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SCIENTIFIC CANADIAN
MECHANICS' MAGAZINE
AND
PATENT OFFICE RECORD

Vol. 7. MARCH, 1879. No. 3.

AGRICULTURE.

THE INEXHAUSTIBLE MINE OF WEALTH TO EVERY NATION.

(Continued from our last.)

IN resuming this subject, we will now endeavour to point out:

First: Why Immigration to Canada during the past thirty-five years has not brought to us the same advantages Immigration has done for the United States, in ratio with the same period of time.

Secondly: The method that should, in future, be adopted to colonize the unsettled lands of the country.

Thirdly: The advantages to be derived by young mechanics, who are now out of employment, becoming cultivators of the soil.

If we look back to the system adopted by Canada about the time when the great tide of emigration rolled over from the Irish coast to these shores, bearing on its waves a famished and fever stricken people, we find that the agents were then appointed, in Canada, by the Governor-General, and by the English Government in Great Britain; and, as it was then most desirable for the Home Government to encourage the emigration of an over-populated country and starving people to a colony like Canada, where land could be obtained at such reasonable rates, agents were appointed in all the principal seaports at home to superintend the shipment of them to North America; and, as now, agents were stationed at Quebec, Montreal, and cities further west to take charge of, and provide for them as far as possible, or forward them to their destination.

This enormous exodus from Ireland, which took place between 1840 and 1850, together with famine and fever, reduced the Irish population from nearly nine to about six millions. The agents, so appointed, were at the time gentlemen of the highest probity and noted for their kindness and humanity. Among them, the names of the late Mr. Buchanan of Quebec, chief Immigration agent, and Mr. Yarwood of the Royal Navy — who died at his post from the malignant fever brought out by the emigrants—will long be remembered for their kind hearts.

We might naturally suppose that out of such a large augmentation to our population, many of them would have become thriving settlers—many farm laborers—many have turned their attention to mechanics—and, many become employed in domestic service—but such was not the case; out of that mass of human beings who crowded over into this country during those years, but few actually became permanent settlers; those who did where of that class who hired out as domestic servants. The greater portion, however, were assisted by the Government, when they had no funds, to go further West, and after drifting through the country for a short time, not knowing where to cast anchor, they passed over into the United States, where they found employment on the numerous railroads, canals, and other public works then being constructed, or got employment as farm laborers to the farmers on the fertile lands in the western territories, and many afterwards became wealthy farmers themselves, some of whose children are now prominent men. At that period when people were coming across the Atlantic in lumber ships freighted with from 300 to 500 human souls, so crowded were the wharves, that with difficulty could temporary accommodation be found for them; and had we at this period possessed a proper organization for settling these people in colonies, on certain districts, and assisted them judiciously until they became accustomed to the method of cultivating the soil, this large influx of people, amounting in ten years to hundreds of thousands, might have become a most valuable acquisition to the country as agriculturists, and our population increased to two millions greater than what it is at present.

After the appointment of immigrant agents, under self-government, became political affairs, we regret to say that, in many instances, a very inferior class were appointed to those who previously filled the office, and the position was frequently given to men totally unfit, either by education or experience, for the situation; so much so, that it would appear as if the Government then considered it a matter of little importance who filled the situation so long as emigrants were sent out to us, and as a consequence, a class was assisted with Canadian money to land on these shores and were forwarded to the West, who only intended to take advantage of this assistance to get so far, and then cross over to the United States. We will not say that the same evil now exists, although there is still great room for improvement. The time has arrived when a very different system must be adopted for the settlement of this vast country to that which has hitherto been pursued, so that the public money shall not be wasted in assisting paupers to immigrate, and thus fruitlessly expended — but on the contrary, that every dollar expended shall prove the means of colonizing the country with an industrious and intelligent people who will settle on its soil, and lay the foundation of greater prosperity in the future.

But, before encouraging or assisting any class of immigrants to this country, it is but just and patriotic that we should first turn our attention to the best means of providing for our own unemployed population; not by any temporary employment, which only exhausts the exchequer and gives no return, but in a way that will give permanent and satisfactory results. To accomplish this every reasonable assistance should be given to these people to become settlers on the fertile lands of the West. By so doing a great weight of poverty would be taken off the land, and from a poverty-stricken people, often driven to crime from their misery and hardships, we could create a new class, who, in a few years, would become extensive cultivators of the soil, and not only add to the revenue of the country by their consumption of its imports, but materially assist our manufactures from the demand that would be annually increasing for agricultural implements. This is the first step that should be taken by the Government towards the relief of those mechanics and laborers who are suffering now so severely from the present depressed state of commercial affairs. The withdrawal of a portion of these from the mechanical branches of industry to become agriculturists, would never be felt by the manufacturers, but would only tend to their future advantage. The progress of invention is now so rapid and machinery can be brought to such perfection, that where five men were wanted ten years ago, two will now suffice, and the inventive genius of the people is really only beginning to develope itself. It would be madness for mechanics, with the present prospect before them, to hang about cities and towns in the expectation of better times coming. No *National Policy*—no ability in the land, however high it may be, can alter, with the stroke of a magician's wand, the present state of affairs. The Government can, and *will* do all that is possible to ameliorate and bring about a more healthy state of business, and do all that can be done to restore public confidence and set money again in circulation; but those who hang on in idleness, in the hope that prosperity will suddenly return, will most assuredly be disappointed. Do not wait therefore for times to mend, but take to the axe and plough, and the sooner the better for yourselves. Fortunately for Canada, she has a vast advantage over European nations, for she is yet in her infancy, and a splendid field of independence awaits every young man who has health, spirit and perseverance enough to go into the forest, or on prairie lands, and build up a home for himself. If a married man, he will see a bright future before him; and should he have a family, every child, instead of being a burthen, will be a help. Every son, as he grows up, will be able to obtain the same independence by following in the footsteps of his father. Can any mechanic expect as much with the prospect before him as he now stands, or can he discern in the gloom what may become of him in his old age, or of his family?

The construction of the Pacific Railroad, as we may judge by the Governor-General's opening speech to Parliament, may now be considered as fully decided upon, with such a majority in favor of the ministry. Here then will be a fine opportunity for thousands of our unemployed to settle along that fertile track of land through which the railroad will pass. The finest land in the whole Dominion, and the finest climate in it also, are to be found in that region which lies along the Great Saskatchawan valley, and the tributaries of the Saskatchawan river, and in that extensive plain of rich fertile land bordering on the Peace river. No finer soil is to be found, according to every report brought to us; and when the road is commenced the Government will have a good opportunity to win greater popularity by giving every reasonable assistance to settlers to colonize that district under a thoroughly organized and practical system.

We have never been believers in that method of colonizing a country by encouraging to it a class of immigrants who are totally unfitted, by habits or education, to become settlers, and then to leave them, after they arrive, to their own resources, to get on the best way they can. We have always considered it a species of refined cruelty to induce immigration to this country of a class who are totally unable to withstand the rigour of a first year's winter exposure in the bush; not that the hardship or cold is so excessive, but many of those who come here are so differently nurtured, and are so much at a loss for resources to overcome difficulties, which to a native would be but a trifling matter. New comers require to be educated by efficient and intelligent agents, who should have charge of districts, and be constantly visiting the new colony, advising and instructing in the best ways to turn everything to the most profitable account—how to cultivate the soil to the best advantage, and to obtain in the easiest and quickest way a return for labor. It is just as necessary for the welfare of the Dominion that judicious assistance should be given to new settlers on wild lands, who take these lands without means, but on certain conditions of payment, as it is to educate our children or to assist agricultural schools. We feel confident that by the adoption of a proper system, and under trained and intelligent superintendents, the Immigration Department of this country could be made the source of much of its future greatness; in fact, such is the extent of the field of operation before us, that a new Bureau might with advantage be made, under the title of the Colonization Department. To lay down any rules for the guidance or for the formation of such a department, if ever created, would be unnecessary here. This fact, however, must sooner or later force itself upon the minds of our rulers—if we wish to grow in numbers and prosper—that some more energetic steps must be taken to colonize the country, from East to West, with a good class of settlers, and that every dollar, so expended for the future, shall bring back a hundred fold.

It must not be supposed, however, from the foregoing observations, that we are adverse to receiving immigrants from the mother or any other country, who voluntarily come to settle here, whether in good circumstances or otherwise, but we most decidedly protest against any encouragement being given by our agents in Great Britain to the shipment of paupers, and that they should represent truthfully the real state of affairs here. How many have come out, led to do so by false representations or deluded by pamphlets written by unpractical people! These people have frequently sacrificed their little all and have returned broken-hearted and penniless to commence life anew. These are a class of people whom the immigrant agents should have judgment enough to know are entirely unfitted for Canadian life in its rough form. They would do well enough for the Cape, New Zealand or Australia. Canada is the country for the young, robust and hardy. We also protest against Government Agents encouraging mechanics to cross the Atlantic when we have no employment for them. Any time when we require skilled mechanics for any particular industry or manufacture, in which our own mechanics have had no experience, we can in a short time obtain them; but for the ordinary class of trades workmen, for some years to come, we have an ample supply, and when, as we expect in time it will be so, the Government establish schools of technical education, we hope to send forth from them mechanics so well trained in applied mechanics and chemistry in those particular branches of manufacture which they intend to follow, that, in consideration of the benefits they have received, they will endeavour, in whatever place they may be acting as foremen, or in a higher position, to impart their information to those under them.

In closing these remarks on the benefits of agriculture to every country, we hope that those who read them will place the MAGAZINE in the hands of mechanics who are suffering from the want of employment; we desire most strongly to impress upon this class, and particularly upon the young, that the day is still far distant when the wheels of the manufactories will all again be moving, and they should make up their minds, as Spring approaches, to become, if possible, agriculturists; by so doing, their trades will often serve them in good stead, and be turned to great advantage. Every mechanic in this country knows something of agricultural pursuits, and the change from one business to the other would be easily effected. A diminution among the trades would, to a certain extent, relieve the incubus that oppresses them, and the others could then obtain more regular work. Let those to whom we offer this advice bear this in mind, that want seldom comes to the farmer's door, for, provided he is industrious and steady, he will always see before him a provision in his old age, and a comfortable home to pass it in, besides having this consoling reflection that, when he dies, his family will be provided for. How few mechanics can, with any degree of certainty, see such a pleasant future in the distance!

URANINE,

A NEW DOUBLE COLORING SUBSTANCE.

We have received, through the courtesy of the publishers of the *Scientific American*, a most remarkable fluorescent substance called Uranine, which is a new product of the coal tar series. So great is the coloring power of this substance, that a single grain is sufficient to give a distinct tint to eleven barrels of water, or almost three hundred and fifty gallons. When a minute portion of the substance is placed in a glass of water, it will send down most beautiful green filaments, resembling the root of a plant. These filaments will assume spiral and tangled forms, gradually enlarging, until at last the color is completely disseminated through the water.

Examined by reflected light the water will present a magnificent fluorescent green color; examined by transmitted light the general color will be amber or golden; placed in sunlight the water will glow with hues of variable color; the goblet of colored water will retain its brilliancy for many days.

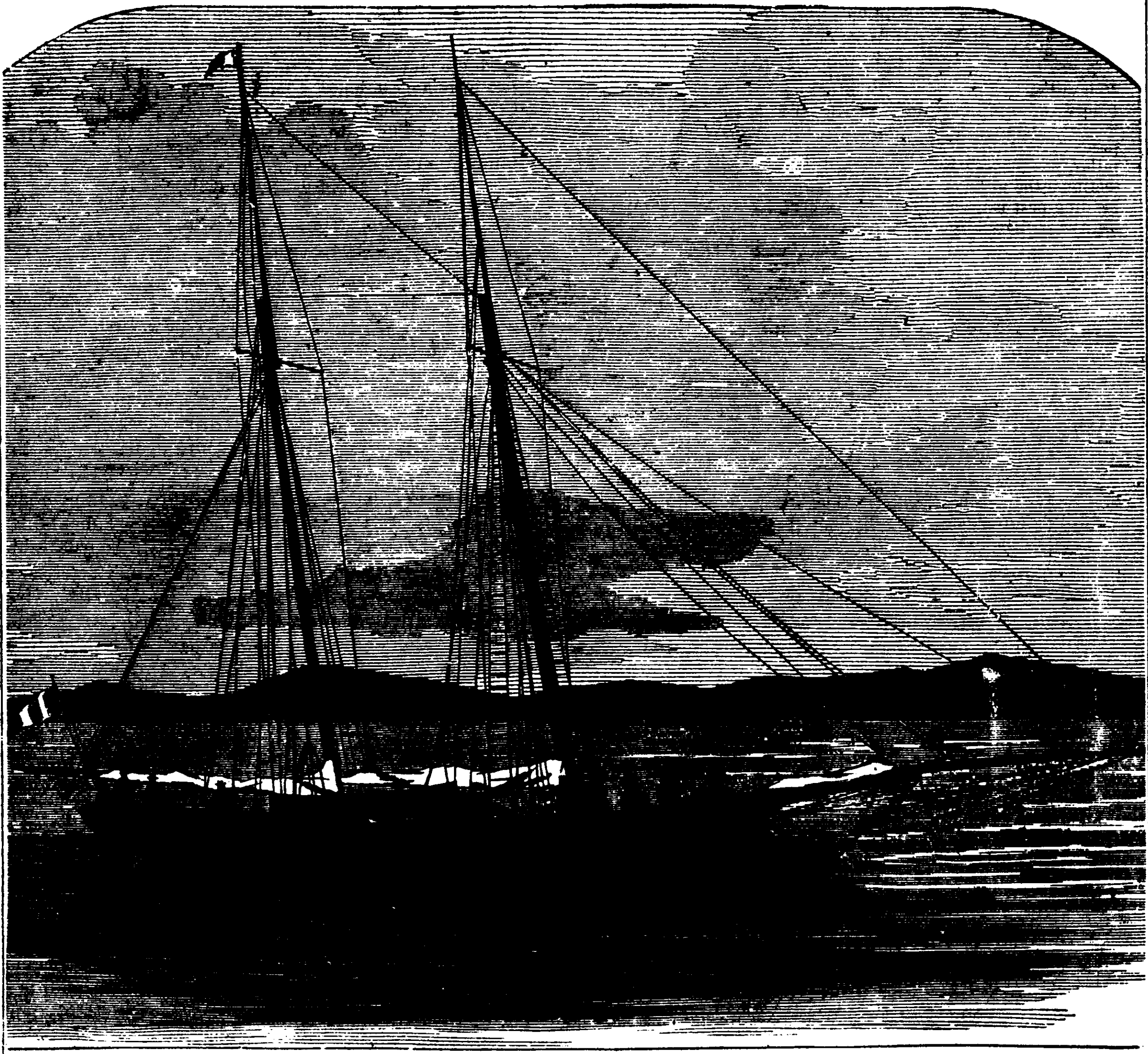
DANGERS FROM THIN ICE.

[For the SCIENTIFIC CANADIAN.]

It might seem strange that in Canada we make so little provision against the dangers arising from breaking through the ice, but that we recollect how little we are troubled with thin ice. It takes so few hours to give a hard setting to the lakes and streams that the trouble arises generally only a few times in each winter, and mainly at the beginning and close of the season. Rapid streams will, however, also render the ice dangerous in places, and scarcely a winter passes but we have some sad record of loss and death from this cause, to remember it by. The latest we call to mind was a lamentable accident on the St. Francis, between Melbourne and Richmond, by the immersion of a sleigh and its passengers. In England, especially in the great cities, the danger is steadily and thoughtfully regarded, and excellent remedies have there been carried out. By the Royal Humane Society the chief expedients in use are poles and ladders, and a light sled for pushing them forward over the ice to the assistance of the immersed skater or pedestrian. There, they have trained men to use them, while in Canada we must train ourselves. Taking a pole, say of birch or tamarac, as the simplest means to adopt, we ought to give a little attention to its proper use. Once get such a pole within the reach of the person who is struggling in the water with head and shoulders emerging through the thin crust of ice, and it will sustain him effectually. It does this by distributing the weight over a larger surface. To this end it should be pushed forward, the person having it in charge approaching no nearer to the broken place, in which his fellow-creature is struggling with the forces of destruction, than he can avoid, so as not to increase the weight by concentration. He may creep on all-fours, pushing forward the pole as he advances. When the body is flatly extended on the ice, the strain is lightest of all; and this might be remembered to advantage when the foot first breaks through.

Then, as to sleighs crossing at certain points of a river, there ought to be separate roads for going and returning, sufficiently wide apart to admit the full length of a pole, and on the shore, in a shanty, should be some one in charge of long and rather stout ice-poles. Two of these to an ordinary sleigh would generally serve for the occupants, and they should hold them across their knees, and, on arrival on the opposite bank, leave the poles with another shantyman, paying a small fee for their use, which use should be made compulsory.

This simple plan would save many a life—even when horse and sleigh might be hopelessly immersed—and such matters are worth the consideration of our municipal bodies, who should also take power to close all river crossings when considered to involve too great risk. The life is more than meat, and the body than raiment—and we do not always remember this. HOMO.



THE "KALA-FISH," FITTED WITH DR. COLLIS BROWN'S PATENT BOW.

THE YACHT THAT MADE THE FASTEST TIME ON RECORD.

Electricity.

A NEW SYSTEM OF ELECTRIC LIGHTING AND A NEW ELECTRIC LAMP.

By Profs. Elihu Thompson and Edwin J. Houston.

Having been engaged in an extended series of experimental researches on dynamo-electric machines, and their application to electric lighting, our attention has been directed to the production of a system that will permit the use of a feebler current for producing an electric light than that ordinarily required, or in other words the use, when required, of a current of insufficient intensity to produce a continuous arc. At the same time, our system permits the use of a powerful current, in such a manner as to operate a considerable number of electric lamps placed in the same circuit.

As is well known, when an electrical current, which flows through a conductor of considerable length, is suddenly broken, a bright flash, called the extra spark, appears at the point of separation. The extra spark will appear, although the current is not sufficient to sustain an arc of any appreciable length at the point of separation.

In our system, one or both of the electrodes, which may be the ordinary carbon electrodes, are caused to vibrate to and from each other. The electrodes are placed at such a distance apart, that in their motion towards each other they touch, and afterwards recede a distance apart which can be regulated. These motions or vibrations are made to follow one another at such a rate, that the effect of the light produced is continuous ; for, as is well known, when flashes of light follow one another at a rate greater than twenty-five or thirty per second, the effect produced is that of a continuous light. The vibratory motions may be communicated to the electrodes by any suitable device, such, for example, as mechanism operated by a coiled spring, a weight, compressed air, &c., but it is evident that the current itself furnishes the most direct method of obtaining such motion, as by the use of an automatic vibrator, or an electric engine.

In practice, instead of vibrating both electrodes, we have found it necessary to give motion to but one, and since the negative electrode may be made of such size as to waste very slowly, motion is imparted to it, in preference to the positive. The carbon electrodes may be replaced by those of various substances of sufficient conducting power.

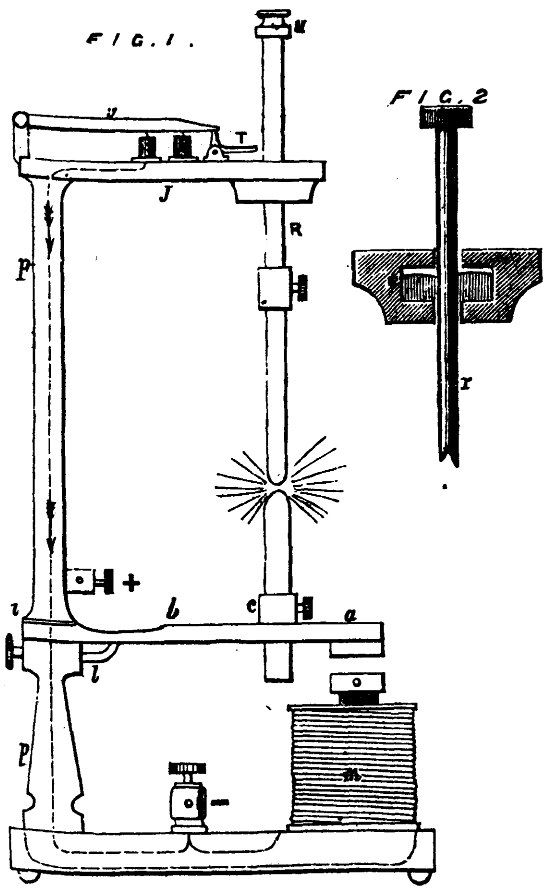
In this system, when desired, an independent battery circuit is employed to control the extinction and lighting of each lamp.

A NEW ELECTRIC LAMP.

The following is a description of one of the forms of electric lamp which we have devised, to be used in connection with our system of electric lighting:—

A flexible bar, *b*, of metal is firmly attached at one of its ends to a pillar, *p*, and bears at its other end an iron armature, *a*, placed opposite the adjustable pole piece of the electro-magnet, *m*. A metal collar, *c*, supports, the negative electrode, the positive electrode being supported by an arm, *j*, attached to the pillar, *p*. The pillar, *p*, is divided, by insulations at *i*, into two sections, the upper one of which conveys the current from the binding post marked ×, to the arm, *j*, and the rod, *r*, supporting the positive electrode.

FIG. 1. FIG. 2



The magnet, *m*, is placed as shown by the dotted lines, in the circuit which produces the light. The pillar, *p*, is hollow, and has an insulated conducting wire enclosed, which connects the circuit-closer, *v*, to the binding post marked —. The current is conveyed to the negative electrode, through *b* and the coils of the magnet, *m*. When the electrodes are in contact, the current circulating through *m* renders it magnetic and attracts the armature, *a*, thus separating the electrodes, when, on the weakening of the current, the elasticity of the rod, *b*, again restores the contact. During the movement of the negative electrode, since it is caused to occur many times per second, the positive electrode, though partially free to fall, cannot follow the rapid motions of the negative electrode, and, therefore, does not rest in permanent contact with it. The slow fall of the positive electrode may be insured either by properly proportioning its weight, or by partly counterpoising it. The positive electrode thus becomes self-feeding.

The rapidity of movement of the negative carbon may be controlled by means of the bar, *l*, which acts, practically, to shorten or lengthen the part vibrating.

In order to obtain an excellent but free contact of the arm, *j*, with the positive electrode, the rod, *r*, made of iron or other suitable metal, passes through a cavity, *s*, Fig. 2, filled with mercury, placed in electrical contact with the arm, *j*. Since the mercury does not wet the metal rod, *r*, or the sides of the opening through which it passes, free movement of the rod is allowed without any escape of the mercury. We believe that this feature could be introduced advantageously into other forms of electric lamps.

In order to prevent a break from occurring in the circuit, when the electrodes are consumed, a button, *v*, is attached to the upper extremity of the rod, *R*, at such a distance that when the carbons are consumed as much as is deemed desirable, it comes into contact with a tripping lever, *t*, which then allows two conducting plugs, attached to the bar, *v*, to fall into their respective mercury cups, attached, respectively, to the positive and negative binding posts by a direct wire. This action practically cuts the lamp out of the circuit.

THE ELECTRIC LIGHT: EDISON'S APPLICATION FOR A PATENT REJECTED.—It is reported from Washington that Edison's application for a patent upon a divisible electric light has been rejected by the Examiner at the Patent-Office. The ground upon which a patent is denied is that Edison's invention is an infringement upon an invention for a divisible light made by John W. Starr, of Cincinnati. Starr, it appears, filed a caveat in 1845, which expired at the end of a year, and subsequently obtained a patent in England. He does not appear to have completed his patent-right in this country, as he died shortly after the issue of the English patent; but his caveat furnishes a sufficient bar to the issue of a patent on a like invention, as it proves previous discovery.—*Scientific News.*

INGENIOUS APPLICATION OF ELECTRICITY IN THE ARTS.—A new and useful application of electricity has been made by an American inventor to the apparatus for reeling silk from the cocoon. The delicate filaments of silk are carried over wire arms which are so nicely balanced that they do not press against the silk strongly enough to break it, and in this relation a current is kept open; but if the filament breaks, the arm falls, the circuit is closed and an electro-magnet instantly stops the reel until the break is repaired. As the work is now done, the detention of a broken filament depends entirely upon the skill of the workmen, and the work must be carried on slowly that the eye can note any break, while with this automatic stop it is said the labour will be much more rapidly done and a more uniform thread produced. The invention is being introduced into France and Italy, the two great silk-producing countries of Europe.

Patent Inventions.

