by the brace, N, Fig. 6. This brace is made of one piece, and is attached to a central bolt and nut and seated against shoes.—*Scientific American.*

TWO DESIGNS FOR COTTAGES.

(See opposite page.)

On another page we give the representations of two designs for cottages, costing respectively $3,600 and $3,200. They are admirable in every respect and contain such features as to render their exterior appearance at once attractive to the eye, and at the same time every portion of the interior is utilized to the very best advantage.

The first is a frame building on a stone foundation. The frame is double boarded, with shingle roof. The interior is finished in pine—no painting; but filled and varnished, a beautiful and inexpensive way of interior finish. The fire-places are built of brick, while all the flues above are the new fire-proof composition pipe, plastered over the same as brick. The first floor of this house contains a parlor 13 x 20 feet; a family or sitting-room, 12 x 15 feet; kitchen, 12 x 14 feet; dining-room, 12 x 18 feet; together with a good sized wash-room off the kitchen and pantry off the dining-room. On the second floor there are five good-sized bedrooms.

The second design is also a frame building, costing only $3,200, double boarded. The first floor contains a parlor 19 x 22 feet; dining-room, 13 x 16 feet; kitchen, 14 x 10 feet, off which there is a pantry, and there is also a pantry off the dining-room. The second floor has four bedrooms and a bath-room.

The inside of this house is finished in a novel manner in linings of cretorm cloth secured to the studding with white-head tacks, and plaited cloth borders in place of cornices; the rooms are wainscotted in pine, and all the wood-work filled and varnished. The effect of the cloth-finish is the same as if the walls were richly papered, is not easily injured, and if it should be, is easily taken off, renewed, or repaired. The beams in the parlor and dining-room are of pine, dressed and chamfered, and show on the ceiling, the flooring on them being 3 inches wide, beaded and dressed. This finish is novel, unique, and very much admired; it enables the house to be very quickly finished, and dispenses entirely with plastering.

At the present time novelty in arrangement and design is what is being sought for, the taste of most persons who build cottages being in that direction, and it only remains for architects to take the hint and act accordingly. Owners are not supposed to know how to execute their own wants, and it remains for architects to develop everything new and as original as possible. A little cottage costing from $700 to $1,000 would be just as beautiful.

Both these cottages have shingle roofs, and cellars under nearly the whole, also a cistern, and plumbing in bath-room, water-closet, &c. Ranges set in brick are being dispensed with, for the new patterns lately introduced require no brick-work, which is a great saving.—*Manufacturer and Builder.*

BRITISH PATENTS IN 1876.

Our London exchange, *Iron*, gives some notes of progress in the British Patent Office. During 1876 the number of applications for letters-patent was 5,060, of which 1,702 were suffered to lapse, leaving 3,367 in force after the first six months. The number of applications in 1875 was 4,561, so that there was an increase of 500, a fact unexampled in the official records. For some years there has been a steady growth, the increase of 1875 being 69, that of 1874 being 193. A calculation over all the years since the Act of 1852 shows that only 28 per cent. of the patents pay the third year's fees and live for seven years, while only 10 per cent. survive the full term of fourteen years by paying $250 at the end of seven years.

As far as can be calculated from the statistics given, there are now, or rather were at the beginning of the year, just 14,440 patents (neglecting new and unpublished applications) in force out of the 84,114 applications since 1852.

The total receipts of the Patent Office in 1876 were $926,855, of which $695,335 was profit. The patents, trade-marks, and designs departments have been united. It appears that the aggregate surplus income since 1857 amounts to about seven millions and a half. In the Designs Registry 9,176 ornamental designs were registered, and a small number of "useful designs." The fees in this department amounted to $23,660. The Trade-Marks Registry makes a first appearance in this year's report of the Commissioners of Patents. Out of the 3,696 applications lodged on behalf of the 10,304 marks by the end of the year, only 261 were registered by that time, but 4,984 marks had been registered by the 31st of July. Inasmuch as by the Act only those trade-marks can be protected by legal process which are actually registered, the position of the other 5,400 marks may possibly raise some nice points in future action for infringement. The fees received on account of the Trade-Marks Registry amounted to $41,475. It appears that the classified abridgements of patent specifications are again to be proceeded with.

TO BRIGHTEN IRON.

The following method of brightening iron, which appears suitable for some of the less important parts of large clocks, is recommended by Boden. The articles to be brightened are, when taken from the forge or the rolls, in the case of such articles as plate, wire, &c., placed in diluted sulphuric acid (1 to 20) where they remain for about an hour. This has the effect of cleansing them, and they are washed clean with water, and dried with sawdust. They are then dipped for about a second in commercial nitrous acid, washed carefully, dried in sawdust, and rubbed clean. It is said that iron goods thus treated acquire, without undergoing any of the usual polishing operations, a bright surface having a white glass. Care should be taken by any one using the nitrous acid not to inhale the fumes.

THE SINNER IN THE CELLAR.

Manufacturers of furnaces will be interested in the following from the New York *Herald*:—Doubtless the most fruitful source of deranged health in this city is the furnace that warms the domicile of the average householder. That subterranean evolver of noxious gases and excessive heat, which leaves people cold because it is so nearly impossible to distribute it properly, is the real author of the myriad headaches, neuralgias and bronchitises, and of at least half the other diseases that are attributed to our changeful climate, our bad sewerage and drainage and our water poisoned with miasm. Our sewerage is bad, our water is far from first rate, and our climate is unjustly abused, and all these have obtained bad names because they have been held responsible for the acts of the great sinner in the cellar.

(Engineering Calculations continued from page 15.)

which the whole matter is summed up with great brevity in an expression which requires the carrying out of no more formidable operation than getting a square root from a table, and multiplying by two, and gives a definite result, without any troublesome qualifications or conditions. This is a royal road to the determination of quantities or of dimensions, but like other royal roads it fails, often enough, to lead to the desired destination. A rule founded on the user's own experience, and devised as a short expression for the conclusion to be drawn from a long series of well-understood facts, is most useful and convenient. A rule picked out of a book, founded (if on anything at all) on some one else's experience, and on facts or hypotheses totally unknown, is seldom useful and often misleading. If it be foolish to base elaborate calculations upon data imperfectly known or imperfectly representing the facts on which they are based, it cannot be less unwise to pin one's faith to "simple" rules in total ignorance of the reasoning which has led up to them, or of the limits within which they really apply to practice.

In answering the question "How to calculate?" at least so far as concerns such calculations as have to be made in the drawing office, we are disposed to agree with those who advocate the use of the scale and straight-edge wherever they can be employed in computation; the making of calculations with lines, that is to say, instead of with figures. The methods of this graphic arithmetic are gradually becoming known in this country, although on this as on many other subjects we are still without a text-book. The study of them will well repay any one who is unacquainted with them, and whose drawing office work includes any considerable amount of calculation. The degree of accuracy attainable by them is quite in excess of that practically required in almost all cases, when they are used, that is to say, by a fairly accurate draughtsman. They are carried out with instruments which the engineer has always at hand, and he is so thoroughly accustomed to the use of these instruments that anything done by their help is done with a minimum of fatigue and uncertainty. In many cases the graphic operations are self-checking (as in "reciprocal diagrams") and tell at once if a mistake has been made, and in many others their direct appeal to the eye greatly facilitates the detection of errors. At the same time they have not the same *appearance* of absolute accuracy that is possessed by a long calculation worked out to several places of decimals, and this must be regarded as a great advantage. For there can be no doubt that mistakes have often resulted simply from the unfelt influence of the decimal places, which seem to delude their user into forgetting that a mere process of accurate manipulation of figures, although essential to the solution of his problem, is not the whole of it.

We have not left ourselves room to say anything as to the use of mechanical aids to calculation, and especially as to the slide rule and the planimeter. It is in some respects to be wondered at that these instruments are not more used than they are, especially as every one who begins to use them seems to continue to do so. Both are labor-saving appliances, the latter with the additional recommendation that it gives results considerably more accurate than can readily be obtained without it. We may perhaps take another opportunity of saying something about these.—*Engineering.*

THE TORTOISE AS A BAROMETER.—M. J. P. Bouchard, says the London *Farmer*, publishes the results of a series of observations he has made for some years past on the habits of the common tortoise as indicative of approaching changes in the weather, more especially of sudden reductions of temperature. At the end of autumn, if a severe winter is at hand the tortoises bury themselves deeply in the ground so as to be completely hidden. If, on the contrary, the winter is about to be exceptionally mild, as was the case last year, they only go just sufficiently deep to cover the openings of the carapace. Taking last winter as an example, he found that they emerged from their retreats during a mild January, and their return to them late in February was shortly followed by severe frosts. One day in March, while the thermometer was standing at 50° Fahr., the tortoises suddenly retired, and the same night it fell to only two degrees above freezing point. Five times in the month of April their disappearance gave timely warning of approaching frosts, and in every instance the warning was justified by the result. M. Bouchard states that by regular attention to the movements of these sensitive weather prophets, he has been able for years past to avoid danger from unexpected night frosts in his numerous glass-houses.

HOW ARE COLORS SET IN ENAMEL?

To answer the above question, the *Jeweler and Silversmith* gained an interview with Mr. Piguet of New York city, who has lately introduced this art to this country. We quote a few paragraphs: "When I first began here I had to make my own enamel. You see, one must be sure he has enamel, and not some counterfeit material or other, called by that name, to deal with, or else he must surely fail. Having become satisfied that my gold or other metal is covered with the genuine article I am ready to begin. The materials we use in painting are made to unite with enamel alone, and ultimately, as you will see, form part of it. If we should be deceived in our enamel we cannot succeed. Well, we find that satisfactory. These fine powders which you see here of different colors are what I use, after admixture properly upon my palette, for the painting. These powders are actually enamels themselves, and are obtained by the colormaker from that material, and are handed to me and I pulverize and triturate them. Then I prepare them for use. Then I begin my work. I study the forms to be reproduced, and I faintly delineate them with the proper pigments upon the smooth surface of the enamels. Then having obtained this much I submit the material to the action of fire. The object of this is to burn the colors into the enamel, so that they become an integral part of the whole substance. This is a most delicate operation, requiring much experience and skill. Two much fire will ruin it, and too little heat will be insufficient to make the colors natural and ineradicable. It is actually painting by heat, for a certain degree of fire gives intensity to color or varies the shade, affecting the tone and quality of the painting. Then I resume my painting, filling in and giving shade and substance to the object. Then fire has to be called into requisition once more, and as skilfully and delicately controlled as previously; one little mistake and alas! all our labor is for naught. But we rarely make any slips nowadays. Then come the final touches; the delicate lines. Then the final action of fire and you have this fine delicate portrait on the porcelain, whose smooth surface, as you rub your hand over it, shows you that the colors are a part of the whole surface."

AMERICAN PATENTS.—The Commissioner of Patents at Washington has completed his annual statement of the business of his office. During the past year the total receipts from October 1st, 1876, to October 1st, 1877, were $709,044; expenditures, $604,-090; showing an excess of receipts over expenditures of $104,-954. The number of patents applied for was 18,629; registered trade marks, 1324; labels, 579. The patents allowed but not issued on account of failure to pay the final fee, owing to the severity of the times, numbered 4271. The patents issued were 14,242, and the trade marks and labels, 1517. This is a decline of about one thousand patents issued as compared with last year. No radical change in the patent system of the United States is at present contemplated. There has been some discussion of the form of legislation necessary for the restoration of the destroyed models. When a case for reissue comes up the applicant might amend the drawing and specifications, but he cannot alter the model, nor can he get a reissue unless it is shown that much difficulty and litigation will ensue. After the fire of 1836 the Government permitted the models to be restored by inventors, simply requiring sworn evidence that they were not duplicates. Several thousand models were thus restored, and the law required that after proper authentication they should be regarded as if they were originals. A recent examination of the ruins of the burnt portions of the Patent Office has elicited the important fact that some thousands of models can be restored sufficiently for the uses of the office. It is proposed at once to clean these and proceed to their identification. One wooden model was found in the rubbish which had gone through the fire without even the label being destroyed. The first United States' patent was issued to Samuel Hopkins, on July 14th, 1790, "for making pot and pearl ashes." Up to 1836, forty-six years, 10,301 patents were issued, and to this date over 195,000.

TESTING LUBRICANTS.—Blue litmus paper will become red in melted acid fats or oils, such as stearic acid, as well as in acid watery solutions. But you may also test for free acid by pouring the oil to be treated over a layer of cuprous oxid contained in a glass. (The ash of the coppersmith answers the purpose, since it contains this oxid.) If the oil contains either the free, fatty, or resinous acid, the same will attack the oxid and color the oil green in a very short time. Slightly heating accelerates the action, which manifests itself in less than half an hour. This test is said to be very delicate and satisfactory.

PRESERVING FENCE-POSTS.

