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SCIENTIFIC CANADIAN
MECHANICS' MAGAZINE
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Vol. 8. JULY, 1880. No. 7.

THE RECIPROCAL DUTIES OF ARCHITECTS AND THEIR EMPLOYERS.

ARCHITECTS' RESPONSIBILITIES.

It is customary with almost every person who has employed an architect to design and superintend the construction of a dwelling, to throw blame upon him after its completion for many things that really the architect was in no way responsible for, and we know many who have employed almost every architect in the city of Montreal and felt equally dissatisfied with the services of them all. Surely they were not all incompetent or to blame. We are inclined to believe that there are many people in this world who are never satisfied, always discontented, always believing every man to be a rogue, and too often thus judging others as they should be judged themselves.

The heaviest charge at first brought against architects by their employers is that of going beyond their estimates. That, we acknowledge, is too often the case, but in most instances the fault lies with the employer. When the extra pulls on his purse commence for sums beyond the original estimate, then commences dissatisfaction, charges of negligence, and suspicions of venality on the part of the architect. On the other hand, the architect complains that too often he even incurs the displeasure of the owner—tacit or expressed—more for attempting to control his employer's inclination to lavishness than endeavouring to lead him into avoidable expense. In nine cases out of ten, however, these additional expenses have been incurred by additions and changes the owner has gone into, voluntarily himself, after the contracts have been given out and the work commenced, which, had he known his mind at first, could have been executed at half the cost. When the day of reckoning comes, and the extra bills paid, the owner finds it a relief to his feelings to lay the blame of over-expenditure on another's shoulders. On the other hand, some architects are in the habit of leading the tastes of the employers into the adoption of a great deal of costly, glaring, pseudo-ornamentation in the expectation that the public will be attracted by the glare, and that it will be an advertisement at their employer's expense.

In the case of public buildings the facilities for increasing the expenditure, whether lawfully or unlawfully, are greatly in the excess. The matter being left in the hands of a building committee, no member of which is personally responsible, and often personal interests, more or less direct, to advance local, social, or family; or perhaps direct pecuniary interests being connected with some line of the building trades to which he himself belongs. Some members of these building committees have considerable influence and weight, but are so ignorant of architecture that they frequently are the cause of estimates exceeding in cost—by even a third—the original estimate, of which Trinity Church is now a notable example.

We have always held the opinion that architects have a moral responsibility on the side of the public as apart from their own personal emoluments and professional ability (which, however, the financial manager of public buildings seldom allow to them.) An architect is morally bound to use whatever influence he possesses to dissuade building committees from wasting the money collected for religious or public beneficience on showy facades or meritricious ornament at the expense of interior space and convenience and sanitary arrangements, and, consequently, at the health and expense of the community for whose health and comfort the money was given. The money wasted upon churches by building committees composed of extravagant, unpractical and interested men has been the cause of dissensions and differences that have gone farther to drive people from worshipping God in a proper humble and lowly spirit than to bring them to Him.

Unfortunately, faithfulness to what is right on the part of the honest and independent architect, will not be rewarded according to his integrity to what is right, but according to his pliancy, egotism and greed; and the effrontery and impudence, the trickery and falsehood which are born of them. These are the men who generally pretend to be so philanthropic as to make designs for churches gratuitously, and thrive upon it, but somehow involve the churches in a debt perhaps to nearly half the amount of the original estimate. Verily, virtue has its reward, and contractors know it.

It unfortunately happens that even though members of a building committee be ever so honest, though they may be shining lights of the church or the exchange, they hardly ever have any available knowledge, for practical purposes, of the theory or technics of buildings. Sometimes one among them may have acquired a little architectural knowledge from books, or may have built a stereotyped house of his own ; may know the market price of bricks, and may have read of a little on the mixing of mortars ; and he, when placed on a committee, is a terror. The ideas of such a person are always hazy. He speaks, probably, of what he does not understand, and the greatest misfortune of having such a person on a committee is that his impartial opinions are given in opposition to the architect, so his vanity is offended, because they cannot be carried out, and he becomes then a stumbling block to the progress of the works and a nuisance.

There is a great deal of confusion in the public mind as to the limitation of those who are employed to direct construction, and it is not impossible that architects themselves do something to increase the confusion in their eagerness for employment and bind themselves to terms of excessive harshness.

There is a popular idea that the architect is somehow responsible, not only for his work, but for that of all the contractors for a building. He is supposed to be in some way capable of watching at once all the workmen employed in a structure, through the whole of their working hours, so that the mechanic who has been astute enough to conceal his bad mortar and rotten timber, during the periodical visits of the superintendent, passes for only having yielded to the impulses of nature ; while the architect, who has failed to find him out, is denounced as incompetent. Perhaps in practice, want of care and diligence is more frequently imputed to architects, than want of skill ; but as to the penalties for want of due care and skill, there seems to be some variations in the practice of different countries.

The French Code, sect. 1792, says : "If the edifice, "built at an agreed price, perish in whole or in part, by "faults in its construction, even by defects in its foun-" dation, the architect and builder are jointly resposible," and, in substance, that is the law of England and the United States ; but the French law makes further distinctions. The architect and builder are jointly answerable for any damage that may accrue to the building for ten years after its completion, provided some damage arises from defects in construction, &c., but the French law has further decided that the architect is solely responsible for damage or failure in a building which has been strictly carried out in accordance with his plans and under his directions ; if the workmanship and materials were not defective. Another decision extends the responsibility of the architect to all cases of damage which may result from a violation or ignorance on his part of the rules of art which he professes, or the laws which it is incumbent for him to know.

This is rather a hard doctrine considering that the architect is supposed to have no interest in permitting the use of bad materials, and can only wholly prevent it by extreme watchfulness.

One of the French commentators asserts the existence of an important rule, that if the superintending architect has given the proper directions for the execution of the work ; and has, before they are actually in place, pointed out the defects in the materials on hand, he escapes liability ; but, then, this must be done under notarial protest. The principal then is the cause of the damage, that is, the contractor or workmen, who by fraud or negligence, has badly executed the work which was confided in him. He is the immediate cause of the damage, and should furnish the reparation. The negligence of the architect is only secondary and accessary, and he should be held as a subsidiary, as a bondsman in case of insolvency of the principal delinquent. We believe that is a point in our French law not generally understood, and there is at least some little comfort in it.

It would seem that there is no want of law to hold the architect to his duty to his employer ; and if the courts set up a high standard of professional deligence and skill it must be acknowledged that the emoluments of the profession should be guided by the same rules as regards fees, that binds the members of nearly all other professions, whereas, on the contrary, the architect who will work for the lowest commission is the most patronized, and professional skill goes for lttle. A man is not an architect who is merely a draftsman, or who can make a classical design. He may know nothing of the practice of the profession ; and yet there are many such so-called architects. There are many people who think an architect is a sort of a cross between a mason and a sketcher, and that his time and labour are not guagable for practical and renumerative purposes as other men's purposes are. It is time, indeed, that employers became better educated and better enabled to place a proper estimate upon the value and skill, and the cost of rendering it upon paper for the use of his employer.

Would any man venture to offer a lawyer, notary, or physician, a set sum for his professional services, or expect him to charge less than the schedule rates adopted by each profession ? Why then should architects, whose profession is one of the oldest and highest, submit to these exactions, which are perfeclty unnecessary, if they would only be united and honest towards each other.

Correspondence.

F. N. Boxer, Esq., Editor, Scientific Canadian :

Dear Sir,—Thanks for the information afforded to me in your interesting publication, The Scientific Canadian and Patent Office Record. I have been a subscriber since it started and it is with pleasure that I write to inform you that every year I like it better, and from every number I receive information which more than pays me for the number.

Having served my apprenticeship in Canada, I think the paper has a claim on me, and not only upon me, but every Canadian who wishes to rise in his calling.

Yours truly,

W. H. Banfield.

Dominion Tin Stamping Co.

Toronto, June 10th, 1880.

We regret that the Illustration of the Suburban Residence mentioned on page 183 of the June Number, has been mislaid, and as the letter press of the magazine had been printed in advance of the Illustration, the paragraph descriptive of it had to remain.

Ed. S. C.

HINTS ON THE USE OF DISINFECTANTS.

The *Manufacturer and Builder*, in an article on this subject, affords the following useful information:

It is a safe rule to follow, not to use a disinfectant of whose composition you are ignorant. The commonest disinfectants are, sulphur, the hypochlorites, carbolic acid and its compounds, and metallic salts, chiefly those of iron and zinc. This enumeration, while it is not by any means complete, is nevertheless sufficiently so for all practical purposes, since those that are not included in this classification are either of questionable value or too expensive for general use.

Stated in the most general way, there are three different conditions under which disinfectants are required: (1) The purification of an infected atmosphere; (2) the purification of sewers, gutters, cesspools, water-pipes, water-closets, and similar places where putrescible matter may accumulate in quantities; and (3) the disinfection of clothing, bedding, utensils, etc., used in and about the sick chamber.