ORDER CONCERNING PATENTS.—An order has been issued at the Patent Office to the effect that from and after January 1, 1879, letters patent and certificates of registration will be perfected and ready for delivery upon the date on which their respective terms will begin to run. Heretofore patents were signed and bore date of issue two weeks before they were completed and ready for delivery. Under the present arrangement the patent will be completed and ready for delivery immediately after signing. This plan will prevent the inconveniences which have arisen from the occasional necessity of withholding a patent after it had been signed, through the discovery of good reason for so doing within the two weeks of interval between signature and delivery. The Commissioner of Patents is also arranging to reduce the time between the granting of a patent and its actual issue from two weeks to one.

ON the 1st of August last year a new patent law came into force in Spain. The previous law was a very defective one, and the charges were very high. The new law comes nearest to that in Belgium (hitherto the most liberal patent law), but affords the inventor even greater facilities. Among its chief arrangements are these:—Two kinds of patents are granted—one for an original invention, the other for the introduction of another's invention from abroad. The former are given for 20 years, the latter only for 5. Patents are granted to every one applying for them without previous testing of the novelty or utility of the invention, and at the applicant's risk if it should afterwards appear that the invention was not new. If only two years have elapsed since patenting an invention in a foreign land the Spanish patent is granted for only ten years. Besides the stamp charges, and those for preparing the specification, there is a yearly tax on the patent. This for the first year is 10 pesetas (about 8s.); for the second year, 20 pesetas; for the third, 30, and so on—*i. e.*, for each additional year 10 pesetas more.

SANITARY.

THE REMOVAL OF SEWAGE AND THE DRAINAGE OF BUILDINGS, WITH PRACTICAL HINTS ON THE PROPER SITUATION AND CARE OF DOMESTIC PLUMBING APPARATUS.

We have been in receipt for some time past of a very practical and sensibly-written pamphlet, on the above most important subject, by Mr. J. W. Hughes, plumber, &c., of this city. We call it a most important subject, because in the whole of the various mechanical trades connected with architecture, there is not one of them of so great importance as perfect drainage and perfect plumber's work. In the construction of the walls of a house we can see, from day to day, what is being done, and imperfect work can be pulled down and rebuilt. In carpenter's work, the very cheapness of our lumber in this country is a protection to joists or beams being used of inadequate strength. Painters may deceive in the quality of paint, but that can be remedied. In roofing, if the roof of a building leaks, the contractor, or the landlord, must at once remedy the defect, as the law would compel him to do so; but in the construction of drains or plumber's work, once the work is covered up, we are all in the dark; and if it is imperfectly done, we have an insiduous enemy always in the house, breeding germs of disease, to be carried by draughts through every part of it. Is it right that we should be left at the mercy of men who are ignorant and incompetent, or who, although fully aware of the danger to health of their imperfect workmanship, are grossly negligent and indifferent as to the fatal results that may follow such apathy on their part; or who, for cheapness' sake, will give out the sanitary part of a dwelling to some petty tinsmith—of whom we have over a hundred in this city, professing to be plumbers—but who never served a day to the trade, and who use the most inferior materials and employ the most incompetent mechanics?

As showing how little landlords themselves understand about the plumber's work of their houses, or of sanitary matters generally, we will give a recent case, that happened in this city, as an illustration:—

A party occupying the upper tenement of an excellent cut stone fronted building in one of the finest streets of this city, complained frequently to his landlord of the smell of the drains throughout the house. The landlord having, he said, spent a considerable sum to have good drainage, could not be made to understand that such could possibly be the case; but as the nuisance to the tenant seemed to increase rather than diminish, the Sanitary Inspector was called in, and this official considered it best to put the matter into the hands of an experienced plumber to find out from whence came the effluvia. On examination it was found that to two sinks and four wash tubs there was but a single trap in the cellar, and this trap had so sagged down that the outlet end had become almost flattened. The overflow pipes from the sinks and wash-tubs were made with slip joints, out of which escaped a most foul smell, which was carried up to the upper tenement, and particularly underneath the floor, out of a slip joint in the sink pipe. The casings to these pipes formed the most perfect ventilators from the lower tenement to the upper.

On carrying the examination still further, it was found that the whole of the tile drains in the cellar had been laid loose, without a particle of cement to connect them, so that out of every joint the effluvia escaped; nor were they built in close where they passed out of the house into the street, from whence came also foul smells and cold air.

This is only one case out of hundreds in Montreal and other cities which are in a most deplorable unsanitary state from bad plumber's work and badly laid drain pipes. This case fully bears out the assertion of the author of the pamphlet, on page 5, that "a perfect "drain with imperfect plumbing apparatus connected "therewith, is even worse than an imperfect drain with "perfect plumbing, because the waste and soil pipes are "but a continuation of the drain into the interior of "the house."

We heartily recommend all proprietors of houses, and especially persons intending to build, to obtain a copy of Mr. Hughes' pamphlet. Our space will not admit of giving more than a few abstracts from this very sensibly-written paper, which might with advantage be published in a smaller form, as a sort of *vade mecum*, to be carried in the pocket by aldermen, corporation officials, and sanitary police in any town or city, as a guide to health.

Mr. Hughes, after some preliminary observations, says:—

"It is not my intention to confine my remarks to the question of sewage and drainage alone, but I shall also make some observations on that portion of the plumbing apparatus of our dwellings more immediately connected with the subject. I allude to the waste and soil pipes of our houses, which are, after all, only continuations of the public sewers and private drains into our private sanctuaries; and any person who has the slightest interest in the sanitary condition of his dwelling should bear the latter assertion constantly in mind.

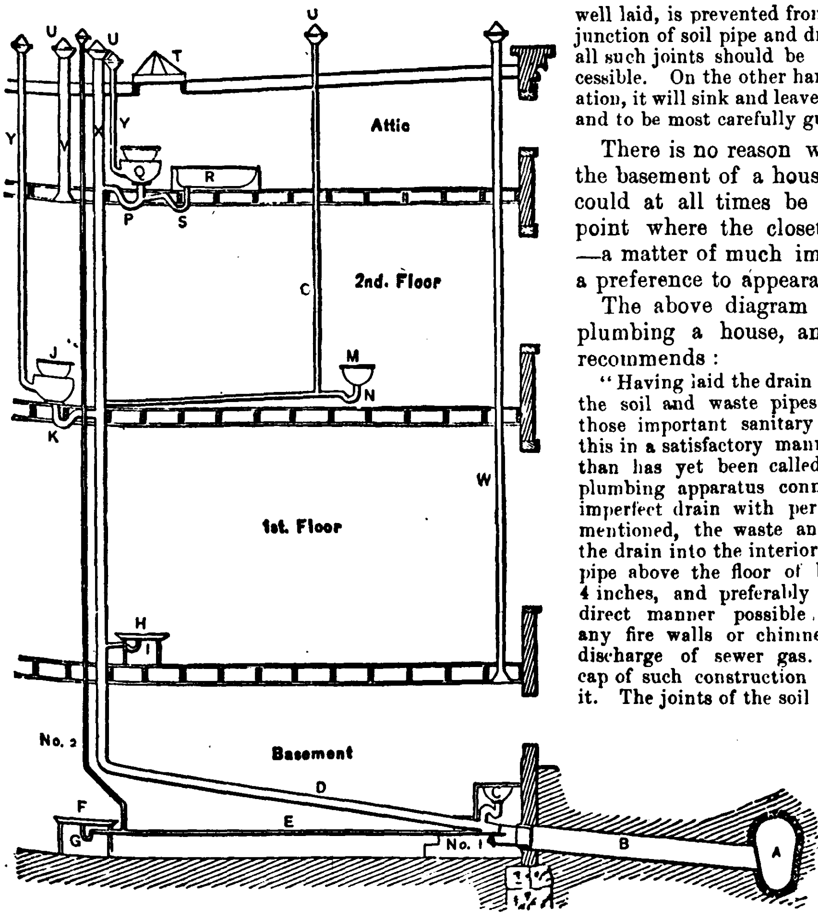
"The following facts should never be lost sight of by persons who are about to lay drains: 1st. They should be of the very best material. 2nd. They should be properly laid or put down. 3rd. They should be thoroughly ventilated. 4th. Never lay a drain under your basement floors if there is any possible means of avoiding it. 5th. Except in exceptional cases, do not put a trap or cesspool in a private drain.

"Regarding my first head, which relates to material, the best is sound glazed earthen pipes (tile); when such is not to be obtained, a drain made of proper-shaped hard-burnt bricks or stone set in cement may be used; but never, under any circumstances, use wood. In selecting drain pipes to carry off sewage matter, two errors are to be avoided: 1st. Do not select a drain that is too small, or it will soon become obstructed by the solid matter that is intended to pass through it. 2nd. Do not select one that is too large, or it will never be properly flushed. A 6-inch drain is as large as can be properly flushed by the waste water from an ordinary dwelling, and the laying of a larger one is only putting in an effective apparatus for the manufacture and storage of sewer gas."

We have seen drains laid down in the United States which were of wood—a log being bored to the diameter required, and lined with hydraulic cement, forced into it by machinery. When dry, these pipes were coated, inside and outside, with pitch, and were said to last admirably. They were easily laid and easily examined, and are excellent substitutes for glazed tile drains. Wood box drains of a rectangular form should in no case be used. When brick drains are used, the bricks should always be hard-burnt and laid in cement, the joints pointed, and the inner surface left smooth so as to cause the least possible friction or interruption to the flow of sewage through them.

"The second point is the proper method of putting in or laying the drain.

"The first and all-important fact to be ascertained is the level or position of the main sewer or other receptacle into which it is proposed to connect the drain about to be laid. Neglect of this has had more to do with badly-drained houses and the consequent ills that result therefrom than any other cause I know of. I think I may safely say that there are hundreds of houses in this city where, owing to neglect in not first obtaining the proper



HOUSE DRAINAGE.

A, sewer; B, house connection with sewer; C, servants' water-closet; D, main soil pipe; E, waste from kitchen sink; F, sink; G, trap under kitchen sink; H I, butler's pantry, sink and trap; J K second, floor water-closet and trap; M N, basin and trap; O, ventilating pipe from basin waste; P & Q, water-closet and trap in attic; R S, attic, bath-tub and trap; T, skylight over attic water-closet; U, ventilator caps; V, ventilator from second floor ceiling; X, soil pipe continued to the roof; Y, ventilating pipe for second floor water-closet receiver, &c.; No. 1, cap giving access to street connection B; No. 2, ventilating pipe from kitchen waste.

level of the main sewer, it has been necessary to dip down in order to get the drain to enter the building below the level of the basement floor; and in consequence of so doing that portion of the drain immediately under the house has always contained more or less sewage matter. Under such circumstances, unless the drain is perfect in itself and the joints have been extra well cemented, this sewage filters out and thoroughly impregnates the soil under the dwelling that is so imperfectly drained."

The writer is perfectly correct in his statement. Not only are there hundreds of houses in this city where, owing to neglect, the laying of the house drain to the main drain has been most imperfectly performed, but in some of the old street drains it is almost impossible to tell which way the sewage flows; it is actually stagnant in them, and oozes out of the joints, poisoning the earth around.

"In laying drains under basement floors, as is the custom in our city, I believe a great mistake is made; but as custom becomes habit, and habit is second nature, it is very hard to prevent its being done, and in many cases all one can do is to see that the least amount of harm is done by this system by having the mechanical operations well done. One weak point in the present system of house drainage is the junction between the soil and waste pipes of the house and the drain. These joints are usually well made with cement; but as the soil pipes are firmly secured to the walls of the building, while the drain is laid on the earth, it will plainly be seen that the slightest settlement of the walls carry the soil pipes with them, while the drain, if well laid, is prevented from sinking. A crack in the joint at the junction of soil pipe and drain is sure to occur, and on this account all such joints should be made above the floor and left easily accessible. On the other hand, if the drain is laid on a poor foundation, it will sink and leave the soil pipe, either mishap being serious, and to be most carefully guarded against."

There is no reason why the flooring over the drain in the basement of a house should not be so laid that access could at all times be obtained to it, particularly at the point where the closet pipe connects with the tile drain—a matter of much importance, and should always have a preference to appearances.

The above diagram illustrates Mr. Hughes' method of plumbing a house, and the following is the system he recommends:

"Having laid the drain from the street sewer to the junction of the soil and waste pipes of the house, the work of putting in those important sanitary agents has yet to be done, and to do this in a satisfactory manner requires greater skill and attention than has yet been called for. A perfect drain with imperfect plumbing apparatus connected therewith is even worse than an imperfect drain with perfect plumbing work, because, as already mentioned, the waste and soil pipes are but a continuation of the drain into the interior of the house. Starting from the drain pipe above the floor of basement, the soil pipe (never less than 4 inches, and preferably of iron) should be carried in the most direct manner possible up through the roof (see sketch) above any fire walls or chimneys that might interfere with the free discharge of sewer gas. It should be fitted on the top with a cap of such construction as will prevent the wind blowing down it. The joints of the soil pipe must be made perfectly water and air-tight, and I may here remark that they usually are so. From this pipe on its way to the roof branches must be left in suitable positions to receive the different fixtures that are to be used. It is at these points that the traps require to be placed. There are various kinds of traps in use, any of which are effective in their working, provided always that they contain a sufficient quantity of water to prevent the escape of sewer gas through them. The quantity of water does not require to be large, as the gases will not force their way through even a small quantity of water when it can freely escape by means of the open pipe going through the roof. But when traps of improved construction are to be had, use them. Where baths, basins, sinks, &c., are placed at a distance from the main soil pipe, it is necessary to have traps placed immediately under them, as well as connecting the ends of pipes leading from them into the trap under the water closet, when it is possible to do so, care being taken always to connect the ends of these pipes well down in the water contained in the large trap under the closet. Good workmanship imperatively demands that all connections of branch pipes to traps should be made low down in the trap, so that the ends of such pipes will be sealed by the water in the trap.

"Besides the trap under each basin, bath, &c., it is much safer to fit an air pipe just outside such traps, and carry it up through the roof, so that any foul odors formed in the branches leading to the different apparatuses may have free escape and not force its way into the rooms in which the apparatus is fitted.

"The fitting of such air pipes will add to the cost of the plumbing apparatus; but I think they will cost much less than a single case of typhoid or other disease that may be caused by the escape of foul air into our dwellings.

"These air pipes are sometimes connected with a chimney, but it is a mistake to so fit them. In our climate, for months every year, the chimneys, excepting that from the kitchen, are not used, and during such periods they are liable at times to a down draft, and consequently the foul air from the pipes connected with them would be blown into the house. Even the kitchen chimneys of houses that are left tenantless are liable to this drawback, and on this account it is much the safest plan to carry all ventilation pipes up through the roof.

"The carrying of soil pipes and air pipes up through roofs serves another purpose of great importance, besides giving free escape for foul gases. They prevent the syphoning of the traps, as the plumbers call it; that is, they prevent the emptying of the traps by air pressure after a vacuum has been formed in the soil pipes by the sudden emptying of a large quantity of water into them.

DRAINAGE.

"By drainage I mean the carrying away of the water that accumulates in the earth, and where such accumulations are large, such as in swamps or low-lying lands, we invariably find disease prevails to a greater or less extent. In fact there are a number of complaints that are peculiar to such localities. That these complaints are caused by the accumulation of water is proved by the fact that removing such surplus water renders the localities, previously unhealthy, salubrious and fit to live in.

"Now, in our city there are certain low-lying districts that were originally swamps or marshes, and notwithstanding that these localities have in many cases been effectually drained in the usual acceptance of the term, that is, they have had sewers put in, they are notoriously the unhealthy districts of our city, as the statistics of our health association will prove. Now, what is the reason of this? These localities have the usual allowance of sewers, yet they are more unhealthy than other districts a little removed from them. Is it not that the provision for draining the soil is not adequate; and although the original swamps are not to be seen, having been built over, still they actually exist, no provision having been made for their eradication, and consequently the parties so unfortunate as to be living over them have their vitality lowered by the unhealthy emanations therefrom, and so fall easy victims to any prevailing disease, besides being subject to the class of complaints peculiar to such localities.

"Our present system of drain inspection, while filling a want, has a tendency to aggravate the state of affairs just alluded to, as drains or sewers, as now laid, are as tight as a bottle; in fact, they must be so from end to end, or else they will not be passed. Now, while this is quite right and proper so far as that portion of the drain or sewer in the house is concerned, I think it is a mistake as regards at least a portion of the sewer, from the line of the outside of the dwelling to the main sewer. Here some provision should be made for the free escape of the water from the surface of the earth. I have frequently seen house drains laid without cement, the parties laying them giving as a reason for not cementing the joints that the locality was swampy and they wished the surface water to escape by the open joints; and I think the evil likely to result from the open joints of a drain under such circumstances would be in a measure neutralized by the good derived from draining the soil, although I by no means advocate the adoption of such a plan. But I would suggest that all sewers laid in the houses and for one or two lengths outside the dwelling be tightly cemented, as is at present the rule. After that I think it would be as well to leave the bottoms of the joints open and fill in round them with gravel or broken stones. That would prevent the earth being washed into the sewer, but would at the same time allow the free escape of surface water. I have heard that there is some provision made in the main sewers for the removal of the water from the soil, but I have no personal knowledge of the arrangement. There should certainly be some plan adopted, especially in our low-lying localities, that would allow for the free and rapid escape of the water from the earth."

The *Metal Worker*, in an editorial note on this subject, justly remarks that there should always be a distinction made between sewers and drains, and that all drains for carrying off surface water, or water accumulating in swampy or low-lying lands. [?] These drains will admit of being made of porous material, as they would carry off pure water; but even when carrying off merely water, care should be taken that they do not become the channel of conveying back through them poisonous gases from the sewer into which they discharge. We have many houses in Montreal where the basements are flooded frequently with water, and no provision made to carry it off. In such cases it is a good plan to sink a hole, or well, and line it with cement, to collect the surface water, and to have a trapped pipe connecting with it and the house drain at its lowest point of exit. There are some houses in St. Denis street where the cellar floor is lower than the house drain, and which will in consequence always be damp and unhealthy until this evil is remedied. A damp cellar is almost as great an evil in a dwelling as a bad drain.

POSITION OF SANITARY APPARATUS.

"As the position of the various sanitary apparatuses in connection with dwellings has a great deal to do with their effectiveness, I will endeavour to lay down a few general principles that may aid persons about to build or put in improved sanitary appliances to place them in such a manner that good working is secured and the least annoyance from smell or derangement of the mechanical parts is avoided.

"The next great requisite besides good workmanship and materials is light, and therefore all water-closets and similar apparatus should be so placed that the fullest benefit from that greatest of all sanitary agents, the sun, is obtained. Closets and bath-rooms should always be so situated that they can be provided with windows opening directly into the outer air, thus securing a proper amount of air and light, without which it is impossible to maintain them in a proper state of sanitary effectiveness. I never knew a water-closet that was imperfectly lighted to give perfect satisfaction.

"The practice of locating water-closets in the interior of a dwelling, like a cupboard, is altogether wrong. Where it is impossible to obtain the necessary amount of room convenient to the outer walls, the following plan, adopted by some of our leading architects, gives excellent results: The bath-room and closets are placed on the top flat, and are lit by means of a skylight, which is so arranged that the sash may be easily opened so much that ventilation at all seasons of the year will be effected. This plan is applicable to most dwellings, the only exceptions being very high buildings, and in those there is not usually that want of space that would prevent a suitable room being provided convenient to the outer walls. In houses intended for the use of small families it is best to have the water-closet, bath, &c., in one room. Where a large number of persons occupy the same building it is necessary that they be separate, and that access be had to them by separate doors.

"Another important matter to be looked to in locating sanitary apparatus is security from frost. In our climate the extreme cold always produces a plentiful harvest to the plumber, and while he gets some small profit thereby, he never fails to get a large amount of polite and sarcastic abuse, as it is the prevailing opinion that the plumber is in league with the elements to draw money out of people's pockets, while in reality the blame rests in many cases with those who are responsible for locating the various apparatuses in such positions that in a climate like ours it would require little short of a miracle to prevent the frost from injuring the work. This is the first great cause of trouble from frost, and in most cases the plumber has no say in the question, but must obey the mandates of those employed to look after such matters. The reasoning of the latter persons may be, with exceptions, well expressed by the following: "It is a pity to waste that nice room by using it for a bath-room and closet. Here is a corner that will do well enough, and you can put that room to a more useful purpose." I ask what more useful purpose is there than to aid in keeping the health of the family. But I am digressing. I hope, however, to have pointed out one preventable cause of frozen pipes."

Many kinds of closets are condemned simply because they have been put up by inexperienced hands, and all the connections are imperfectly done and the materials of an inferior kind. We heartily endorse the recommendation of the writer, that air pipes should be fitted outside of traps. They are the best of safeguards against syphoning, independent of their carrying off foul air as fast as it accumulates. With respect to ventilating into unused chimneys, a down draft seldom occurs if the flue is always open from below, and it may thus often be used to great advantage.

The author has made some excellent remarks on the proper position of sanitary apparatus, as having a good deal to do with their effectiveness, and particularly recommends that closets should always be well lighted. Also, with respect to their ventilation, &c., he writes very strongly.

We conclude these remarks on Mr. Hughes' pamphlet by observing that he deserves the thanks of the community for the pains he has taken to point out, in a very sensible and comprehensible manner, the causes of many of the sanitary evils in cities of the present day, and the way in which they can be so easily avoided.

AN INSPECTOR OF PLUMBING.—The reputable plumbers of the city of Baltimore intend to ask the city council to appoint an inspector of plumbing.

[We hope the plumbers of Montreal will take a hint from the above, and ask for an inspector of plumbing. If the plumber's work was properly performed we should have far less complaints about bad drains.]—ED. S. C. & M. M.

COOLING A JOURNAL.—A very ingenious as well as simple method of cooling a journal, consists in placing an endless belt of loose water-absorbing texture on the shaft, as near the heated part as may be, allowing the lower bight to run in cold water, which may be held in a vessel at a convenient distance below the shaft. In order to bring it to a horizontal position the sheet-iron cylinder is provided with trunnions. A lip of the crucible accurately fits a casting gutter attached to the upper part of the furnace. To provide for the casting form being brought close to the furnace, Piat has mounted it on a carriage. A furnace constructed by Fletcher, similar in its object, has recently been brought out in England by the Patent Plumbago Crucible Company, of Battersea.

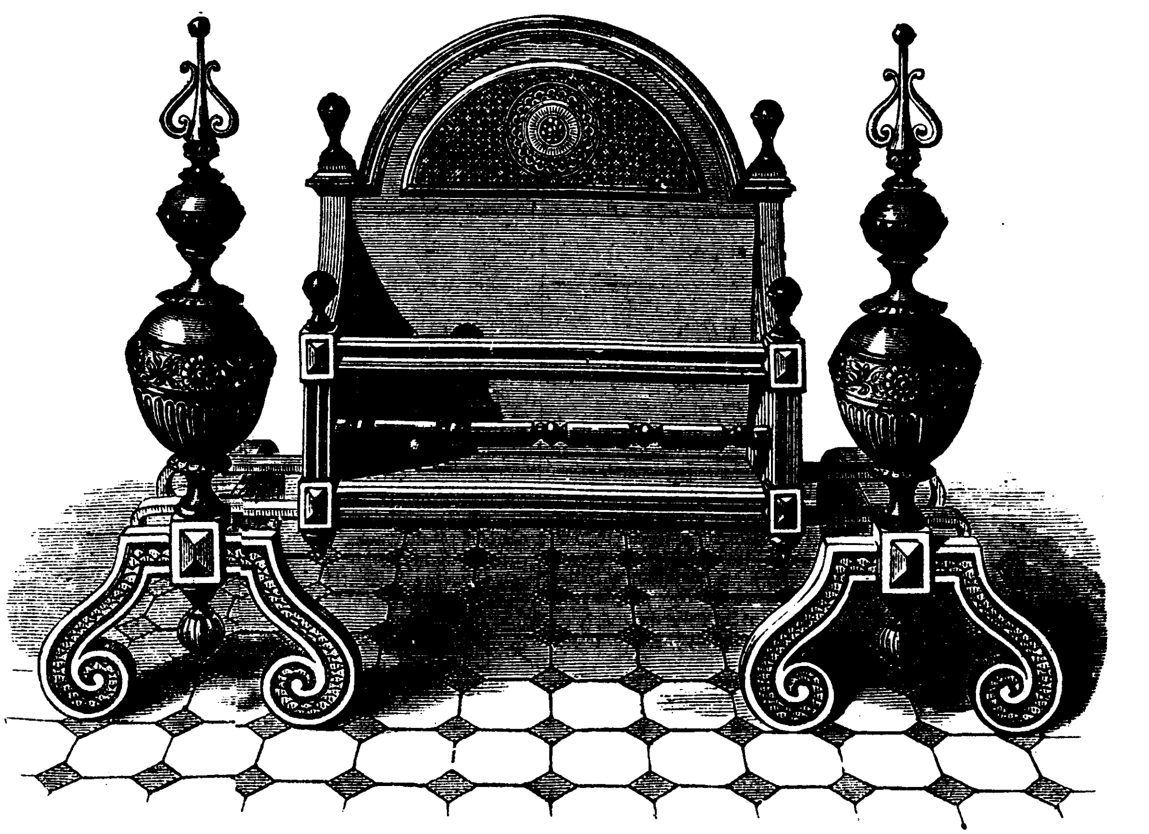
PREVENTION OF INCRUSTATION.—We learn from the *Manufacturer and Builder* that the process of Dr. de Haen for preventing incrustation in steam boilers, consists in the treatment of the feed-water with the proper amount of barid chloride and milk of lime, as determined by quantitative analysis, seems to grow in favour for locomotive and stationary engines, and is to be employed for the 310 boilers of Krupp's steel foundry at Essen.