On this subject the *Journal of Forestry* has the following:—The proper seasoning of timber before being used in any structure is far more important than the season of the year it is felled in, kind of timber used, or preventives employed. There are paints, washes, and heterogeneous steps recommended for preserving posts, but each are comparatively costly, and only partially successful. One great objection to the application of solutions externally rests on the fact that the sap being confined accelerates decomposition in the interior. Most foresters must have observed this. What I would recommend with fencing-posts is, the materials, when felled, to be directly sawn into posts and stored under sheds thoroughly ventilated, where they will remain at least a year exposed to "sun and wind." The neck and part between wind and water of each post should be slowly charred over a strong fire—slowly, because our principle means heating the timber thoroughly to the heart, so as to extract any moisture which may be still lodged at the centre, and hardening a crust on the surface of the posts. Afterwards, to prevent the posts absorbing water, they should be well coated with coal tar, having its acid destroyed with fresh quicklime. The tar should be thoroughly boiled to evaporate all watery matter, and applied boiling hot. A large tank, holding the posts set on end, and filled with the scalding tar from a boiler, answers the purpose very well. Of course the upper half of the posts can be painted when placed *in situ*. I am fully convinced coal tar, properly applied to thoroughly seasoned timber, is far more effectual in preserving posts than creosoting, poisoning, kyanising, or all the paraphernalia of iron prongs, sheet-iron wrappers (an American invention), &c. One great recommendation in favour of the above process is that it requires no skilled labour, and the cost is a mere trifle.

On the Manufacture of Plaster Casts.

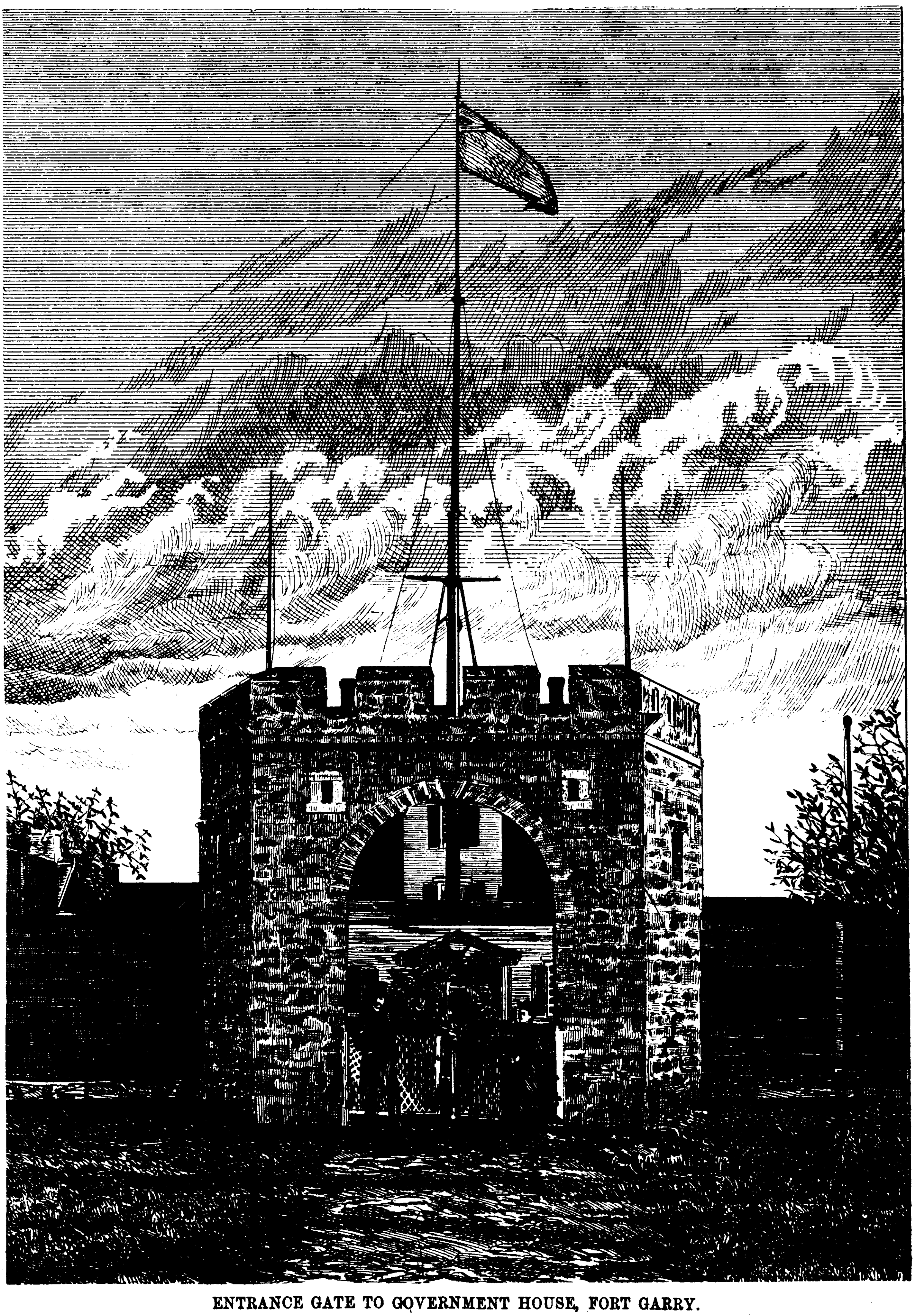
There are two little points which require special care in casting plaster of Paris: one is greasing the article to be moulded, and the other is stirring up the gypsum with water. For the first purpose it does not require a penetrating fat, but one that remains on the surface and covers it. In marking the paste, water must not be poured upon the plaster of Paris, but the latter must be strewn in as loose condition as possible upon the water until the plaster reaches the surface of the water, and then quickly stirred together. The substance employed to oil the moulds is prepared by adding some fatty oil, generally lamp oil, to a solution of soap in water; this is called "smear."

If, for example, a rosette 12 inches in diameter is to be cast on a 4 inch high rim, the following method is employed. The pattern made by the artist in gypsum must be repeatedly coated with shellac solution, to prevent, as much as possible, the oil from penetrating and make it easier to separate the casting from the model.

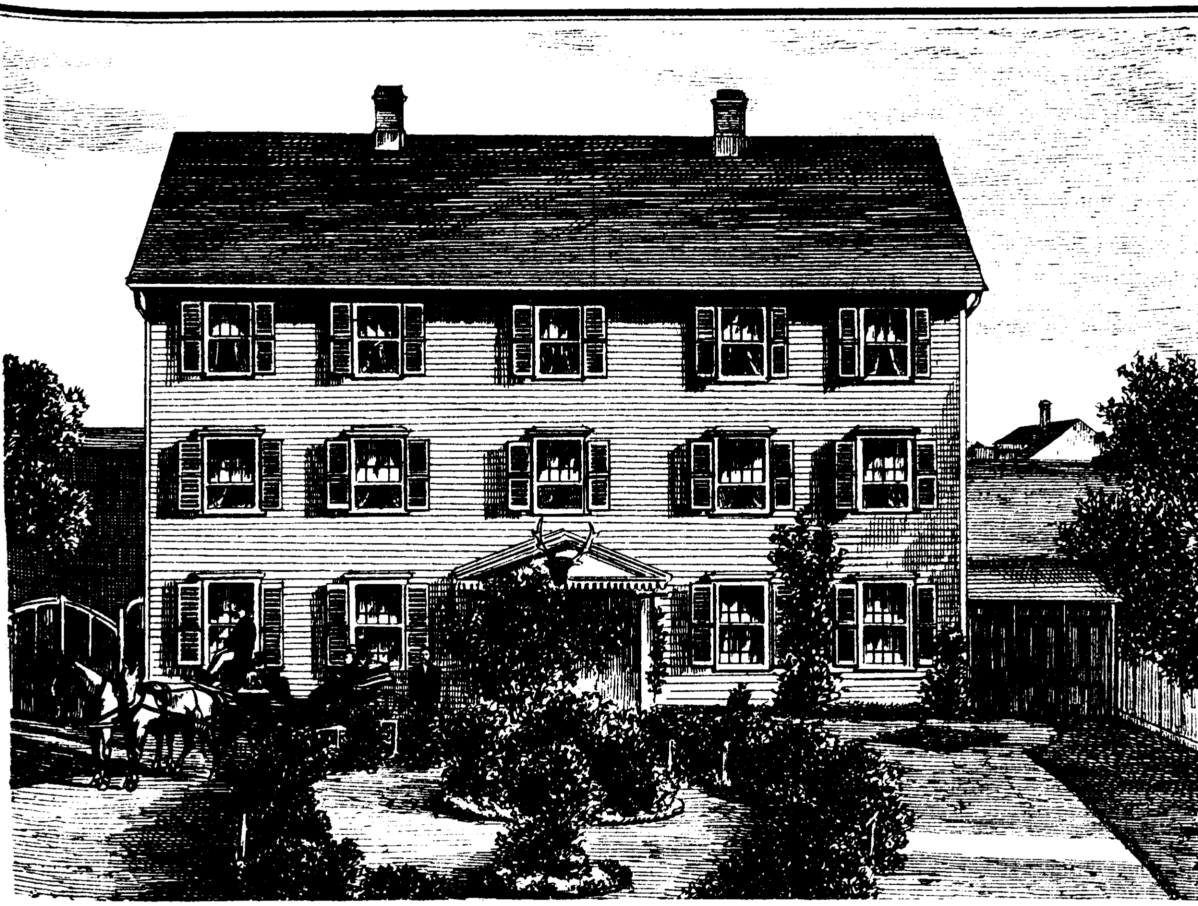
The wedge-shape pieces that are to form the vertical part of the rosette are cast first and are three in number, a strip of clay being used to form three sides of the first one, two sides of the second (for a side of No. 1 forms one side of No. 2), and one side of the third, for this is bounded on two sides by Nos. 1 and 2.

Each part of the mould must be varnished and greased or oiled before a second part is cast in contact with it, to insure separation when dry. The surface of the model is again carefully oiled and a cast made of the whole model without taking away the side pieces, but making a fresh wall of clay close about the model. To preserve the necessary sharpness and avoid bubbles, and bare places, the first layer of plaster poured upon the model should be as thin as possible, and a soft pencil be employed to remove bubbles and bring it into contact with the edges and cavities. Thick plaster it next poured upon this and finally the thick sediment can be scraped out upon the cast and smoothed off. In a short time it can be removed from the model, the side pieces taken apart, and all carefully dried. Before making a cast from this mould the separate parts are placed together, after oiling, backed up and adjusted with clay walls, etc.

LEAD EXPLOSION.—The mechanics have had their patience sorely tried when pouring lead around a damp or wet joint, to find it explode, blow out, or scatter from the effects of steam generated by the heat of the lead. The whole trouble may be stopped by putting a piece of resin, the size of the end of a man's thumb, into the ladle and allowing it to melt before pouring.



ENTRANCE GATE TO GOVERNMENT HOUSE, FORT GARRY.



CANADIAN TROPHY AT THE PARIS EXHIBITION.

(See page 4.)

We publish to-day a sketch of the Canadian Trophy, which is to be exhibited at the Paris Universal Exposition, taken from a photograph by Mr. McLaughlin, photographer for the Public Works Department. The drawing was prepared by Mr. Watts, under the direction of Mr. Scott, Chief Architect Public Works Department. This trophy is to be placed inside a tower on the right of the main entrance, at the junction of two of the principal wings. The trophy will be 99 feet in height from the ground to the top of the flag-pole, or 85 feet to the top of the roof. It will contain four storeys with three galleries, and be constructed principally of walnut and pine. There is a base of 30 feet. It is 16ft. 6 in. from the ground to the first gallery, 16ft. to the second, 16ft. to the third, and 11ft. 6 in. from thence to the roof. From the commencement of the roof to the top is about 25 feet. The lower storey will be filled with cases for small exhibits, there being four cases of 11 sections each, making 44 sections in all. This section will be decorated with wild flowers. The first gallery will be decorated with goods, and on the veranda are two cases elevated, one above the other, with a roof on top, thus forming miniature towers. The cases in the centre of this section will be filled with vials containing geological specimens and specimens of agricultural produce. The gallery above is supported with ornamental brackets, festooned with rope and twine. The second gallery is about 23 feet square, and will be decorated with lumbermen's tools, agricultural implements, etc., while moose heads decorate each side. The third gallery will be adorned with a canoe suspended from its side, with fishing nets, spears, tackle, cricket bats, and other sporting implements, above being a large buffalo head, and on the side corn brooms. The roof will contain a specimen of shingling and slating, while at the top of the tower, on the four sides, is the word "Canada." There will be a circular staircase in the interior, so visitors may go up and pass out on each gallery. The trophy promises to be one of the features of the exhibition.

GOVERNMENT HOUSE, FORT GARRY.

This building is situated within the walls of the fort. It belongs to the Hudson's Bay Company and was the residence of Mr. MacTavish (deceased), and others of the Governors prior to the transfer of the territory to Canada. In it General Wolsley found shelter when he went up in pursuit of Riel. Governors Archibald and Morris have resided in it, and it will be the official mansion of Hon. Mr. Cauchon. In our illustration there is an open carriage in which are seated Mr. and Mrs. Morris. The other view on another page represents the entrance to the Government House with its quaint old gate, which is a part of Fort Garry proper. Governor and Mrs. Morris are seen standing at this gate.

A Patent Law for Switzerland.