The purification of an infected atmosphere, as of a ship, house, hospital, etc., can be effectually accomplished only by the use of some disinfectant that shall give off some gaseous element that may pervade the entire space and penetrate into every nook and corner. For this duty, a volatile agent is called for, and the first three substances named in our list are the most generally employed—namely, sulphur, hypochlorite, of lime (commonly called chloride of lime) and carbolic acid.

In every such case, the entire space or apartment should be effectually closed against the escape of the purifying agent, and the atmosphere should be thoroughly saturated with it for at least twenty-four hours. The sulphur should be burned in open vessels, the chloride of lime acidified with dilute sulphuric acid, and the carbolic left standing about in vessels open to the air. When the thorough impregnation of the atmosphere has been effected, it will be advisable to thoroughly scrub the wood-work with a one or two per cent. solution of one of the metallic salts, preferably the chloride of zinc. Of the three disinfectants named above, sulphur and chloride of lime are to be preferred as more certain in their action, since carbolic acid of commerce is notoriously unreliable in quality, and the very pungent and persistent odor that even a trifling quantity of it leaves behind, is apt to create a false sense of security.

The purification of sewers, gutters, kitchen sinks, drain-pipes, water-closets, etc., is best accomplished by means of the metallic disinfectants, of which the best known and the most effective are the salts of zinc and iron; and as the best known representatives of this class of compounds we may name chloride of zinc (Burnett's Fluid, also known by the trade name of No. 1 Disinfectant), and sulphate of iron (copperas). The action of these compounds is not very unlike, as they act on the sulphur and ammonia compounds to which the offensive odor of decomposing animal and vegetable refuse is to be chiefly ascribed, and bind them in the form of solid and inodorous combinations and also act on the albuminous constituents of such refuse to coagulate them, and thus hinder their further decomposition. Of the two disinfectants named as best adapted for this form of disinfection, green vitriol has been and is most commonly used, because of its cheapness; but the zinc salts is much more prompt and effective, and if its price could be brought low enough to enable it to compete with that of copperas, it should be preferred to the latter. Of late, it may be added in this connection, there have been decided advances made in the production of cheap zinc salts, by patent processes for utilizing certain wasted products of the galvanizing works; and it is affirmed that zinc salts (chloride or sulphate) can now be supplied at prices considerably below those that have hitherto ruled. We should add here that neither carbolic acid nor chloride of lime can be used to good purposes to any large accumulation of offensive matter—as, for example, in sewers, gutters, cesspools, water-closets, etc., for the following reasons: The quantity of carbolic acid required for the task of purification would be so great as to place its use out of the question on the score of expense. And the action of the chloride of lime will be speedily checked by the alkaline character of such bodies of decomposing refuse.

For the disinfection of the sick chamber, the bed linen, towels, and necessaries there in use, zinc salts are greatly to be preferred to any others. The chloride of lime and carbolic acid are unendurable by reason of their disagreeable and irritating odor, while the zinc salts is odorless. A sheet or towel suspended in the room, and from time to time dampened by immersion in a dilute solution of this kind will be generally found sufficient to keep the atmosphere of the room quite free from disagreeable odors, by reason of the air currents which the evaporation of the moisture establishes, bringing the air of the chamber in contact with the disinfectant.

The rules prescribed last summer by the National Board of Health, and of which we give below a brief summary, will be found to agree substantially with the suggestions contained in the foregoing. The National Board recommends for fumigation (that is, the purification of an infected atmosphere), roll sulphur: for cesspools, sewers, etc., sulphate of iron, (copperas); and for clothing, bed linen, etc., zinc salts.

Dr. J. Lane Natter, of the British Army Medical Department, who has made a most careful and thorough experimental study of the comparative value and merits of the disinfecting fluids and powders most widely known and used, has reached substantially the same results.

SHEFFIELD WATER FOR TEMPERING STEEL.—A curious example, which illustrates to what extent prejudice may influence the "skilled workman," was lately brought to light in the case of a number of Sheffield cutlers, who were imported into this country by an English manufacturing firm, who proprosed to make Sheffield razors in the states. The cutlers having, somehow got the notion that American water would not suit for hardening, they actually had tanks specially built for the purpose of storing a supply of Sheffield water, and carried it across the Atlantic. Here we follow a correspondent of the London *Trade Journal*: "The day came when the water was exhausted, and recourse was had to the native element. Then it was found that the rumour was no fiction. The American water would not harden razor-blades, nor even give the polish necessary for the secondary sorts." The result of this unfortunate state of affairs, the *Journal* adds, was the return of the wanderers, and saving Sheffield from the fear of seeing one of her oldest industries transplanted to the States.

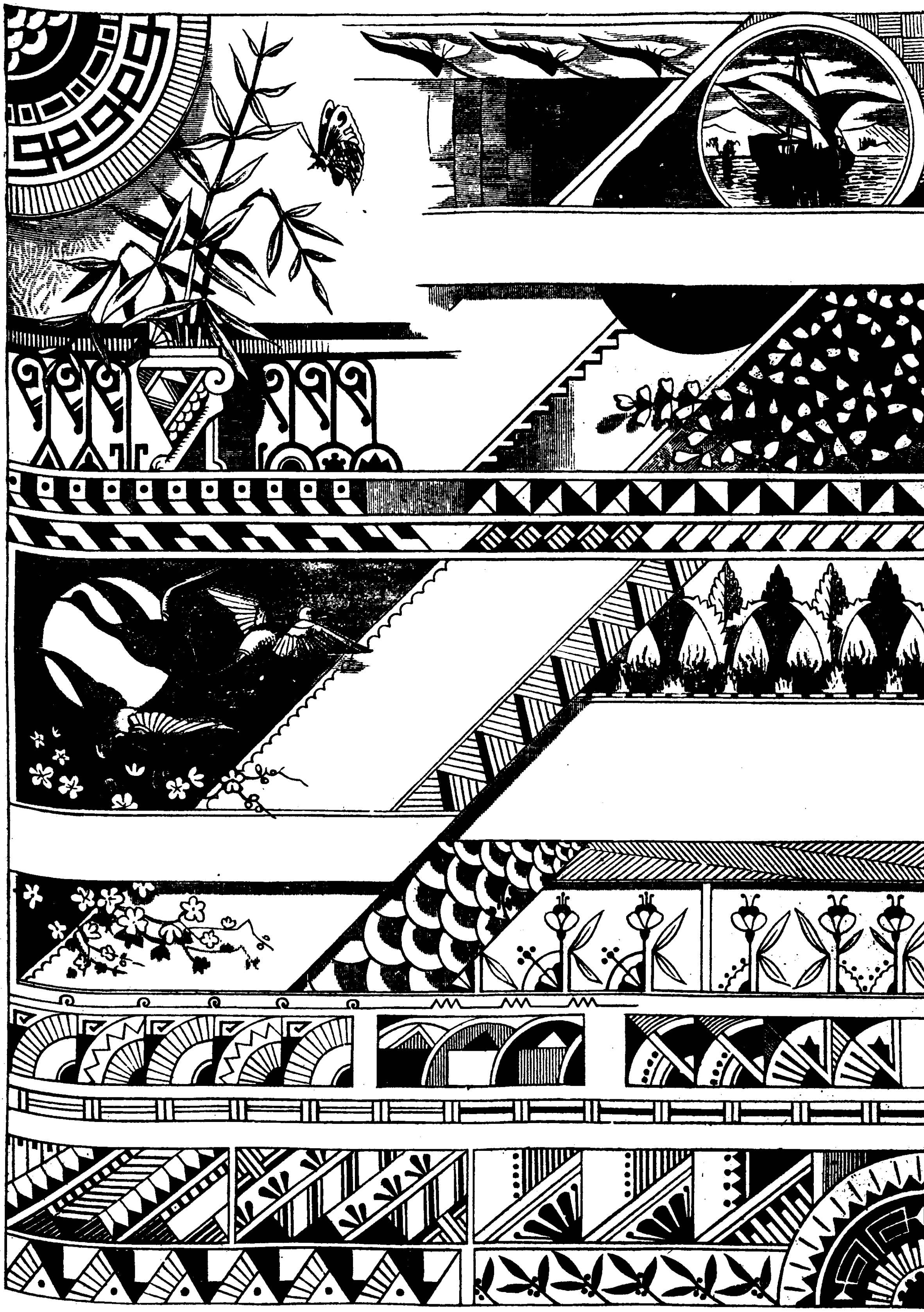
We remember seeing a mention, at the time, of the fact that a lot of Sheffield cutlers had brought their native water with them, but looked upon the statement as too absurd for serious belief. But the verification of the fact removes all doubt. For ignorant prejudice and bull-headed stupidity, the Sheffield cutlers deserve the champion belt. The time was not long ago, one of our exchanges remarks in taking note of this fact, when English blacksmiths in this country could work with nothing but English steel; and when given anything which they suspected ro be American steel, they were sure to spoil it, and were vehement in their assurances that it it could not be worked successfully. This lasted until employers found out that American steel could be worked as well as any other, if it only had English marks on it; and when the blacksmiths found they had to choose between American steel or looking for another place, the change in the quality of the home-made product was surprising.