Horology and Goldsmith's Work.

IMPROVEMENT IN WATCHES.—A notable improvement in watches is reported from Chaux de Fonds, Switzerland. By a peculiar process the figures on the dial are rendered luminous, so that if exposed once during the day to the sunlight they remain phosphorescent and visible throughout the night. According to *Nature*, preparations are being made for the production of these watches on a large scale.

COLOURING GOLD.—In order to colour gold properly you require, in the first place, a circular scratch-brush. This should be mounted in a box lined with zinc. There should be a contrivance for allowing porter to run on to the brush. The porter runs through the bottom of the box, and is poured back for use. The articles to be coloured should be annealed and pickled. The following materials should be put into a crucible with a little water, and placed on the fire. When they are melted and well mixed you can put in the articles to be coloured. They should be attached to a platinum wire, which should be well annealed every time it is used. By the side of the fire have a vessel of boiling water, take out your goods from time to time and examine them, but the moment you take them out dip them for an instant in the hot water, scratch-brush them, and if they are going on all right you may keep them in for half an hour. If there is any silver solder it will get black and dissolve. Gold solder sometimes gets a little black at first, but that comes off. If you wish to remove pewter of tin solder from a coloured gold brooch in order to repair it properly, put it in the colour; that will remove every trace of tin or lead.

ALUMINIUM AND PLATINUM IN WATCHES.—In ordinary watches their correctness depends greatly on their position, whether this be a vertical or horizontal one. The reason is that the more rapidly rotating wheels principally, but more or less all of them, are made of too heavy material. Brass, or a similar composition, is, as a rule, too heavy, and, as an immediate consequence, it will not be immaterial whether a wheel presses with



ELIZABETHAN FIRE-PLACE.

The accompanying engraving represents an Elizabethan fire-place from the factory of Messrs. Barnard, Bishop & Barnard, of Norwich, England. This admirable specimen of ironwork was a part of the furniture of the Elizabethan house placed at the disposal of the Prince of Wales at the Paris Exhibition.

its full weight vertically upon the axis—that is, rests on the point of it—or whether the pressure of its weight is exerted on the circumference of the axis. The latter is naturally the more correct position, insuring a correct, even, and unchanged movement of the watch. Hence the steady desire to keep the watch in an upright position. The influence of changed position, especially of that of the more rapidly rotating wheels, will not be so great if these are made of the lighter aluminium instead of brass. Used for that purpose aluminium constitutes an important improvement, since the position then becomes a matter of no influence on the movement of the watch. The friction, and therefore the wear of the wheels, are reduced, and oiling may be often dispensed with. Platinum, however, by its heaviness, is indicated for the manufacture of balances, as they become thereby more independent of exterior shocks.—*G. F. Reisenbichler.*

Electro-Gilding.—"A gilding solution should always be worked hot." In common with other correspondents I have given this advice time after time, and when I dabbled in gilding a few years since I observed the same routine, following the example of professional gilders. I stated a week or two since that I thought a good deposit could be obtained with a cold solution (that is, at the ordinary temperature). I have to-day tried what a cold solution would do, with a very satisfactory result, and with far less trouble and annoyance than I experienced with what I must term the old method. When using a hot solution I always had a little trouble in getting the bath into working order. One great fault is in the use of too large and too strong a battery. The general run of small articles require a very small and weak battery. I used to-day a Daniel battery, and the articles gilt included brass, silver, and platinum, and a few minutes sufficed to bring them to a splendid colour. The anode was a piece of 16-carat gold, kept under the blow-pipe for about 15 minutes (without borax) in order to discharge as much of the copper as possible—the silver, of course, remaining. This was rolled to 1 in. in length, and about ¼ in. broad, and one of the articles gilt was about six times this size. The bath was made with about 10 grains of chloride of gold dissolved in three-quarters of a pint of ordinary water, and about ½ oz. of cyanide of potassium thrown in. The zinc for the battery measured 3½ in. x 2 in.; this I placed in a flat porous cell, which was then filled with a strong solution of common salt. The copper (an old card plate) was a little larger, and was placed by the side of a porous cell in a solution of sulphate of copper (no acid). Thick copper (bell) wires were soldered to both zinc and copper. The articles should be scratch-brushed with common porter. I find nothing to equal this. A rotary scratching-brush will turn out the best work. The brush should revolve in a zinc-lined box, with a reservoir on the top for the porter, which runs on to the brush from a small India-rubber tube. It escapes from a hole in the bottom of the box, and is then poured back again for use.

Organs and Pianos.

HOW TO KEEP A PIANO IN ORDER.

NOISE IN THE ACTION.

The cure is, as a rule, easily effected, the chief difficulty being to discover the cause. To do this the different parts of the action should be isolated, so as to test from which portion it arises. It will be of some assistance also to notice whether the noise occurs on percussion, or during the simple motion of the mechanism. If the former, it will most likely be caused by a loose lead in either a key, stricker, or damper, a faulty stricker hinge, or a loose hammer stem. Among the latter causes may be enumerated the rubbing of a hammer against the damper wire or of this against a badly clothed socket hole; the accidental introduction also of the smallest particle of paper or shaving between any of the parts will occasionally produce a rattling noise out of all proportion to the cause. It will, indeed, be generally found that the more insignificant this is the harder it will be to discover, so that the most practised hands are sometimes completely puzzled. An amateur need not, therefore, be discouraged if he is not immediately successful.

UNEVEN KEYS,

though they do not affect the tone, have a very unsightly appearance; if below the general level, they may be raised by placing any requisite thickness of paper beneath the centre cloth, or if too high may be lowered by planing the centre of the key. Where the spaces between they keys are not regular, the front key-pin may be slightly bent towards the open side. A tuning-hammer forms a convenient lever for this purpose.

REPAIRING A BROKEN HAMMER STEM.

Where it is impossible this should be spliced and tied round with thread. If the fracture is too short to admit of this, the greatest care must be exercised in boring out the old stem from the hammer-butt; perhaps the best tool for this is a round pointed pen-knife blade. For the new stem any straight grained wood will answer, preferably pencil cedar.

Such further accidents as may possibly occur are too general in their nature to render any special description necessary, and most amateurs will, with occasional practice, become sufficiently familiar with the different parts of the mechanism as to be quite at home with their movements, and able to discover for themselves the cause and remedy of any fault that may need attention. As regards the tuning, so many treatises have been written on this subject that it would be simply wasting the reader's time to attempt any further description of it, and indeed to most, perfect theory would be of small avail without the years of weary practice necessary to strengthen the wrist, so as to obtain complete command of the wrest-pins and be able to attain, without overpassing, the required pitch of the strings, and so avoid unnecessary turning, which would tend both to loosen the pins and render the steel wire very liable to break and go out of tune. This applies, of course, only to the tuning as a whole, and not to the occasional picking up of a bad octave or unison, as this may be performed without fear of injury by any one with a tolerably quick ear (not necessarily musical). Practice of this kind will also have its value in training the ear to a critical appreciation of the finer qualities of tone as well as tune, including a practical acquaintance with pitch. The latter, though a simple acquisition, is of such importance that no one who values the well-being of his piano should be without it.

All modern pianos worthy of the name are made to such a scale that the strings are at their fullest vibration, and consequently the tone is at its best when the instrument is at concert pitch, so that it should never be allowed to go much below that standard. A glance at a few of the "Directions to Tuners" will disclose the anxiety felt by leading makers on that head, though, usually through negligence or ignorance on the part of the owner, it is often not acted up to; and a piano once allowed to get flat has every chance of remaining so—for, under existing circumstances, most tuners are chary of raising a low-pitched piano unless specially requested to do so, well knowing that the tension thus suddenly added to the strings will cause them to go badly out of tune, and that the blame will unjustly be laid to unskilful workmanship on their part instead of where it is really due. Many persons also think or allow themselves to be persuaded that the strings are more liable to break or to go out of tune when they are up to pitch. This is so far from being true that the reverse is the case, for a piano never stands so well in tune as when the wires are evenly-balanced between their elastic and drawing tension, and there are certain notes, especially in piccolo pianos, about the lower middle of the gamut, that—except under these conditions—can never be said to be in tune, as they vary with every change of temperature, and even granting that some of the treble notes are too rusty or rotten to bear this tension, the trifling cost of their renewal is but small compared to the other advantages gained, without counting their increased brilliancy as one of them.

Unfortunately there are pianos that will not bear the strain of concert pitch, though when the immense amount of this is taken into consideration it is much to the credit of the trade that such instances are comparatively rare. They may be divided into two classes:—1st. Those that were never intended to stand at concert, or any other pitch (it does not require much experience to recognise these, especially after a little wear, by the opening of joints and general indications of a rapid break up. 2nd. Fairly well made instruments that through the effects of damp or a want of proper fastenings show signs of such local collapse as the wrest plank or bent side pulling off, the first symptoms of which may be easily detected by one who has made himself familiar with its peculiar idiosyncrasies, and may usually be put right by a few bolts and screws judiciously distributed. But for the former class there can be no remedy, for as soon as one part is strengthened another will be sure to give way, until the cost of repairs exceeds the value of the wreck. Such instruments should, therefore, be promptly got rid of, either by returning them to the vendor, if responsible, or by disposing of them as greater bargains than ever.—*English Mechanic.*

TUNING THE VIOLIN.— Get an "A" tuning fork, not the Philharmonic, but old or lower pitch ; tune your second string to this tone. You are aware that by stopping the string with the first finger a tone higher is produced ; and so again with the second and the third stopping two more higher tones are got. Now, when the fourth finger stops the "A" string "E" is found which is a fifth tone higher than the open string, and is the sound for the first string. But, as you cannot place the fourth finger properly, just lay the finger lightly on the string, then bow, and the harmonic E will guide you. The third finger stops D, and this is the tone for the third string (the thickest of the uncovered gut strings), only an octave lower ; now place the fourth finger harmonically, as above directed, only on the third "D" string, and compare with the second "A." You have now three strings tuned. Proceed with the fourth, or silver string, as recommended for the third, and you will do. After this place the third finger on he E string, and find upper "A" to agree with open "A" string ; then place third finger on "A," and find "D" to agree with open "D" string, then do the same for the last string "G." Understand that the fourth finger placed lightly on a string produces an harmonic fifth, which should agree with the open string next above it. All this, however, is nothing like a good taught ear, which comes in time.

Magnetism.

THE MAGNETISM NEEDLE—CAUSE OF SECULAR VARIATIONS.

BY THOMAS JOB, UTAH ; FROM "VAN NOSTRAND'S MAGAZINE.'

Nearly three centuries ago philosophers observed that the magnetic needle did not always lie in the same direct line, even on the same meridian, but that in the northern hemisphere its north pole has a secular movement around a certain point or pole, not far from the pole of the world ; it points sometimes to the east and at other times to the west of the same meridian, performing the northern half of a revolution in 318 years. "The Earth a Great Magnet" (Prof. A. M. Mayer). A very remarkable phenomenon is observed—it follows the law of a swinging pendulum—retarding in velocity from the meridian of the station to its easterly or westerly tropic.

In the year 1622 the declination of the needle at London was 6° to the east of the geographical meridian. In 1660 the needle pointed due north and south, thus varying 6° in 38 years, while vibrating near the meridian of the place. In 1818 the needle varied, according to Prof. Watts, 24° 36' to the west, and in 1865, 21° 6' west ; that is, varying only 3° 35' in 45 years, when moving near its westerly tropic.

The cause of this secular change in the declination of the compass needle has been a theme of investigation with philosophers ever since its discovery, and in no time more ardently than in our day ; but no satisfaction has yet been given to scientists. All that has been accomplished by observers is to show that the north magnetic pole is now vibrating from west to east, and at London approaching the meridian.

It has been further observed that the magnetic needle, in its grand secular swing, makes some minor vibrations and deflections, some of which appear to follow regular laws and be periodical ; their physical cause is found to be dependent on the sun as primary mover ; others are evidently irregular changes, disturbing more or less the periodical variations.

The most remarkable of the periodical variations is what is called the daily vibration ; it manifests its relation to the sun by following him in his apparent daily motion around the earth, in the northern hemisphere, and during the hours of the day from east to west, and from west to east in the hours of the night ; but the contrary way in the southern hemisphere.

These easterly and westerly variations in all parts of the globe where observations have been made, are obviously governed by distinct laws. The westerly deflections in the British Isles, as represented by the self-moving records of Kew, as Dr. Noades observes, have their chief prevalence from 5 a.m. to 5 p.m., and the easterly deflections during the remaining hours, causing the needle to return to its former position by 5 o'clock the next morning.

The extent of the daily oscillation of the needle is small, and also variable. Its mean value at Philadelphia, as observed by Dr. Bache, is 7·5'. The mean extent of the vibration at any station varies with the daily changes in the sun's declination, and so having semi-annual inequality, being deflected towards the east, and therefore with a negative sign, or less than unity, when the sun is north of the equator ; but towards the west, and consequently more than the mean, when the sun is south of the equator.

The annual variation, independent of the daily, is a very small quantity, amounting, in the British Isles, to only about 59·56 sec., as given by General Sabine, being 28·95 sec., from March 21st to the 21st of September, with the signs minus and plus 29·9 sec., during the remaining six months. It affects in like manner both the northern and southern needles.

The daily variation of the needle also varies with variation in the latitude of the observer ; reckoning from a certain and seemingly fixed line, termed the *magnetic equator*. In fact the needle, in its daily swing, does not play backward and forward, pendulum-like, across the meridian of a station, but virtually its north pole revolves with the sun around the earth—towards the west in the northmen's day, and toward the east in the day of the southern hemisphere. So in the southern hemisphere the motion of the needle appears to be reversed, towards the east in the day time, and towards the west in the night.

The case is also the same with the *secular vibration ;* in the southern hemisphere the needle appears to vibrate in the opposite direction to what it does in the northern.

Only that part of the daily motion in which the needle swings westward belongs to the northern hemisphere ; the same with its corresponding secular vibration ; and that part below the earth, where the needle moves from west to east, represents the secular swing in the southern hemisphere ; even as it is day there when it is night with us, and the positive pole of the needle follows the sun.

Proper investigation will show that this daily vibration is the fundamental cause of both the annular and the secular variations of the magnetic needle.

There are in our common year 366 sidereal days, but only about 365¼ solar days ; that is, while the earth rotates 366 times on its axis, it revolves once in an orbit around the sun in the same direction—from west to east—and thus we have only 365¼ days out of 366 earth rotations ; so the sun appears as if to step backwards—towards the west—from the earth, to the amount of one day's motion in a year. Thus he continues to recede westward from the earth in the northern hemisphere, by the same space, year after year, till he returns again to the starting point in the orbit, where the earth will meet him, after gaining on him one whole revolution. The pole of the magnetic needle, which, as shown above, respects the sun in all its movements, also recedes westwards—in the northern hemisphere—from the meridian of the place by the space of one day's westward swing in a solar year. From this point of view one can clearly discern, what our theory admits, that the magnetic equator of a planet lies direct in the plane of the equator of the sun ; hence, in the case of our earth, it inclines to the ecliptic, according to Dr. Herschel, by the angle of 7° 20'. But the axis of the ecliptic inclines to that of the earth's equator by the angle of 23° 27 nearly, from which take the angle 7° 20', and there remains 16° 7' for the inclination of the earth's equator to that of the sun, which is the very degree given by Dr. Mayor as the mean inclination of the magnetic equator to the terrestrial, as found on actual observations.

Now, it is evident that the magnetic meridian which passes through the node or point of intersection of these two equators is at right angles with the magnetic equator, and consequently inclines to the true meridian at that point by the same angle of 16° 7'. When the needle in its secular swing comes to this meridian—which I shall term the *prime*—the rate per year of declination should be of the greatest value, and its tropics, east and west, should decline from it by the same angle of 16° nearly.

Next I shall inquire as to whether this accords with the observations already made by scientists. The following table gives the declination of the compass needle at London with the mean rate of its motion as referred to periods of observation between 1580 to 1865, comprising a part of an easterly half, the whole of the westerly, and a part of the next westerly half vibration. (Sir Wm. S. Harris's Rudiments of Magnetism. Dr. Woad's Ed. page 258 ; also Dr. Lloyd of Dublin.)

EASTERLY DECLINATION.

Years of observation - - - -	1580	1622	1660
Declination - - - - - -	11° 5'	6° 0'	0° 0'
Rate per year of declination - -	0° 7'	0° 8'	0° 10'

WESTERLY DECLINATION.

Years	1692	1723	1730	1765	1818	1852	1865
Decl.	6° 0	8° 36'	13° 0'	20° 0'	24° 36'	22° 30'	20° 44'
R. p. Y.	11·	11·7'	11·5'	0·9'	0·0'	0·5'	0·7'

Here we see that the rate per year of the variation was greatest about 1723, the time the declination at London was 8 ° 36', that the tropic was reached in 1818, when the rate per year was zero and the declination from London 24 ° 36' or about 16 ° from the point where the rate per year was the greatest, or the node of the two equators.

Now, this prime meridian, or that which lies in the plane of the sun's axis, and intersects the two equators at their nodes, must become an important line in terrestrial magnetism, for when the horizontal magnet, on its secular swing, passes over it, it is then at its greatest amplitude, or most distant point from its tropics, its rate per year the swiftest, and the daily vibration of the greatest value ; and the nearer a station is to this line on the same magnetic latitude, the greatest in proportion is the visible range of its daily vibration.

And even this is not all. When the dipping needle, in its secular vibration, comes to this line, it is always in one of its tropics. This is, as I shall soon prove, the very line of its apsides.

I have now arrived at my evidence that the magnetic equator of the earth lies in the plane of the equator of the sun, and since the magnetic pole revolves about that of the earth, it is plain that the magnetic meridian cannot, in all places and at all times, cut the magnetic equator at right angles ; it can only do so at that place called the nodes of the two equators.

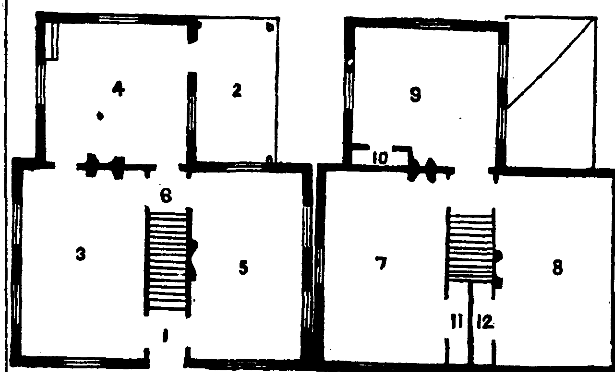
Sir Wm. Snow Harris, in the volume just alluded to, observes that the oscillation of the needle across the true meridian is variable, that the limit of its angular variation at London is 34 ° 36'. It seems that he also understood that the limit is not of that amount at all places, that it is only so at London, and those places under the same meridian. In fact, this angular variation at any station depends on the distance of its meridian from the prime meridian— the difference of its declination at London from the prime meridian is 8 ° 36', which added to 16 ° gives 24 ° 36', the observed angular variations of the needle at London, when it arrives at its westerly station where the variation rate per year is zero.

I further discovered that the extent of the mean yearly vibration at any station is equal to the daily vibration at the time the needle comes to the prime meridian. The rate of the vibration at any station evidently increases or decreases with the rate per year at which the needle moves in that declination, which is as the square root of the declination itself ; both the rate per year and the extent of the swing is evidently greater in the plane of the prime meridian, even as the magnetic intensity is greater in the solar axis.

THE OPEN POLAR SEA.

The San Francisco *Chronicle* says :—Capt. Barker, who was in command of the whaler "Japan" when she was lost, in the fall of 1870, told a *Chronicle* reporter that from his own observations he was a believer in an open Polar Sea. Capt. Barker is a man of more than ordinary intelligence and evidently a close observer. The "Japan" went ashore just off East Cape, while he was trying to beat out of Behring Strait, and he was obliged to winter among the natives with his crew, and was not rescued until the return of the whaling fleet in 1871. He says that early in February the current began to set very strongly to the north, and took the ice from the shore far out to sea, in a northerly direction. Soon after this, while hunting on top of the mountains along the coast, he heard distinctly the voice of the surf breaking far to the northward. In that atmosphere a noise of any kind can be heard a long distance, and to a nautical ear the sound of breaking surf can never be misunderstood. Captain Barker says that the natives with whom he remained during the winter have a legend to the effect that many years ago a colony of their tribe went over to Wrangel Land, and have never returned. He has been close enough to the latter coast to see vegetation upon the mountain side, and the natives claim that they used formerly to cut trees there. Capt. Barker has great faith that the "Jeannette" will solve the Polar problem. Capt. Lewis Williams, of Oakland, another whaling captain, also contributed some valuable information regarding Wrangel's Land. He had been along its coast as high as 75 ° north latitude and stated that north-east from Herald Island, which is the direction in which the coast of Wrangel's Land extends, there is a deep, canal-like passage, through which the current flows rapidly to the north. He believes that vegetation and a comparatively mild climate will be found on the west coast of this *terra incognito*. All the facts gathered in regard to this subject are of interest, and cannot fail to be of value to the explorer of the future.

A CHEAP ORNAMENTAL COTTAGE.



First Floor. Second Floor.

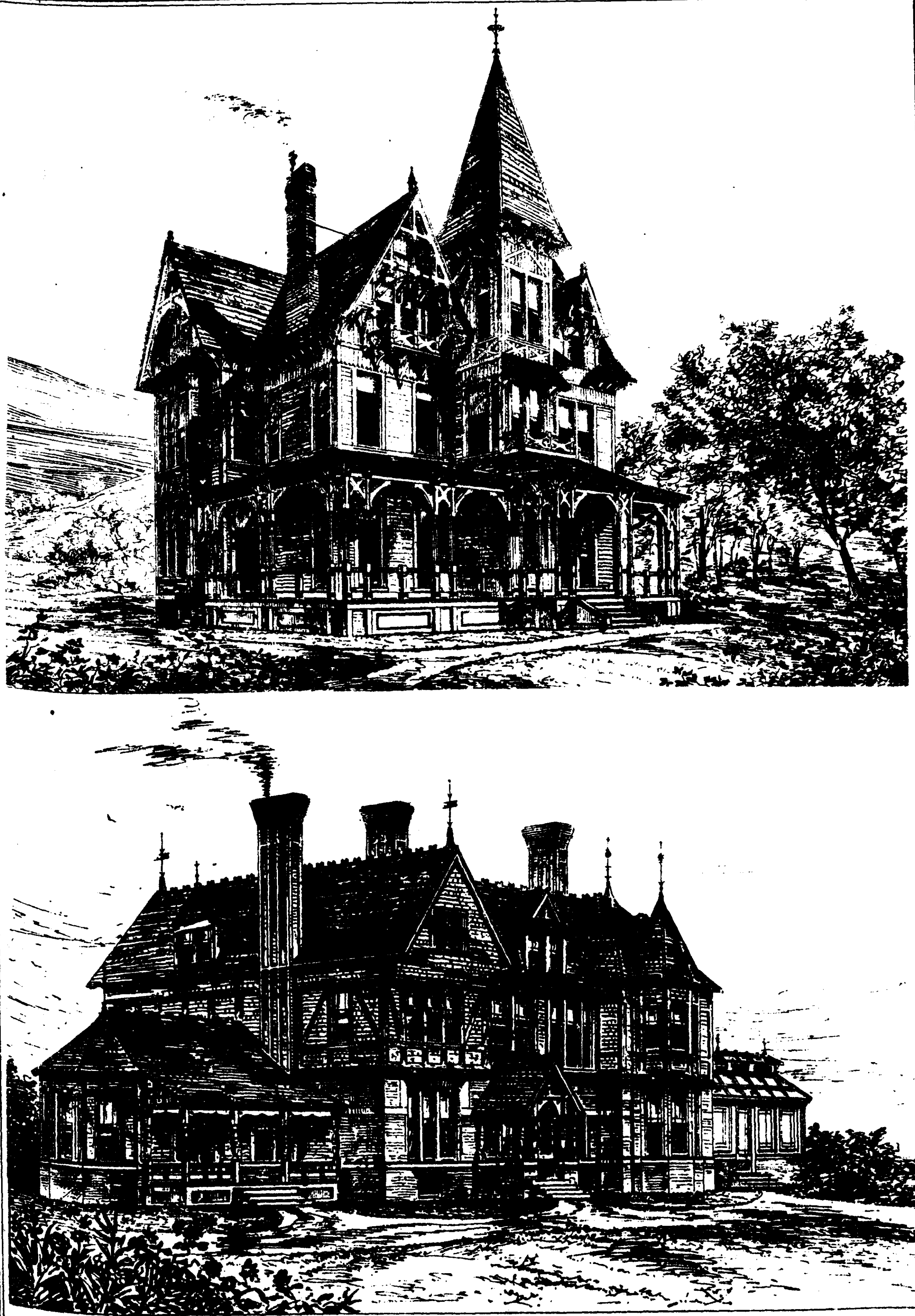
A COSY COTTAGE HOME.