Switzerland and Holland are the only two European nations that at the present time refuse to inventors the protection of patents. Holland, it seems, is soon to be left alone in that glory. A bill is now under discussion, prepared by Federal Councillor Droz, which if passed will give to the republic of Switzerland a patent law system very much like that of the United States. The fees for patents are to be small, and the mode of securing inventions simple. We shall give our readers due notice of the passage of the Swiss patent law.

CHARCOAL FOR OFFENSIVE BREATH.—A correspondent of the *Dental Cosmos* says that the best treatment in regard to offensive breath is the use of pulverized charcoal, two or three tablespoonfuls per week, taken in a glass of water before retiring for the night.

MANUFACTURE OF MORTAR AND CEMENT.

We are indebted to Mr. John C. Goodridge, Jr., President of the N. Y. State Contracting Co., for the exposition of his views in regard to the hardening or setting of lime, and which we publish here as an introduction to the description of his patented process, which appears at the close of this article.

That we for the greater part agree with his views may be seen from two articles which we wrote on the same subject, one entitled "Common Mortar," and the other "Hydraulic Mortar," published in our January and May numbers for 1869, pages 13 and 135, and which contains perhaps some valuable suggestions, to which we refer all those interested in this subject.

The cause of the setting of lime and cement has been attributed too largely to the absorption of carbonic acid. That theory has been so commonly believed, that artificial means have been gravely suggested to introduce carbonic acid into mortar concrete and artificial stone. The only evidence that we have of the hardening of lime and cement by such absorption is, first, that limestone contains a large proportion of carbonic acid, and lime, long exposed to the air, is found to contain a large amount of it.

Lime is very greedy of carbonic acid, and absorbs it most readily. On this account it has been used in mines to purify the air. The amount of the acid a mortar or lime contains may be evidence of its age and time of exposure, but it is no measure of its strength, except as incidentally it may be of its age. If the gas is supplied to concrete by artificial means, it does not harden it. Lime properly burned and allowed to absorb carbonic acid gas, does not harden if left in air; mortar neither does if put under water or if it is alternately left in air and water.

In order to harden lime must be mixed with some other material; if mixed with sand it solidifies; we must then look to some action or reaction caused by the sand. In cement we have a combination of lime with clay, which is a silicate of alumina. Cement will set both in air or water. The alumina is of no value, but is detrimental; but it is so associated with the silica or silicic acid that it has to be introduced. We have then in both cases lime setting when in combination with silica or silicic acid, and on this the solidification largely depends. If lime hardened by hydration simply, it should set under water, which it wil' not do.

Analysis shows that in the setting of cements and limes a silicate of lime is formed, and that in addition to this there is a process of crystallization carried on, the lime forming into minute crystals, which to an extent explains why, in making mortar or concrete, there should be only a thin layer of lime or cement sufficient to cover each grain of sand.

In the mixing of lime or cement due regard should be had for the difference in their methods of crystallization. Cement containing a large quantity of magnesia in combination with lime cannot be strong. The ordinary cement mixed with the Portland cement weakens it more than the addition of sand; from the different forces at work, each tearing the other apart.

We are led to the belief that the absorption of carbonic acid and the hydration of themselves are of but little moment in the hardening of lime or its combination, but that the solidification comes from the formation of silicates of lime and their crystallization. This process is assisted by moisture and during the time the greedy lime absorbs carbonic acid.

There are certain alkaline salts found in lime, and particularly in cements, which assist in the process of manufacture of cement, acting as a kind of flux; but they are detrimental to the final use of cement. Silicates have been added to cements and concrete in the form of silicate of soda. This has also been used as a matrix to bind together grains of stone. To prevent the detrimental effect of soda, chlorid of calcium is then added, and the chlorid of sodium (common salt) so formed is then washed out. This can be done satisfactorily only with great care and on a small scale, and is not applicable in building. The small amount contained in salt water does not prevent the setting of cement, and under certain circumstances may be advantageous, as it retards the setting and allows it to retain more moisture. The appearance of salt in cement or brickwork, which is often very noticeable from their being wet with salt water, is very objectionable.

The impurities in mortar and concrete consist of humus nitrogenous matters and alkaline salts; when present, they produce, by decomposition, deliquescent salts, which disintegrate and destroy the cohesive power. Alkaline chlorids undergo decomposition, giving rise to alkaline carbonates and chlorid of calcium, which is a most deliquescent salt. The humus and nitrogenous matters when decomposed in the presence of hydrate of lime, produce nitric acid, which, when combined with the latter, yields nitrate of lime, also a deliquescent salt, which is observed in the form of an efflorescence; other efflorescences appear as sulphate of soda, carbonate of soda, chlorid of sodium, together with carbonate of potassa and chlorid of potassium. These arise partly from the lime and cement stone and from the ashes of the fuel used in the burning.

Another defect in mixing concrete is mixing first the cement and sand together, and then wetting them, and in using wet sand. In either case the sand becomes covered with water, which is held by capillary attraction, and is an excess, and it likewise forms a slight coating around the sand which prevents the absolute apposition of the particles of sand and cement when first mixed. A much better, though more difficult way, is to first wet the cement; the amount of water is thus accurately gauged, and the bond far stronger. Cement alone contracts, and forces the excess of water out, but cannot do so when mixed with sand.

We give as a complete and the best process for making cement, the one now used by the N. Y. Stone Contracting Co., of Third Avenue, Brooklyn, and patented by its President, John C. Goodridge, Jr., whose works we have had occasion to note before in this volume.

This consists in a special mode of preparing cement and mixing it with sand and a specified quantity of water, and their manipulation in such manner as to make a beton or concrete which shall be more uniform in composition and stronger than any heretofore made, and without the unsightly and injurious checks and efflorescence which appear in all previous combinations of sand and cement.

In the method now employed of making beton or concrete, cement and sand are used without previously preparing the cement. In the Coignet methods sufficient water only is added to make a plastic pulvurulent paste. This does not contain sufficient water to form hydrates, unless lime enters largely into the composition, in which case the moisture held by the lime is taken up by the cement during its crystallization, the lime absorbing its moisture from the air; but lime in a large quantity weakens the beton, from having but a low adhesive power in comparison with cement. Neither is it able to withstand the action of water or fit for under-ground work, as it does not become hard when kept constantly damp, nor does it become hard in the interior of large monoliths when it is removed from the effects caused by the atmosphere.

In the other and ordinary methods a large quantity of water is used—sufficient to make a semi-liquid mass that will flow. This excess of water is forced out of the concrete by the contraction of the cement during its crystallization, and leaves the stone porous. It also prevents the proper ramming of the beton, and gives rise to the difficulty known as "*laitance*," hereinafter described. On the other hand, a beton containing too little water becomes friable.

The process is as follows: When, in the construction of large monoliths or structures, largely under ground, the checks and efflorescence which usually appear are not a serious objection, sand and cement may be mixed in the proportion of from three to six parts of sand to one of cement. This may be done by means of machinery, or by hoes, shovels, and rakes. During this process water is added by means of a hose or watering-pot with a rose jet. The water is added gradually until the sand and cement contains so much that a handful of the beton will, if squeezed, allow a little water to exude, but will, when laid down, still retain the impression of the hand. The beton so mixed will have about the consistency of melting snow. It can be compressed in the same way, and pressure will force the moisture out of it. This condition, though difficult to describe, is learned at sight by the workman, and the correct amount of water is more accurately gauged by trying the beton from time to time in the hand during its mixture (as it varies in different cements) than can be done by any rule of measurement. The beton is then placed in position and rammed, as described below.

The quantity of water thus gauged will be enough to form hydrates, in combination with the components of the cement, leaving no excess to be forced out during crystallization, and does not prevent the proper ramming of the beton, while there is not sufficient to cause *laitance*. But to obtain a perfect result where a finished surface is requisite, and to make a beton free from the deleterious ingredients that are found in all cements, and to insure the use of a proper quantity of water, Mr. Goodridge proceeds as follows:—Having obtained the heaviest slow-setting cement, the first step in this process is to separate from it the light, earthy impurities—the uncombined lime and clay and the soluble salts. This can be done to a considerable extent by a regulated current of air being driven against the cement while falling from a hight, and in a proper inclosure ; or it can be done by revolving screens, or by means of a contrifugal mill. But the method which he prefers, and recommends as more perfect, is to allow the cement to fall slowly into a box filled and constantly fed by a stream of water, the entrance of which is preferably near the bottom of the box. One side of the box is lower than the others, for the overflow of the water. Where a constant stream of water cannot be had the result may be obtained by agitating the cement with water in a swinging box or other convenient way, pouring off the water and supplying its place with fresh water from time to time.

A box may be placed in and on the bottom of the larger box to collect the cement as it settles. The portion thus preserved consists of the heavy, gritty, and inactive parts of the cement, which is without adhesive power, and which acts simply as so much sand. This equals about ten per cent of the whole mass of cement.

Cements containing a larger amount than usual of this gritty portion, may, when mixed pure, stand a high test, but will not bear a large admixture of sand. With this gritty part settles the true cement, which is called the "matrix." This is that portion which is capable of crystallization or hydro-silicatization, called "setting." This portion of the cement is the only one of value, and is about 80 per cent of it.

The third or lighter portion, which is washed away with the overflowing water, consists of impurities, light earthy matter, combined lime and clay, and soluble salts. This portion of the cement is entirely without adhesive power, and, when separated from the other portions of the cement, acts in all respects like the impure and dirty clay. When dry, it shrivels and contracts, and when wet expands and becomes slippery. This portion of the cement is the cause of the unsightly checks, and what appears to be cracks, but which are simply projections of this earthy portion, which, by its own action in contracting and expanding, and the crystallization of the cement, has become separated from it. With this earthy portion the alkaline salts, consisting mainly of soda and potash, escapes. This is the portion that causes the efflorescence or white appearance on the stone as heretofore made, and alsowhat is known as *laitance* on concrete laid in water.

The light, earthy, and soluble portions having been removed from the cement, the supply of water is turned off, and it is allowed to escape from the wash-box.

Japanese Method of Cooking Rice.—A letter from Japan says: "They know how to cook rice here. Only just enough cold water is poured on to prevent the rice from burning to the bottom of the pot, which has a close-fitting cover and is set on a moderate fire. The rice is steamed, rather than boiled, until it is nearly done ; then the cover of the pot is taken off, the surplus steam and moisture is allowed to escape, and the rice turns out a mass of snow-white kernels, each separate from the other, and as much superior to the soggy mass we usually get in the United States as a fine mealy potato is to the water-soaked article."

To make Cow's Milk more Digestible.—In a German paper we note a hint given by Dr. Schaal with reference to the taking of cow's milk by persons who have a weak stomach. He says he has always succeeded in avoiding any evil effects by eating a little salt on bread either before or after taking the milk. When he omits to do this, a single glass of milk will produce diarrhœa, whereas with salt he can take a whole liter.

Bismuth Snuff.—Dr. Ferrier, in the *Lancet*, suggests a bismuth snuff for cold in the head. He states that he began to suffer one evening with symptoms of cold in the head—irritation of the nostrils, sneezing, watering of the eyes, and a commencing flow of the mucus secretion. Having some trinitrate of bismuth at hand, he took repeated pinches of it in the form of snuff, inhaling it strongly, so as to carry it well into the interior of the nostrils. In a short time the tickling in the nostrils and sneezing ceased, and the next morning all traces of cold had completely disappeared. But as bismuth by itself is rather heavy and not easily inhaled, and it being also necessary that it should form a coating on the mucus membrane, Dr. Ferrier says it is best to combine it with pulv. acaciæ, which renders the bulk larger and the powder easier to inhale, while the secretion of the nostrils causes the formation of an adherent mucilaginous coating—of itself a great sedative of an irritated surface, and the sedative effect is greatly strengthened by the addition of a small quantity of hydrochlorate of morphia.

HOW TO PAINT MAGIC LANTERNS.

The colors used for painting magic lantern pictures on glass must be either transparent or semi-transparent. The former include Prussian blue, gamboge, carmine, verdigris, madder brown, indigo, crimson lake, and ivory black ; the latter, raw sienna, burnt sienna, cappah brown and Vandyke brown, are semi-transparent. By combinations of these almost any desired tint can be produced. No particular mixing of the colors is requisite, but if oil colors are used megilp is the best thinning material. Water colors for first washes should be laid on with a hot solution of transparent gelatin. Camels' hair pencils are preferable to sable for painting on glass, as their elasticity is less and the trouble of working out the brush marks, which must always be attended to, not so great. Dry colors may be mixed with varnish, in which case the glass must be covered with a coat of turpentine which must be allowed to dry. The simplest way of producing the picture on the glass is by using a series of stencils, as represented. Fig. 1, for example, is the picture to be produced. The artist places over this a piece of oiled paper, and on this he traces the outlines of all that portion of the picture which is to be tinted with yellow or in which yellow enters in the compound tints. This portion of the design is represented in Fig. 2. Next, on another piece of paper, the red portions are traced as in Fig. 3. On a third piece are traced the green parts ; and lastly, on a fifth piece of paper, are drawn the blue parts. The colors on these bases to be used would be gamboge, carmine, verdigris, and Prussian blue. Next, with a sharp penknife, the portions of the several papers included in the various outlines are carefully cut out, so that each piece of paper becomes a stencil. It only remains to apply the stencils, in the order already named, to the glass, and rub the color over them in turn to produce the picture, the different colors being superposed, and consequently combining. When the paint is dry it is coated with colorless varnish and the edges of the glass are surrounded with strips of strong paper.