The notion of the Sheffield cutlers is, of course, the most arrant nonsense, and eould only have had its origin in ignorance and prejudice. We are surprised, however, to find the London *Trade Journal* take it up without comment. Tempering steel and making Burton ale are two very different operations.

MICROSCOPIC TESTS.—Mr. B. G. West has succeeded in tracing on glass the curves called after Lisagou. He has traced these in lines of 55,000 to the inch, and finds that they are much better for testing the power of a microscope than straight lines. Aside from their great beauty, and the necessity of skilful illumination to see them well, the intersection of some lines and the gradual approximation of others arising from the variation in the figures, where every degree of the sharpness of a curve is obtainable, from a line returning almost upon itself at an exceedingly acute angle, to curves so flat as to present in parts virtually the appearance of parallel straight lines—all this, combined with a knowledge up to a certain point of the nature of all lines cut in glass, make these rulings more instructive perhaps than the markings on diatom valves, in regard to which there is as much question. A curious feature of some of these figures is that though all the lines would seem to be in the same plane, it sometimes happens that an alteration of focus is requisite to bring out the transverse lines. The same fact has been noticed in observing the transverse markings of the diatomaceæ.

HOW BIRDS SING.—It seems difficult to account for so small a creature as a bird making tones as loud in singing, as an animal 1,000 times its size. But it has been discovered that in birds the lungs have several openings communicating with corresponding air bags or cells, which fill the whole cavity of the body from the neck downwards, and into which the air passes and repasses.

JAPANESE ORNAMENTATION.—See page 218.



JAPANESE ORNAMENTATION.—See page 218.

New Publications.

BOOK OF JAPANESE ORNAMENATION, COMPRISING DESIGNS FOR THE USE OF PAINTERS, DECORATORS, DESIGNERS, SILVERSMITHS AND MANY OTHER PURPOSES.

By D. H. Maser.

The most obvious peculiarity of Japanese ornamentation, as compared with European and American forms of ornamentation, is its *unexpectedness*. That is to say, where for instance in our ordinary style, the four sides of a rectangle would have each quarter like the other, or each half like the other, the Japanese artist throws an ornamental ribbon, bar or border across one corner, or across the whole figure, say at a distance of one-third or two-fifths the length of the figure from its left-hand side. He rejects the idea of *balance*, to which European and American painters have always conformed with almost servile fear. Yet no one will deny to Japanese ornamental art a grace, a lightness and a consistency peculiar to itself, which makes it acceptable to the eye—just as freshness or originality in speech win attention to the speaker, and produce an undefined sense of pleasure in the mind of the hearer. Let the reader, however, not fancy that in this seeming irregularity of his, the Japanese designer produces a feeling of incompleteness or one-sidedness. On the contrary, marked by continuous surprises as his style is, you will see that all parts of the design harmonize—at least harmonize sufficiently to secure the result desired. Sometimes it seems as if the draughtsman or painter wished to suggest that a piece of broken ornament was thrown upon his work and stuck there--but he never fails to have such an intruding piece of ornament blend sufficiently with the whole. Not too much, however ; he knows too much to wish to subordinate the play of his fancy entirely. We have known artists who were so careful about balance and exact harmony of color and form, that their work entirely lacked emphasis ; no part of it was conspicuous—in short, the whole thing when done was so tame as to obtain little or no notice—although to attract notice was the chief object of its existence at all.

Let then the user of this book take to heart this fact, that within certain limits it is not necessary to have perfect balance and absolute harmony. That the outlines of a sign, for instance, ought of course to be uniform, generally speaking, but within the limits of that outline may be painted an oblique bar, a semi-circle, a quarter-circle, a bird, a kite, a ship or a vase, introduced in an unexpected position—looking, indeed, as if it might be by accident—which shall relieve that figure and all within its lines of monotony, and makes it fairly conspicuous, or emphatic. On the other hand, let the painter or designer beware of crowding his ground. If any one will examine Japanese ornament, especially any of the popular kind (for the very expensive articles in Japan are sometimes overloaded with ornament) he will see that the artist gains his effects with few touches. The American designer is tempted by the ease with which the thing is done to put in a bird, a bar and the quarter-circle, a vase and a tree ; when one, or at most two of these give his design greater strength.

This book does not pretend to give a complete view of Japanese decorative art. That would be impossible within its present limits or at its cost. It would also require the aid of colors and a book at least ten times the extent of the one before the reader. What we have sought to do is to give as many of the most useful ornaments as possible within the space allowed. When wishing to make use of this volume, the designer or painter will select what he wants. A border, band or corner piece, for instance, will sometimes have two or three methods of treatment within a space of a few inches. The designer will take of this only the part most suitable, and carry it out to completion without regard to the other similar portions in the same figure, or he can often use the band with its variations. The intention is to furnish *ideas*, and to give as many as possible.

Shading is not characteristic of Japanese work, ornamental effects being obtained in most cases by flat work in contrasting colors. The human figure and drapery is sometimes shaded slightly. The colors are generally positive, though often a sky or water is introduced, beginning in a positive and melting into a middle tint. The Japanese artist has perhaps not at his command the many colors or tints to which the Western painter is indebted for his effects—at any rate, he depends mainly on Red, Yellow, Gold, Blue, Orange, Purple and Emerald Green.

The first specimens of Japanese work which came to the notice of our people seemed barbarous to eyes accustomed to an entirely different school. The "loud" coloring, fantastic forms, and seemingly incongruous designs defied our own theories of decorative art. But as the first strangeness wore off, we began to perceive that the Japanese designs had a richness and force which formed an agreeable contrast to those which were prevailing with us. The uses to which "Jap" could be applied were found to be remarkably extensive, and at the present writing it bids fair to be the prevailing style for at least a season. That it will by and by culminate and wane is probable, but it will unquestionably for many years be extensively used and maintain its popularity for some purposes. It is, certainly, a very acceptable addition to our decorative art.

We trust the following pages will be found useful to those for whom this book is intended. If it should be found so, it will be followed at an early day with other works embracing designs calculated to suit the ever-changing taste of the public. The price of this book, which is quarto size, is $2.00. Orders sent through the Editor of the Scientific Canadian, 243 St. Denis street, Montreal, will receive prompt attention.

PROF. HUXLEY'S INTRODUCTORY.*

The long-promised introductory science primer by Prof. Huxley has made its appearance, and though the delay has been rather vexatious to those who were using the other primers, the quality of the matter makes amends. In his own manner Prof. Huxley touches upon the salient facts in nature and science, and in a few sentences conveys as much information to the minds of his readers as some writers can do in as many pages. The book answers strictly to its title ; it is introductory, and leads the way to the study of the other primers in the series. In less than 100 comparatively small pages, Prof. Huxley has covered the whole field, so far as introduction is concerned, and covered it in such a manner as to make the old information partake of some of the freshness of new discoveries. The work is divided into three sections. 1, Nature and Science ; 2, Material Objects ; and 3, Immaterial Objects. The chief merit of Prof. Huxley's work is that he not only puts what he has to say very clearly, but he drives it home with some happy illustration that the student is not likely to forget. No one who carefully reads the few lines forming the section headed "The Reason Why" is likely to confuse cause and effect, or to imagine that he has completely explained a phenomenon when he has discovered its proximate cause. The fundamental principle of all progress is well expressed by the statement that "the improvement of the arts depends upon our learning more and more of the properties and powers of natural objects, and discovering how to turn the properties and the powers of things, and the connections of cause and effect among them, to our own advantage." In explaining what are the laws of nature, and the difference between law and cause, Prof. Huxley makes the distinction clear, and then enforces it by suitable comparisons. Stones do not fall to the ground in consequence of a law, but the law is a way of asserting that which invariably happens when certain causes are at work. He compares the laws of nature with human laws, and points out that just as a man who breaks the latter will speedily find himself "in trouble," so if any one attempts to live contrary to the laws of nature his life would be but a short one ; for we cannot alter the seasons nor change the processes of nature, but by such knowledge as we can acquire of those laws we can take advantage of them. Then comes the question as to what is knowledge. All accurate knowledge is science, and all exact reasoning is scientific reason, but, says Prof. Huxley, there is not one person in a hundred who can describe the commonest occurrence with even an approach to accuracy. Either he will omit something which did occur, and which is of importance, or he will imply or suggest the occurrence of something which he did not actually observe, but which he unconsciously infers must have happened. Thus the difference between common knowledge and scientific knowledge is just the difference between the observations of the untrained and the trained observer, and consequently scientific observation is at once full, precise, and free from unconscious inference. Anything short of that is not scientific knowledge. Untrained observers, says Prof. Huxley, mix up together their inferences from what they see with that which they actually see in the most wonderful way ; and even experinced and careful observers are in constant danger of falling into the same error. Hence, the really scientific man accepts nothing as true until it has been demonstrated beyond the possibility of doubt. He will, however, accept a probable explanation, and treat it as a "good working