We give on this page a view and floor plans of a cosy cottage, which we copy from the *Scientific and Mining Press*, and which some of our beginners in the art of home making, or some of our more advanced readers who have small families, may find adapted to their requirements. It is a pretty little dwelling. It looks rather bare in the engraving perhaps, but with barn behind it, and with the fore-ground nicely laid out and planted more freely with shrubs and flowers, it would soon grow into a little gem of a home. The design is drawn to aid those who have not the money to build large or more ornate dwellings, and it could be erected and finished for about $1,000.

The cottage contains three rooms upon the first floor, a parlor, a dining-room and a kitchen, and there are three chambers with closets upon the second floor. The roof is so constructed as to admit circulation of air between the rooms. Above the ceiling of the upper floor there is an air chamber with ventilators in each gable. This helps to cool the upper rooms by allowing the passage of air beneath the roof while the hot sunshine is beating down upon it. The cottage is to be built of wood and to have a shingled roof.

The following explanation interprets the numbers upon the engravings, and gives the dimensions of the rooms : 1, vestibule, 3½ ft. wide by 4½ ft. long ; 3, parlor, 12 by 18 ft. in clear ; 5, living room, 12 by 18 ft. ; 4, kitchen, 15 by 18 ft. ; 2, back porch, 8 feet long by 15 feet wide ; 6, a small entry, affording entrance to the living room, parlor, and to the stairway leading to the cellar. The second floor rooms are all private and are entered from the little landing at the head of the stairs. Nos. 7, 8 and 9 are the chambers ; 10, 11 and 12 are closets, one to each room.

It will be seen that the little building has no waste room, but gives the inmates the full benefit of all the space. Although it is small the rooms are of good size. The style is unpretentious, but it will hold a happy wife and babies and afford a spare room for a nice mother-in-law, and what more does a man need, anyway ?



DESIGNS FOR COUNTRY HOUSES.—From *The American Architect and Building News.*

Scientific.

IMPROVED COPYING PENCILS.

Pencils made to produce marks from which copies can be obtained in an ordinary copying press, have usually the disadvantage that, consisting mainly of aniline, the colour of the copy faded very soon. Gustav Schwanbauser overcomes this difficulty by doing away with aniline altogether. He prepares the pencils as follows :— 101 lb. of the best logwood are boiled repeatedly with 100 lb. of water, and the decoction so obtained is evaporated down to 10 lb. The liquid is heated to the boiling point, and small quantities of the nitrate of oxide of chromium added, till the bronze-coloured precipitate formed at first is redissolved in a deep dark blue colour. The liquid is now evaporated to the consistency of a syrup, and the finest levigated fat clay is added in the proportion of 1 part of clay for every 3 or 3½ parts of the extract. To form a good mass to manipulate, a little mucilage of gum tragacanth may be used. The quantity of nitrate of chromium must be in the right proportion to the extract, as a surplus prevents an easy writing, and a deficiency prevents the easy solubility of the mass for copying purposes. No other salt of chromium will answer the purpose, as they all crystallise, and the crystals formed in the mass will cause the pencil to be rough and brittle. Nitrate of chromium does not crystallise ; its combination with the extract of logwood is the most easily soluble and the blackest ink. The nitrate is prepared as follows :—20 lb. of chrome-alum are dissolved in 200 lb. of boiling water. To the solution is gradually added a solution of carbonate of sodium of the same strength, till all the hydrated oxide of chromium has been precipitated. After subsidation of the precipitate the supernatant liquid is decanted and the precipitate washed with distilled water, till the filtrate does not contain any more traces of sulphate of kalium and sodium, as may be shown by the addition of a little solution of chloride of barium. To the precipitate collected on the filter are successively added small portions of heated pure nitric acid, previously diluted by its own volume of distilled water, in such quantity that on boiling a small quantity of the hydrated oxide remains undissolved. In this way a perfectly saturated solution of nitrated oxide of chromium is obtained, containing no excess of nitric acid. This is a great advantage, since an addition of nitric acid to the ink changes its colour to a muddy red. Another advantage is, that no basic nitrate is formed, and no excess of hydrated oxide is contained in the produced salt, as is the case in most other salts of chromium. Such basic salts form an insoluble compound with the extract of logwood, instead of entering into solution. The writing furnished by these pencils is easily transferable ; it is of a penetrating jet black colour. Alkalies and acids are without any effect on the ink.

THE TELEMACHON. — American newspapers state that "at Ansonia, Conn., Wm. Wallace is experimenting with a new electrical machine. He calls it the telemachon, and claims that by it, when perfected, power can be transmitted hundreds of miles through an ordinary cable. For instance, a steam-engine in Scranton, Penn., could be connected by cable with a factory in New York, and the latter be run for the cost of the cable and the greatly decreased cost of coal in Scranton. With this new invention working as it is claimed it will, the cities near the coal mines would become vast centres of power filled with engines sufficient to run all the factories of the Middle States at one-half the present cost of fuel. Mills would be filled with whirring spindles and rattling looms hundreds of miles away from the engines that run them. Only a small wire cable entering a building would show the source, though hardly the philosophy, of the transmitted force. The possibilities of the invention go further. The cable can be tapped like a telegraph wire, so that one continuous cable can do the whole work of the country, provided there is power enough at the starting point. These are the possibilities of the telemachon as developed by Wallace. But Edison has been down to Ansonia and discovered still greater possibilities. He is confident that not only can power be transmitted by the telemachon, but that light and heat can be created by it. This would do away with the use of coal almost entirely. Great mills could be run by Niagara through the instrumentality of the telemachon, and lighted and heated by the instrument itself."

THE American journals have referred to three systems for the cure of yellow fever. First, a Mr. Hard, of Florida, supposes that discharges of artillery in infected places during the night, when the germs are in the air, arrest the fever, and he himself engages to stop it in any town in forty-eight hours. He considers that the sulphurous acid developed by combustion of gunpowder is an important means of purifying the air, and he advises burning about a teaspoonful of powder in all occupied rooms where yellow fever prevails. Next, a captain of a merchant vessel reports that he visited Cuba when it was wasted by the fever, and that his men escaped, though they had no other preservative than a large quantity of guano in the ship. This guano seems to have warded off the disease. Lastly, it is said that Dr. Humboldt, nephew of the eminent naturalist, has, in his practice at Havana, found the poison of the scorpion a remedy against yellow fever. Of 2,478 men of the garrison inoculated with this poison, only 676 were attacked, and of this number only 16 died.

BRAIN POISONED BY TOBACCO.— A peculiar case of menta hallucination has just appeared in Battle Creek, Mich., in the person of a young man about 18 or 20 years old. He is a cigar-maker by trade, and has been in the habit of smoking from 10 to 30 "green" cigars daily. He has not drank liquor sufficient to produce delerium, and yet he is a raving lunatic, and suffers all the horrible phantasmagoria that pertain to the fully developed tremens. He has worked in and used tobacco ever since early boyhood. Of late years he had used it extensively, principally in strong cigars ; and it is supposed that the nicotine has so poisoned and shattered his mind as to partly paralyze it, thus producing the disorder. He has been taken to the insane asylum at Kalamazoo for treatment.

THE MICROSCOPICAL STRUCTURE OF SPIEGELEISEN.—An interesting inquiry into the microscopic structure of spiegeleisen, by Herr Martens, appears in the November number of the *Zeitsch, des Ver. Deut. Ing.* He states that spiegeleisen consists of a mechanical mixture of the chemical combination between iron and carbon, and of iron without chemically combined carbon ; and he finds that the two constituents of this mixture are placed together regularly, and according to determinable laws, the former constituent crystalling after the rhombic system, the latter after the quadratic system. The individual constituents assume the tempering colors at different rates, and so they can be sharply and distinctly recognized in grindings.

NEW MODE OF DETERMINING MOLECULAR WEIGHT.—In the course of some recent experiments M. Naumann has discovered indications of a new method of determination of molecular weight, which is specially applicable to substances which, in the pure state, are not volatile without decomposition. In studying the distillation of liquids, which cannot be mixed with water, by a current of aqueous vapor at constant boiling temperature, he has found that the quantities of two liquids passed in distillation and estimated in molecular weights, are in the same ratio to each other as the tensions of vapor of these liquids measured at the constant temperature at which distillation is effected.

TINTED PAPER.—Tinted paper may be prepared in any desirable shade as follows : 1 gm. of any aniline color is dissolved in 30 gms. of strong alcohol, 300 gms. of distilled water are added, and finally a solution of 1½ gms. of tannin in 15 gms. of alcohol. The tannin acts as a mordant. Moderately sized white paper is spread on a marble slab, or other smooth, hard surface, and the coloring liquid is applied in even horizontal lines by means of a small sponge. The paper is then hung up to dry, and may be covered after a few days with a concentrated solution of sodium silicate, to every 100 parts of which 10 parts of glycerin have been added, if it is desired to impart to it a gloss.

A CHEAP and simple way of protecting houses from the effects of lightning is reported to have been recently made in France. It consists merely in bundles of straw attached to sticks or broom-handles and placed on the roofs of houses in an upright position. The first trials of this simple apparatus were made at Tarbes (Haute-Pyrénées) by some intelligent agriculturists, and the results were so satisfactory that afterward eighteen communes of the Tarbes district provided all their houses with these bundles of straw, and there have been no accidents from lightning since in the district.

A NEW MODE FOR OBTAINING HYDROGEN.—Fire is generally used for producing hydrogen on a large scale ; but recently a new method has been suggested by Dr. Kollman of the Berlin School of Mines. He states that the gas can be easily produced and at a lower price from ferro-manganese by treating it with sulphuric acid.

THE POPULATION OF THE WORLD.

According to Behm & Wagner's "Bevolkerung der Erde," a very reliable statistical table of the population of the earth, the following are the latest figures that have been obtained relative to the countries of Europe, Asia, and Australia :—

EUROPE.

Germany, 1875	42,727,300
Austria-Hungary, 1876	37,350,090
Liechtenstein, 1876	8,664
Switzerland, 1876	2,759,854
Netherlands, 1876	3,865,456
Luxemburg, 1875	205,158
European Russia, 1872	72,392,770
Finland, 1875	1,912,647
Sweden, 1876	4,429,713
Norway, 1875	1,807,555
Denmark, 1876	1,903,000
Belgium, 1876	5,336,185
France, 1876	36,905,788
Great Britain, 1878	34,242,966
Faroes, 1876	10,600
Iceland, 1876	71,300
Spain (without Canaries) 1871	16,526,511
Andorra	12,000
Gibraltar, 1873	5,143
Portugal (with Azores), 1875	4,319,284
Italy, 1876	27,769,475
European Turkey (before division)	9,573,000
Roumania, 1873	5,073,000
Servia, 1876	1,366,923
Montenegro	185,000
Greece, 1870	1,457,604
Malta, 1873	145,604

ASIA.

Siberia, 1873	3,440,362
Russian Central Asia	4,505,876
Turcoman Region	175,000
Khiva	700,000
Bokhara	2,030,000
Karategin	100,000
Caucasia, 1876	5,391,744
Asiatic Turkey	17,880,000
Samos, 1877	35,878
Arabia (Independent)	3,700,000
Aden, 1872	22,707
Persia	6,000,000
Afghanistan	4,000,000
Kafiristan	300,000
Beloochistan	350,000
China Proper	405,000,000
Chinese border-lands, including Eastern Turkistan and Djungaria	29,580,000
Hong Kong, 1876	139,144
Macoa, 1871	71,834
Japan, 1874	33,623,373
British India within British Burmah, 1872	188,421,264
Native States	48,110,200
Himilaya States	3,300,000
French Settlements, 1875	271,460
Portuguese Settlements	444,617
Ceylon, 1875	2,459,542
Laccadives and Maldives	156,800
British Burmah, 1871	2,747,148
Manipur	126,000
Burmah	4,000,000
Siam	5,750,000
Annani	21,000,000
French Cochin China, 1875	1,600,000
Cambodia	880,000
Malacca (Independent)	209,000
Straits Settlements	308,097
East India Islands	34,051,900

AUSTRALIA, ETC.

New South Wales, 1876	630,843
Victoria, 1876	841,968
South Australia, 1876	229,630
Queensland, 1876	187,100
West Australia, 1876	27,321
Tasmania, 1876	105,484
New Zealand and Chatham, 1876	444,545
Rest of Polynesia	1,899,090

The total population of Europe is set down at 312,398,480 ; Asia, 831,000,000 ; Africa, 205,219,500 ; Australia and Polynesia, 4,411,300 ; America, 86,116,000.

AN INSOLUBLE CEMENT.

A very valuable cement has been discovered by Mr. A. C. Fox of which details are published in *Dingler's Polytechnisches Journal*. It consists of a chromium preparation and isinglass, and forms a solid cement, which is not only insoluble in hot and cold water, but even in steam, while neither acids nor alkalies have any action upon it. The chromium preparation and the isinglass or gelatin do not come into contact until the moment the cement is desired, and when applied to adhesive envelopes, for which the author holds it to be especially adapted, the one material is put on the envelope covered by the flap (and therefore not touched by the tongue), while the isinglass, dissolved in acetic acid, is applied under the flap. The chromium preparation is made by dissolving crystallized chromic acid in water. You take :

Crystallized chromic acid	2·5	grammes.
Water	15	"
Ammonia	15	"

To this solution about 10 drops of sulphuric acid are added, and finally 30 grammes of sulphate of ammonia and 4 grammes of fine white paper. In the case of envelopes, this is applied to that portion lying under the flap, while a solution prepared by dissolving isinglass in dilute acetic acid (1 part acid to 7 parts water) is applied to the flap of the envelope. The latter is moistened, and then is pressed down upon the chromic preparation, when the two unite, forming, as we have said, a firm and insoluble cement.

SPONTANEOUS COMBUSTION.

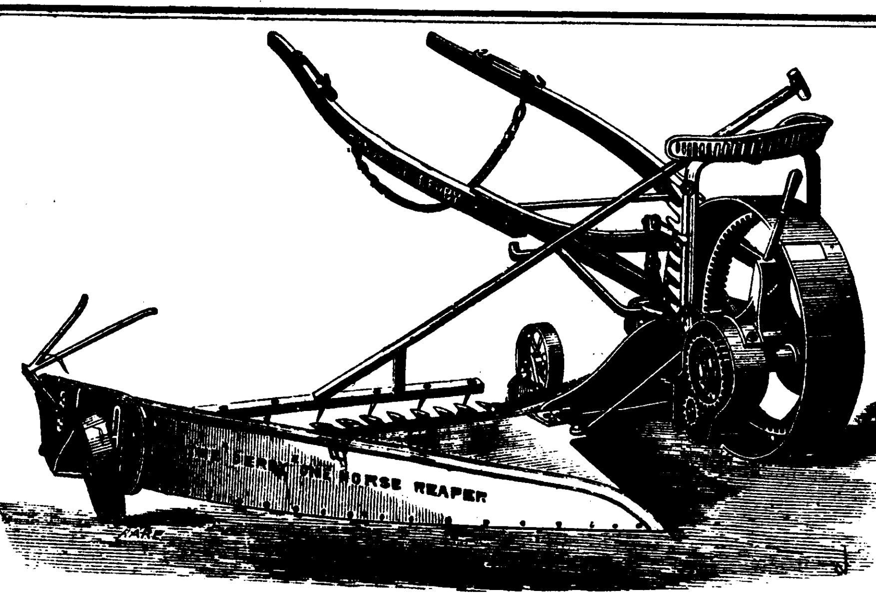
A lot of paper rags hung in a tight closet, or piled in a store where there is no ventilation, will sooner or later start a fire. There are dealers who know this, and would as soon think of throwing a lighted match into cotton-batting as of closing the storage-room against ventilation. The lower sash of at least one window should be taken out during the summer, and it would be better to have an opposite one raised a few inches, so as to secure a strong draught. A few months since some oiled rags in the basement of a Detroit picture store took fire on a hot Sunday morning and called out the fire department, although one of the basement windows was open for ventilation. It was through this window that the smoke poured and gave fire alarm.

At the Detroit House of Correction, in December, 1870, one of the prisoners employed in the chair-finishing room piled up a bundle of oiled rags in the corner as the bell rang for close of working hours, and at eight o'clock, only two hours, the shop was fired by spontaneous combustion, and several thousand dollars damage done. The room was close, contained many chairs just finished, and as soon as the rags were piled and packed together the foundation was laid for a destructive conflagration.

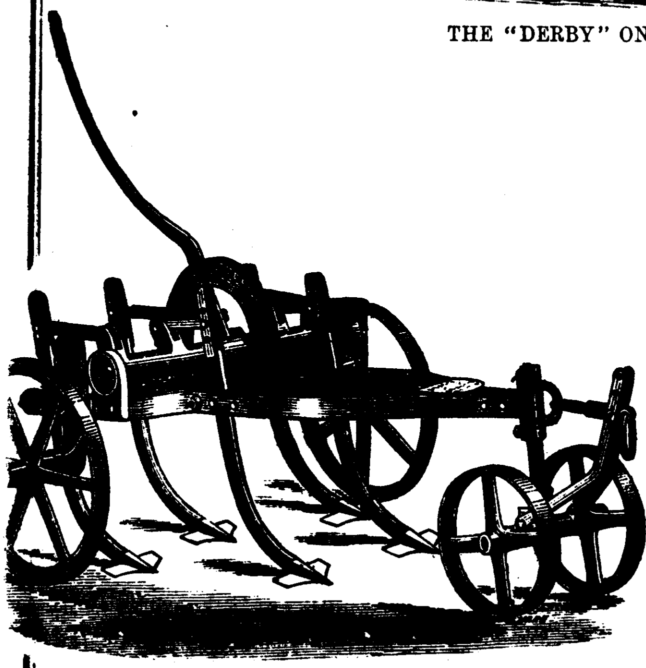
The Detroit Car and Manufacturing Works, during a period of three years, had three fires from spontaneous combustion, each fire being traced to oil rags. That establishment is now provided with iron boxes for storage of rags, and on one occasion a fire took place in one of these boxes, the result of spontaneous combustion, and burned up all the rags.

About two years ago one winter evening, the watchman at the Michigan Central Railroad car shops, located a short distance below the company's passenger depot in the city of Detroit, passed through the pattern and wood shop, and found everything quiet and safe. Fifteen minutes later he was alarmed by the smell of smoke, and while mounting the stairs leading to the second story of the shop the flames burst out in one end, and the entire shop was destroyed within an hour. A pattern-maker had used some oil and a rag just before six o'clock to oil a pattern just finished, and he had probably flung the rag among the shavings. There was no stove in that end of the shop, smoking was prohibited, and no one had a doubt that the conflagration was brought about through the medium of that oiled rag.

AN Evener, provided with rubber blocks placed in recesses for clevis and hammer bolts to rest against, has been patented by Mr. M. O. Smith, of Chenango Forks, N. Y.



THE "DERBY" ONE-HORSE REAPER.



PATENT DOUBLE FOUR-WHEELED CULTIVATOR.

Agricultural Implements.

THE DERBY ONE-HORSE REAPER.

Messrs. A. Handyside & Co. (Limited), of the Britannia Iron-works, Derby, England, exhibited several of their new mowing and reaping machines constructed on Phillips' patent principle. One of the most noteworthy of these is Phillips' Patent One-horse "Derby" Reaper, with manual side-delivery platform, which we illustrate. We need hardly say that the application of a platform to a reaper is in itself not new, but the adaptation of a light platform to a purely one-horse reaper, gives special advantages which the patentee claims for this machine. The fact that the track for one-horse need not be so wide as for a pair, makes the labour but little in excess of that of working the ordinary back delivery reaper, to bring the sheaf to the side so as to leave a clearance for the horse to pass round without the necessity for the sheaves having to be bound up, which is the case with the ordinary back delivery reaper. Machines of this kind are very desirable upon light sandy soils, and in wet weather when the land is sodden, the power required to drive the rakes and knife together, as in the self-acting machines. The one-horse "Derby" reaper supplies a want in a way which many farmers are likely to appreciate, especially in these times when economy in the first cost and efficiency in after use must be considered in the selection of farm implements of every kind. A handy little treadle grinder for grinding reaper and mower knives, and applicable to general purposes, was also shown on this stand.

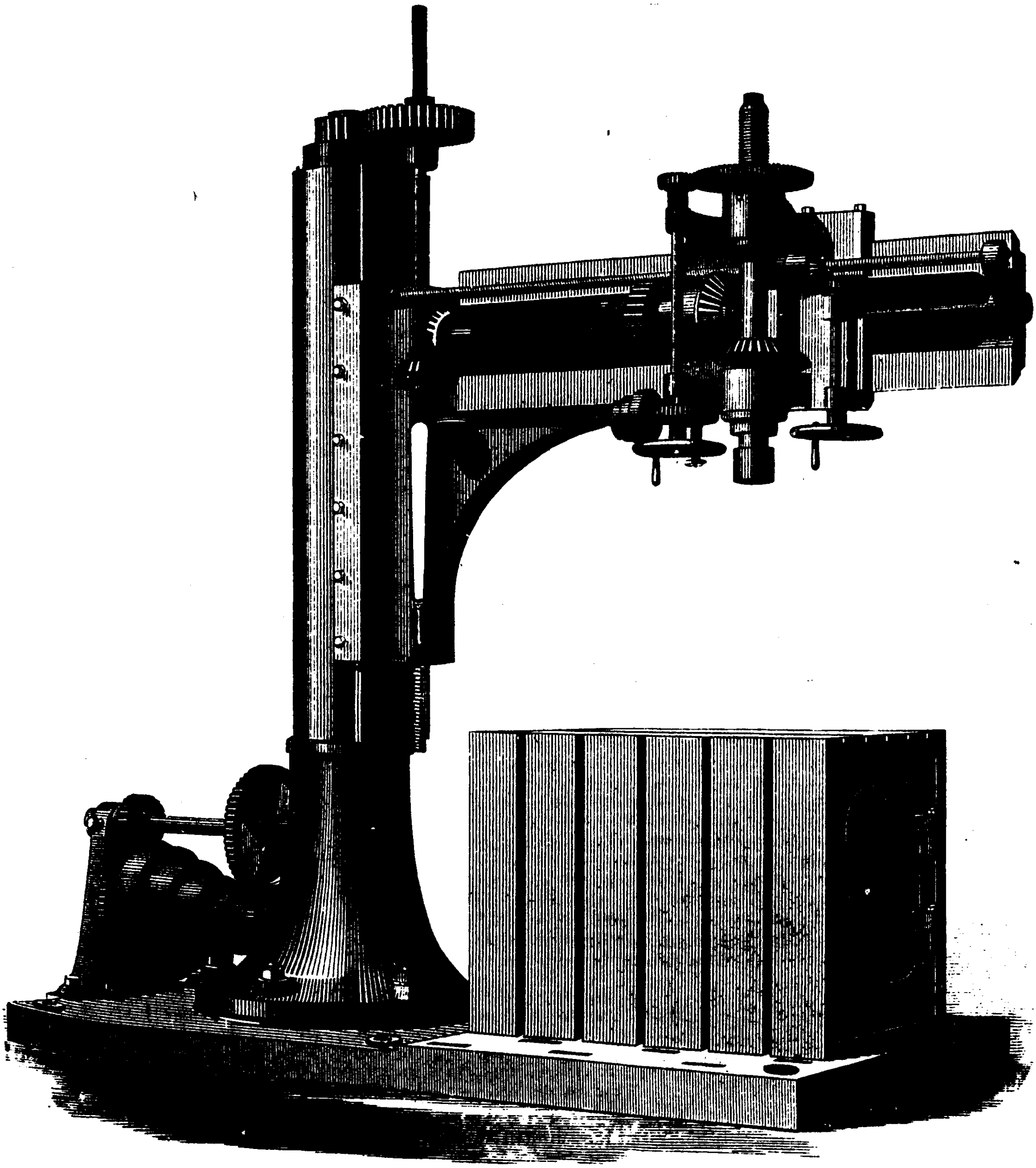
NEW PATENT DOUBLE FRONT WHEEL CULTIVATOR.