Burning Iron Castings Together.

The usual mode is by imbedding the castings in the sand, having a little space left vacant round about the joint where it is to be burned. Two gates must then be provided, one lying on a level with the lower side of this space and the other raised so that the metal, which must be very hot, is poured in at the higher one ; it passes round, fills the space, and runs off at the lower gate. A constant supply of metal is thus kept up, till the parts of the casting are supposed to be on the eve of melting. The lower gate is then closed, and the supply stopped. When cool, and the superfluous metal chipped off, it forms as strong a joint as if it had been original.

The Scheme for Telegraphing Without Wires by means of ærial currents of electricity, has been revised by Professor Loomis. He has met with success in using kites for this purpose, a copper wire being substituted for the usual kite string. Signals were transmitted thus between kites ten miles apart. His new experiments are made in the mountainous regions of West Virginia, between lofty peaks. Continuous ærial currents are found at these altitudes, which will serve the purposes of the telegraph, except when rarely interrupted by violent disturbances of the atmosphere. A scheme is now on foot to test the merits of ærial telegraphy in the Alps. The cheapness of the apparatus, as no wire is required between the stations, is greatly in favor of the method, and may counterbalance its liability to occasional interruption.—*N. Y. Tribune.*

Restoring the Color of Lace.—Lace may be restored to its original whiteness by first ironing it slightly, then folding it and sewing it into a clean linen bag, which is placed for twenty-four hours in pure olive oil. Afterwards the bag is to be boiled in a solution of soap and water for fifteen minutes, then well rinsed in lukewarm water, and finally dipped into water containing a slight proportion of starch. The lace is then to be taken from the bag and stretched on pins to dry.

The quantity of herrings caught this year on the Danish coasts is said to be enormous, and it is hoped that these fish, which suddenly deserted the Danish waters about three hundred years ago, after having for centuries represented the chief source of revenue to the country, may now again direct their migrations to the Danish coast.

A little alum added to saffron in soft hot water makes a beautiful yellow ink.

LONG-LEGGED BIRDS.—THE WHOOPING CRANE—YOUNG AND OLD.

You do not have any difficulty in telling a bird from any other animal; though birds among themselves show wonderful differences, yet you are never in doubt whether a particular specimen is a bird or not. Yet how great the difference between a humming-bird, not larger than some insects, and with a flight so rapid that you can hardly see its wings, and a domestic goose, which rarely flies, is awkward in all its movements, and large enough for a dinner for a whole family. Some birds feed only on other birds, or small quadrupeds, and such other animals as they can catch; others live on insects; still others find their food in various seeds and fruits; then when we come to the sea-shore, or the great lakes, we find birds that live upon fish, which they catch in deep water, or along shore, where the water is shallow. If birds all lived upon one thing, they would soon find a scarcity of food, and it is very interesting to observe that each class of birds is so formed that it can best get its living in one particular way. A look at a hawk, with its fierce bill and powerful claws, shows that it is intended to prey upon living creatures; if a duck, with its broad, blunt bill, and clumsy web-feet, should try to carry off a young rabbit, what poor work it would make of it! It would get along no better than would a hawk if obliged to swim and dive to the bottom of the river for its dinner. Wherever we look, whether at birds, at quadrupeds, or other animals, or even at plants, we find that each and all are especially adapted to live in a certain manner, and in particular places, and it is not possible for any thinking person, even a child, to fail to see that all this has not happened by chance. Men do not build locomotive engines to run upon the water, or construct steam-boats to travel on the land, and it is very plain that the Creator designed these different forms of birds and other creatures for a particular purpose. If a naturalist is studying birds (and it is so with other departments), he finds those which get their living in a particular manner, are constructed, or built, so to speak, on a similar plan, and he groups the birds according to this plan as shown in their structure. You would not class the duck and the hen, or the pigeon and the hawk together, and while you, perhaps, could not tell at once all their differences, you know that they are fitted in their feet, their bills, and all their parts, each for a particular mode of life. Everybody, even young people, are naturalists to some extent. Those who make a special study of birds, are called *ornithologists*, as they study ornithology—a pretty long word, but perhaps it will not seem hard or difficult to remember if you know that it means "bird-discourse," or as we may say "bird-talk"; the name, when it was found necessary to have one, was make from the Greek *ornis*, a bird, and *logos*, a discourse, and means the science of birds. Ornithologists differ as to the manner in which they group or classify birds, but they nearly all agree in having a group or order of Waders. These are birds with very long bill, neck, and legs, and a very short tail; the leg is also bare of feathers for some distance above the lower joint, and they mostly live in marshes, or on the shores near the water. These are further divided into several sub-orders, on account of minor differences, but they all agree in the leading points here named. The Waders include birds of various sizes, from the little plovers and sand-pipers, up to the bitterns, the herons, and the cranes. To show the general appearance of the Waders, and at the same time give the portrait of a rather rare bird, here is a picture of what is called the Whooping Crane, which is found in the States of the Valley of the Mississippi, in the Gulf States, and occasionally in the Middle States. It is one of the grandest of our native birds, it being between four and five feet long. Its plumage is entirely white, except some black on the wings, its legs are black, the head carmine. The two birds shown in the engraving, are not different cranes, but an old and a young one. The young does not appear in a white dress the first season, but goes about in modest gray and brown, and it has been mistaken for a different bird. The flight of this crane is very high and rapid, and as they pass far over head, their coarse note, which gives them the name of Whooping Crane, may be heard for a great distance. It is stated that when mating, the male birds have severe fights, and that their cries at this time have been heard for three miles. They feed upon small fishes, frogs and other reptiles, and upon the roots of various plants that grow in muddy places. As they pass from North to South, they are said to stop on the sweet-potato fields, to search for any potatoes that may be left in digging. Travellers on the far western prairies, where the air is so peculiar that all distant things are strangely magnified, tell numerous stories of being deceived by this bird. One teamster followed one of these cranes for several miles, thinking that it was a mule that had strayed from the camp; and an old hunter has been known to crawl a long distance on his belly to get a shot at what he took for an antelope, and he only found out his mistake when his antelope took wing and flew off as a Whooping Crane. They are exceedingly quick to catch the least sound, and if once alarmed, they keep on the alert. It is said that these birds were formerly found in New Jersey and other Eastern States, but they have been killed off or frightened away from all the thickly settled parts of the country. That any one should wish to kill such a noble bird, that is not useful for food, and does no harm to any one, seems not only thoughtless, but wicked. We do not envy the feelings of one who, for the sake of shooting something, can stop the flight of this beautiful white Crane, and see it drop a lifeless mass of useless flesh and blood-stained feathers. Audubon states that they become very tame in captivity, and he gives an account of the odd and suspicious ways of one that he had.

THE DUCK-BILLED PLATYPUS.

The *ornithorhynchus* or platypus is a singular animal, which seems to form a connecting link between the animals and birds, and in some respects having affinities even with reptiles. It is from 18 to 22 inches long, and has a stubby tail 5 inches long. The color is brown above and whitish below. The jaws are inclosed in a horny sheath, very sensitive, like the bill of a duck, and have two horny teeth on each side ; the snout is flat and broad, the lower jaw shorter and narrower, the eyes small and brilliant ; ears not apparent externally, with an aperture that can be opened or shut at will; and the fur is soft and thick, like that of the otter. The legs are short, and the feet five toed, and webbed. It secretes milk for the nourishment of its young, which are born blind and naked. It burrows in the banks of streams, where it passes the day in sleep, rolled up like a ball, coming out at dusk and during the night in search of food. It is an excellent swimmer and diver, and feeds upon worms, insects, and small aquatic animals, in the manner of a duck. It walks very well, and climbs trees with facility. It can remain under water for eight minutes at a time ; it is cleanly in habit, and fond of warmth and dryness. The young die very soon in confinement.

THE DUCK-BILLED PLATYPUS.

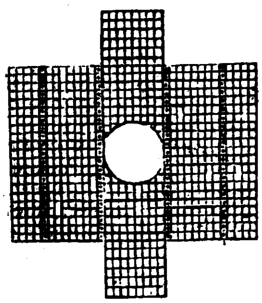


Fig. 2.—WIRE FOR SCREEN.

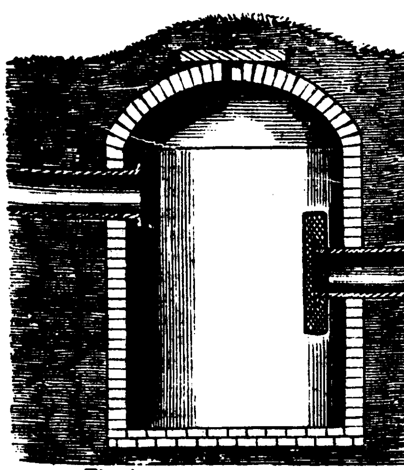


Fig. 1.—CESSPOOL WITH SCREEN.

DRAIN FROM A CESS-POOL.—(SEE PAGE 31.)

THE COLOR AND FRAGRANCE OF FLOWERS.

Prof. Vogel discourses pleasantly on "The Color and Fragrance of Flowers" in the *International Review* wherein he says : "The chemical transformations in the bodies of living plants, by which the most manifold and brilliant colors are produced, are almost entirely unknown to us. We see a flower pass through the entire scale of red, from the softest pink to the darkest purple-brown ; but can give no explanation whatever of the mysterious process. We know, for instance, that the light of the sun greatly influences the color of living plants, and experience has taught us that in most cases its total exclusion is equivalent to the absence of every color ; in other words, that it produces white leaves and blossoms. However, this rule is by no means without exception, as many roots, the roots of Alcanna, for instance, although buried in the soil, and completely secluded from the rays of the sun, possess a strong and vivid color. We can explain neither the rule nor the exception ; on the contrary, we know that, as far as lifeless matter is concerned, mineral or vegetable colors are weakened, and gradually destroyed, rather than enhanced, by the action of the light. Our ignorance in this respect restricts our influence upon the coloration of flowers and blossoms to a very modest and merely empirical one. A mere chance has led to the discovery that the infusion of sulphates of iron into the soil darkens the hue of certain plants which contain a considerable quantity of tannin ; and gardeners have profitted by this discovery for the culture of the Horthensia (*Hydrangea*). But these examples are rare ; and as yet we must renounce all claim to the control and influence of the natural course of things in this field. We may be able to change the color of a plant or flower by transferring it into another soil ; but we are never sure of the result, and cannot give any scientific explanation of it.

"The fragrance of a flower is likewise produced by chemical action which hitherto has escaped our closest investigations ; we see the result ; we see that a flower, like the bee which transforms pollen into honey and wax, fabricates volatile oils out of air, water, and light ; but the chemical process itself is a complete mystery to us. We only know that the slowness or rapidity of the evaporation of these oils is the cause of the stronger or weaker odor of the flower. The mode of their formation is a good example of the unlimited variability and manifold variety of vegetation's chemical powers. Many plants do not limit themselves to the formation of a certain volatile oil in their blossoms or flowers, but produce at the same time various kinds of oils in their different parts. The orange tree, for instance, produces volatile oils in the leaves, flowers, and the rind of its fruit. A close investigation convinces us that these differ, not only in their smell and taste, but also in their weight, density, and other physical and chemical quantities ; that, in short, they are different and independent substances which cannot be mistaken for each other. The same plant must therefore possess three different organisms, by which it generates three entirely different substances out of the same ingredients. What chemical laboratory, be it ever so well furnished and skilfully managed, can boast of results in any respect so wonderful ?"

HOW OIL CLOTH IS MADE.