* Science Primers. Introductory. By Prof. Huxley, F.R.S. London : MacMillan & Co.

hypothesis," but all the time he keeps his mind open to receive and duly weigh fresh facts and other hypotheses, which may run counter to his own. Prof. Huxley drives this fact home by the use of homely illustrations : it is a matter of common observation that water sometimes freezes, or that wood floats upon water ; but the observation does not become scientific until the exact conditions of the freezing, and the reason of the floating, are discovered and defined. From scientific knowledge to scientific reasoning is but a step, and the latter differs from ordinary reasoning in just the same way as scientific observation and experiment—that is, it strives to be accurate, and is not considered sound until it has been severely tested. Science and common sense are not opposed, as it is sometimes asserted, but the former is the latter perfected. Therefore, the way to science, says Prof. Huxley, lies through common knowledge : we must extend that knowledge by careful observation and experiment, and learn how to state the results of our investigations accurately, in general rules or laws of nature ; finally, we must learn how to reason accurately from these rules, and thus arrive at rational explanations of natural phenomena, which may suffice for our guidance in life. We have dwelt on the introduction to Prof. Huxley's Introductory because it serves not only to show his method of treating his subject, but at the same time teaches the primary or fundamental truths of all scientific learning : in the second section he has introduced a multitude of facts, and has compressed the text for whole volumes into a few pages. There is, of course, nothing novel in the facts stated, but the manner of stating them is remarkable for its simplicity and forcefulness. Here and there we come upon passages which old students would do well to ponder, as in the short articles on "Suppositions or Hypotheses," in which Prof. Huxley, while pointing out that it is perfectly legitimate, and often extremely useful to make a supposition as to what we should see were it possible to carry our direct observations a step further, declares that we are bound to throw away an hypothesis without hesitation as soon as it is shown to be inconsistent with any part of the order of nature. His example of an hypothesis is a good one. If two persons are alone, and one is struck on the back it is a legitimate hypothesis for him to suppose that he was struck by the only other person present, because, in the first place, it explains the fact, and, secondly, because no other explanation is probable. The other person may suggest that the blow was only the result of fancy, or that an invisible spirit was the striking agent. Either hypothesis is improbable, because, in the ordinary course of nature fancies of the kind do not occur, nor do spirits strike blows. Hence, the latter hypotheses are illegitimate, while the former is legitimate—a "good working hypothesis," to be thrown aside when, and only when, a more probable explanation of the blow is forthcoming. In the affairs of everyday life we are constantly inventing hypotheses ; we believe a man on the hypothesis that he is always truthful ; we gave him credit on the hypothesis that he is solvent, and the hypotheses are perfectly legitimate. Hypotheses are just as legitimate and necessary in science as in common life, only we must be careful to regard them as a means, and not as an end, and hold ourselves ready to discard them the moment they are shown to be antagonistic to the order of nature. It is easy to discriminate between a fact and an hypothesis. Up to the present time, no one has been able to get out of pure mercury anything but pure mercury—that is a fact ; and it is a legitimate hypothesis to assert in consequence that mercury is a simple substance which cannot be broken up into others. It is not a fact, because just as a hundred and fifty years ago water was believed to be an element, so fifty years hence somebody may succeed in dissociating mercury, and prove as a fact that it is not a simple substance. The section treating of immaterial objects is necessarily a short one, a page and a half containing all that Prof. Huxley thinks it advisable to write on that branch, but that suffices to draw a clear distinction between sensations, emotions, thoughts, and things or objects. The little book, which might easily have been much better printed, will doubtless have, as it deserves, a large sale, and probably in future editions, the few errors it contains may be eliminated. Such expressions as "an universal" are pedantic, and the statement that gluten is the substance known in commerce as "maccaroni" is likely to lead to misconception, for maccaroni, though made from flour rich in gluten, is not exactly gluten pure and simple. These, however, are small errors in an excellent primer.

LIME has never been found in a native state ; it is always united to an acid, as to the carbonic in chalk. By subjecting chalk or limestone to a red heat it is freed from the acid, and the lime is left in a state of purity.

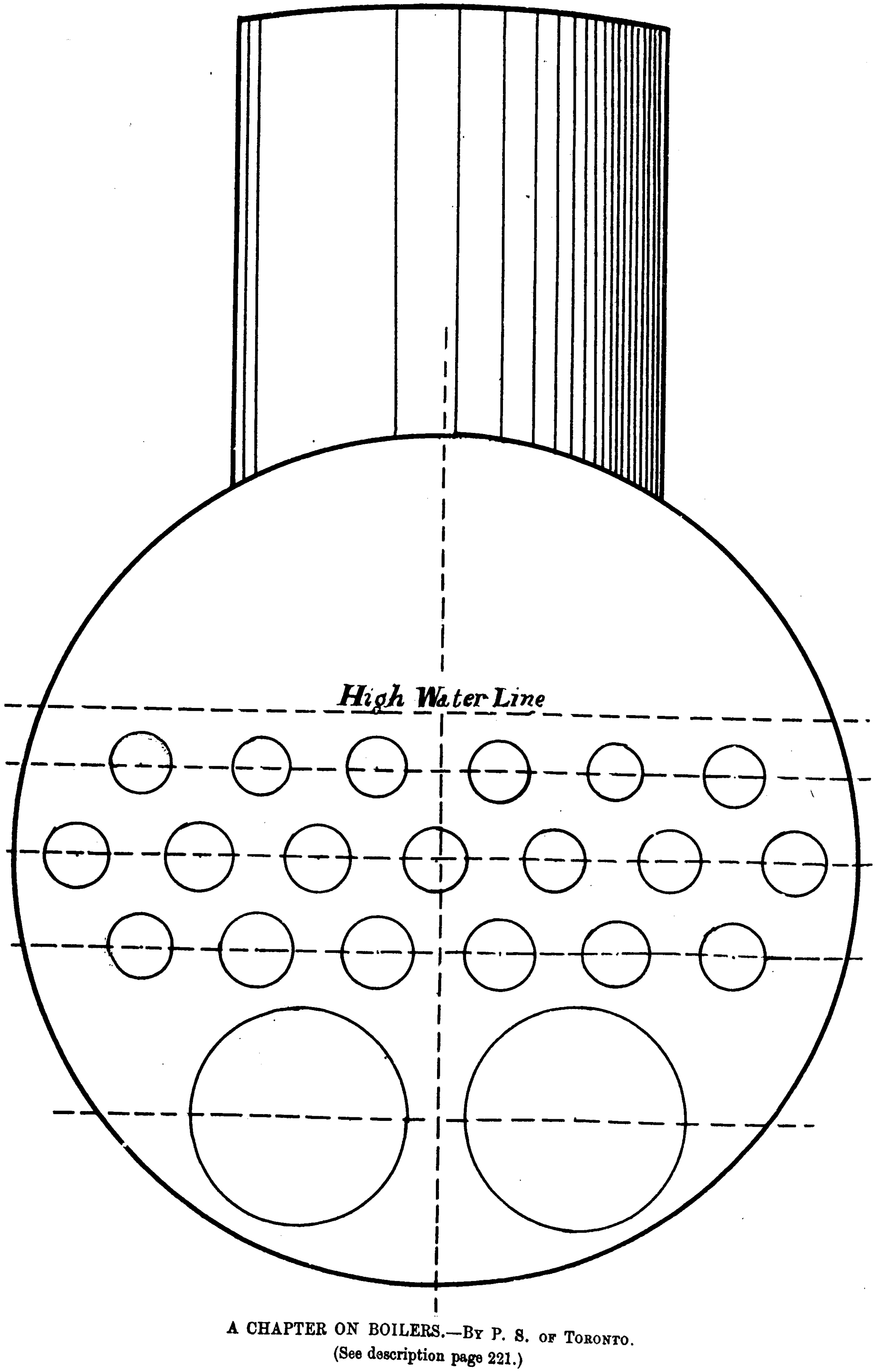
THE COMING COMET.

In a letter to the Boston *Advertiser*, Professor Benjamin Pierce, of Cambridge, says that he is fully persuaded that the comet recently discovered by our eminent American Astronomer (Dr. Gould in South America), is a return of the wonderful comet of 1843, which has been considered as in many respects "the most interesting of any on record" (Cooper's Cometic Orbits). The first record of this comet is in 1770 before Christ, with an average period of about seven years. The subsequent visible and recorded returns are, 370 before Christ, 252 and 183 before Christ, and after Christ 336, 422, 533, 582, 708, 729, 882, 1077, 1106, 1208, 1313, 1362, 1382, 1402, 1454, 1491, 1511, 1528, 1668, 1689, 1702, 1843, and 1880."

The appearance of this comet in 1843 is thus described by Professor Pierce .