AGRICULTURAL IMPLEMENTS AND MACHINERY DISPLAYED AT THE SMITHFIELD SHOW.

Messrs. Coleman & Morton, of Chelmsford, have long been celebrated for their cultivators, and they have now introduced a new patent arrangement for the front wheels, which materially adds to their steadiness and durability. Our illustration shows the machine right for work. It will be seen that in place of the single wheel and span iron, or crotch, which support the fore part of the implement, there are a pair of wheels, one of which is pinned to a steel axle, the other being loose. The axle is thus made to revolve in a suitable bearing of considerable length, entirely preventing any wear in the bosses of the wheels, and giving great steadiness to the implement. This arrangement also considerably lightens the draught, which in any case where a fair test has been applied, has proved lighter than any cultivator capable of doing the same work.

Staining Floors.—The London *Furniture Gazette* commends the following method of staining floors in oak or walnut colours: Put 1 oz. Vandyke brown in oil, 3 ozs. pearlash, and 2 drachms dragon's blood, into an earthenware pan or large pitcher; pour on the mixture 1 quart of boiling water; stir with a piece of wood. The stain may be used hot or cold. The boards should be smoothed with a plane and glass-papered; fill up the cracks with plaster of Paris; take a stiff brush, dip in the stain, and rub this in well; the brush should not be rubbed across the boards, but lengthwise. Only a small piece should be done at a time. By rubbing in one place more than another an appearance of oak or walnut is more apparent; when quite dry the boards should be sized with glue size, made by boiling glue in water, and brushing it in the boards hot. When this is dry the boards should be papered smooth and varnished with brown hard varnish or oak varnish; the brown hard varnish will wear better and dry quicker; it should be thinned with a little French polish, and laid on the boards with a smooth brush.

Making Plaster Set Quickly or Slowly.—In order to make plaster set quickly, mix it with warm water into which a little sulphate of potash has been dissolved. To make it set slowly, mix it with fine slacked lime. The time of setting may be regulated by changing the relative quantities.



ENGLISH RADIAL DRILLING MACHINE.

RADIAL DRILLING MACHINE.

In the annexed engraving is shown a double-geared independent radial drilling and boring machine, exhibited at Paris by Messrs. Sharp, Stewart & Co., of Manchester, England. The machine is provided with a prolonged base plate, which carries the main standard and outer bearing for the double gear, and which is also planed to receive large articles. The table is movable, and is, when required, mounted on the base plate, as shown, so that small objects may be readily and accurately set and fixed to it. The table forms a cupboard for drills, etc. The radial arm which carries the drill spindle swings through an arc of 280°, while radially the spindle can be adjusted from a radius of 2 feet 7 inches to one of 6 feet. The shifting of the spindle carriage on the radial arm is effected by a hand wheel close to the spindle itself, so that the man in charge of the machine can make the adjustment while keeping his eye on the drill. The radial arm is also adjustable vertically by either hand or power, so as to enable the machine to take in objects from 4 feet to 6 feet in height. *Engineering*, to which we are indebted for the illustration, speaks highly of the workmanship of all the parts.

ARTIST'S CANVAS.—The raw canvas must be stretched on a frame, wetted, and restretched if loosened by wetting, and coated with a mixture of equal parts of dry whiting and white lead, ground up with raw and boiled linseed oil, and laid on with a trowel like a plasterer's trowel, but longer and tinner in the blade. If the canvas shows through the first coat, a second and a third may be applied, the under coats being rubbed down with pumice stone. A little raw umber may be added if a stone-coloured surface is preferred. The use of the trowel, of course, requires the dexterity acquired by long practice.

Painter's Work.

ROOM DECORATION.

BY WILLIAM HODGSON.

I am not astonished at the fact that many persons have grey and white drawing-rooms, when I think of the hideous effects sometimes shown me as decorations, where perhaps a pale emerald green, a grey and a ghastly pink—the very pink that will not harmonize with the crude green in question—are the colors employed. The hideousness of some decorations, so called, is beyond expression, and white walls are infinitely preferable to such.

A *dining-room* we generally make rather dark; citrine, or blue of medium depth, and with greyish hue, looks well for the walls of a dining-room, and a maroon dado is very suitable. The emblems of the feast—fish, birds, and beasts—may sometimes be incorporated with the decoration of a dining-room with advantage. The effect of lightness is usually given to drawing-rooms. I think we generally make these rooms too light; we give to them a coldness which is freezing, rather than that depth of tint which gives a snugness, and that cheerfulness which promotes conversation. Furniture cannot look well against a very light wall, and against this as a background every object seems cut out with offensive sharpness and hardness.

Bedrooms are wrongly made very light. The decorations of a bedroom should be soothing. In the hour of sickness we all feel this—it is not whiteness to dazzle that we want, it is that which is soothing and which conduces to rest. There must be an absence of spots or specially attractive features from all good decoration, but in a bedroom this is especially necessary.

A *smoking-room*, or "sanctum," is the one room where we may indulge in the grotesque and humerous, but the grotesque must always be clever and vigorous.

In these days of competition, when the brain is ever active, and the nerve force is kept for many hours together in constant play, it is peculiarly desirable that our rooms be soothing in effect and snug in appearance. If special richness is to be indulged in, bestow it upon the library.

ON THE WOOD-WORK OF ROOMS.

If the wood-work of a room is simply varnished, or stained and varnished, then the decoration of the walls and ceiling must harmonise with it, for it is a tint we cannot alter: if, however, it is painted, then it can be colored as may be required. Whatever acts as a frame to something else is better darker than that which it frames, or in some way stronger in effect. A cornice, as the frame of a ceiling, should be stronger in effect than the ceiling; in like manner a skirting which frames the floor should always be dark. I have never yet seen a room which was altogether satisfying to the eye where the skirting was light. I often make the skirting black, but in this case I generally varnish the greater portion of it, yet leave parts "dead," thus getting a contrast between a bright and dead surface. I sometimes run a few lines of color upon its mouldings, but I never in any way ornament it. It should be retiring yet bold in effect; hence its treatment must be simple. If not black it may be brown, rich maroon, dull blue, or bronze green. A dark color gives the idea of strength; that portion of a wall on which weight appears especially to rest should be dark.

I like to see the wood-work of a room generally of darker tint than the walls. A door should always be conspicuous. I find that a room almost invariably looks better when the doors are darker than the walls, and the advantage of dark architraves must be obvious to all who have tried them. A door should rarely, if ever, be of the color of the wall, even if of darker tint; this is a resort of those who cannot form a harmony with the wall color. If a wall is citrine the door may be dark, low-toned Antwerp blue, or it may be of dark bronze green, but in this latter case a line of red should be run round the inside of the architrave. If the wall is blue a dark orange-green will do well for the door, but a line of red round the door will improve it, or the door may be an orange-maroon. If the wall is bright turquoise in color the door may be indian-red (vermillion brought to a beautiful tertiary shade with ultramarine). These are mere illustrations of numerous harmonious combinations which may be made, but they serve to show my meaning.

The architraves of doors may often be varnished black, or consist in part of bright and in part of "dead" black; if the architraves of doors are black, one or two lines of color may be run upon them. If the lines are very narrow, say 1-16 in. in width, they may be of the lightest colors; if broad, say ⅜ in., they should be much subdued in tone, and hardly brighter in tint than the color of the wall. I rarely find it necessary to decorate the panels of doors and shutters, and I never place ornaments on the "styles." If an ornament is placed on a panel it is better quaint or slightly heraldic in appearance. A monogram may in some cases be applied to a door, but it must not be frequently repeated.

ON THE DECORATION OF WALLS.

Perhaps the best treatment of walls is that of arranging a dado upon them. Let a room be 12 feet high; the cornice will take 6 in. from the top of the wall, and the skirting will be 12 in. from the bottom. Let us now draw a line three feet above the skirting, or a little over four feet from the floor. The wall we make cream color, but the dado, a portion below the line, we paint maroon or chocolate; on this lower portion we place a pattern called a dado rail. A cream color wall comes well with a dark blue dado. In this case the blue should consist of ultramarine, with a little black, and a little white added to give a certain amount of neutrality; a ceiling must look pure, a wall somewhat neutral. A citrine wall looks well with a dark blue dado; a grey blue wall of middle tint looks well with a rich and slightly orange maroon dado. Dados may advantageously vary in height; in some cases they may be two-thirds the height of a room. This gives quaintness of effect. Dados may vary from 18 in. to 7 feet in height, according to circumstances. A wall should never be divided into equal parts; the more difficult to detect proportions the better. A dado in relation to a wall may be as four to eleven, as seven to twelve, and so on, but not as three to six.

CORNICES.

Nothing in the way of decoration is so difficult as rightly to color a cornice. Each member occupies a particular place, and has a particular sectional form; we have to color a cornice that every member shall appear to be in its proper position, and look to be exactly what it really is. A cornice is the frame to the ceiling, and the uppermost boundary of a wall; it should therefore be stronger in effect than the wall. It is also much smaller as a quantity than either walls or ceilings; it may therefore be more "colory" in effect. Strong colors may generally be used with advantage on a cornice, even pure vermillion, carmine, and ultramarine. But with these colors it is often necessary to have a much paler, and somewhat grey, shade of blue, and it is generally necessary to have also a soft shade of yellow (formed of middle chrome and white). Yellow is an advancing color, and should therefore be used in advancing or convex members. Red, as a color, is about stationary; that is, a red object looks neither nearer nor farther from us than it actually is; it should therefore be used chiefly on flat surfaces. It looks best in shades; in light it is too attractive. Blue is a receding color. It is adapted for hollows, as covings or concave mouldings. Now the difficulty in coloring a cornice rests in our having to render every member distinct, and in so modifying our yellows, blues, and reds, or whatever colors we employ, as to cause each separate member to appear to advance or recede to the exact extent that it actually does. If a cornice is uncolored, it is often impossible to judge of its sectional shape. If there are flat members in a cornice of an inch and a half or more in breadth, these may be enriched with simple patterns in blue and white or red and white, or in any colors demanded by the situation of the member; a coving, if sufficiently large, may be enriched. Care must always be taken not to cause a cornice to look liney; there must be a certain amount of breadth of treatment. If the cornice only consists of narrow lines, it cannot look well. There must be broad members, as well as those which are narrow. It is often necessary that the colors employed in the decoration of a cornice, especially if they be "primaries," be separated from each other by a white line, or by a white member. Red and blue, if of the same depth, produce a "swimmy" effect if juxtaposed, and the production of this dazzling is not desirable; it is prevented, however, by a white line interposing between them.

The principles that apply to the coloring of cornices also apply to the treatment of all relief ornament. Red is best in shadow, blue on receding surfaces, yellow on advancing members. I will say a few words, in conclusion, on the necessity for harmony in all parts of a room.

Harmony between the various decorations can be achieved in many ways. A ceiling in which blue prevails, or even a plain blue ceiling, a suitable colored cornice, citrine walls and a rich maroon dado, will produce a harmony. A ceiling of blue-green, general effect, walls of low-toned yellow-orange, and a dado of deep red purple, will produce a harmony. In both these cases the doors might be of bronze-green, and the architraves black. A plain blue ceiling, I have said, will harmonise with a citrine wall and a maroon dado; but if the ceiling decoration presents various pure colors, so arranged that its general hue is olive, and the wall ornaments are formed of bright colors so disposed that they yield a citrine tint, and the dado is made of such an admixture of colors that the general tone is russet, the three will produce a harmony; for olive, citrine, and russet are the three tertiary colors, and they together form a harmony, and the harmony produced will be refined, intricate, and peculiarly pleasant to dwell upon. When rooms open one into the other, it is often desirable to give to one a general citrine hue, to another a russet hue, and to another an olive hue; for in such a case the three, when seen through the openings which lead from one to the other, produce a harmony. If there are but two rooms adjoining, one may have a red hue and the other a green hue, or one may have a blue tone and the other an orange tone; in either case a harmony will be produced. It must be especially noticed that I speak of hues and tones of colors only, and not of positive tints, which are always too strong for walls.

If your readers will follow out these simple yet truthful instructions, which I have gleaned from proficient masters in the decorative art, also from thirty-five years' practical experience, I will venture to say they will feel satisfied with the result of their labors.

Notes and Clippings.

New Uses of Sawdust. — We have tried the experiment in our garden of mixing the rich, heavy, solid, clayish earth with sawdust, and find it makes the soil loose, giving a chance for water and air to penetrate, preventing the hard caking on the top, which before was a most objectionable fault, while the plants and seeds grow better than ever before. We ought to mention that we have also added some bone-dust, and moistened all with a weak solution of nitrate of potash.

Another use of sawdust we find reported in the *Polytechnic Review*. It says that a French authority recommends the use of sawdust instead of hair in the mortar to prevent its peeling off. His own house, exposed to prolong storms on the sea coast, had patches of mortar to be renewed every spring, and after trying without effect a number of substitutes, he found sawdust perfectly satisfactory. It was thoroughly dried and sifted through an ordinary grain sieve to remove the larger particles. The mortar was made by mixing one part cement, two lime, two sawdust, and five sharp sand, the saw-dust being first well mixed dry with the cement and sand.

Bricks of Lime and Sand.—Dr. Ternikow has obtained a patent in Germany to make bricks and artificial stone of lime and sand, which was baked at a low temperature of from 250° to 300° Fah., while bricks of clay require nearly a white heat—from 1,200° to 1,600° Fah. The recipe is from 80 to 90 per cent of sand and from 20 to 10 of slacked lime. The time for heating is the same as for clay bricks, but it requires a great deal less fuel, and consequently a considerable saving in this respect. The stones can be shaped in brick machines, and also given various shapes, as they are less apt to lose their form at the low temperature of baking than is the case with bricks.

Burning Sewer Gas.—San Francisco authorities are considering with favor a proposition to get rid of sewer gas by burning it. The method is simple, consisting chiefly of such connection of the sewers with the street lamps, that when the latter are lighted they will burn the sewer gas along with the carburetted hydrogen. The addition of the sewer gas is said to have no appreciable effect upon the light. Professor Davidson, in response to an invitation to express his views on the subject, speaks very favorably of the scheme. The *Bulletin* refers to it as the invention of a San Francisco lady.

Marble is a limestone that has become crystallized and hardened by heat so as to be capable of receiving a high polish. The action of heat on ordinary limestone is seen wherever such strata have come in close proximity to granite, the heat from which, when in a molten state, having converted the limestone into crystalline marble. The various colors of the marbles are due to the admixture of the oxides of metals, iron giving the red and brown tints, copper the green, and manganese the black.

Mother of Pearl.—Small articles may be made of imitation mother of pearl by producing the articles in horn, which is boiled in a solution of sugar of lead, and then laid in very dilute hydro-chloric acid.

The Bells of St. Paul's.—The cost of the twelve new bells which have been placed in the north-western tower of St. Paul's Cathedral, London, together with the work of mounting them, has been about $100,000. The largest bell weighs 6,500 pounds and the smallest 500, while the weight of all is nearly 40,000 pounds. No. 10, the largest, was given by the corporation. London has waited more than 200 years to hear a chime of bells from its cathedral belfry.

To Turn Oak Black.—According to the *Revue Industrielle*, Paris, oak may be dyed black, and made to resemble ebony, by the following means:—Immerse the wood for 48 hours in a hot saturated solution of alum, and then brush it over with a logwood decoction, as follows: Boil one part of the best logwood with 10 parts of water, filter through linen, and evaporate at a gentle heat until the volume is reduced one-half. To every quart of this add from 10 to 15 drops of a saturated solution of indigo. After applying this dye to the wood, rub the latter with a saturated and filtered solution of verdigris in hot concentrated acetic acid, and repeat the operation until a black of the desired intensity is obtained. Oak stained in this manner is said to be a close as well as a splendid imitation of ebony.

Aquarium Cement.—Mix white and red lead together with stiff gold size to the consistency of dough. A little lampblack will darken it. This sets quickly, and becomes as hard as iron in a few days. The various complicated receipts are all troublesome bosh. Small aquariums are best made of sash-bar zinc. This is not expensive, and easily soldered together. There should always be a zinc bottom under the slate, above which a perforated zinc bottom raised about an inch and movable will keep the water clear. Do not place the aquarium in too sunny a position, and keep it shaded in very bright weather.

Cleaning and Re-bronzing Old Lamp Stands.—If iron, take off the brass mountings; take some sulphuric acid, and put into a stoneware cistern, pan, or foot-bath; proportion one part by weight of sulphuric acid to 12 of water, and place them in pickle; watch them, and when all the rust is gone off transfer to a bath of common soda, ½ to a gallon of water, and scrub with sand and the outside shell of a cocoanut or a fibre brush; well rinse in clean water, and thoroughly dry. Coat them with gold size, and with a camel's-hair dabber cover with bronze powder when tacky; they must not be too wet, or you will not make a job of them. Stand aside to dry, dust off, and give them a coat of glaze, with a little water in it. After they are dry lacquer them, and put them in an oven to brighten, and it is done.

A Dilemma for "Cold Water" Men.—One of the most curious, and, we believe, well substantiated inferences, drawn by those geologists who have devoted attention to the chemical metamorphoses which the rocks composing the crust of the earth are subject to, is the conclusion that the earth is gradually losing its water, or drying up. It is generally assumed that the evaporation of the water from the surfaces of our oceans, lakes, rivers, etc., is practically balanced by the various forms of precipitation, rain, snow, hail, etc., from the clouds, by which it finds its way again to the earth. This is strictly true in the sense that not a particle of water passes beyond the limits of our atmosphere, and that all that finds its way into the atmosphere by evaporation, sooner or later is returned again. Nevertheless, the water supply of our earth is slowly but steadily diminishing. It is not destroyed, but is so modified as to be no longer available for the sustenance of animal or vegetable life; since it is absorbed and bound up in the rocks. This disappearance of water is to be accounted for partly by mechanical absorption, partly by the hydration (or binding of water) which is generally one of the phenomena attending the superficial weathering of the rocks, and partly by the crystallization and re-crystallization of the constituents of many of the rocks, and the extensive chemical changes going on at unknown depths within the bowels of the earth, as manifested in the phenomena of volcanoes. In the course of time, though happily many ages from the present, the combined result of these several causes of desiccation must be the complete absorption of all the water, and its disappearance from the surface of the earth.

The estimate has been made that about one-seventeenth of the original quantity of water the earth was provided with, has already been bound up in the rocks or absorbed beyond the possible reach of the organisms living upon her surface.

ANCIENT POTTERY FROM CYPRUS.

ANCIENT GLASSWARE FROM CYPRUS.

Fine Arts.

POTTERY AND GLASSWARE.

Those who admire the beautiful in form and ornamental design will be pleased with the accompanying illustrations of specimens of the artistic terra cotta and glass work exhibited at Paris. It is interesting to note how early in the development of these departments of art industry the perfection of artistic forms was reached. The most beautiful shapes of modern times are little more than copies of antique designs. In surface ornamentation the finer glassware of to-day is infinitely superior to the old; but the forms attained by the glass blowers of Cyprus, 3,500 years ago, if Di Cesnola's estimates are correct, are unsurpassed. Many of the specimens exhibited by him, during his recent lectures in this city, were strikingly beautiful. Some of them were transparent and translucent. Originally they were colorless, but some of the more modern ones were beautifully colored. The vessels were found in tombs. They had large bodies and very small necks, and had evidently held some precious liquid perfume, which was doled out by drops through the narrow necks. Those found in damp tombs showed signs of decomposition, while those found in dry places were perfectly preserved. Roman lamps were found in the tombs. The invention of lamps had been attributed to the Egyptians. Those found in Cyprian tombs were made in moulds of harder clay, in two pieces.

The rage for art decoration among ladies of leisure has given a decided impetus to the production of terra cotta and other pottery of artistic form in this country. At the recent convention of the United States Potters' Association, the President confidently asserted that the manufacture of artistic ceramics is bound to become one of the important industrial interests of this country. The average value of earthenware and china, of all grades, imported during the past six years, is nearly a million dollars in excess of the imports of the year just closing; and during the past ten years the importations have been steadily declining. From this it appears that our potters have not only kept pace with the increase in population, but are steadily reducing the amount demanded from abroad. At present the number of potteries in the United States, of all kinds, is 777; steam engines employed 8, with a horse-power of 1,586; eight water wheels, power 122; hands employed, 6,116; capital invested, $5,294,-398; yearly wages paid, $2,247,173; value of the products, $6,045,536.

Miscellaneous.

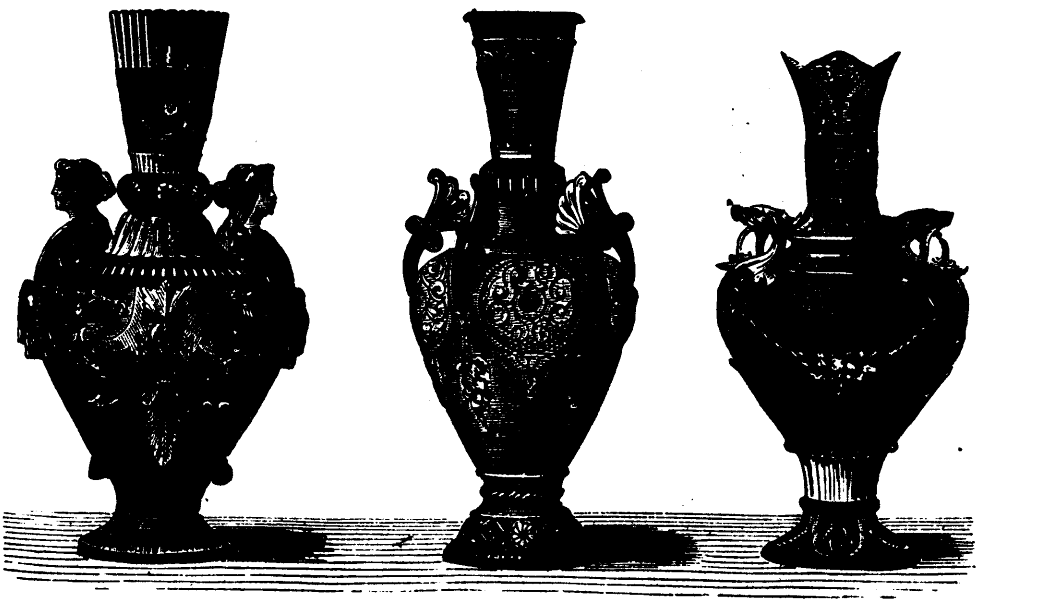
To Make India Ink.—A German paper gives the following recipe for making a deep black India ink, which will also give neutral tints in its half shades: Rub thoroughly together eight parts of lampblack, 64 parts of water, and four parts of finely pulverized indigo. Boil the mixture until most of the water has evaporated, then add five parts gum arabic, two parts of glue, and one part of extract of chiccory. Boil the mixture again till it has thickened to paste, then shape it in wooden molds which have been rubbed with olive or almond oil.

A Locomotive in a Quicksand.—A locomotive went through a bridge on the Kiowa creek, 42 miles east of Denver, Col., last spring, and instantly disappeared in the quicksand bed of the creek, baffling all attempts to recover it. For the past six months the search for the missing locomotive has been kept up, resulting in success a few days ago, when it was found buried 40 feet deep in the quicksand. The sand had been removed for a great number of yards around the scene of the disappearance of the engine, a hydraulic ram being used, the locomotive being found at last after a search of six months. The instance is one of the most remarkable on record.