The *Polytechnic Review* has been looking into the manufacture of oil cloth, and from the results of its investigations we take a general description of the process, which we believe will be interesting to all readers: The oil cloth, so called, as used for floor covering, consists of strong jute cloth ("burlap") covered with mineral colors ground in oil. The burlaps weigh from 9 ounces to 12 ounces per square yard. Their open texture must be filled up, and a smooth, heavy ground color put on before the reception of the pattern. For best quality goods, from six to eight coats of ochre and whiting, ground in linseed oil, are applied. The cloth for third quality goods is "starched" with a glue size as a priming coat, receiving afterward several coats of oil color. The "painting machine" is primitive in construction, but rapid and effectual in operation: it is used for either starching or grounding with oil. The 50-yard roll is attached by hooks to the base of a wooden triangle, and a rope attached to the apex of the triangle drags the roll through the painter and along a drying rack. The paint is applied with a dipper, and is spread by the cloth passing between an oil cloth cushion and a steel knife edge, slanting in the direction of motion. Fifty lineal yards a minute can be printed; in all from 8,000 to 10,000 yards in the various grades are daily printed in the whole establishment. After each of the first four coats of oil color, the goods must be "shaved," as the fibers of burlap make the surface somewhat fuzzy and uneven. The "shaving" machine has a table over which the cloth is passed, lightly stretched, while two bars, each bearing two pumice stone "bricks" (or more according to width), scrub the surface with a longitudinal and traversing motion, imitating hand-scrubbing. The pumice stone rubbing gives a fine, even surface; and after the last ground coat, the pattern or color blocks may be applied. The blocks employed in printing are similar to those used in wall-paper printing, being maple blocks, one cut for each color. These blocks are either in peg-work, line-work or rule work. The first are made by sawing the blocks lengthwise and crosswise with a circular saw (leaving square "pegs" projecting), and then cutting away those portions not intended to print. The line work has its design in parallel lines only. The brass or copper blocks have the design traced in the flat block, and then sharp brass rules driven into the required outlines. Peg-work is repaired by driving in copper wire cut square at one end and sharp at the other. Line-work is repaired by brass rules driven in. The felt filling used between the rules of some wall-paper blocks is not here employed, as preventing proper impression. For mat-work the block embraces one-fourth of the pattern, and must be of such a character as to admit being turned to print successive corner quarters. After all the single color impressions have been given, one block, called the "masher," which has no color applied to it, and which has on it the whole pattern, is applied, and given a strong impression. After printing, drying is in order, and should last at least 10 days. The older oil cloth is, the better, as the paint hardens. "Dryers' injuriously affect the linseed oil; air drying is preferable, but the American market cannot afford it. In England, a piece of oil cloth is frequently six months in making; here it is generally but 30 days. The heat is graduated to 130° F., running up from 90°. The principal pigments employed are vermilion, drop black, Venetian red, Sienna, chrome yellows, white lead and umbers. After printing and drying, varnishing is in order, copal varnishes being sprinkled on the roll and distributed by two vibrating arms, each bearing five soft brushes. The roll is handled by means of the triangle and drag rope, and hauled through and into the drying racks.

PUMPHREY'S PATENT LETTER BINDER.— Readers desirous of obtaining a good reading case for the MECHANICS' MAGAZINE, or other journals, loose papers, accounts, and the like, should obtain a new letter-binder, just issued by Mr. J. Pumphrey, of Broad-street, Birmingham, which is the simplest and most durable we have seen. From the illustration it will be perceived that there are no springs used, a metal hinge in the back of the book forms a fulcrum by which the papers are put into their place, and by the use of movable pins and metal sheaths, the papers when so collated are removable to loose covers, where they are securely enveloped and conveniently placed for reference. There are no loose strings or wires to get mislaid or out of order, as in other binders; the case is complete in itself, and the mere act of closing the covers secures the loose papers as they are added.

CURE FOR CHILBLAINS.—There is nothing better than extract of lead. Take of acetate of lead, 5 oz.; litharge, in powder, 3½ oz.; distilled water, 1 pint, or a sufficiency. Boil the acetate of lead and the litharge in the water for half an hour, constantly stirring, then filter, and when the liquid is cold add to it more distilled water, until the product measures 20 fluid ounces. Keep the clear solution in stoppered bottles. Use it thus: Soak the part on which the chilblain is situated for a short time in warm water, gently dry with a soft cloth, and having well wetted a double-fold of lint with the extract of lead, envelope the chilblain entirely in it, and as the lint becomes dry let it be re-wetted in the same manner, and re-applied two or three times, or oftener, if requisite. One or two applications will remove all inflammatory action.

HOW TO WELD CAST STEEL.—Take borax and sal-ammoniac, pound them up fine, put into an iron ladle, and slowly melt. Skim off all the spume which arises. When quite clear, let it cool, and then pound into fine powder. Split end of one of the pieces of steel, taper the end of the other, and fit it in as in steeling a pick-axe. Now, take a nice mild heat, and use your powder as you would sand to wrought iron or shear steel. Watch until you see it run on the joint like melted glass, whip out of fire, and strike gently, and you will succeed in welding it.

A CORRESPONDENT in reply to a question, how to keep gold fish? says: If the fish have plenty of fresh river water (often changed) they require little or no food, but I should prefer to give them some. Small worms which are common to the water suffice for their food in general; but the Chinese, who bring gold fish to perfection, throw small balls of paste into the water, of which the fish are very fond. They also give them lean pork, dried in the sun, and reduced to fine powder. They like bread and biscuit, but care must be taken not to give too much at a time lest, turning sour, it corrupts the water. They will live on the aquatic plant, called lemma or duck's weed. Hawkins, the editor of *Walton*, says that fine gravel should be strewed at the bottom of the vessel which contains them, and he directs them to be fed on bread and gentles, and to have their water frequently changed.

POISONING BY PARIS GREEN—ANTIDOTE.—Paris Green is so deadly a poison that the utmost care should be taken to prevent accident, and every one should know what to do in case poison has been taken into the stomach. There is but one tolerably certain antidote, the freshly prepared *Hydrated Peroxide of Iron*, or *Ferric Hydrate*. This cannot be kept on hand long, as it soon changes and becomes inert. All well managed drug stores keep on hand the means of preparing it at once. In case of poisoning by Paris Green or any other form of arsenic give an emetic. Mustard is always at hand; give two tablespoonfuls of *Ground Mustard* stirred in a quart of luke-warm *Water*.—Drink freely, tickling the throat with the finger to induce vomiting. When the stomach is emptied, give *Calcined Magnesia* in tablespoonful doses, stirred in milk, repeating every 15 minutes. When the vomiting ceases, give a large dose of Castor Oil. BUT send first to the nearest physician, and also to the nearest apothecary for *Hydrated Peroxide of Iron*; the doctor will want it; if he is not present, give it in tablespoonful doses every 10 or 15 minutes until the patient is relieved. It is in the form of pulp like Indian-red paint. No harm can come from giving too much. When the doctor comes, follow his directions.

A 502 DOLLAR ROOSTER.—That famous $50,000 cow which was so much talked about in this country a few years ago, has found a rival in point of proportionate pecuniary worth in a $502 chicken. The *English Agricultural Gazette* says that a game cock was recently sold for the above excessive price, and suggests that in the future the raising of such chickens would prove a very lucrative source of income. The same journal, we notice, says that over $13,000,000 worth of eggs were imported into England in 1876, and yet the supply was short of the demand. Here is an opening for poultrymen, and a wider field for inventors of egg-preserving processes and egg-carrying devices.

NEW USE FOR FLOUR.—A foreign contemporary says that a composition of very thin flour paste, thickened with clean sawdust, makes a very good coating for steam pipes and boilers, to prevent loss of heat. It adheres very firmly to iron, but on brass or copper it is necessary to apply a very thin coating of fuller's earth, when the paste will adhere with sufficient tenacity. Out of doors it is advisable to give a few coats of coal tar after the necessary number of coats of sawdust paste, in order to make the covering water-proof. About five coats of paste will be found sufficient, and each should be allowed to dry perfectly before the next is applied.

CLEANING ALABASTER.—A correspondent, in reply to a question in the English *Mechanic*, says : I brought some tazzas from Italy ten years ago, and inquired of the vendors how they were to be cleaned. I was told with cold water and a hard brush. They have never been cleaned any other way, and are as good as the day I bought them. Soap is utter ruin to alabaster as far as my experience goes.—DELTA.

CARVER'S SQUEEZING WAX.—This preparation is used for obtaining the exact patterns of carvings, and to give the workman a clearer idea of projections or depths than a drawing would do, unless a considerable time were expended upon it. In cases where it is required to match furniture which is at a distance, and cannot be removed, the wax can be applied without injury to the carving, and can be made from either of the following :—Suet, 1 part ; beeswax, 2 parts. Wax, 5 parts ; olive oil, 1 part. Wax, 4 parts ; common turpentine, 1 part. The parts only need be melted together, and allowed to cool ; the wax is then fit for use. It sho ld be well pressed into the carving. Sometimes it is only possible to take the front or side of an object at a time, as it must be drawn off in the form of a mould. The sections, when ready, should be filled with plaster of Paris and water, made into a thick paste, and allowed to set. The mould is then removed, and the plaster cast is ready to work from.

MONSTROSITY IN THE HORSE.—A correspondent writes to us (*Lancet*) to the effect that he has recently seen on the Boulevards at Paris a horse with eight feet, the four extra feet growing out of the fetlocks of the horse. The case, we presume, is one of supernumerary digits, and is an instance of reversion. On the evolutionary theory, the horse is derived from some quadruped which possessed five complete digits on each foot, and the successive stages have been better followed out, and lend more support to the theory of evolution, than is the case with any other animal. The remains of horses almost identical with those now existing are found in the Quaternary and later Tertiary strata as far back as the Pliocene formation. But in the deposits of the earlier Pliocene and later Miocene period the bones of an animal —the hipparion—are found in which the two splint horns representing the first and third metacarpal and metatarsals of the horse are as long as the central bone, and to each of them a small three-jointed digit is attached. In still older deposits belonging to the earlier Miocene and later Eocene period, a distinctly three-toed animal—the anchitherium—existed ; and at about the same period, or before, one—the mesohippus—with three toes and a splint-like rudiment of the fourth to the fore-limb, and three toes to the hind-leg. Lastly, in the orchippus, the oldest member of the equine species, there are four complete toes on the fore-limb, and three on the hind. Our correspondent does not state the position of the supernumerary digit.

HINTS ABOUT GLUE.—Good glue should be a light brown colour, semi-transparent, and free from waves or cloudy lines. Glue loses much of its strength by frequent re-melting ; therefore, glue which is newly made is preferable to that which has been re-boiled. The hotter the glue the more force it will exert in keeping the joined parts glued together. In all large and long joints it should be applied immediately after boiling. Apply pressure until it is set or hardened.

CEMENT FOR BELTING.—A simple prescription is to dissolve gutta-percha in bi-sulphid of carbon to the consistency of molasses. Slice down and thin the ends to be united, warm the parts, and apply the cement ; then hammer lightly on a smooth anvil, or submit the parts to a heavy pressure. This is thoroughly water-proof.

UPHOLSTERING OLD CANE CHAIRS.—When the cane seat of a chair is broken, it may be made as good as new, or better, by unholstering it at home, as described by a contemporary. After removing the superfluous bits of cane, cover the space with matting formed of 3-inch wide canvas belting woven together. Tack it temporarily in places. After placing over this some coarse muslin, draw both smooth, and secure at the edge with twine, making use of the perforations. Remove the tacks, turn the raw edge over toward the center, and baste it down. Arrange the hair and wool, or whatever you propose to use for stuffing, and keep it in position by basting over it a piece of muslin ; then carefully fit the rep, pin it in different places until you are certain it is in perfect shape, and tack it permanently, following, of course, the tracing made for the cane. Cover the edge with fringe to match the rep, using tiny ornamental tacks, and tie with an upholsterer's needle in as many places as is desirable, leaving a button on the upper side. When the back of the chair is to be repaired, a facing must be tacked on the outside.

CURLING OSTRICH PLUMES.—A correspondent of the *Inter-Ocean* says : If possible, an old plume should be used to practice on until one gets her "hand in," as two or three broken feathers in a nice plume might spoil it. With the left thumb and forefinger hold that part of the quill to which the feathers being curled are attached, and with a rather dull but pointed penknife take up the slender feathers, one at a time, beginning the base of the plume and working toward the point. The pointed blade will enable one to pick up the feathers readily ; then, with a quick movement, acquired only by practice, the blade and thumb between which the feather is held are to be drawn to and off the end of the feather, when it will curl back toward the quill, more or less according to how tightly it was held while being drawn between the thumb and knife. If it is only desired to curl the tip end, as in long plumes, it is best to hold part of the way down the vane, instead of holding the quill. Patient practice will enable one to curl plumes nicely within a reasonable time, and their added beauty will repay the trouble.

HOW TO MAKE PAPER TRANSPARENT FOR PHOTO-CHROMOS —Allow the photograph to remain in water until thoroughly soaked, then place it between blotting paper, and let it remain until just damp enough to be pliable. Then coat the face of the picture with good starch paste, and lay, face down, on the glass. Commence in the centre of the picture and rub outward toward the edges to dispel all air and excess of paste, care being observed not to get paste on the back of the print. While rubbing keep the paper damp with a sponge. When dry lay on a heavy coat of castor oil, and after a time rub off the excess of oil with a cloth. After standing a day or two it may be colored. Cover the back with a thin plate of glass, and bind the edges.