"About noon on the 28th of February, 1843, groups of people in many of the towns of New England, especially in Portland, Maine, collected at the corners of the streets, gazing up toward the sun. Protecting their eyes in the shadow of the houses, they saw a brilliant object close to the sun. Such a marvelous spectacle had never before been seen. A thoughtful sea captain Mr. Clark, brought out his sextant, and repeatedly measured the distance of the strange object from the limb of the sun. These unique observations are on record, and submitted to rigid criticism, attest the accuracy of the observer. In about a week from this time a wonderfully brilliant tail of a comet was seen skirting the horizon soon after sunset, and reaching more than one-third of the way round the sky. It was now a tail without a head, as it was at first head without tail ; but they were members of the same comet. The best determination of its path was accomplished by the distinguished astronomer, Sears O. Walker. At its perihelion it passed nearer the sun than any known comet, with the single exception of that of 1680. Computed by Sir Isaac Newton, and in the discussion of which in the Principia he broached the first approximation to the true theory of the cometary tail. These two comets approached so close to the sun that it would seem quite possible that they touched its surface, or, at least, swept in nearer than the solar corona. It would not have been an absurd hypothesis, that they were ejected from the sun at the time of penetration, had it not been for the fact that the comet of 1680 was seen on its way down to the sun, and for the remarkable phenomenon which we are about to describe concerning the comet of 1843. It may be claimed, as a not impossible hypothesis, that each of these comets was at some former time the product of a solar eruption, in accordance with Buffon's theory of the origin of comets. It would only involve a force which would double the greater velocity given to the solar field of hydrogen. But a juster interpretation of the phenomenon, and one which avoids the necessity of an extravagant volcanic action, is to be found in the relation between the comets and the meteors. It is simply the spash of the falling meteors. In about an hour and a half the comet of 1843 like that of 1680, went round the sun from one side to the other. What would have become of the tail, which was reaching out about 100,000,000 of miles from the sun to the earth's orbit ? There have been those who have actually adopted the incredible, I may say the impossible, hypothesis that the tail rotated through this immense circuit, developing a centrifugal force which all the united powers of the universe could not have sustained. No ! The comet practically left its tail behind it, and began to grow a new tail as it receded from the sun. There were thus two tails nearly side by side. The new tail was distinguished because it commenced at the head of the comet, whereas the old deserted tail began without any head at some distance from the nucleus, and extended further from the sun than the new tail. That such should be the phenomena of this comet was suggested by a geometer, without knowing that it had been actually observed. It was as veritable and honest a prediction as if it had been made previous to the observation. A double tail was observed on the first four nights after the comet's appearance at noonday. The visible separation of the two tails only lasted for a few days, because the earth passed almost at once into the plane of the comet's orbit, so that one tail eclipsed the other."

THE Imperial Oil Company, of London, Ont., have commenced tearing down Spencer's refinery. The best portions of the machinery from this and all the other refineries owned by the members of the company will be placed in the Victor Works. The idea is to make these latter works equal to all the others combined. A large parafine factory will also be built on the Victor grounds, and the works of Waterman Bros. closed down.



A CHAPTER ON BOILERS.—By P. S. of Toronto.

(See description page 221.)

Mechanics.

ANOTHER CHAPTER ON BOILERS.

By P. S. of Toronto.

To the Editor of the Scientific Canadian :—

Dear Sir.—In your January magazine, you have given us a chapter on boilers, and some of the defects discovered in their shape and manufacture in the past and present time, taken from the *English Mechanic*, a good work.