Damaged Looking-Glass.—The glass should be laid on a table. With a sharp knife remove the spotted silver. Now, procure a piece of tinfoil larger than the place to be covered, lay it in a tray, and pour on it some quicksilver. Rub this over the foil. (N.B.—A hare's foot is a good thing to use.) When sufficient is spread, lay the glass on the foil, supporting the remainder so that it may lie quite flat. See that the silvered foil covers every part that has been removed, put on some heavy weights, allow them to remain five or six hours, and the glass is ready for use.

There is at last some hope that a uniform gauge for metal and wire will be adopted. The Birmingham Chamber of Commerce has been sending circulars out on the subject, and the chambers to which they are addressed have had no difficulty in "resolving" that it is desirable, &c. The chambers cannot do better than agree to accept Sir Joseph Whitworth's proposed decimal gauge.

A woven book has been manufactured at Lyons, the whole of the letter-press being executed in silken thread. Portraits, verses, and brief addresses have often been reproduced by the loom, but an entire volume from the weaver's hand is a novelty.



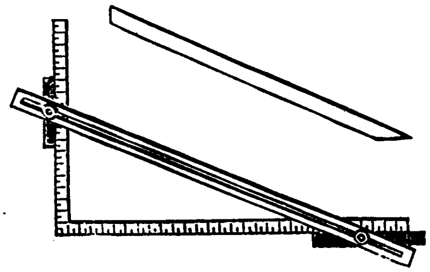
DESIGNS FOR VASES.

The engraving on this page shows three elegant designs for vases in metal or ceramics. These designs are from the firm of Villeroy, of Mettlach.

Constructive Carpentry.

MEASURING AND MAKING RAFTERS.

The difficulties of fitting rafters may be overcome by the following simple means: Take a strip of wood 2 inches wide, 24 to 30 inches long, and 1 inch thick; saw a slit in the center a quarter of an inch wide, as shown in the engraving; mark the inches and other divisions of the scale upon each edge. Make two strips of brass or steel 1 inch wide and 1-16th thick, and 6 inches or more in length. Connect these to the long strip by means of thumb screws. To use the gauge, lay it upon a square, as shown, with the zero (0) of the scale on the figure of the long arm of the square which shows half the width of the building in feet; and place the edge of the gauge upon the figure of the short arm of the square, which marks the pitch of the roof. Thus, for a building 28 feet wide, and with a roof pitch of 10 feet, the 0 should come on the long arm and the edge of the gauge meet 10 on the short arm. The figures on the gauge will mark the length, 17 ft. 3 in., of the top side of the rafter. Then by tightening the thumb screws, and fixing the metal guides even with the arms of the square, the bevel of the ends of the rafter will be given. A rafter cut according to the gauge is represented at the top of the illustration. The projection of the rafter beyond the eave of the roof is to be added to the above length. This simple apparatus will enable any one handy with tools to cut rafters of the proper length and shape, and it will also facilitate the operations of an experienced workman.



APPARATUS FOR MEASURING RAFTERS.

Engineering, Civil & Mechanical.

GETTING A SHAFT IN THE LATHE.

J. J. Grant writes for the *American Machinist* his method of preparing a shaft for turning. Although he in the main describes the steps and precautions which good machinists usually observe, there are some points of practice which it will be worth while to read about and experiment with: As the centering of a shaft, or piece of work, is the first operation, and as all subsequent operations are dependent on the centers, it is, of course, necessary that they should be as perfect as possible. In the first place, *never* turn a piece of work, no matter how short the job, without drilling and countersinking the centers, as the lathe, or male centers, retain their accuracy for a much longer time than when work is done on them without being so made ready.

To center a piece of work properly it should be, if a long shaft, straightened as near as possible with the eye, which may be done either with a sledge or under a screw press, then with center punch, prick as near as possible, and only deep enough to hold on the centers; it can then either be revolved and marked with chalk on the full side, and drawn with the center punch, or it may be "square centered;" which is done by having a center ground square, leaving four cutting edges.

Care should be taken to put the square center into the tail stock of the lathe, so as to present two cutting edges to the front. A "crotch" tool made in the form of a V at the end of a common lathe tool, having an opening large enough to take in the shaft, is then clamped into the tool post, and set so that the center of the V is on a level with the lathe centers.

The shaft should be revolved at a speed as fast as practicable, say from 50 to 300 per minute, according to the size. The crotch tool should be forced against the revolving shaft, and, at the same time, the square center must be gradually worked in, care being taken not to make the center too large before the shaft has become true. A little practice will enable a beginner to center a shaft true and quickly.

Never drill or ream a center too large or out of proportion with the work, as nothing looks worse to a mechanic than to see centers in a piece of work one-half its diameter.

The size of center drills for different diameters of shafts should be about as follows:—¼ in. to ½ in., inclusive, 1-32; ⅝ in. to 1 in., inclusive, 1-20; 1¼ in. to 3 in., inclusive, ⅛; 3½ in. and above, 5-32. The largest or outside diameter of the countersink should be about three times the diameter of the drills, but these proportions must, of course, be inversed if the shaft is to run on centers, and not in journal boxes.

Having now centered the shaft, the next operation is to straighten it. There are various appliances for this purpose, but the best is a screw press, made to traverse the bed of the lathe, and in the best make having wedge blocks with a V on the top that can be raised, and also moved close together, or far apart, as the crook in the shaft is short or long.

Now, while the shaft is revolving, mark the full side with a piece of chalk every three or four inches for the full length, as by so doing you get the proper place to begin. Sometimes it should be bent more than is necessary to bring the exact spot true, as when the full side or crooks are on opposite sides, when by bending the other crooks it will bring it back.

It is always necessary to loosen the centers when using the press; the wedges should only be brought to bear and not forced under the shaft too tight. To become an expert at this part of the work requires long practice, and can only be attained by closely noticing the effect of each blow or strain of the sledge or press upon each part of the shaft. I have seen a shaft, when pronounced finished by a good hand, run as true as a turned shaft.

When we have the shaft properly straightened, it must be squared true with a side tool, and the centers re-reamed with the square center, care being taken to have the center *exactly* 60° angle. Drill the centers with the proper sized drill only about one-eighth inch deep, and the shaft is ready for the next operation, which is turning.

COLOURING AND POLISHING BRASS WORK.

To prevent the every-day rusting of brass goods, the trade has long resorted to means for protecting the surface from the action of the atmosphere, the first plan of which is to force a change to take place. Thus, if brass is left in damp sand, it acquires a beautiful brown colour, which, when polished with a dry brush, remains permanent and requires no cleaning. It is also possible to impart a green and light coating of verdigris on the surface of the brass by means of dilute acids, allowed to dry spontaneously. The antique appearance thus given is very pleasing, and more or less permanent. But it is not always possible to wait for goods so long as such processes require, and hence more speedy methods became necessary, many of which had to be further protected by a coating of varnish. Before bronzing, however, all the requisite fitting is finished, and the brass annealed, pickled in old or dilute nitric acid till the scales can be removed from the surface, scoured with sand and water, and dried. Bronzing is then performed according to the colour desired; for although the word means a brown colour, being taken from the Italian "*bronzino*," signifying burnt brown, yet in commercial language it includes all colours.

Browns of all shades are obtained by immersion in solutions of nitrate or the perchloride of iron; the strength of the solutions determining the depth of colour. Violets are produced by dipping in a solution of chloride of antimony, or of permuriate of iron. Chocolate is obtained by burning on the surface of the brass moist red oxide of iron, and polishing with a very small quantity of black lead.

Olive green results from making the surface black by means of a solution of iron and arsenic in muriatic acid, polishing with a black-lead brush, and coating it, when warm, with a lacquer composed of one part lac-varnish, four of turmeric, and one of gamboge.

A steel-grey colour is deposited on brass from a dilute boiling solution of muriate of arsenic; and a blue by careful treatment with strong hydrosulphite of soda.

Black is much used for optical brass work, and is obtained by coating the brass with a solution of platinum, or with chloride of gold mixed with nitrate of tin. The Japanese bronze their brass by boiling it in a solution of sulphate of copper, alum, and verdigris.

Success in the art of bronzing greatly depends on circumstances, such as the temperature of the alloy or of the solution, the proportions of the metals used in forming the alloy, and the quality of the materials. The moment at which to withdraw the goods, the drying of them, and a hundred little items of care and manipulation, require attention which experience alone can impart.

To avoid giving any artificial colour to brass, and yet to preserve it from becoming tarnished, it is usual to cover properly cleaned brass with a varnish called "lacquer." To prepare the brass for this, the goods, after being annealed, pickled, scoured and washed, as already explained, are either dipped for an instant in pure commercial nitrous acid, washed in clean water, and dried in sawdust, or immersed in a mixture of one part of nitric acid with four of water, till a white curd covers the surface, at which moment the goods are withdrawn, washed in clean water, and dried in sawdust. In the first case, the brass will be bright; in the latter, a dead flat, which is usually relieved by burnishing the prominent parts. Then the goods are dipped for an instant in commercial nitric acid, and well washed in water containing some argol (to preserve the colour till lacquered), and dried in warm sawdust. So prepared, the goods are conveyed to the lacquer room, where they are heated on a hot plate and varnished.

The varnish used is one of spirit, consisting, in its simple form, of one ounce of shellac dissolved in one pint (imperial) of methylated spirits of wine. To this simple varnish are added such colouring substances as red sanders, dragon's blood, and annatto, for imparting richness of colour. To lower the tone of colour, turmeric, gamboge, saffron, Cape aloes, and sandarac are used. The first group reddens, the second yellows the varnish, while a mixture of the two gives a pleasing orange.

A good pale lacquer consists of three parts of Cape aloes and one of turmeric to one of simple lac-varnish. A full yellow contains four of turmeric and one of annatto to one of lac-varnish. A gold lacquer, four of dragon's blood and one of turmeric to one of lac-varnish. A red, thirty-two parts of annatto and eight of dragon's blood to one of lac-varnish.

Lacquers suffer a chemical change by heat and light, and must, therefore, be kept in a cool place and in dark vessels. The pans in use are either of glass or earthenware, and the brushes of camel's hair, with no metal fittings.—*Ironmongers' Review.*

DRILLING SQUARE HOLES.

To drill a square hole with a rotary motion at one operation may seem to many a novelty in mechanics, but Mr. J. Hall, of Chancery Lane, has obtained a patent for a method of accomplishing the feat. For this purpose he employs a three-sided drill, either flat or fluted, which, in cross section, is of the form of an equilateral triangle. He makes the bottom or cutting edges of the drill perfectly flat, and three in number, each cutting edge extending from one of the outer corners to the centre of the triangle. The proposed method of using such drills in an ordinary vertical drilling-machine is as follows: A special drill chuck, forming part of the invention, is provided, and attached to the lower end of the drilling spindle. The chuck is constructed in such manner as to admit of the drill travelling automatically in a horizontal plane some little distance. This is rendered necessary by the peculiar movement of the cutting edges of the drill, which does not operate or rotate on a fixed central point, but diverges somewhat in proportion to the size of the hole.

The drill chuck is constructed in the following manner: The upper part of the cavity of a metal cylinder is bored out circularly, so as to fit on to the drilling spindle, to which it is screwed by one or more screws. Below the circular bore a square recess is made, and below this latter, and coming well within the limits of the square recess, there is a circular hole passing through the end of the cylinder. The drill holder or socket is in a separate piece, the bottom portion of which is provided with a square or round recess for holding the shank or upper end of the drill, which is held firmly in its place by means of a set screw. The device is shown in the accompanying engraving, which we take from the *English Mechanic.* The upper part consists, first, of a screw, S, at the top, Fig. 1; secondly, of a square shoulder, B; thirdly, of a circular shoulder, D; and, fourthly, of another but much larger circular shoulder, E. Through the circular hole at the bottom of the hollow cylinder the upper portion of the drill holder is inserted until the large circular shoulder meets the bottom of such cylinder. A loose square collar, A (Figs. 1 and 2), provided with an oblong rectangular slot, is then placed within the cylinder and over the square above mentioned, above and on to which is screwed down a nut, N, from the inside of the cylinder. The loose square is of such thickness that when the nut is tightened down on to the square shoulder the loose collar is left to work freely. When this is done the drill holder will readily travel in a horizontal plane such distance as the play between two of the sides of the loose collar, and two of the sides of the square recess, in one direction, and in another direction the distance of the play between two of the sides of the small square shoulder of the drill holder and the ends of the rectangular slot in the loose collar. The horizontal travel or play is proportionate to the size of the hole to be drilled. Near to the lower end or cutting edges of the drill is fixed rigidly a metal guide bar or plate, F. The guide bar is provided with a square hole similar to the hole it is required to drill, the dimensions of the three sides of the drill being such that the distance from the base to the apex of the triangle, which such three sides form, is the same as of the sides of the square holes it is required to drill.

Mr. Hall prefers to make the guide bar of steel, which he hardens at that part where the guide hole is made. The method of operation is then as follows: The three sided drill being fixed in the self-adjusting chuck, the guide bar with the square guide hole therein rigidly fixed above the point where it is required to drill, the drilling spindle carrying the chuck drill is made to revolve, and is screwed or pressed downwards, upon which the drill works downwards through the square guide hole, and drills holes similar in size and form to that in the guide. The triangular drill for drilling dead square holes may also be used without the self-adjusting drill chuck in any ordinary chuck, when the substance operated upon is not very heavy nor stationary; then, instead of the lateral movement of the drill, such lateral movement will be communicated to the drill by the substance operated upon.

Although the patentee only cites the case of a vertical drilling machine in connection with this invention, he declares that the specified improvements are equally applicable to lathes, ordinary braces, ratchet braces, and all other descriptions of drilling apparatus. In making oblong dead square cornered holes, either the substance to be operated upon must be allowed to move in one direction more than another, or the hole in the guide plate must be made to the shape required, and the drill chuck made to give the drill greater play in one direction. Fig. 1 shows a vertical section of the improved chuck, in which A is the hollow cylinder, which may be attached to any ordinary drilling machine; H is the drill holder; S is a screw; B is a square shoulder; D is a circular shoulder; E is a circular shoulder of a larger dimension; N is a screw nut for tightening on to the square shoulder, B, and the loose square collar. Fig. 2 is a plan view of Fig. 1. Fig. 3 is an elevation of the improved chuck; C showing the three-sided drill and the guide bar, F, complete. Fig. 4 is a plan of the guide bar, F, showing the three-sided drill in cross section.

PLUMBAGO AS A LUBRICANT.

Blacklead has long been used for producing a smooth and slippery surface on wood, and mixed with grease it forms an excellent lubricant for many purposes. The success of the metalline bearings appears to have directed the attention of engineers and mechanics to the utility of finely powdered plumbago as a general lubricating agent, and it has been successfully employed even in steam cylinders. On this branch of the subject Mr. J. H. Cooper, of New York, writes:—Mr. W. J. Williams, Philadelphia, has called my attention to the successful use of dry pulverized graphite for lubricating steam cylinders. He applies 137 grains twice a day, introducing it into the cylinder through the usual form of tallow-cup. Six months of continuous use, in a horizontal cylinder, 11 in. diameter, 30 in. stroke, working to its full capacity, prove this lubricant superior in every way to oils or tallow, both of which he had used for years. No oil whatever is introduced with the graphite. At 30 cents per pound, this engine would require 1⅛ cents worth per day. After a run of four months following the above tests, Mr. W. says: "I took off the cylinder head of my engine to examine the interior. I found the piston perfectly clean, with no appearance of wear or abrasion. I feel very positive that had I been using animal or vegetable oils, the parts would be in a much worse condition to-day. The working part of the cylinder is everywhere covered with a coat of plumbago, readily soiling the fingers. The conclusion I have come to about the choking up of passages is, that plumbago alone will not do it; but wherever there is friction of one or more moving parts, some of it will adhere to them."

REPAIRING BOILERS.

The following hints in reference to repairing boilers are taken from the *American Machinist* :—

It is commonly noticed in boilers that have seams of rivets exposed to the action of the fire, that after being at work for some time, cracks begin to appear, running from the rivets towards the centre of the plate. The cause is, that one lap being covered by another, prevents the water from getting to the one nearest the fire ; consequently the lap nearest the fire becomes hotter, and expands to a much greater extent than any other part of the plate, and its constant unequal expansion and contraction, as the boiler becomes alternately hot and cold, inevitably results in a crack. These cracks may be temporarily repaired by drilling a hole in the bottom or extremity of them, so that the crack is completely drilled out ; and, as a rule, this may be safely done if the crack is not more than three inches long, but if of greater length, do not tamper with it, but have the plate out, if possible.

If it is not practicable to take the plate out, cut out so large a piece that the seams of the patch shall be as far from the fire as possible. Let it be well borne in mind that, in addition to the two laps causing unequal expansion, the sediment or scale inside the boiler obstinately sticks in between the rivet-heads and under the edge of the lap, from whence it is seldom or never properly removed in cleaning the boiler. After drilling out the end of the crack, countersink the drilled hole, and also the hole in the seam above it ; so that when rivets are again put in, they will meet each other, or nearly so. Let the heads of these rivets be as thin as possible, so as not again to retain the heat, or attract or harbor dirt.

Sometimes it will be observed that a crack in the seam is running from hole to hole between the rivets. This is always dangerous, and the cracked plate should be cut out and replaced by a new one as soon as possible. In putting patches on any part of a boiler, never cut a hole out with square corners, like the inside of a picture frame ; but cut the holes which are to be covered with a patch, round, or as nearly circular as possible. But it is always better "not to put a patch on," but to cut out the defective plate and put in a new one, thus making the boiler as nearly as possible what it was when new. In putting a new plate in a very old boiler, it is advisable to have it a little thinner than the old plates were when new, say one-sixteenth of an inch. In putting on a new plate, arrange it, if possible, so that the caulking shall be done on the new iron ; but never place the edge of the laps toward the fire, unless a considerable distance from it.

STEEL BOILERS.—We lately alluded to the use of steel in boiler making. A late number of *Engineering* sums up the result in England of the employment of steel as follows : "That of some 80 boiler makers who have fairly tried steel plates, only some eight or nine can be said to have persevered with its use and used it extensively ; that when the use of steel plates has been persevered in against the advice and feeling of the boiler maker, the result has generally been unsatisfactory ; that it may be taken for granted that the prejudice on the part of boiler makers against the use of steel, is, as a rule, inversely proportionate to the extent of their acquaintance with it." The same article estimates that there are working in the United Kingdom about 2,500 boilers with steel shells and 7,000 with steel furnaces and fire-boxes. It is impossible to tell, says the *Iron Age*, how many are in use in the United States, but the number is far in excess of this, and steel for this purpose is rapidly growing in favour with boiler makers. This is also true in England. The great facility with which low steel can be made by the Siemens-Martin process is doubtless one cause of this increased favour, but the breaking down of prejudice is another.

LAYING OUT CURVES.—A simple instrument has been devised by E. R. Dale, of England, for measuring the diameters of circular curves. It consists of a tube bearing at its lower end a fork, having in its centre a feeler pressed against the curve to be measured by a spring contained in the tube. The upper end of the feeler is fitted with a small rack, gearing into a pinion of the spindle of a hand the motion of which indicates on a graduated disk the diameter of the circle of which the arc is a part. In order to measure with the instrument the central feeler is pushed inward until it, as well as the ends of the fork, touch the arc to be measured.

Furniture.

PRACTICAL HINTS.

POLISHING FRETWORK.—This is rather a delicate job. Polish the wood first, or at least give it a couple of coats ; then, when cut, finish off. If the fretwork is sawn, procure a gill of French polish, make a rubber of flannel or of wadding, moisten with polish, cover with linen rag, and then rub with a circular motion. When dry, paper smooth, and polish again ; then finish off with spirits. For fancy light wood use the white French polish. The simplest plan is to use a brush polish made as follows : 1 gill brown hard varnish, ½ gill French polish (mix in a bottle if for light wood), 1 gill white hard varnish, ½ gill white polish. Apply with a fine camel's-hair brush. When the first coat is dry, paper smooth and give another coat ; then, when dry, a coat of glaze. If carefully done it is nearly equal to polish. Very little varnish should be used at a time, to prevent running.

MORDANTS FOR STAINING WOOD.—Sulphuric acid, more or less diluted, according to the intensity of the colour to be produced, is applied with a brush to the wood, previously cleaned and dried. A lighter or darker brown stain is obtained, according to the strength of the acid. When the acid has acted sufficiently its further action is arrested by the application of ammonia. Tincture of iodine yields a fine brown coloration, which, however, is not permanent unless the air is excluded by a thick coating of polish. Nitric acid gives a fine permanent yellow, which is converted into a dark brown by the subsequent application of tincture of iodine.

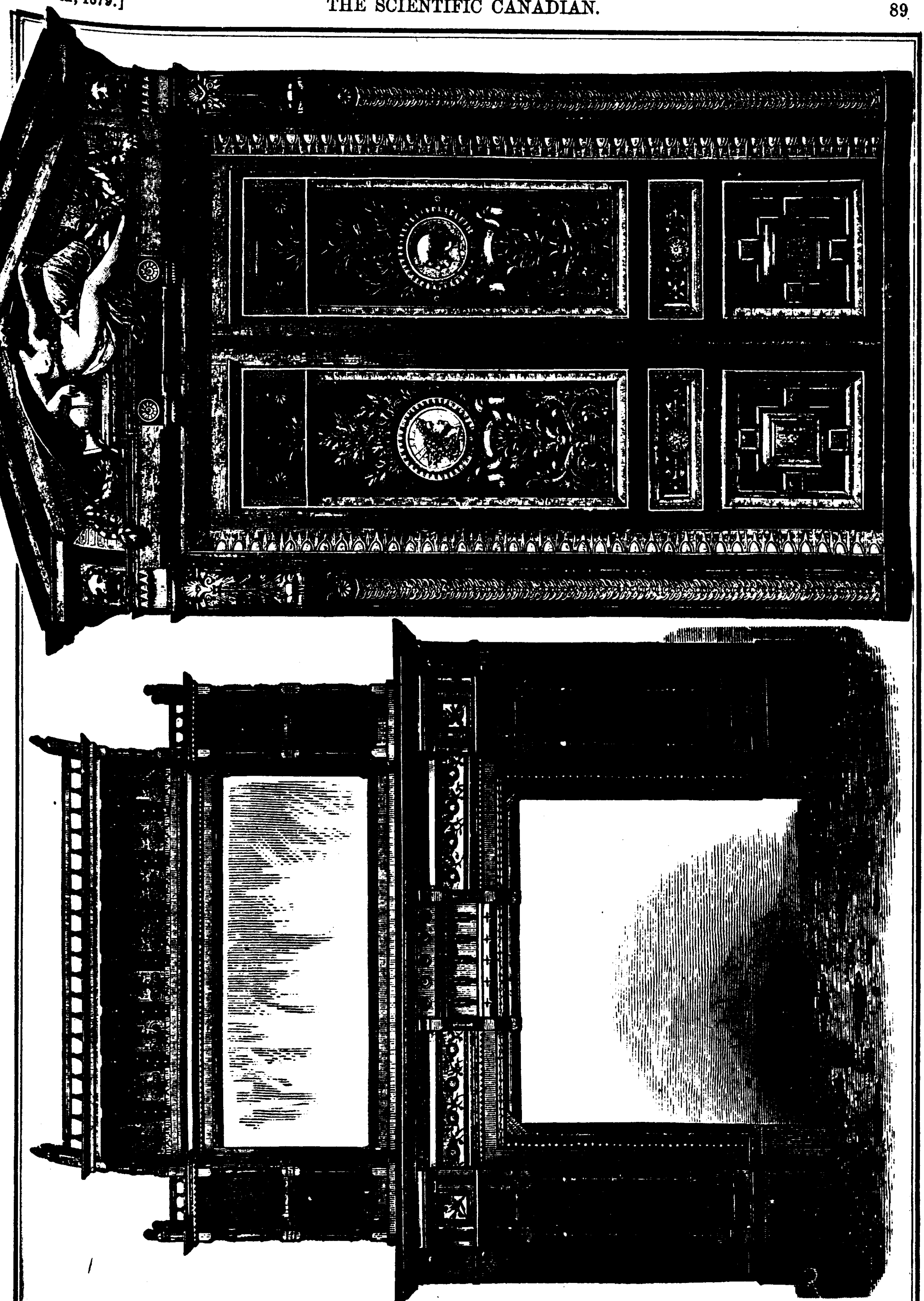
EBONIZING.—To French-polish a black sideboard it is not absolutely necessary to use black polish, but it is usual to do so, as it produces a finer black. The sideboard, or any kind of furniture, is polished in the usual manner, by using black polish, and filling up the grain with black ; the simplest kind is weak glue and lamp-black. When dry, paper down and polish as usual. The rubber of the polisher should be dipped in ivory-black, or gas-black, moistened with black polish, covered with linen rag, a touch of linseed oil, and used as usual. Black polish is made thus :—One gill dark French polish poured into a clean bottle, then add ½oz. best ivory-black, or gas-black is best ; in fine powder well, shake until mixed, and use as before described. Gas-black is made by impinging a broad gas burner on the bottom of a glue-pot or sheet of metal, and gathering the black as made.