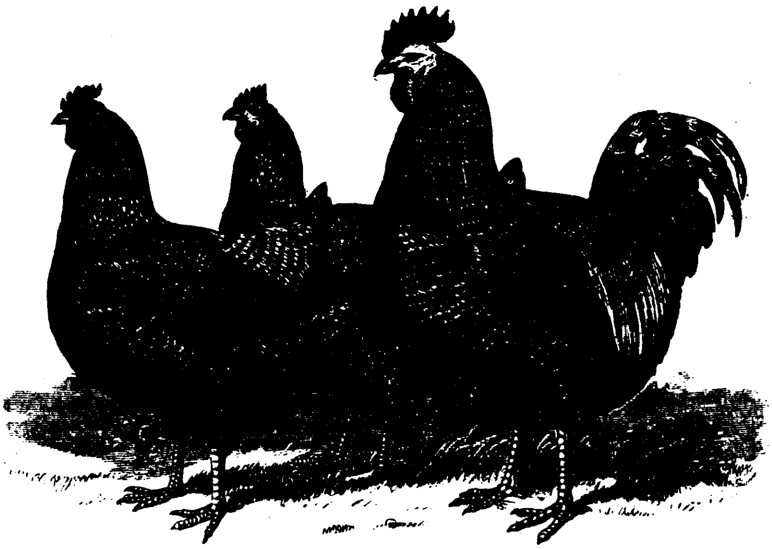
CLEANLINESS.—Dr. N. H. Paaren writes as follows in the *Western Stock Journal* : It is true in all cases known to us, that the finer instincts agree with the conclusion of laborious scientific research. The great laws of nature do not jar, but show a constant harmony ; and it is pleasant to see the education of these truths, which may sound too grand to be mentioned in connection with the operation of cleaning a stable. We cannot, however, refrain from admiring this harmony, when we see the busy housewife and clean, industrious male servant scrubbing at floors and furniture, apparently perfectly clean, and washing and scalding dishes which we would at first sight think might be purified much more simply. Their instincts are true. You come into the room after the furniture has been scrubbed, and you breathe a fresher air, and are in fact a healthier, and therefore a happier and better being. You eat of these dishes—the food tastes better and it digests better ; you therefore become, from this cause also, healthier and happier. The reason of this is, that the furniture receives upon its surface the organic matter arising from all living creatures, which after a time is apt to become unpleasant and unwholesome. Every chair, then, and every table becomes a source of disease ; every piece of the wall and ceiling are the same. This is especially the case with the furniture most in use ; every touch of the hand—even the whitest hand—is a source of impurity, and that which is used most has most need of being cleaned. Many porous bodies—and amongst these, cloth—take up these odors in great abundance, and sometimes retain them so much as not to give out any perceptible quantity until they are very much filled. We find this to be the case with carpets, which do not till after some time become offensive and stifling, but when they are so, are very difficult to clean. The process of cleaning is too often confined to beating. It is to be hoped that washing of carpets will become more general. Until this is the case we shall never get quite free from the unwholesome mustiness of some of our floors.

ICE WATER WITHOUT ICE.

Toselli's cooling goblet consists of a cylindrical cup for holding any liquid, into which may be plunged an inner goblet shaped like an inverted truncated cone, and having a bed which rests on the outer cup. Putting about 4 ounces of nitrate of ammonia in the inner goolet, filling it with cold water and stirring it, so as to hasten the solution, the temperature of the outer liquid is soon reduced at least 22 degrees Fahr. The salt may be used for an indefinite period by spreading it on a plate after each trial, and exposing it to the sun until it crystallizes anew. The inventor prepares a salt which will lower the temperature 50 degrees Fahr. in the warmest countries.

Improved Plymouth Rocks.

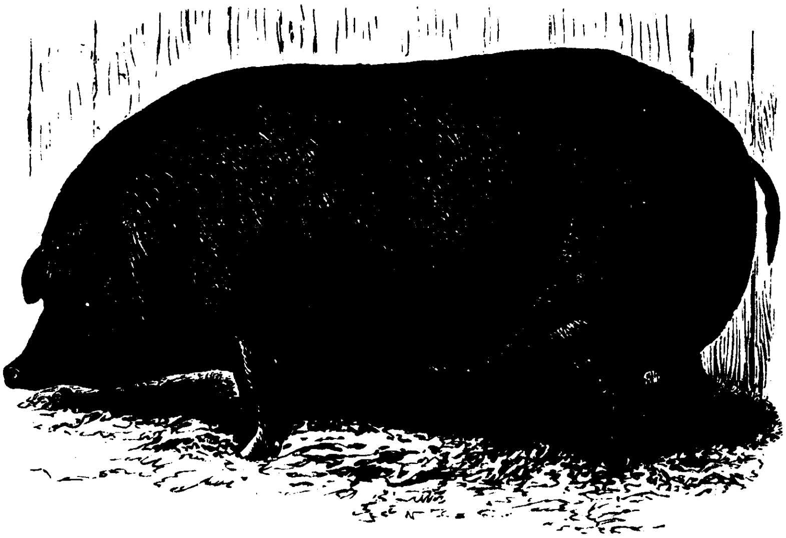
The very handsome breed of poultry known as "Plymouth Rock," is deservedly becoming very popular among those who keep fowls for profit. These fowls, as may be seen from our illustration on this page, which has been carefully drawn from a trio of living birds, possess many favorable characteristics. First among the good qualities of a fowl, is size. This the Plymouth Rocks have in an unusual degree. There are many excellent breeds of poultry, which are all that can be desired except as to size, and the lack of this is fatal to their popularity; for, after all, profit is the chief object with most people in choosing a kind of fowl to keep. Hardiness of constitution and vigor; pleasing form; handsome and attractive plumage, and prolific production of eggs, are all very desirable qualities in fowls, and these all belong to this breed. It will probably be noticed that the birds pictured in our illustration, are remarkably heavy-bodied. This is a peculiarity which belongs in an especial degree to a strain bred by Mr. F. H. Corbin, of Newington, Conn. This form of body, which is more like that of the Dorking than any other fowl, occurred accidentally, we believe, and the fowls with which this peculiarity originated, in Mr. Corbin's yards, were bred from with care, and their desirable shape has been permanently fixed. The future of the Plymouth Rocks will depend greatly upon the care or fortunate success with which they are bred. Difference of taste leads breeders to favor different styles, and thus "strains" are originated. If these styles are made to depart too much from a rigid standard, there is danger that an important and essential point may be sacrificed for some minor fancy. To prevent this, and to induce or to enforce care and consistency in breeding, it would be well that a very close adherence to the standard be insisted upon in all exhibitions, and that a very rigid one be adopted. In the case of the birds here represented, they come fully up to the accepted Standard of Excellence of American breeders, and meet it in every respect. The points required are: the breast to be "broad, deep, and full," and the body to be "large, square, and compact." The form of these birds is therefore nearly perfect, and if all breeders of the Plymouth Rocks emulate Mr. Corbin's skill in taking advantage of favorable accidents in breeding, and in fixing them upon his strain, or in using care in selecting birds for breeding, as any skillful breeder may readily do, the future history of this breed will be a very gratifying one. Among some of seventy breeds recognized in the American Standard of Excellence, there are only two of American origin, viz., the old-fashioned Dominique and the Plymouth Rock. The latter originated in Connecticut, and after some years of careful breeding, has been brought to such a condition of merit, that it is now one of the most popular breeds, and promises to be one of the most suitable for farmers, and attractive to amateurs. The birds here shown are entered in the American Poultry Record; the cock is Cæsar (5,970), the hen in the foreground is Pauline (5,972), and the one in the rear is Juliet (5,971). This strain of Mr. Corbin's has been favorably noticed by the best poultry authority in the country, a compliment which it certainly deserves.



IMPROVED PLYMOUTH ROCKS, BRED BY F. H. CORBIN, NEWINGTON, CONN.

Duroc or Red Swine.

The farmers of New Jersey, Pennsylvania, and parts of New York, have long been acquainted with a breed of hogs known as "Jersey Reds." These have been a very favorite kind of swine on account of their fine, small bone; long, deep, round body; good feeding qualities, and hardy constitution. Some years ago, these excellent hogs were taken in hand by some breeders, more than usually careful, and have since been considerably improved, so that, at the present time, this breed will challenge comparison with any other whatever for all the valuable points which make swine desirable or profitable. We have noticed of late that these red hogs have become widely distributed, a large sale of them having occurred in Kentucky, where they were favorably received by the very critical buyers of that well-known breeding State. When at the N. Y. State Fair, at Rochester, in September last, we saw a good specimen of these swine, which was exhibited by Wm. M. Holmes & Son, of Greenwich, Washington Co., N. Y., who make breeding them a special business. We have been favored by Mr. Holmes with a photograph of this animal, from which we have prepared the engraving here given. The picture is, therefore, no fancy one, but an exact portrait of the animal, so far as photography and careful drawing in copying can produce it. In all photographs, there are some exaggerations, the effects of which are so well known, that they have no detrimental effect on the subject, any more than the converging lines of a perspective drawing would mislead a person into supposing they were not really parallel. Thus the central portion of the photographic picture is an exact copy of the object, while the extremities are always more or less enlarged. If proper allowances are made for these, we then get a life-like representation, more nearly exact than any artist could possibly draw one by hand. In this portrait, the head and ears are not so fine as they should have been, or are in the living animal; nevertheless, we get a very good idea of what this breed of swine really is. At the National Swine Breeders' Convention, held at Indianapolis in 1871, it was decided to call this breed the Duroc, and it is now so called by those who give attention to it. The history of the breed dates back over 50 years, or to 1823, when Mr. H. Kelsey, owner of the noted horse Duroc, imported a pair of red hogs from England. A Mr. Frink, of Saratoga Co., N. Y., procured a boar pig of a litter from this pair, and named it Duroc, after the famous horse; hence the origin of the name, under which the breed has become popular in that locality. The pigs themselves are reasonably supposed to be related to the Berkshire; the old Berkshires were frequently reddish, or sandy-colored, and spotted with black, and had lopped ears. The Durocs may be properly considered to more nearly represent the old Berkshires, than the trim, smooth, prick-eared, blue-black and white-faced and white-footed modern Berkshire, as these points are all brought from foreign blood; while the red hogs have never lost their ancestral character, except so far as it has been improved by selection and good breeding. At least this is claimed for these hogs by their ad-

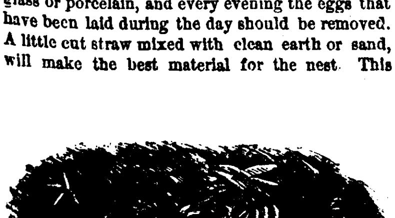


DUROC SWINE, BRED BY WM. M. HOLMES & SON, GREENWICH, N. Y.

mirers. Their history all through, tells a story of quick feeders, with necessarily quiet dispositions, hardy, healthy, with great capacity for flesh and excellent quality of meat when dressed. They take naturally to grass, and may be wintered on hay in great part, as they eat it as readily as sheep will do. The animal given on the preceding page, is 19 months old, had no grain from April last until Sept. 24th, when he was sent to the fair, weighing then 476 pounds. On Oct. 24th, or 30 days afterwards, he weighed 570, gaining 94 lbs., being fed solely on raw corn-meal and water. He is 32 inches high, 5 feet 8½ inches long, and girts 6 feet. His belly reaches to within 3 inches of the ground when standing. In a recent case, 52 of these hogs fattened at Salem, N. J., at 18 months old, averaged, when dressed, 528 pounds; the lightest weighed 460 pounds. With such a character as this, the Duroc is certainly worthy of being known everywhere.

Movable Nests for Hens.

Hens, as a general thing, are remarkably self-willed and obstinate. Perhaps an exception may be made as regards the Brahmas, which are very docile and easily managed. On account of this general peculiarity of fowls, many people who possess a somewhat similar disposition, find no success in keeping them. Their hens will not lay in the nests provided for them, or after sitting a few days upon a nest of eggs, leave them and never return. The consequences are, either no eggs at all, or nests hidden where they can not be reached; no chickens, and time and labor lost. This may all be avoided if the owners will only study the habits and instincts of their poultry reasonably. One of the most inveterate habits of hens, is that of hiding their nests or seeking them in retired shaded places. Those who would have plenty of eggs, must make their arrangements accordingly. A very cheap and convenient nest is shown in the accompanying illustration. It is made of pieces of board eighteen inches long, nailed endwise to three-sided cleats at the top and bottom. The box need not be more than eighteen or twenty inches in length. Some corner pieces are nailed at the front to make it firm, and the back should be closed. These nests may be placed in secluded corners, behind sheds, or beneath bushes in the back yard, or behind a barrel or a bundle of straw. The nest egg should be of glass or porcelain, and every evening the eggs that have been laid during the day should be removed. A little cut straw mixed with clean earth or sand, will make the best material for the nest. This



A MOVABLE HEN'S NEST.

should be renewed occasionally, for the sake of cleanliness. When a hen has taken possession of one of these nests, it may be removed at night to the hatching house, without disturbing her. Before the nests are used, they should be thoroughly well lime-washed around the joints, to keep away lice.

BEE MANAGEMENT.

Introduction.

My sole object in writing these articles is to give clear, plain instructions in bee management, which will, if faithfully carried out, result in an undoubted profit, and a most instructive and interesting recreation (without that pain which must be felt by any one with an ordinary amount of feeling, who, following the old barbarous system, has to reap that profit at the expense of thousands of lives). It will be quite unnecessary to take any retrograde steps to see what the plan adopted by the ancients was, but rather to bring forward the most modern improvements and principles, and give such descriptions of "bee furniture" as will enable any one desirous of doing so, to make his own hives and fittings. Nor will it be necessary to go into the truly scientific portion of bee history, further than to point out such principles as are really necessary for a proper understanding of the methods now commonly adopted by advanced agriculturists.

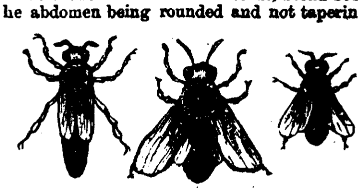
Part First.

Natural History of the Bee.