As it takes a practical person, or one who has madè boilers, to be able to point out the weak parts, unknown to the theoretical writer, I will venture to bring before your readers, on this subject, a few remarks on the defects in the manufacture of boilers (not mentioned in the chapter,) in Canada now. The rivet holes should be punched, or drilled; every one should be made to agree with its fellow hole, not by drifting or cutting out a little bit, as the practice is now, so as to be able to get in the rivet, but every hole should be drilled out with a taper drill so that both holes should be exactly a line with each other. Often have I seen the plates split by stretching the iron with the drift pin to bring the holes somewhat with each other, and the rivet driven in crooked, which ought not to be ; the rivet cannot fill the hole in such a case (if it were pressed or hammered in), neither can the plates lay quite close together, in such a case it is often found to leak, although the seam may be well caulked. If our manufacturers are not able, or cannot afford to get a steam pressing machine, let them be sure each rivet point is well set before it gets cold, in a good hole. Every rivet should be of the best iron, white hot and not burnt, before it is set in the hole, so that it may be finished before it it is cold, and every head straight and close up to the plate, otherwise it may leak, or the head fall off. The same complaint exists to-day, as it did in James Watt's day, good plans are frequently in danger of being a failure because of bad workmanship and bad material. I do not wonder at men asking for steel plates instead of iron for their boilers, knowing that so much depends on the boiler. Allow me to say that all boilers should be inspected by some competent person before the purchaser be allowed to remove them from the maker's shop, and receive a certificate as to the amount and pressure of steam the boiler is able with safety to carry, and not allow every person to put in a boiler and do as he pleases, to kill himself and others. Too often do we find old boilers, as well as new ones, not equal to the work allotted to them. It appears to me many men think more of the engine then they do of the boiler; it is very nice to see a well-made engine, bright and clean, running smoothly, well balanced and all that can be done to make it run well with little steam, yet the power with danger to life and property is not formed here, but only such as we may turn on to it from the boiler. It has been said, "the engine somewhat resembles man before he breathed, beautiful in all its parts and a wonderful piece of machinery, but man was made perfect and upright, good and in the image of his Creator," while the engine may yet be improved very much. Look at man with your mind's eye, before he breathed, motionless, still, like all metals, dust of the earth, taken from the ground and put together; no life until our Great Father breathed into him the breath of life and he became alive, a soul, a moving man; walked about, ready to perform his duties of dressing the garden, when taught; God spoke with him, and when instructed in his language he conversed with his newly-made wife, and so handed down to his children how to work for their own comforts, and how to communicate their thoughts to each other. The man did not create his own breath, but having the power given to him to draw and let out the air, which existed before he was made, and also he had the power to collect water and food for his daily support. So it is with the engine, it has the means or valves to let in and let out the steam offered by the boiler; the engine, not the boiler, has the power to create the steam, but the boiler is that part of the whole machine which collects the steam (and gives it to the engine to move) from those powers already existing. Having said so much and metaphorically we will now suppose we have in a mill, or factory, a certain amount of machinery to be put in motion, or a number of gallons of water to pump, we will get an engine and boiler, said to be quite large enough for our purpose, the boiler to be fourteen feet long, forty-eight ins. in diameter, made of the best iron and good workmanship, a ¼ of an inch plate for the shell and ⅜ heads, with a large steam dome, two 12-inch flues in the bottom, riveted or welded together, and above those two we will have 20 four inch tubes, with a dividing plate behind; a smoke box in front, so that the fire will be under the boiler and the flame going through the flues, and the hot smoke or gas returning to the back end through the tubes to the smoke pipe or chimney. You will do well to get your pencil and sketch a few lines, so as to be able to clearly understand what I am about to say. Our engine we will have made for pumping water, perpendicularly, on four good strong legs, set on a foundation plate level with the floor; one crank and side rod to plungers; pump 4 inch by 2 feet stroke, one each side; valves in boxes and in foot or check box, 6 inches long by 4 inches wide, hinge on a pin hinge, with a cover, each valve opens full; the pumps siting on a heavy foundation plate and stones, close by the side of the well, about four feet from the surface. Our cylinder to sit in the centre of the upper foundation plate, between the legs, 12 inches diameter, 2 feet stroke, full jacketed, with plenty of room for the exhaust steam to pass between the cylinder and the jacket; a connecting rod or fork, about 5½ feet long, working between two cranks to a pin; a flat slide valve, worked by a rocking shaft, with lap enough to cut off the steam at 5-6 or at 20 inches of the stroke. The fly wheel to be about 6 feet diameter and balanced so that the two cranks, piston and rods, shall be just balanced, the pump cranks and rods will balance each other, all well made and fitted, clean and bright. Here suction pipes, connected in the well with valves to open just in the middle of the water, because here is the best water, the end of the pipes to the bottom within 18 inches, allowing for mud, &c. She now moves freely by the balance wheel, we will cover her up from dirt while we get the boiler into its place. One of my young friends asks me what power she has, the maker says she is 21.47, or nearly 21½ horse power; what is meant by nominal, and how do you find out the horse power? well, I really cannot stay just now to answer those questions, but as we are practical as well as theoretical, we will get the engine to work and then we will explain and answer your questions. Come with me, one take the crow bar, another the rollers, others pull on those blocks to get the boiler into this bed of brickwork. The foundation of the wall you see are 14 inches thick. The ash pit is marked out. The boiler being 4 feet diameter, the walls will be 4 feet 1 inch apart. The back end of the boiler must set over the edge about 4 inches, so that a cavity will be left behind for soot and ashes; under the boiler we will lay some blocks of wood and also in the ash pit, and on these we will wedge up the boiler until the walls are built up to the brackets, under each of these four brackets, which are riveted to the boiler, we will lay on the bricks a piece of sheet iron for the boiler to move when it expands. The front is fastened to the smoke box, 14 inches deep, resting on a good foundation, level and perpendicular. The boiler is also level and the dome straight up, some are dipped a little at one end, but this one we will have level. The mouth-pieces, 15 inches deep and 15 inches high, are in with a dead plate, 10 inches wide, resting on the walls. The fire bars, 4½ feet long and 3½ feet wide, we will now put them in. You will observe the back ends are raised 6 inches nearer the bottom of the boiler, or about 14 inches from it; the bottom of the ash pit is about 2½ feet from the bars, the fire place is lined with fire-bricks and clay, sides and bottom, behind the bars. You observe we have no bridge, the bricks sloping up so near the back end of the boiler is all the bridge we will have. The cavity behind the boiler, with a 14 inch wide by 2½ feet high iron door, will allow a man to get in and stand up, to repair leaks, &c. Here you see we have two blow-off pipes, one for the scum of the water and the other for the dirt at the bottom of the boiler. At this end you see a piece of angle iron fastened to the boiler for the dividing plate to rest on, just above the flues and below the tubes: on top of the boiler, or about one inch above, is a bar of iron, its ends resting on the side walls, for the smoke pipe plate and the back walls to rest on. A short piece of smoke-pipe to the 60 feet chimney, the walls are a brick less in thickness above the boiler brackets for the bars and sheet iron cove to rest, on this cover of sheet iron we will lay bricks flat and plaster them over with mortar. The man-hole, and sheet iron cover, can be made a half circle with flanges, and ends to set over the hole, in the main sheet iron cover, so that the bricks need not be moved every time you wish to look at the man-hole joint, for it should not be allowed to leak. The dome can be covered with felt so as to keep it as warm as possible. Our steam gauge we will connect with the top of the dome and fasten it against the wall; that little tap at the bottom of it is to blow through every day to clean the pipes from rust, dirt, &c. Our three water guage and steam taps, with glass guage, will connect with those three pipes, tapped into the side of the boiler, just behind the smoke box, coming through the brick wall we can join them together by T's, or a bracket made for the purpose, so that each pipe may be blown through freely. You observe one pipe is just at the bottom of the upper row of tubes, the middle one is just at the top of the same tube, and the third one is four inches above, which makes the centre of the bottom pipe, to the top one just one foot, and our high water line is one inch above the tubes, which will give our glass three inches for steam and five inches for water, in sight. Our boiler being four feet diameter, our high water line, above the bottom of the boiler, is thirty-two inches of water and sixteen inches for steam, you can make good use of a little spare time in finding the number of gallons and pounds of water in the boiler, at 10 lbs. per gallon, before the engine goes to work, when we will spend a little time in calculating the water, steam, fuel, duty, power, &c., of the whole. On the top of the dome we have a 3 in. cast iron T bolt, the perpendicular flange is for the steam pipe, and the horizontal one is for the safety valve to be bolted to, so that it can be taken off and the valve ground without moving the steam pipes, or breaking the joint on the dome, which must be kept from leaking, because a little steam oozing out will soon eat away the boiler or dome plate. You cannot be too particular about this matter, which many men think nothing of. These flanges are all turned with rubber joints ; wrought iron steam pipes are very good, they should be covered with felt and canvas, wood or anything else that will keep in the heat. Observe on the safety lever the figures are large and plain ; the ball is screwed fast to the 50 lbs. figure ; the valve lever is well fitted and works quite freely. You will observe we have no governor to this engine, because we do not want to keep in motion any more journals than we are obliged to. The steam or starting valve is not a globe, as many will have but a straight steam way slide valve, worked with a screw ; it is easier to keep in good repair and no check to the steam. The cut-off tap on the steam pipe, close by the dome, is a straight cut-off tap, brass. Our cylinder drain traps are all of brass and screwed in. Oil cup to every journal with weeks inside. Some like the oil to be driven into the cylinder with the steam, but we will have ours screwed into the cover of the cylinder and another on the steam chest. Our heater for the feed water is a very simple one : a cast iron pipe, 1 foot diameter, with flanges, a shifting box in each end for a 1½ inch pipe, three lengths put together with return bends inside, so that the steam passes all round the outside of these pipes, the water being inside which makes it, to about 150° of heat, then the steam passes freely up the exhaust pipe, not into the chimney, but out through the roof of the house. The heater has a drain pipe to take away the condensed steam water. we will now fill the boiler with water from the well by a hand pump, as we have no other means. Our man hole joints we will make with platted hemp, four strands, four threads in each strand, the ends nicely sewed together, and hemmed smoothly all over, covered with thick red lead and linseed oil putty on both sides, the cover joint is cleaned off smoothly, no rough sand or iron skin left on it. The glans fit quite loosely across the boiler-hole, so that the screwing of the nuts do not bind the bolts in any, as each turn of the nut is made, the red lead squeezes out on every side. The man hole in the boiler is well faced and strengthened so that it will not spring with the pressure of the glans. If this joint is not good, we will make it with rubber and red lead putty, I thing it will be good for six months or more we will now lower it over with the sheet-iron cover. Our chimney being finished by the bricklayer, 60 feet high, we will draw our damper, yes it works freely, a slide valve in a cast frame built into the walls just above the end of the boiler, the opening in our damper is 18 inches by 16 on 288 square snches, and the opening in the top of the chimney, is 18 inches square plastered all the way from bottom to top. This damper we will open or shut to suit the draft. Our four inch main water pipes, are all laid and connected with a tank 105 feet above the surface of the water, in the well. Our feed is connected with the main just, behind the main check or foot valve, so that the full weight of the water in the main pipes shall be on the feed valves, one on each side of the heater, in this case we do not want a boiler check valve, having so far connected our pipe to the boiler and engine, we will put a fire of hard wood under the boiler to warm the water while we are pricking the stuffing boxes with cotton or hemp, and grease. As the water is increasing in temperature, a few brakes are seen at the tube ends and some of the seams ; you say let us put into the boiler some oatmeal, horse-manure, or something considered by some men to be necessary for stopping leaks. Well I am not in favour of putting anything into the boiler, but the cleanest water we can get ; be not alarmed about the leaks, but just watch them and you will see the iron in a well made boiler will use the best means to stop them by expanding and throwing off some rust which will be better than we can put in, but if we find them too large, we will help the iron a little by caulking with a sharp tool but not cut the plates, as is frequently done. We will now clean up the engine room floor, fill up the oil cups, and make things look neat, and orderly, we will lay the oil cloth on the floor with this the engine pipes and room being finished painting, we will now clean up the floor and make things look neat, and clean, spread this oil cloth on the floor, lay this mat at the door, clean the glass in the door so that we may be able to see the engine working from the boiler-room. With a good lock on the door, it can be kept closed to keep out the dust. In the boiler-room wehave a bench, a vice, a cupboard, and a few tools for daily use, hammer, chisel, two or three files, some rubber packing, a little hemp, and other things needful, our oil cans are made of copper, and nice and bright full of oil, we will now fill the cups and get ready for starting, for the steam is just beginning to rise, the air which is not required in the water for making steam. The heat is driving up to the surface of the water, the guage now indicates four pounds, we will open the valves and let the air work the engine a few strokes, as well as blow through the guage taps, for I like to get the air out of the boiler,, first, because I have seen joints broken with it, that would stand the steam pressure. I have a very strong impression on my mind, that a tremendous power can be gained by a little steam and air brought together, the proposition has yet to be worked out. Nature's laws are what we want to apply to our use. Our guage indicates five pounds per square inch. I will now start her , she will run awhile, as soon as the air pressure is removed, the steam will rise quickly, there you see she will not run over 300 revolutions, she is stopped, the guage pressure is down again. Now while the steam is rising, I want you to assist me in finding out how many gallons of water we had in the boiler to begin with : Boiler 2-4 feet square 4 × 4 = 16 feet × 14 feet long = 224 cubic round feet × 4,89474 = to 1096'42176 gallons the boiler will contain without the dome 2 flues and 19 tubes. Some of you say you are not well skilled in figures, so as to understand how I have worked that, or found those figures, well allow me and I will explain in a very simple way for I think it the duty of every speaker or writer to give what he knows in the simplest way, and no way is equal to the practical. Now mark out on the floor a square four feet, within these four lines mark three lines one foot apart from the side lines, which will make four divisions a foot each, now do the same the other way and then you will find within the four outer lines sixteen square spaces a square foot each or a foot each way, this shows you have sixteen square feet on the surface or area, suppose you now cut out the floor to those lines and dig down fourteen feet, then you will have a hole filled with air, 16 multiplied by 14 equal to 224 cubic square feet and each cubic foot contains $\frac{6\,268}{1000}$ gallons of air or water , the meaning of these ·268 decimals is, suppose one gallon was divided into one thousand parts, and we take 268 parts, you see it is a little over a quarter of a gallon ; then 224 cubic square feet multiplied by 6·268 (gallons in one foot) gives 1086·42176 gallons, but you say the boiler is round, not square, true, we can have round cubic feet as well as square ; with this difference, that a cylindrical foot has but 4.89475 gallons in it. These figures I have worked out purposely, to make easy way for you to find the number of gallons in a round vessel, and my future calculations, and to find the number of lbs, place the decimal dot between the 4 and 2 like this 10964·2176 or × 10 lbs.. Our next process is to find half of the contents of the boiler, 1096·42176 ÷ 2 = 548·21088 gallons, now we will find the number of gallons in the 8 inches above the centre line to those fgures. The line across the front, above the centre line is just 45 inches and the line 8 inches below is the same, these to 45 + 45 ÷ 48 the centre line = 138 ÷ 3 = 46, here we have a rectangular fire 46 × = 368 inches area or face near enough for our purposes × 168 inches (= to 14 feet long) gives = 61824 inches + by 277·274 the number of inches a square gallon = 222·97 ; gallons of space in the 8 inches : add these to the half of the boiler 222·97 + 548·21088 = 781·18088 gallons of space in the 32 inches of the boiler, out of these we will take the 2 flues 1 foot in diameter each = 14 + 14 = 28 cubic round feet × 4.89475 = 137·053 gallons in the space of the 2 flues,—now we have 19 tubes 2-4 inches diameter = 16 × 168 = 2688 cubic round inches in each tube × 19 = 51072 ÷ 353·03 (round cubic inches in a cylinder gallon) = 144·664 gallons of space, now add 137·053 × 144·664 = 281·717 gallons to be taken out of the whole 771·18088 = 281·717 = 489·38388 gallons of water in the boiler and by taking the 8 inch space out of the upper part of the boiler 548·21088 = 222·97 = 325·24088 gallons of space for steam above water line. add to these the dome 2 feet diameter ½ = 4 × 2 feet high = 8 cubic round feet × 4·89474 = 39·15792 gallons in the dome, add ×325·22088=364·37880 gallons of space in the boiler above the water line.