PICTURE FRAMES.—A simple plan for holding frames in position till dry is to tack lengths of wood on a board, and after laying the frame between them, gently press wedges till the joints are home. It is such a common complaint of the non-conformity between the first and last mitre, that gilt corners are made ready, like charity, to cover a multitude of sins. These, if laid on a damp cloth, soon become sufficiently pliable to take the bend of the moulding, and, besides being very cheap, are a great improvement and a blessing to many besides amateurs.

VARNISH FOR TOOLS.—For tool handles there is nothing better than shellac varnish. It should be put on before the handle is removed from the lathe. Use it the same as French polish, and in small quantities.

SIZE FOR PREPARING FRAMES, ETC.—Take ½lb. of parchment shavings, or cuttings of white leather ; add three quarts of water, and boil it in a proper vessel till it is reduced to nearly half the quantity ; take it off the fire and strain it through a sieve ; be careful in the boiling to keep it well stirred, and do not let it burn.

LAYING GOLD ON FRAMES.—This is a most difficult operation, and requires some practice, but with a little caution and attention, it may be easily performed. Turn the gold out of the book on the cushion, a leaf at a time ; then passing the gilding knife under it, bring it into a convenient part of the cushion for cutting it into the size of the pieces required ; breathe gently on the centre of the leaf, and it will lie flat on the cushion ; then cut it to the sizes required ; by bringing the knife perpendicularly over it, and sawing it gently, it will be divided. Place the work before you, nearly horizontal, and with a long-haired camel-hair pencil, dipped in water (some use a small quantity of brandy in the water), go over as much of the work as it is intended to cover with the piece of gold ; then take up the gold from the cushion by means of the tip ; by drawing it over the forehead, or cheek, it will be damped sufficiently to adhere to the gold, which must then be carefully transferred to the work, and gently breathing on it, it will be found to adhere ; but it must be observed that the part it is applied to is sufficiently wet ; indeed, it must be



DESIGNS FOR A MANTLE-PIECE AND DOOR, EXHIBITED AT THE PARIS EXHIBITION.

floating, or the gold will be apt to crack. Proceed in this manner, a little at a time, and do not attempt to cover too much at once, till by experience the operator finds he is able to handle the gold with freedom. Be careful in proceeding with the work, if any flaws or cracks appear, to take a corresponding piece of gold and apply it immediately; sometimes, also, it will be found necessary, when the gold does not appear to adhere sufficiently tight, to draw a pencil quite filled with water close to the edge of the gold, that the water may run underneath it, which will answer the expectation.

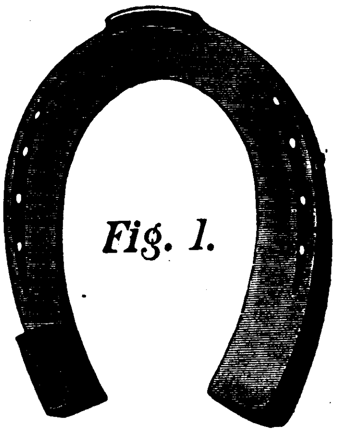
CLEANING FURNITURE.—Mix a little turpentine with some boiled linseed oil, and rub gently with a soft rag, giving plenty of "elbow grease."

BLACK AND GOLD FURNITURE.—The wood should be stained as follows:—Procure 1 lb. logwood chips, add two quarts of water, boil one hour, brush the liquor in hot, and when dry give another coat. Now procure 1 oz. of green copperas, dissolve it in warm water, well mix, and brush the solution over the wood, it will bring out a fine black; but the wood should be dried out-doors, as the black sets better; a common store brush is best. If polish cannot be used, proceed as follows: — Fill up the grain with black glue—*i.e.*, thin glue and lampblack brushed over the parts accessible (not in the carvings); when dry, paper down with fine paper. Now procure, say, a gill of French polish, in which mix 1 oz. best ivory-black, or gas-black is best, well shake it until quite thick pasty mass, procure half a pint of brown hard varnish, pour a portion into a cup, add enough black polish to make it quite dark, then varnish the work; two thin coats are better than one thick coat. The first coat may be glass-papered down where accessible, as it will look better. A coat of glaze over the whole gives a London finish. N.B.—Enough varnish should be mixed at once for the job, to make it all one colour—*i.e.*, good black.

Horse Shoeing and Smith's Work.

TO PREVENT HORSES INTERFERING.—Nature has provided a proper hoof for the horse, but sometimes it is round and flat and the animal will strike itself with the crust when not shod; the natural tendency being to travel very close, especially with the hind-feet.

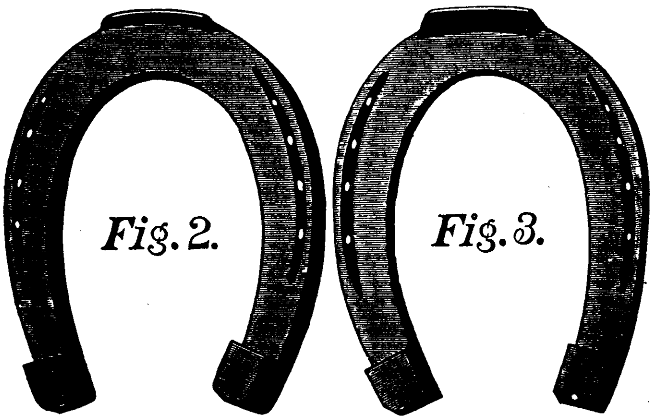
Well-informed minds, together with the mechanical skill of many blacksmiths, have been brought to bear upon this topic, and after years of experience and research they have been unable to remedy this evil. As such I term it, because horses have suffered much, and become depreciated in value because of being addicted to the annoying habit of interfering.



I here propose to give a sure and certain remedy that has never been known to fail. The preparation of the hoof is by no means as important as that of the shoe; yet, should the animal interfere very badly, it may be better to leave the outside a trifle the lowest; however, the smith ought to be governed by circumstances, not as to the shoe, but to paring the hoof. All that can be removed from the inside without putting the hoof out of shape ought to be done. Also pare the hoof at the toe instead of the heel, simply rasping it so as to form a level surface. Prepare the shoe carefully in accordance with the following directions, and as illustrated on foregoing engraving Fig. 1:

Make the inside twice the width and twice the thickness that you do the outside, gradually tapering the width and thickness from the toe-calk. Make the heel-calk on the inside or heavy part of the shoe, about an inch long, and lengthwise from heel to toe, and incline it a little inward to the frog of the foot. Don't allow your shoes to remain on longer than four weeks at most, and use as small nails as possible.

OVER-REACHING.—Young horses are more subject to over-reaching than old ones. It very frequently disappears as the speed of the animal is increased. At a moderate gait, the front



INTERFERING AND OVER-REACHING.

feet do not always get out of the way in time for the hind ones, as they are brought forward. Sometimes the heels are cut or badly bruised, and occasionally the shoes are torn from the fore feet.

Remedy.—Have the front shoes made nearly twice the weight of the hind shoes. Lower the toe-calk on the fore shoe and increase the ordinary length of the calk on the hind shoe, and do not make the fore shoe to project more than half an inch beyond the heel. If the horse should have a good square heel, don't allow the shoe to project any. Observe to instruct the smith to pare the toe or forward part of the fore foot, and *not the heel*, simply rasping it to form a level surface. See illustration of shoes, Figs. 2 and 3.—"*Pratt's Treatise on Horseshoeing.*"

TYPE MADE OF GLASS.

It would appear, according to an English contemporary, that the usefulness of toughened glass bids fair to be greater and more serious than was at first supposed. Some experiments are reported to have been made in France, with a view to showing whether this substance can be pressed into the printer's service, and substituted for the metal composition of which types are made. The metal now used does not at first sight strike the observer as the best that could be found. It is bright enough when the letters first come from the foundry, and before they have seen any service; but a few days' wear gives them a very much more dingy appearance, and before they are finally returned to the melting pot they have degenerated into a very squalid form, looking dirty on their bodies as well as battered on their faces. The idea is now to discard these long proved but unattractive servants and fill their places with glittering types of glass. The advantages in point of cleanliness alone would, it is alleged, be not insignificant. But there are other and more solid improvements involved in the new system. The toughened glass, which is not to be made in quite the same way as that used for tumblers and wine glasses, and need not, of course, be quite as transparent, is naturally much harder than the old metal, and can hardly be crushed out of shape by those little accidents which so shorten the life and spoil the beauty of the only type we now employ. It is also capable of being cast into more delicate shapes, so that the difference, for instance, between the thin and thick strokes can be more clearly defined. Finally, it is now found that the new material can be cast in exactly the same molds as the old, and that, therefore, there need be no expense incurred in altering the machines and implements now used in the manufacture of type. If our information is correct, and the experiments have been completely successful, the adaptability of toughened glass to printing and to numerous other purposes is likely, ere long, to be fully established.

Health and Home.

THE USE OF TEA.—The following hints concerning the use of tea may prove useful :

1. Whoever uses tea should do it in great moderation.
2. It should form a part of the meal, but never be taken before eating, or between meals, or on an empty stomach as is too frequently done.
3. The best time to take tea is after a hearty meal.
4. Those who suffer with weak nerves should never take it at all.
5. Those who are troubled with inability to sleep nights should not use tea, or if they do, take it only in the morning.
6. Brain-workers should never goad on their brains to overwork on the stimulus of tea.
7. Children and the young should not use tea.
8. The over-worked and under-fed should not use tea.
9. Tea should never be drank very strong.
10. It is better with considerable milk and sugar.
11. Its use should at once be abandoned when harm comes from it.
12. Multitudes of diseases come from the excessive use of tea, and for this reason those who cannot use it without going to excess should not use it at all.

FLOATING SOAP.—A patent has been granted for an invention in which a piece of cork or other substance of less specific gravity than water is encased in the cake of soap, thereby rendering the latter capable of floating on the surface of the water. The same effect may be obtained by forming central cavities in the soap.

THE taking of cod-liver oil is seldom found a pleasant operation. M. de Pontever recommends in the *Union Médicale*, mixing a spoonful of the oil with the yolk of an egg and ten drops of oil of peppermint, and adding half a glass of water with some sugar. This is said to effectually conceal the characteristic taste and odour.

PIE FOR DYSPEPTICS.—Four tablespoonsful of oatmeal, one pint of water ; let stand a few hours, or till the meal is well swelled. Then add two large apples, pared and sliced, a little salt, one cup of sugar, one tablespoonful of flour. Mix all well together and bake in a buttered pie-dish ; and you have a most delicious pie, which may be eaten with safety by the sick or well.

THE NAILS.—The growth of the nails is more rapid in children than in adults, and slowest in the aged ; goes on faster in summer than in winter, so that the same nail which is renewed in 132 days in winter, requires only 116 in summer. The increase of the nails of the right hand is more rapid than those of the left ; moreover, it differs for the different fingers, and in order corresponds with the length of the finger, consequently it is the fastest in the middle finger, nearly equal in the two on either side of this, slower in the little finger and slowest in the thumb. The growth of all the nails on the left hand requires 82 days more than those of the right.

RAW ONION AS A DIURETIC.—Dr. G. W. Balfour, in the Edinburgh *Medical Journal*, records three cases in which much benefit was afforded patients by the eating of raw onions in large quantities. They acted as a diuretic in each instance. Case first was a woman who had suffered from a large white kidney and constriction of the mitral valve of the heart. Her abdomen and legs had been tapped several times, but after using onions as above she had been free from dropsy for two years, although still suffering from albuminuria. Case second suffered from heart disease, cirrhotic liver and dropsy. Case third had dropsy depending on tumor of the liver. In both of them the remedy had been used with good results. Both had been previously tapped, purgatives and diuretics alike having failed to give relief. All other treatment having failed to give relief, recourse was had to the onions. Under their use the amount passed steadily rose from 10 to 15 ounces to 78 or 100.—*Herald of Health.*

FOOD TOO EASILY DIGESTED. — The healthy adult requires food which will give the stomach work to do. The stomach requires work as much as legs or arms. The nutriment of food for such should not be abstracted and ready prepared, as, for instance, it is in milk, eggs, meat ; it is better that the stomach abstract it by the process of digestion from food. With the sick and the young, however, the case is very different. The stomach of a strong man is like a quartz crushing machine, capable of doing vigorous work. That of a dyspeptic is quite different, and may need great care to enable it to do its work at all. Weak stomachs, however, may be trained by slow degrees to do their work well by giving them just the right food, properly chewed, and stopping the expenditure of nerve force in other directions so that the blood may go to it. By such a course half the dyspepsia might be avoided or cured.—*Herald of Health.*

TOIL AND BE HAPPY.—The *Christian at Work* thinks Ruskin never said a truer thing than this : "If you want knowledge, you must toil for it ; if food, you must toil for it ; and if pleasure, you must toil for it." Toil is the law. Pleasure comes through toil, and not by self-indulgence and indolence. When one gets to love work his life is a happy one. Said a poor man in Brooklyn, the other day, with a family of eleven to provide for : "If I were worth a million dollars I should not wish to do much different than I do now every day, working hour after hour. I love it a thousand times better than to rest." He has for nearly half a century been surrounded by workers, and has caught the spirit of industry. He loves his work better than food or sleep. He is happy who has conquered laziness, once and forever.

THE SANITARY EFFECT OF HOUSEWORK UPON WOMEN.—Many of the ills and diseases prevalent among women in our day are, no doubt, traceable to the sedentary mode of life so common among them. The progress with much of the household drudgery to which women were formerly subjected, and the result is, in too many cases, want of sufficient occupation for needed bodily exercise. The fruits of this state of things are strikingly exhibited in certain observations made by the late Mr. Robertson, a Manchester surgeon, who, in his practice as a specialist for women's diseases, found that in women who themselves performed all their work there was no trace of certain complaints ; that these complaints begin to make their appearance in women with one servant, becomes more pronounced with women who have two servants, or worse still with those who have three servants, and so on. He showed statistically that the deaths from childbirth were four times greater in the case of women with four servants than those with none.—*Popular Science Monthly.*

SANITARY SCIENCE.—Mrs. Hobart writes to the *Inter-Ocean* as follows :—"The wise mechanic, although impatiently anxious to perform quick work and achieve results speedily, will yet take time to put all machinery to be used in perfect order, knowing that the single drop of oil, promptly applied to prevent friction, is a much more economic expenditure than hours of time and an incalculable amount of patience to mend the machine after it is once broken. Many social scientists begin to realize that, better than legislation, prohibitory or penal, better than reformation and repentance, and all of those expensive pounds of cure, is the old-fashioned ounce of prevention. Give us well-ordered homes, universal sanitary knowledge, and cleanly children, and we believe crime as well as suffering will rapidly decrease. Not until we have facts in regard to the number of children starved, abused, or poisoned into crime by poor food, bad management and foul air, can we estimate the importance of sanitary science."

THOUGHTS FOR WINTER.—A writer in the New York *Independent* says : "Typhus, typhoid fever, and diphtheria are more abundant in winter than in summer ; while, if the specific infective diseases get any foothold in the fall, they are apt to linger with continuous pertinacity until the late spring. It is quite apparent too that our population suffers from the winter confinement amid impure air, even where no special distemper is produced. One reason why it seems so necessary for our urban population to spend the summer on the seashore or in the mountains is just because there has been a reduction of vital force by surroundings, which must be thus repaired. These heated chambers beneath the basement do not send into these household lungs enough of the pure air of heaven. Nature struggles on, with her compensations and adjustments, until she institutes a longing for a change, and so restores the balance, at a disadvantage."

CEMENT FOR SEALING BOTTLES, ETC. — Mix three parts of resin, one of caustic soda, and five of water ; this composition is then mixed with half its weight of plaster of Paris. The compound sets in three quarters of an hour, adheres strongly, is not permeable like plaster used alone, and is attacked only slightly by warm water.

Machine Construction & Drawing.

(From *Collin's Elementary Science Series.*)

(*Continued from page 60.*)

22. Rivets.—Another method of connecting two pieces is given in figs. 52, 53, illustrating a *single riveted lap-joint*, as used for boilers, &c. Rivets are used where the pieces are not required to be separated, and where the nature of the material will permit of the process of riveting. We may say, speaking generally, rivets are used to form a permanent connection, and bolts a temporary one. There are also other considerations besides these which determine the method to be adopted. The *lap* is the distance *a*, the *pitch* *p* is the distance of the rivets apart from centre to centre. Fig. 52 is a front elevation; on the right of the line *bc*, the rivets are shown in section. Fig. 53 is a cross-section through *bc* in fig. 52.

Figs. 54, 55, show two views of the rivets used in the

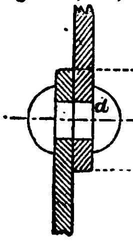


Fig. 53.

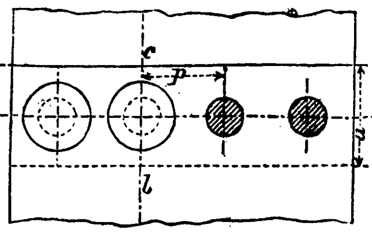


Fig. 52.

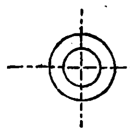


Fig. 54.

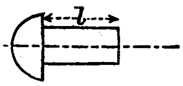


Fig. 55.

example given in figs. 52, 53, before they are heated and fixed in position; allowance is made in the length *l* for the head *d*, fig. 53.

23. Shafting.—Shafts are used for the purpose of transmitting motion; they are provided with wheels, pulleys or drums, cams, &c., according to the kind of motion required, and are generally made of a circular cross-section, in some cases the section is square or of other form. The material chiefly used is *wrought-iron; cast-iron* and also *steel* are, however, in some cases employed. The relative strength of shafts varies as the cube of their diameters; that is to say, if a shaft of 2 inches diameter is strong enough to transmit four horse-power, then one four inches in diameter, under the same conditions, would transmit thirty-two horse-power.*

24. The wheels, pulleys, &c., are firmly connected to the shafts by means of *keys*, which are pieces of metal, generally steel, of a square or rectangular cross-section, and slightly taper in direction *de*, fig. 56, to admit of being driven *home* tight; they should fit easily on the sides of the *key-bed* or *key-way*. In some cases the key is required to slide along the groove in the shaft with the wheel, the key being fixed to the wheel. Figs. 58, 59, illustrate one method of doing this, the key being *dove-tailed* into the *boss a* of the wheel. In the example shown in figs. 56, 57, the key has a *head f* to allow of its being *drawn*. Fig. 56 is a sectional elevation, with part of the shaft in section, so as to show the key in full. Fig. 57 is an end-view.

Figs. 58, 59, are similar views of the dovetailed key arrangement; fig. 58, a sectional elevation, fig. 59 an

KEYS FOR SHAFTS.

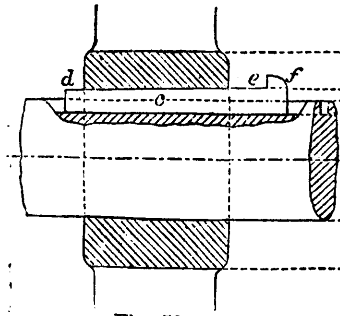


Fig. 56.

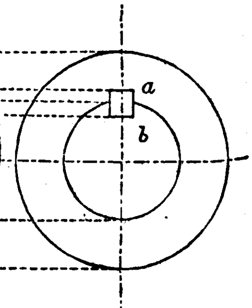


Fig. 57.

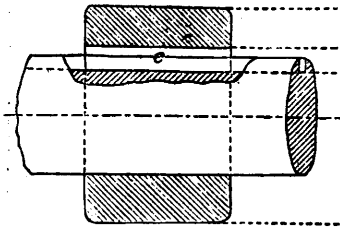


Fig. 58.

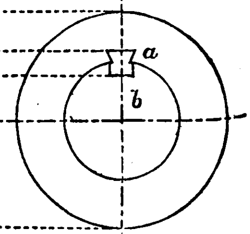


Fig. 59.

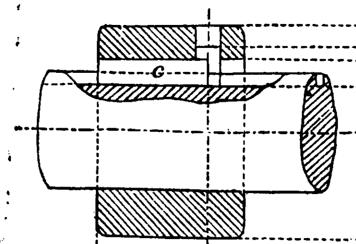


Fig. 60.

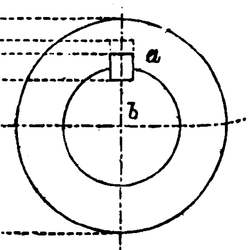


Fig. 61.

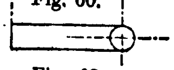


Fig. 62. *Scale* ¼.

end-view. The boss of the wheel is marked *a*, the shaft *b*, and the key *c*. Scale ¼ for both examples.

25. Another form of sliding key is shown in figs. 60, 61, 62; the key has a head which fits into a circular hole in the boss of the wheel. Fig. 62 is a plan of the key.

26. Fig. 63 is a front-elevation, and fig. 64 an end-elevation, of an ordinary shaft; if the length is such that it cannot be shown in full according to scale, it is *broken off*,† as at *ab*, and the length is marked in figures, as shown. Projecting cylindrical pieces *cc*, termed *collars*, are *welded* to the shaft, their object is to prevent the shaft from leaving the *bearings* in direction of its length. The portion between the collars is called the *neck*, and is supported in an accurately fitting surface termed a *bearing*. The length of the neck is generally made 1½ times the diameter of the shaft, for shafts under 6 inches diameter; some makers allow as much as two diameters, and in special cases even more than this.

*If d = dia. of the first shaft (2 in.), h = horse-power transmitted, d' = dia. of the second shaft (4 in.), h' = horse-power transmitted;

$$\text{Then } h : h' :: d^3 : d'^3$$
$$4 : h' :: 8 : 64$$
$$h' = 32$$

† This is the usual way of representing parts of machinery, which, for the reason stated, cannot be drawn in full.

27. In cases where the fixed collars would prevent the fixing of wheels, pulleys, &c., a *loose collar d* is used. The loose collar is shown in figs. 65 and 66. Fig. 66 is partly in section showing the screw *f*, which fixes the collar to the shaft. Figs. 63, 64, are drawn to a scale of $\frac{1}{8}$. Figs. 65, 66, to a scale of $\frac{1}{4}$.

28. **Bearings.**—By the term bearings is to be understood the *surfaces of contact* between the shaft, or other moving piece, and its support; the form of the bearings depends upon the kind of motion given to the moving piece. The motion of shafting is generally one of *rotation*,* the bearings are therefore surfaces of revolution, as circular cylinders, cones, &c. In figs. 63, 64, the bearings are cylindrical.

If the motion of the shaft or other moving piece is one of straight translation (motion in a straight line), as, for example, the piston-rod and the slide-block of a steam engine, the bearings have a circular, square, triangular, or other straight-lined cross-section, and are perfectly straight in the direction of motion.

A kind of motion made up of the two former is termed *helical* or *screw motion*, the bearings of which must have helical surfaces.

The supporting pieces for the three kinds of motion named are, for rotating pieces, *journals*, *bushes*, and *pivots*; for straight translation, *slides*; and for screws, *nuts*.

29. **Journals** are sometimes formed in the frame of the machine, and generally consist of movable pieces, termed *steps*, made of brass or other alloy. In cases where it is inconvenient or impracticable to adopt this form, *pedestals* or *plummer-blocks* are employed, to which the steps are attached, as illustrated in the drawings of a pedestal, Plate XXIV., figs. 177 to 179.†

30. **Bushes** usually consist of a hollow cylinder of metal, cast-iron, steel, or brass, in which the shaft rotates; they are generally fixed in the frame of the machine. Two common forms of bushes are shown in figs. 67, 68, 69, the drawing of which should present no difficulty to the student. In figs. 67, 68, the bush consists of a plain hollow cylinder *b*, fitting accurately the hole in the frame, and fixed to the latter by means of a screw *s*; *a* is the shaft, *cc* the frame. Half the elevation in fig. 68 is in section. The bush shown in fig. 69, half of which is in section, has a collar *d* on one end, with a screw or screws passing through it, and fixing the bush to the frame; the same letters of reference are used for this example as for the former. Where the wear is considerable it is not advisable to use bushes, unless they can be turned round a little, as they wear, or be replaced readily, as they soon get out of truth; the common plan is to use movable steps, which admit of adjustment to compensate for wear. See drawing of pedestal, Plate XXIV., figs. 177 to 179.†

31. **Slides.**—In figs. 70, 71, is represented a common form of slide; *a* is the fixed surface or *bed*, *b* the sliding piece, *c* is a *strip*, a piece of metal fixed to the sliding piece by the screws *d*, which is acted upon with screws *e*, so as to compensate for wear of the surfaces. Slides are of very common use; among others we may mention the *slide-bars* of steam-engines, the *slide-rests* of lathes, the *cross-slides* of planing machines, &c. Fig. 70 is an elevation showing part of the sliding piece and bed; the latter is in section, as also is the portion of the former, which shows the strip and screws. Fig. 71 is a plan. The figures are drawn to a scale of $\frac{1}{8}$.