If any one will stand close to a healthy hive on a fine day about the end of June, he will notice two kinds of bees, one being perceptibly smaller than the other, the smaller greatly outnumbering the larger. The difference is so great that the merest tyro may notice it. The larger bees are the drones; the smaller the workers.

The Drone.

The drone or male bee is a stout, broad bee; he abdomen being rounded and not tapering



Queen. Drone. Worker.

Queen's Cell.

as in the worker. The head of the drone bears a strong resemblance to that of a blue-bottle fly. The eyes are a bright brown, the body brighter than that of the worker, the hum is very deep and loud, and when a large number are flying at once, the sound has been most aptly termed a roar. The sole use of the drones is the impregnation of the queen, which being accomplished, their destiny is fulfilled, and the workers soon after drive them from the hive to perish. The drones having no stings are quite unable to defend themselves. The drone is perfected about 25 days after the egg is laid.

The Worker.

The worker is a dwarfed and imperfect female, in which the reproductive organs are dwarfed and the sting is greatly developed. The workers are most aptly named, for on them rests the whole labour of the hive. They gather the honey, feed the larvæ, build the combs, attend upon the queen, and ventilate and clear the hive from all pollution. The worker is about 21 days in its different stages before it emerges a perfect insect, and is several days after that confined to the hive, performing internal duties, but quite unable to fly abroad. When large quantities of young bees are hatching daily—as about the middle of July—they will be noticed hovering around the hive in great numbers, trying their wings and taking a survey of their residence. Young bees are readily distinguished from old ones by their lighter colour; having the appearance of being powdered with flour. The worker lives about nine months.

The Queen.

The queen is the only bee which lays, and she is, therefore, the mother of the hive. Should a hive become queenless, either by death or swarming, the workers immediately tear down several cells, and fix a cell—generally on the edge of a comb—which closely resembles an inverted bird's nest; as shown by illustration (illustration of "queen cell"). In this cell an egg is placed which has been taken from a worker cell, and which would, if undisturbed, develop into a common worker—and here we come to the most remarkable fact in the whole of bee natural history. This egg being hatched, the tiny grub is fed upon a substance called by apiarians "royal jelly." It is quite unknown at present where the bees obtain this substance from. Its properties are most remarkable; for the grub which is fed upon it becomes a perfect insect in about seven days sooner than it would if fed on pollen, &c., and instead of being a common worker, emerges a perfect female—a princess of the blood royal. Should the bees have no worker eggs in the hive at the time the queen is lost, larvæ which are less than four days old are enthroned in royal cells, and are developed into perfect queens. Should the larvæ all exceed this age, no amount of royal jelly is sufficient to develop them into queens; but workers which have the power of laying drone eggs—and only drone eggs—emerge, and usurp the place of the true queens. These are termed "fertile workers," and a great nuisance they are to any one whose hives are honoured by their presence.

The young queen being hatched, stays in the hive for the first day or two of her existence, and then choosing the first fair day, leaves the hive on her wedding flight. Should she be lucky in meeting a drone, she returns to the hive a "fertile queen," and about a week afterwards commences her laying duties, which duties she continues to perform for four years, although she never comes in contact with the drone afterwards; nor does she leave the hive except at swarming time. Should the young queen not meet the drone before she is a fortnight old, she lays but few eggs, and they all hatch into drones. The eggs laid by a fertile queen are of two kinds: male and female eggs. The first hatch into drones, and no treatment of the bees can transform them into anything else. The second, as I have just shown, are transformed into perfect or imperfect females by the treatment they receive. Drone eggs, as we shall see farther on, are always laid in drone cells, and worker eggs in worker cells; showing that her majesty is quite aware as to the sex of the eggs she lays. The queen ceases laying about the middle of August, and recommences the following March, though this period may be extended, as will be shown, at the will of the bee-master. The queen bears the stamp of refinement and royalty, being much larger than the worker; and though less than the drone, her body is longer. This appears more evident from the comparative shortness of her wings, which do not exceed in length those of the worker. She possesses a sting, which is much smaller and more curved than that of the worker. She never uses it except in her combats with other queens. Impregnation never takes place inside the hive; consequently the mate of the queen is generally a drone from another hive, and as drones fly many miles, the chances are very great of an introduction of new blood and fresh vigour into the hive.

During wet summers, such as the one we have just had (1877), queens often miss meeting the drones, as these latter are fine weather gentlemen, and seldom fly far except during sunny weather, and the consequence is the queens become drone-breeders. Unless a fertile queen is given to it, the hive is doomed to certain destruction. During the height of the breeding season, extending through the hot summer months, a fertile queen lays at least 2,000 eggs per day. For the assistance of beginners in apiculture, the drawings of the queen, drone, and worker are given life-size.

GLUE FOR POLISHED STEEL.

The Turks glue diamonds and other jewels to their metal settings with a mixture made as follows: Dissolve five or six bits of gum mastic, each the size of a large pea, in as much spirits of wine as will suffice to render it liquid. In another vessel dissolve in brandy as much isinglass, previously softened in water, as will make a two ounce phial of strong glue, adding two small bits of gum ammoniac, which must be rubbed until dissolved. Then mix the whole with heat. Keep in a phial closely stopped. When it is to be used set the phial in boiling water. This cement perfectly resists moisture, and it is said to be able to unite effectively two surfaces of polished steel.

Bluing Iron and Steel by Boiling.—If iron or steel articles be boiled in the following mixture they will take a fine blue tint: Dissolve 4 ozs. hyposulphite of soda in $1\frac{1}{2}$ pints of water, and then add a solution of 1 oz. acetate or lead in 1 oz. of water.

The Importance of Training the Senses.—The importance of training or educating the senses becomes evident when we reflect that it is from impressions received through the eye and the ear that men are enabled to bear witness to what passes in the external world; and teachers of drawing and of music only fully know what false witness, without any *mal prepense*, these senses are before they have been properly trained. Let it not be forgotten either that it is upon the testimony of these two senses that character and life are frequently at stake. The desire to obey the commandment, "Thou shalt not bear false witness," may be strengthened, but evidence, nevertheless, cannot be guaranteed by a man being put upon his oath. For if a witness be an imperfect observer by eye and by ear, as he commonly is, in default of his not having received that sense-training upon which we are insisting, he may quite conscientiously swear to the absolute truth of his false impressions, of his imperfect perceptions. There is an art-teacher who frequently points this moral in his class,—'If,' he says, 'you misapprehend the truth with respect to the model immediately before you, and biding your own time to be deliberately inspected, how can you expect to accurately observe and recollect the moving scenes and occurrences of every-day life?' It is, however, not only in the witness-box that trained senses are required, but for the recognition and appreciation of beauty in nature to preside watchfully over all kinds of work, and to endow the arts and the manufactures of a nation with those excellent qualities which would ensure their appreciation throughout the civilised world. We are now, of course, referring more immediately to the sense of sight. You will find that painters and sculptors can more readily turn their hands to any kind of work than any other men,—and why? Not solely because their professions require the greatest nicety of touch, but because their sense of vision having been better trained they see more correctly.... Drawing, modelling, and instrumental music contribute respectively to the perfecting of sight and of touch, and of hearing and of touch,—to the perfections of those three most important senses by which all work is compassed. They are to those senses what gymnastics are to the general physique."

Washing Flannels.—A lady correspondent says: "I will give a little of my experience in washing flannels. I was taught to wash flannel in hot water, but it is a great mistake. In Italy my flannels were a wonder to me; they always came home from the wash so soft and white. I learned that the Italian women washed them in cold water. Many a time I have watched them kneeling in a box, which had one end taken out to keep them out of the mud, by the bank of a stream, washing in the running water, and drying on the bank or gravel, without boiling; and I never had washing done better, and flannels never helf so well. I have tried it since, and find the secret of nice soft flannels to be the washing of them in cold or luke-warm water, and plenty of stretching before hanging out. Many recipes say, don't rub soap on flannels; but you can rub soap on to the advantage of the flannels, if you will rinse it out afterward and use no hot water about them, not forgetting to stretch the threads in both directions before drying. Flannels so cared for will never become stiff, shrunken or yellow."

Shaving Soap.—To obtain a good soap for shaving, says the *Druggists' Circular*, is by no means always easy. The great desideratum is to have a soap that makes readily a rich lather which is slow to dry and that does not require the ceremony of calling for hot water. The most convenient for use are in the shape of paste, so that a little may be taken on the finger and rubbed over the beard, then the brush finished the process of preparation for the razor. If we take the following ingredients and compound them an excellent soap is produced that leaves nothing further in this respect to be desired: Take white soap, four ounces; spermaceti, one-half ounce; olive oil, one-half ounce. Melt them together and stir until nearly cold. Scent with such oils as may be most agreeable. Another soap may be made by taking white wax, spermaceti and almond oil, of each, one-quarter ounce. Melt and, before cooling, rub in two cakes of Windsor soap, which have previously been reduced to a paste, with a small quantity of rose water. This last, probably, is not unlike a superior shaving soap that has long been in use, and is known as "Rypophagon" soap, a first-rate thing with a very wonderful name.

Division of Labor in Science.—St. George Mivart remarks on this subject: "The principle of the division of labor renders necessary the application of one man's almost entire energy to a more and more restricted field of scientific labor. Only intellectual giants can now hope for eminence in widely remote areas of study and research. To take an example from one science, men have not only almost ceased to be general zoologists, and become ornithologists, entomologists, etc., as the case may be, but we hear of lives being devoted to the study of small sections of natural orders, and that this naturalist is a *Carabidist* (that is, devoted to that family of beetles termed *Carabidæ*), and that a *Curculionist* (devoted to the long-snouted beetles termed *Curculionidæ*,) while a German naturalist has even published a quarto volume, with large plates and numerous tables, the whole being devoted to the anatomy of the lower part of the hindmost bone of the skull of the carp."

To make a bright crimson writing fluid.—Powdered cochineal, 1 oz.; hot water, $\frac{1}{2}$ pint. Digest, and when quite cold add ammonia 1 oz., diluted with 3 or 4 ozs. of water. Macerate for a few days and decant when clear.

To make good yellow soap.—Tallow and sal soda of each $1\frac{1}{2}$ lbs.; resin, 56 lbs.; stone lime, 28 lbs.; palm oil, 8 ozs.; soft water, 28 gallons. Put soda lime and water into a kettle and boil, stirring well; then let it settle and pour off the lye. In another kettle melt the tallow, resin, and palm oil, having it hot, the lye being also boiling hot. Mix altogether, stirring well, and the work is done.

Starch to give a smooth glossy appearance to starched goods.—One tablespoonful of strong gum arabic solution to each pint of starch.

How to clean iron rust off window glass.—Mix muriatic acid with an equal quantity of water, and apply this with a small cloth cushion to the spot.

How to make and apply a black japan to small iron castings that will dry soon and become very hard and durable at a small cost.—Apply a ground of asphaltum, 3 ozs. Mix by heat and when cooling thin with turpentine. Lay on three coats, and between each dry the article in an oven heated from 250° to 300°. Lay on several coats of varnish, drying in an oven between each, then polish with powdered pumice and rub with oil.

Good sizing for linen.—Crystallized carbonate of soda, 1 part; white wax, 4 to 6 parts; stearine, 4 to 6 parts; pure white soap, 4 to 6 parts; Paris white, 20 parts; potato starch, 40 parts; wheat starch, 160 parts. Boil with sufficient water to form 1,600 parts altogether, adding if desired some ultramarine to counteract the yellow tint of the linen.

What kind of a preparation do watch repairers use to give that fine polished appearance to the brass movements of a watch? For brass, Spanish whiting is mixed with clear rain water, in the proportion of two lbs. to the gallon. Stir and let stand for a few minutes to allow the gritty portion to settle; decant off the water into another vessel and again allow it to stand. The settlings in the second vessel are mixed with jeweller's rouge and used for polishing. What kind to the steel portions? Take a flat burnishing file, warm it and coat it lightly with beeswax. When cold wipe off as much of the wax as can be readily removed, and with the file polish the metal. This is said to be equal to the finest buff polish.

An Exchange says:—"Under Secretary Schurz, the Patent Office is becoming more profitable still to the government. Its copyists now earn about $108 each to the government monthly, while their pay is but $75, and the bureau has a balance of $1,000,000 to its credit in the Treasury."

ELECTRIC CANDLES—A NEW THING.

"Among other battles at which one assists this moment, in France, is that between electric candles and gaslight. Yesterday evening I visited this peculiar candle manufactory, in the Avenue des Villiers, the director of which is a Russian engineer and also the inventor, M. Joblockoff. Now, as Voltaire observed, light comes from the north. The laboratory is hung with pictures and colored stuffs, which can be as easily distinguished in their shades as if in full noonday. The candles have the same ratio to gas and oil lamps as sun to moonlight. The inventor poured some glasses of water on the flame of his dips, but they burned away all the same. They emit no smoke, and consequently cannot blacken objects, nor any heat—350 times less than an ordinary candle—hence books will not fall out of their bindings, nor tapestry turn into black snuff. There can be no fire, no explosions, and the light can be laid on some three to fifteen times cheaper than gas or oil light. The light does not tremble or twinkle much, and none at all if it passes through a globe slightly opaque. The candle is composed of two cylindrical sticks of charcoal, separated by a preparation of sand, ground glass and kaolin; a magneto-electro machine furnishes the current, which flows from one point to the other of the charcoal rods. Each candle burns three hours, and the extinction of one lights up another. We are more than on the eve of a great discovery; but as the proof of the pudding is in the eating of it, the invention will soon be tested, as the circus, the opera, the Louvre drapery shop, and the railway termini are to be illuminated by the new process."