Water 489·38388 gallons. } in the boiler.
Steam 364·37880 " }

(*To be continued in our next.*)

PLUMBING REGULATIONS IN MONTREAL.

(*See Illustration on page 225*)

MONTREAL, May 25th, 1880.

To the Editor of the Metal Worker.—It has lately been ordered, and is, I believe, about to become a law, that a trap is to be fitted in all private sewers (house drains), at or near the curb stone, and a ventilator provided just outside the front wall of all buildings. As soil pipes are carried above the roof, I claim that by this arrangement a circulation of cold air is going to be established in the drains that will freeze up the surrounding earth, heave up the drains, freeze water in taps, heave up walls of buildings, and do an incalculable amount of mischief. My experience with traps in drains is that they are a nuisance; but leaving the question of their advantage or disadvantage out of account, is not the damage by frost to which I allude certain to occur in a climate like ours, where we sometimes have for days and weeks a temperature varying from 0 to 20 below zero? In milder climates it might be very well, but is it, in your opinion, suited for the climate of Montreal? We have no trouble from frost when soil pipes and ventilators were carried up and traps omitted, as the warm air from the sewers keeps them open.

J. W. HUGHES.

Comments by the Editor.—We consider the plans shown in Mr. Hughes' sketch and described in his letter objectionable for many reasons, all of which have been fully set forth in these columns. The trap shown in the house drain is wholly superfluous, and will probably give rise to all the trouble which our correspondent predicts. In winter the air current following down the front ventilating pipe will be very cold, and will probably move with considerable velocity, as the temperature of the soil pipe must necessarily be from fifteen to twenty degrees at least above that of the outside air pipe. Under these circumstances there is no reason why the traps in branch wastes should not freeze, and why, under ordinary conditions, the worst results which our correspondent fears should not be experienced. The circulation will be shown by the arrows in the drawing. It might answer under peculiar circumstances, but in a Canadian climate it would be a tremendously dangerous experiment.

Trapping a house drain is almost always bad practice, and is only justifiable when we can do nothing better. It may be necessary at times to cut a boot to ease a corn, but it is much better to cure the corn or have a sound boot made that will not pinch it. Even the wayfaring man, though a politician, should be able to see that there can be no such thing as a pressure, nor even a stationary column of bad air, in a tube open at both ends; and that if one end of a house drainage system opens into the sewer and the other into the open air above the roof, there is no need of cutting it in two in the middle with a trap. A trap cannot resist the pressure of air in the sewer when it seeks an outlet. Its only function is to close a pipe against drafts or air currents, and this is exactly what should not be done at any point along the line of a house drain or soil pipe.

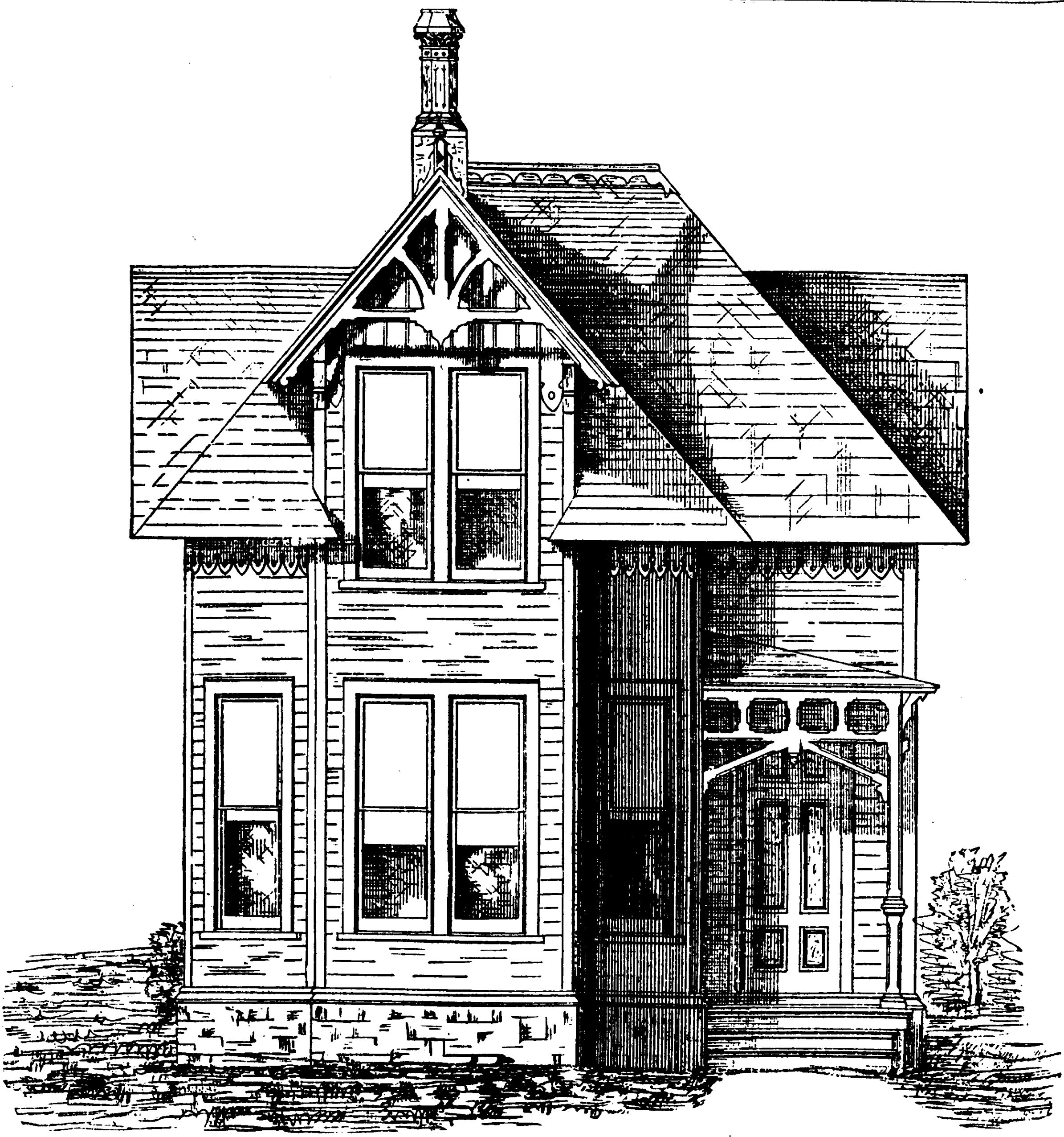
We agree with Mr. Hughes and the Editor of the *Metal Worker*, for the reasons given in condemning the method shown on the illustration, for the ventilation of the soil pipe of a house, and we object to the trapping of a house drain in this climate outside the walls of a house, where it would be very difficult to get at in case of obstruction, but, do not agree with the *Metal Worker* that "*the trapping of a house drain is always bad practice* The fact is that when we live in a city where no faith can be put in the workmanship of the plumber—any botcher will be employed if his estimate is low enough—then there is no more dangerous system than that of ventilating city sewers through the house. We have placed a plan before the Health Committee which will, at a later period, appear in these columns, and which, if adopted by the Corporation, will, remedy many of the evils, in respect to sanitation, now so much complained of. By the plan now before the Health Committee all danger from sewer gas entering into the house is entirely avoided and its ventilation is perfect—we only use the water conductor in summer as a scourer—it can be disconnected at any time without trouble. Our arrangement places every source of danger within sight and is easily remedied by a tenant without the necessity of always calling in a plumber.