* The term *rotation* is employed to denote the act of turning about an axis.

† These plates will appear in future numbers.

32. **Nuts.**—On Plate VII. is shown the bearing surface of a screw; fig. 87 is an elevation of the screw; fig. 89 a sectional elevation of the bearing or nut, taken through the line SP in fig. 88; fig. 90 shows a section of the screw and nut in contact. The drawing of the screw and nut will be explained later on.

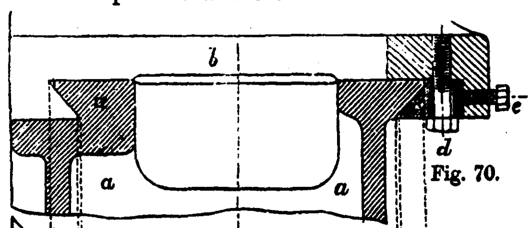


Fig. 70.

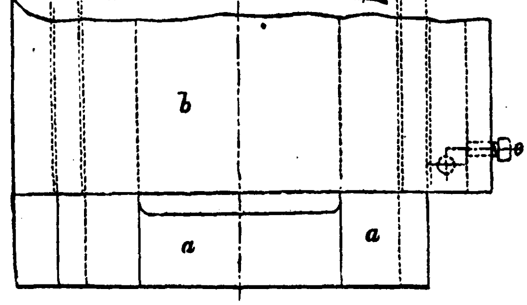


Fig. 71.

33. **Couplings.**—Shafting is usually made in lengths, whose length varies according to circumstances, for convenience in erecting and mounting, and to allow of disconnecting portions of it. These lengths are connected by couplings. We may divide couplings into two classes; first, those used for shafts, which require disconnecting only at long intervals; and, secondly, where they are being disconnected constantly.

The *box butt*, *box half-lap*, and *face-plate* are the chief kinds used in the first class. In the second class there is a great variety, including *clutches* with from two teeth upwards, *friction cones*, &c. Plate V. shows two forms of the first class, viz., the butt and the half-lap box couplings.

Fig. 72, 73, 74, are views of the butt box coupling; figs. 74 is a plan; fig. 73 an elevation, showing in section the box and portion of the shaft ends, *a* and *b*; fig. 72 is an end-elevation. The two shafts are *swelled out* at the ends so as not to reduce the strength of the shaft by the key-ways, and also that the box may pass over any collars that may be on the shaft. The ends of the shafts and the box are firmly connected by the key *d*. It is usual to place couplings near to the bearings, as shown in the figures; the bearing is on the shaft *a*, and is marked *e*; *c* is the box.

The half-lap box coupling is represented in figs. 75, 76, 77, which are respectively end-elevation, front-elevation, and plan. The front-elevation is in section, showing the half-lap of the shafts and the connecting key. This coupling was introduced by Mr. Fairbairn.* The following are the proportions given by him:—

Area of coupling - - - -	= 2 × area of the shaft.
Or, in other words, diameter of coupling - - - -	= 1·4142 × area of shaft.
Length of lap - - - -	= diameter of shaft.
Length of box - - - -	= 2 × diameter of shaft.
To which may be added outside diameter of box - - -	= $2\frac{1}{4}$ × diameter of shaft.

(To be continued.)

Chemistry, Physics, Technology.

SPREADING DIPHTHERIA BY KISSES.

From the report of the physicians in attendance upon the grand ducal family of Hesse-Darmstadt during the recent outbreak of diphtheria which resulted in the death of Princess Alice, the range of the disease appears to have been sharply limited. From November 8 to the 14th six of the family were attacked; on the 6th, Princess Victoria, aged 16; in the night from the 11th to the 12th, Princess Alice, aged 6; on the 12th, Princess Mary, aged 4; in the night from the 12th to the 13th, Princess Irene, aged 12; in the afternoon of the 13th, the Hereditary Grand Duke Ernst Ludwig, aged 10; and on the 14th, the Grand Duke himself. Of the entire family, the Grand Duchess (Princess Alice of Great Britain) and one daughter (Princess Elizabeth) were only spared at the outbreak of the disease. The Grand Duchess, however, was attacked afterward. Immediately after the first member of the family (Princess Victoria) had fallen ill, she was seen by a physician and at once separated from all the others. The same caution was observed after the falling ill of the other princesses, but without preventing the outbreak of the disease in the rest of the family. In all cases there were large patches of false membrane on the tonsils, and in most of them swelling of the lymphatic glands in the angle of the jaw. All the patients recovered with the exception of Princess Mary, in whose case the disease from its very beginning had shown a very insidious character. No member of the household (in all 60 persons), no nurse, no physician was infected. It is, therefore, clear, the British *Medical Journal* asserts, that "all the cases were produced by direct infection, doubtless by kisses." The physicans ascribe the intensity and limited extension of the epidemic to three conditions: 1. To the intensity of the infection carried from outside, because the membrane in the case of the first patient (Princess Victoria) looked from their very appearance discolored and ecchymosed; 2. To the direct transference of the infectious matter by kisses; 3. To the condition of the mucous membrane of the tonsils and of the pharynx of the infected persons, all of them having suffered very frequently from acute and chronic affection of these parts.

The lesson to be derived from this not exceptional experience is very clear.

As every physician knows, it is no uncommon thing for adults to have diphtheria so mildly that it is mistaken for an ordinary sore throat resulting from cold; yet such a person can easily infect a child, and the child become a center of malignant infection. In view of the fatal prevalence of diphtheria, therefore, the kissing of a child upon the mouth by a person with a sore throat is hazardous, if not criminal; and scarcely less so is the practice of allowing children to kiss their ailing playmates. It would be wise o exercise great caution in this matter, if not to discontinue the practice of kissing upon the mouth altogether.

Engraving by Electricity.—A M. Bayley, of Paris, has invented an electric spark pen which possesses some points of interest. If a sheet of thin paper is attached to a plate of copper or zinc, it is stated that an engraving may be made with extraordinary facility by means of this pen. If one of the poles of a Ruhmkorff machine is attached to the plate and the other to the upper end of the pen, the current will run through, and in drawing the paper is perforated. When the drawing is finished, ink is laid on with an ordinary roller, and the greasy fluid penetrates through the holes. The plate is then plunged in water, which detaches the paper, and it is ready for immersion in the acid. The advantage claimed for this method is that the artist does all parts of his work and has no more trouble than if he were working with an ordinary pencil. He can even work in a dark room without any other light than the glare from the induction spark. —*Nature*.

Mr. Edison has perfected a machine for measuring the current used in the electric light—at least, so it is said, a saving clause which is necessary in any announcement with which Mr. Edison's name is coupled. If so, then we may shortly expect to learn the real nature and wonderful mystery of Mr. Edison's light. It is worthy of remark that the "notice to proceed" has been opposed in this country, a step rarely taken unless the opponents are tolerably sure of their facts, for of course it has to be taken in almost complete ignorance of the real nature of the inventions. A technical contemporary publishes the statement that Mr. Edison had not lodged any patent specifications in his own country for electric lighting, but on the other hand we are told that his patents will be issued at Washington next week. The fact appears to be that Mr. Edison has taken out so many patents and has still so many applications pending, that no one but himself or his agents can possibly know whether he has patented the electric light of the future. He has already reduced its expense below that of gas, but does not intend to disclose the results until he has found the minimum of cost. According to an "interviewer" of the New York *World*, Mr. Edison said:—"It is almost impossible to calculate with certainty the resources of my light, but I have engaged a mathematician to work out the problem from my data." We are afraid rather those reporters have fine imaginations. The statements made and the beliefs expressed by Dr. Siemens and Mr. Fresco of the Society of Arts last week will tend to allay the fears of the shareholders in gas companies.

Borax as a Preservative.—It is known that borax has been advantageously applied in preservation of meat. Some experiments have lately been made by M. De Cyon, as to the physiological action of that substance. He fed dogs, in one series of experiments, on meat preserved by M. Jourde's process, and in another on fresh food to which various quantities of borax were added. It was found that borax added to meat to the extent of 12 grammes daily (which is ten times what the Jourde's process requires), may be taken in diet without causing the least disorder of general nutrition. Further, borax substituted for marine salt increases the power of assimilating meat, and may greatly increase the weight of an animal, even when the alimentation is exclusively albuminoid. These observations, we are reminded, apply only to *pure* borax, *i.e.*, containing neither salts of alum and lead, nor carbonate of soda, which are often met with in the borax of commerce.

A new continuous brake is coming out. In addition to the usual brake blocks resistance is by the aid of electricity applied to the revolutions of the axles of the wheels. The inventor is Mr. W. Wiseman, of the Indian Public Works Department. We hope the invention is something better than the idea of increasing the adhesion of the engine wheels by converting them into magnets.

Deprivation of Solar Light.—It has been repeatedly claimed depriving miners of solar light injuriously affects their health. This point has recently engrossed the attention of Dr. Favre at the Commentry collieries. He does not think that the mortality of miners must be attributed to the action of the deprivation of solar light upon the blood, and cites by way of confirmation that he examined the blood of certain of the horses which were kept underground all the year, and he found the normal number of corpuscles in the blood.

Green Ink.—Dissolve 180 grains bichromate of potassia in one fluid ounce of water, add while warm half an ounce spirit of wine, then decompose the mixture with concentrated sulphuric acid until it assumes a brown color; evaporate this liquor until its quantity is reduced to one-half, dilute it with two ounces distilled water; filter it and add half an ounce of alcohol, followed by a few drops of strong sulphuric acid; it is now allowed to rest, and after a time assumes a beautiful green color. Add a small quantity of gum arabic and it is ready for use.

Remedy for Color Blindness.—*La France Médicale* states that M. Delbœuf has found that if a person afflicted with Daltonism looks through a layer of fuchsine in solution, his infirmity disappears. A practical application of this discovery has been made by M. Joval, by interposing between two glasses a thin layer of gelatine previously tinted with fuchsine. By regarding objects through such a medium all the difficulties of color blindness are said to be corrected.

Standing Room for the Human Race.—An Englishman with a hobby has discovered that there is room for all creation on the Isle of Wight. According to the most recent estimate the population of the earth is about 1,440,000,000. Two square feet of standing room being allotted to each individual, this number would cover 66,115 acres; and the area of the island is 93,341 acres.

A Man who Burst.—A German medical journal gives an account of a man who literally burst from taking four plates of potato soup, and many (how many is not stated) cups of tea and milk, followed by a large dose of bicarbonate of soda to aid digestion. His stomach swelled enormously, and tore the diaphragm, causing immediate death.

Carvers' and Gilders' Work.

Whiting and Limewash.—Lime is always apt to turn a bad color. The way to whitewash a ceiling is to first thoroughly wash with clean water, not one pail, which speedily gets dirty, but with several. Then steep balls of whiting in water, and the next day reduce them to a thick cream. Put a kettle on the fire, with sufficient size, and when hot pour it on the whiting, adding, at same time, some fine ground blue-black. The proportions are, say, 6 balls whiting, 2 lb. size, and from ¼ to 1 oz. of blue-black, according to taste. I prefer a blue tinge, and sometimes use washing blue for the purpose. The mixture must be allowed to cool before using. To limewash, clean first, and then proceed to make up the following: Take ½ bushel of lime, and slake it; add 1 lb. common salt, ½ lb. of white vitriol, and a gallon of skim milk. With a clean surface this will not shell off, neither will lime-white and size, when properly prepared and laid on a clean surface.

To Paint Photographs.—Oxgall is an excellent means of preparing photographs for water colors. It can be obtained from any artist's colorman, and must be used as sparingly as possible. If the first wash does not seem to answer, rub it gently in with a soft brush. It will catch the paper after a time. If the solution is too strong it may cause blotches in the paper, which would have to be painted over with opaque color. Experiment will teach the strength of the solution.

Gilding Letters on Wire Blind.—The letters should be first painted, but an experienced man can do without the paint. However, paint with lead-paint the letters—be sure the outline is clear, as that is where the failure may occur—when dry, paint with gold size, and lay out the leaf. If care be used, failure is out of the question.

To Make Plum Colored Paint.—Mix a quantity of red ochre in an iron pot with melted size: tone to color by adding more or less water to the desired tint; it is then brushed on the legs; when dry rub smooth with glass-paper, and varnish with 2 parts crown hard varnish, and one part French polish.

Miscellaneous.

Singular Occurrence.—The fishing smacks along the coast of Florida report a stream of fresh or poisonous water along the coast, that kills all the fish in its range. They report sailing for 200 miles through dead fish, covering the sea as far as the eye could reach, with all the varieties. Immediately on the shore the water is salt and natural, while less than a mile off it appears of a red brick colour.

A Humane Dog.—Two gentlemen who were passing a house in Worcester, Mass., recently, were attracted by a large Newfoundland dog, which kept running toward them and then returning in the direction of a pond in the grove, where something was evidently wrong. They followed the dog to the pond, where they found another dog in the water and unable to get out. His front paws were on the curbstone, but he could not get sufficient hold to draw himself up. He was nearly exhausted, and would probably have been drowned had not the gentlemen assisted him. The dogs showed their gratitude in unmistakable signs.

To Make Corks Air-tight and Water-tight.—A German chemical journal commends the use of paraffine as the best method of making porous corks gas-tight and water-tight. Allow the corks to remain for about five minutes beneath the surface of melted paraffine in a suitable vessel, the corks being held down either by a perforated lid, wire screen, or similar device. Corks thus prepared, the writer says, can be easily cut and bored, have a perfectly smooth exterior, may be introduced and removed from the neck of a flask with ease, and make a perfect seal.

What Makes a Car-load?—This question is thus answered by the *Butter, Cheese and Egg Reporter*: Nominally, an American car-load is 20,000 pounds. It is also 70 barrels of salt, 70 of lime, 90 of flour, 70 of whiskey, 200 sacks of flour, 6 cords of soft wood, 15 or 20 head of cattle, 50 or 60 head of hogs, 80 to 100 head of sheep, 6,000 feet of solid boards, 340 bushels of wheat, 400 of corn, 680 of oats, 400 of barley, 360 of flax-seed, 360 of apples, 430 of Irish potatoes, 300 of sweet potatoes, 1,000 bushels of bran, 130 to 180 barrels of eggs, and 15,000 to 26,000 pounds of butter.

Miscellaneous Mechanical Items.

Mechanical Wrinkles: Improved Method of Managing Steam Boiler Fires.—When the furnace door of a steam-boiler is opened, there should be a simultaneous partial closing of the damper to prevent sudden chilling of the boiler and flues. To accomplish this, with certainty, for every opening of the doors, Mr. William Weightman, of Powers & Weightman, has had arranged and applied a system of levers and rods, connecting the furnace door with the damper, so contrived that whether there be one or more doors to one furnace, or to which one damper is supplied, the act of opening any one door will invariably close the damper. Whether this application of simple and ingenious devices is new or not, every engineer will regard it as one of the good things for aiding the better management of steam-boilers.

To Prevent Rust.—Prof. Olmstead, author of "Olmstead's Natural Philosophy," gives the following as a preventive of rust: For farm implements of all kinds, having metal surfaces exposed, for knives and forks, and other household apparatus, indeed for all metals likely to be injured by oxidation or "rusting:" Take any quantity of good lard, and to every half pound or so, add of common resin ("rosin") an amount about equal to the size of an egg or less—a little more or less is of no consequence. Melt them slowly together, stirring as they cool. Apply this with a cloth or otherwise, just enough to give a thin coating to the metal surface to be protected. It can be wiped off nearly clean from surfaces where it will be undesirable, as in the case of knives and forks, etc. The resin prevents rancidity, and the mixture precludes the ready access of air and moisture. A fresh application may be needed when the coating is washed off by friction of beating storms or otherwise.

New Levelling Device.—Every millwright experiences difficulty in levelling shafting, when pulleys, hangers, walls, etc., are in the way of applying the "straight-edge" from bearing to bearing which it is desired to bring to a level. Mr. George Jennison, millwright at Powers & Weightman's, has adapted a very simple and readily-applied apparatus, which can be used without the usual "level-boards" and "straight-edges," and without regard to the obstructions in the way.

He takes an ordinary ⅜" or ½" gum tube, say 16 or 20 feet long, and to each end secures a stout glass tube 10" to 12" long; fills the gum tube with water to within, say, 4" of each end of the glass tubes, puts a cork in each, and the apparatus is complete. To use this, hold each glass vertically at the bearings, and withdraw the corks; the water will soon find its level, and show how the bearings stand with regard to the level line.

Steel Wire Ropes are coming more and more into use on shipboard, in mines, and for other purposes. An Eastern exchange, in alluding to their introduction on the great lakes as tow lines, speaks of one 660 feet long, and weighing only 800 lbs. Steel traction ropes are used by three street railroads in this city to haul the cars over our high hills. The California Street railroad employs a wire 1,800 feet long, which was made in two pieces of 900 feet each, 1¼ inches in diameter. The Clay Street road employs a wire made in a single length, 11,000 feet long and one inch in diameter. All these wires were made by A. S. Hallidie, of this city, from the best English crucible steel.

Preparing Wood for Polishing.—After staining, size over with varnish or polish; for mahogany, walnut, and similar woods, finish the surface with No. 0 sandpaper; oil with linseed oil, coloured red with alkanet root; let them stand for a time until the oil has thoroughly soaked in, then proceed to fill in the pores with the following composition: Plaster of Paris, 3 parts; tallow, 1; and a little red polish (ordinary polish coloured with dragon's blood). Work the whole until it is thoroughly mixed and becomes a crumbly mass. Rub well into the wood with a piece of rag, clear off all the superfluous filling in, and the surface is ready to body in and polish.

Fluxes for Alloys.—The best flux for alloys of copper and tin is resin. It should be added when the metals are almost melted. Another good flux is sal-ammonia. In using this flux the copper is usually melted first and the flux added. When it is in the mushy state, after the flux has been put in, the zinc and tin are then added. A good flux for old brass is common resin soap. It should be added in small lumps and stirred down into the metal when in the molten state. In forming alloys of different metals the molten metals should always be kept under a covering of black glass or pulverized charcoal, to prevent oxidation.

FIG. 1.

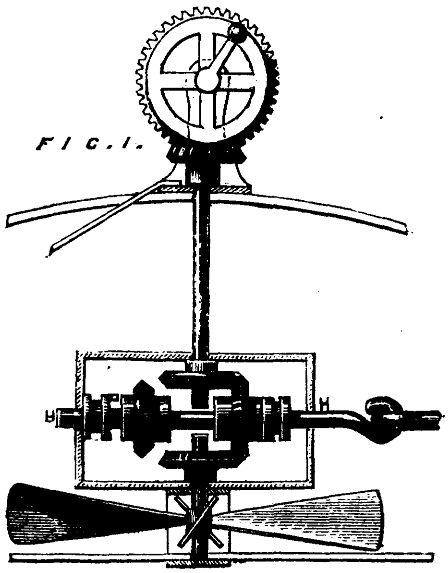
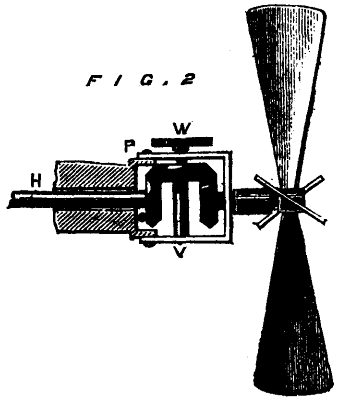


FIG. 2



THE NEW FLYING MACHINE.

We are now enabled to place before our readers the principal details of the new flying machine. It will be remembered that two very successful ascents were made with the machine, and sufficient was done to show that properly worked out the idea was the most practical of any then invented. The patent was secured a few months ago, in this country, by F. A. Lehmann, of Washington, and C. Ritchel, of Corry, Penn. The features claimed by the patentees are:—1st. Pivoting or journaling a propeller wheel upon the front end of the machine, whereby the machine can be made to move either backward or forward, or turn to the right or left, thus enabling the operator to move the machine in any direction desired. 2nd. The combination of a balloon, an operating mechanism, a propeller wheel to raise the machine, and a propeller wheel that is pivoted upon the front end of the machine, so that it can be turned in any direction, and which moves the machine in any desired direction. Fig. 1 is a side elevation of the devices for operating the lifting wheel; and Fig. 2 is a detail view of the device for operating the guiding and propelling wheel upon the front end of the machine.

The latter consists of a balloon of any shape, size, or construction, provided it has a lifting capacity sufficient to almost lift the apparatus together with at least one person, thus leaving very little for the lifting wheel to do. By thus giving the balloon such a lifting power all the more force may be applied to driving the machine back and forth and from side to side, and the descent will be more easy and gradual. Secured to the under side of this balloon, by means of suitable light strong rods and braces, is a frame of any desired construction or material, for the support of the operator and the driving machinery. Resting upon two of the cross bars of this frame is the seat upon which the operator sits, and this seat is so located in respect to the machinery as to enable him to apply his whole strength to the propulsion and management of the machine.

To the main driving wheel is secured a crank, by means of which the machinery is operated. This bevelled wheel meshes with a bevelled pinion, which is secured to the top of the vertical shaft Fig. 1. To the lower end of this shaft is secured a bevelled wheel, which is always in gear with one of the two bevelled wheels on the horizontal shaft H. These two wheels are placed loosely on shaft H, and gear at their lower edges with a bevelled wheel on the top of the shaft, to which the lifting propeller wheel is secured. Feathered upon the shaft H, on the outer side of each wheel, is a clutch, which may be thrown in gear alternately with either wheel by means of a hand lever, placed within easy reach of the operator. By throwing one clutch in gear the propeller will be made to revolve in one direction, and lift the machine upward, and by throwing in the other clutch the shaft H will revolve in the opposite direction, and cause the machine to move backward.

The shaft H may be made in one continuous piece, or may be jointed, as here shown, and have its forward end project through the front of the frame to receive the bevelled wheel S, Fig. 2. This wheel meshes with a similar wheel placed on the vertical shaft V, journalled in suitable bearings, which wheel communicates motion to the wheel secured to the inner end of the shaft to which the guiding and propelling fan is secured. The frame carrying the propelling fan and the gear is pivoted, P, to the supports extending from the balloon; hence the fan can be moved around to either side. A treadle is placed near the foot of the operator, to which is connected a rod, the front of which has a rack formed upon it for the purpose of engaging with the wheel W, secured to the top of the vertical shaft V, to which the bearings of the propelling fan are secured. The operator, by pressing with his foot upon the treadle, can turn the propelling fan to the front, or around to either side, or to any intermediate point between. The operator having started the main driving wheel, throws one of the clutches in gear, and the propeller (Fig. 1) causes the machine to rise upward, at the same time as the propelling fan causes the machine to move forward. By means of the treadle the operator causes the propelling fan to turn in any direction, and thereby makes the machine move straight ahead to either side, back, or turn completely round, as upon a pivot. By reversing the horizontal fan the machine will descend at any desired rate of speed, and the front propeller (Fig. 2) may be made to stand still if desired. Although the latter is shown as having only a horizontal shaft, the patentees may in some instances use a universal joint, and thus employ it for assisting the machine to rise vertically upward and to descend, as well as to move the machine backwards or forwards or around in a circle.

Correspondence.

To the Editor of THE SCIENTIFIC CANADIAN:

DEAR SIR,—Calling your attention to your article "Room for Invention," page 41, February number, let me assure you that the navigation of the air need not long remain undemonstrated; in these times science and mechanism can supply everything needful to a good, practicable air-ship, which will travel at great speed, and be perfectly under control. By giving these remarks publicity, you may assist science by attracting the needed capital to practically prove the feasibility of aerial navigation.

Communications addressed "Aeronautica," P. O. Lachute, P. Q., will receive attention.

[Our correspondent will find on this page something *à propos* to his communication.]—ED.