THE CURE OF DIPHTHERIA.

Dr. E. N. Chapman, of Brooklyn, N. Y., has discovered an antidote to the poison of diphtheria, by which the percentage of deaths is reduced to less than one in fifty. Statistics show that the percentage of recoveries in cases treated under the usual practice is about thirteen, or eighty-seven out of a hundred sufferers succomb to the fell disease.

Diphtheria first appeared in this country in 1858. Dr. Chapman, in 1859, lost several cases, and became distrustful of the regular methods. He had been using alcohol in the cure of ship fever, and he determined, though contrary to all rules, to try it in diphtheria. To his surprise, several of his patients recovered. He then tried quinia, and found it acted well, but not so quickly. At last he settled on a combination of the two, alcohol and quinia, and with these remedies, he claims that diphtheria is more amenable to treatment than many common diseases. In an epidemic, such as diphtheria, all are affected by the morbific agent; but a few only yield to it. Mature, vigorous persons have vitality enough to resist the disease. Children and weakly adults are its usual subjects. Dr. Chapman considers that there is, almost always, super-added a local and direct exciting cause, such as defective exercise, improper diet, dark rooms, damp houses, imperfect ventilation, and poisonous emanations from decomposing filth in privies, cesspools, sewer pipes, etc. To such agencies the strongest constitution will soon succomb. The blood being deteriorated, its crasis is impaired and its vitality lowered; and then the sympathetic nerves, failing to receive due stimulus, waver in their efforts to carry on the animal functions.

"All local treatment," he says, "is worse than useless." It exhausts the nerve force and induces greater injection of the blood vessels, thus favoring the exudation.

"Alcohol neutralizes the diphtheritic poison, sets free the nerves of animal life, subdues the fever and inflammation, destroys the pabulum that sustains the membrane, cuts short the disease, conquers its sequelæ, and shields other members of the family from an attack. Upon the subsidence of the fever, as is usually the case in from twenty-four to thirty-six hours, a purulent secretion begins to loosen the membrane, and soon, thereafter, to detach it in flaky, ragged fragments. This process may take place, and recovery be possible, even when the larynx and trachea are implicated. The membrane is seldom renewed, when this secretion is maintained by a steady use of the remedy. Alcohol is as antagonistic to diphtheria as belladonna to opium, or quinia to malaria. Like any other antidote, it must be given promptly at the outset, or otherwise its potency will be lessened, perhaps lost altogether.

"Alcohol does not act as a stimulant, nor induce any of its ordinary effects. Enough may be given to cause profound intoxication in health, and yet there exists no signs of excitement or odor in the breath.

Quinia is an efficient alloy to alcohol. It energizes the ganglionic nervous system, and thus enables the organism to right itself and resume its function.

Dr. Chapman sustains his position by citing numerous cases in which this treatment was successful. He states that in his long experience, he only knew of one case where a drunkard had diphtheria. He generally gives the alcohol in the form of whiskey.

DRAIN FROM A CESSPOOL.

(See page 25.)

The best method of disposing of the waste of the house is a matter of serious consideration with persons living in country places, or in small towns or villages, which are not provided with a complete system of public drains and sewers. This waste has a considerable value, if it can be used as a fertilizer upon grass, in the compost heap, or in the garden, and some manner of thus using it should be provided if possible. Generally, where cesspools are used to collect the waste from water-closets, bath-rooms, and wash-tubs, in houses provided with these conveniences, there are some matters which it is desirable to retain in the cesspool, as the liquid portion only is conveniently utilized. Sometimes cesspools are drained into rivers or smaller streams, and the overflow only is required to pass off. In this case it will be convenient to provide a screen for the outflow, to prevent objectionable matters from escaping. If this is provided, the cesspool may then be flushed out at every heavy rain, and to a very considerable extent cleansed or purified without permitting any disagreeable results, and the periods of thorough cleaning out postponed for several years. A screen that has been used for this purpose, is shown at figure 1. It consists of a piece of strong galvanized iron wire netting, with a mesh half an inch square, cut into the shape shown at figure 2. The drain-pipe is passed through the round hole in the center, which is cut to fit the pipe, and the netting is bent where shown by the dotted lines, around the shoulder of the pipe, in the form shown at figure 1, the flap at each end forming the ends of the screen. The joints are then secured by lacing with wire. It is impossible for this screen to be choked and rendered useless, for when the water rises to the lower part of the screen there is no current against it to hold floating matter, and this rises until the current flows out at the mouth of the outlet. If the floating matter gathers here, the water escapes under it; if not the mass rises with the water until an opening is cleared below it. The inlet to the cesspool is shown on the opposite side of it. In a case in which such a screen as this was made, the top of the cesspool was covered with a flag-stone, and a round bed of soil was made over it and planted with hardy bulbs, by which the precise locality can always be ascertained.

Singing Mice.—The question as to whether mice sing, has been revived. M. Brierre described before the Society of Acclimatization his experience in La Vendee in 1851-3. He had bought an old cupboard which happened to contain mice. About sunset the mice began to sing. By lubricating the doors and hinges of the cupboard, M. Brierre was enabled to open it in one instance, without disturbing the song. He literally caught the songster in the act. It was an old mouse, which held its nose in air like a dog when howling. Its song was like that of a wren. M. Brierre seized the mouse in his hand, but afterward allowed it to escape. On subsequent evenings the singing was renewed. There were no birds in the house. The utterance of a less musical sound has latterly been discovered as part of the capacity of the scorpion, on the authority of Mr. J. Wood Mason, and described before the London Entomological Society. The experiments were made at Bombay, by teasing two large scorpions, placed face to face on a table. The sound is stridulous, somewhat like that from scraping a stiff brush with the finger-nails. An anatomical examination showed that the insect is provided with an apparatus consisting of a scraper and a rasp; these appendages could be made to give sound when separated from the scorpions, after death.—*N. Y. Tribune.*

[The singing mouse is the common field mouse, which, in winter, often takes up its abode in dwellings.—*Ed. C. M. M.*]

The Liquefaction of Oxygen.—On Saturday last the liquefaction of oxygen was for the first time accomplished. The successful experimenter was Professor Pictet, of Geneva, who accomplished the liquefaction of the gas at a temperature of 100 deg. Cent., and under a presure of 320 atmospheres.

American Small Arms for Turkey.—The Providence (Rhode Island) Tool Company turned out 3000 guns for the Turks in one weeck recently, and the manufacture is still going on, although the Turkish Government is stated to be in arrear with its payments.

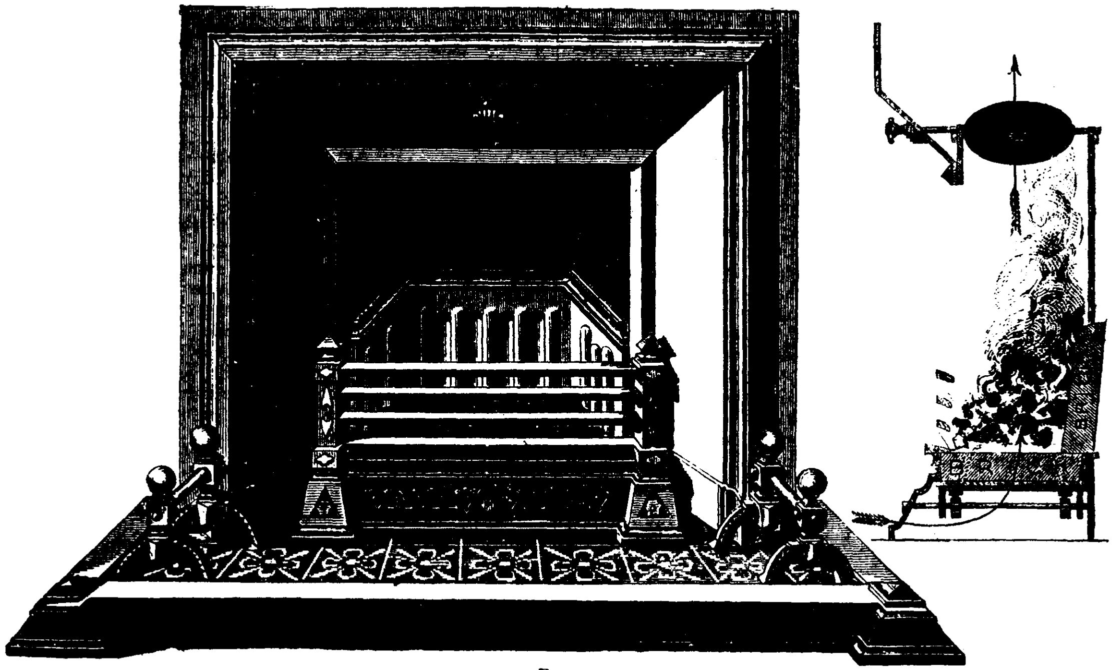


FIG. 3.

VENTILATION.—(SEE PAGE 31.)

Fig. 1.

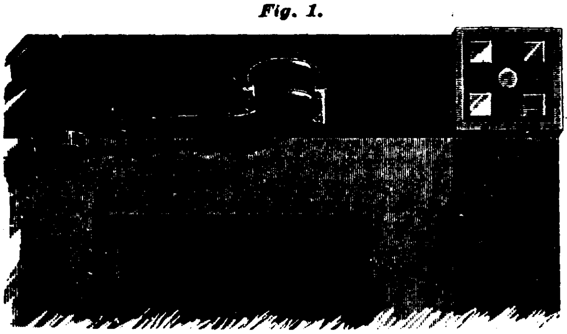
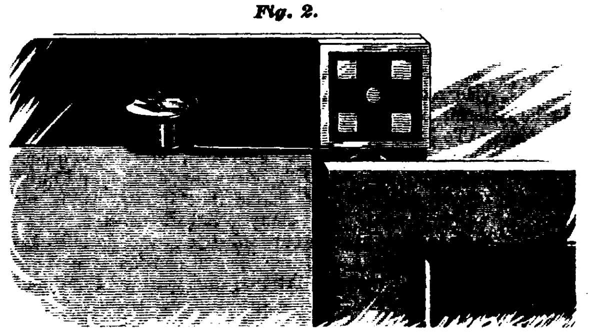


Fig. 2.



IMPROVED LEVER DOOR SPRING.

A simple and effective door spring which possesses the rare quality of exerting the greatest pressure on the door when closed, and the least when it is open, has been much sought after, but never, we believe, attained in any degree of perfection until the invention of the one we here illustrate. Indeed we have seen none, until our attention has ben called to this, which could be considered a spring at all, that lay claim to the quality above described. In the engravings with which we illustrate this article, Fig. 1 represents the position of the spring when the door is closed, and Fig. 2 its position when the door is open. The device consists of a cylindrical barrel, containing a flat spring, the said barrel being provided with a flange whereby it is screwed to the casing-strip above the door inside. The string is coiled in the barrel and the inner end is attached to a center spindle which projects down through the bottom of the barrel and bears a perforated disk. The spindle projects through the disk and carries on its extremity a lever, the said lever turning loosely thereon. This lever has a teat or projection on its upper side which engages with one of the perforations of the plate before mentioned. On the end of the lever—which is made of malleable iron—is mounted a roller of hard wood, boiled in oil to prevent cracking. This roller impinges against the inside of the door near the top, but is not attached thereto.

The spring-barrel is screwed to the casing of the door, as shown in the figures, at point in relation to the hinging axis of the same, in such a manner that when the door is open the roller will press upon it near the hinged edge, and thus act with very little force ; while as the door is being closed, it will travel further out, increasing the pressure all the time, until the maximum is reached when the door is shut.

The method of adjusting the tension of the spring is very simple, and admits also of the pressure being entirely released when desired, without unwinding the spring or detaching any part. In Fig. 2 is seen the head of a pin, which projects through the top of the barrel just back of the central pivot, and is held up by a small spiral spring. This pin passes down through the barrel, and when pressed down its lower end will enter the holes in the disk below. If greater force is required to close the door, the lever is turned back, and this pin pressed down into one of the holes in the disk. This holds the disk, and keeps the spring from unwinding, while the lever is disengaged and flung back to its first position, where its projection again engages the disk. To entirely relieve the pressure on the door and permit it to swing freely, the pin is engaged with the disk, and the lever disengaged.

This spring is self-contained, has no attachments to the door, is easily applied and adjusted, and closes the door as perfectly if only opened a few inches as if opened wide. It has been in practical use for the past two years, being repeatedly subjected to the severest tests, and has proved thoroughly strong, reliable and efficient. It is being extensively adopted by several railroads for use on car doors, as it is so readily thrown out of gear without disconnecting any part.

This spring is manufactured under several patents by the Sabin Manufacturing Company, of Montpelier, Vermont. Those wishing any further information should address them for circular and prices.