BENEFITS OF GOOD TOOLS.

There is an old saying to the effect that "it takes a good workman to make a good job with poor tools." So it does, and there have been many triumphs, recorded and unrecorded, of brain and skill over seemingly insurmountable obstacles. It is a satisfaction to compass a result with apparently inadequate means, and the mechanic who does it is justly proud of his success. But working with poor tools is never certain to produce good results, however great the skill and inventive the brain. Misses are made as well as hits, and even the most self-assured workman feels safer with good and applicable tools. No workman can afford to risk his reputation and success with poor tools; there is so much risk of a failure and such anxiety for the result, that even if success is attained it has been at the expense of time, thought, muscle and trouble that robs it of half its gratification.

The time has gone by when the workman was expected to "make something out of nothing;" when one implement or appliance was made to do duty for another, and "make-shifts," their origination, use and application to the job in hand were part of the kit of the workman. The constant and growing improvement in tools and labor-saving machinery has not only increased the profits of the manufacturer, but lightened the labors of the workman. The machinist who learned his trade 30 years go would now be ashamed to resort to the wretched substitutes' of tools with which he was then compelled to do his work. The carpenter knows the advantages of the mortising machine, the moulding machine, the band-saw and other improvements. The blacksmith sees the advantages of the drop-hammer, the shears, the steam-hammer and the portable forge; and even the farmer, who keeps up with the times, appreciates the mowing machine and the many improved hand-tools which facilitate his operations and reduce his labor. There may have been brain energy and labor wasted in the production of improved tools and appliances; for there are some which have never met the expectations of their contrivers or filled the wants of the users. But in truth, there has been no portion or department of mechanical endeavor that has accomplished better results or reached higher success. The number of special tools now used is wonderfully great as compared with 30 years ago. There is no manufacture of consequence that has not its special appliances, machinery and tools, and in tools for general work the improvement has been fully as marked. Even in hand-tools the improvement is obvious to the slightest observation. In every department of industry these improvements have made their mark. They save time and labor, and produce more satisfactory results. It is a wise economy to reject imperfect tools, and, as the patent-medicine men advertise, "use the best." Whenever an improved implement is put into the market—one that will do the work better or quicker—it is economy to buy it, even if the old one is intact and serviceable.—*Boston Journal of Commerce.*

AVOIDANCE OF VIBRATION WITH MACHINERY.—Mr. W. H. Delano, in a paper read before the British Institution of Civil Engineers suggests the use of asphalt for the foundation of machinery, notably for those running at high speeds, the asphalt having the valuable quality of absorbing vibration. This was instanced in the case of a Carr disintegrator, which, being mounted in a pit lined with bituminous concrete was worked at 500 revolutions per minute with sensible tremor, whereas with the former wooden mountings on an ordinary concrete base, the vibration was excessive and extended over a radius of 25 yards. In the Paris exhibition ot 1878 there was shown a block of bituminous concrete weighing 46 tons, forming the foundation of a Carr disintegrator used as a flour mill, and making 1,400 revolutions a minute a speed which would have been impracticable on an ordinary foundation. Extensive applications of the material for this purpose are made in France, especially in connection with steam engines and steam hammers.



DESIGN FOR A CHEAP COTTAGE.
(From the Manufacturer and Builder.)

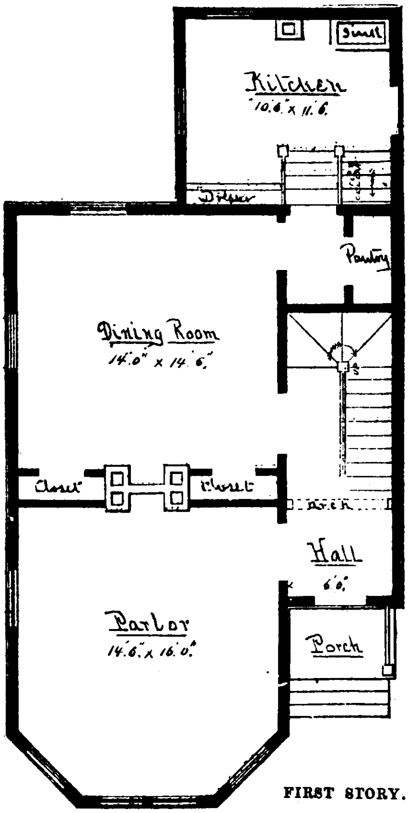
ONE-STORY FACTORY BUILDINGS.

The new discussion in reference to mill architecture is still attracting much attention in New England, and important changes are looked for in the near future in the substitution of one-story buildings for the high structures heretofore employed. This idea is about to be carried out on a large scale by the Willimantic Linen Company of Connecticut. The design contemplates having all the work on one floor, the machinery to be run by shaftins in the basement, and the power to be supplied from engines in the engine house behind the main building. By so bringing all the operations together, it is claimed that there is a very great saving of labor.

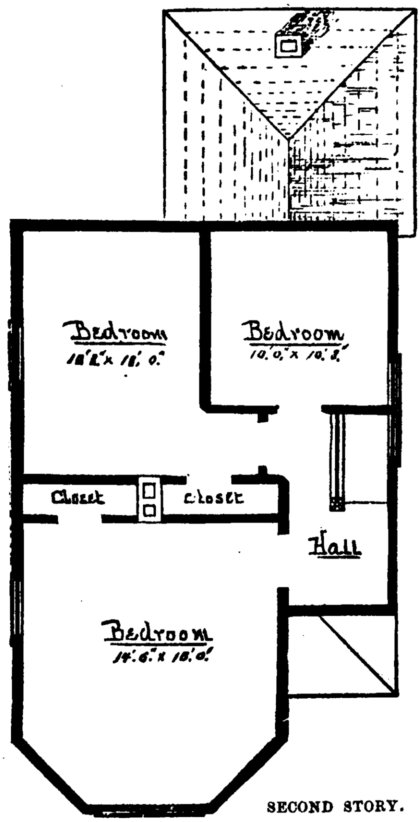
The area of the contemplated building is nearly three and a half acres, its ground dimensions being 820 by 172 feet. There will also be an annex at each end of 70 by 50 feet. The hight of the main building from the water table to the eaves is to be 16 feet, and there will be three towers each 40 feet high with provisions for ventilation in the piers.

Mill-owners and managers will watch this experiment with interest, and undoubtedly many of the architectural ideas involved in this plan will be adopted and carried into effect in the erection of great mills in the future. Where land can be obtained at a reasonable price, the advantages to be obtained in the way of plenty of light, good ventilation, convenience, and safety in case of fire, speak strongly in favor of the adoption of one-story factories, especially if this can be secured without sacrificing architectural beauty.—*Manufacturer and Builder.*

Brown Tint for Iron and Steel.—.—Dissolve in four parts of water, two parts of crystallized chloride of iron, two parts of chloride of antimony and one part of gallic acid, and apply the solution with a sponge or cloth to the article and dry it in the air. Repeat this any number of times, according to the depth of color which it is desired to produce. Wash with water and dry, and, finally, rub the articles over with boiled linseed oil. The metal thus receives a brown tint and resists moisture. The chloride of antimony should be as little acid as possible.



FIRST STORY.



SECOND STORY.

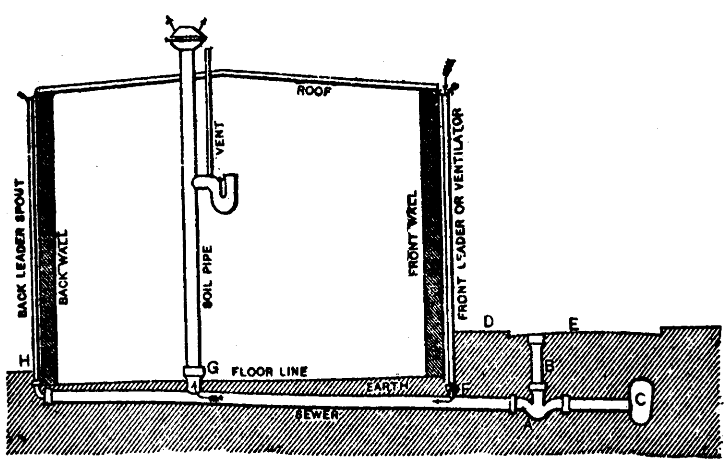


ILLUSTRATION OF PROPOSED METHOD OF PLUMBING IN MONTREAL.

See page 223.

PRACTICAL CABINET-MAKING.

COMPILED FROM DESIGN AND WORK.

The shooting and mitre board as follows: Get two pieces of pine (Bay mahogany makes a better one) each 30 in. long, 6 in. broad, and 1 in. thick. Overlap the one with the other 2 in., and screw them together, thus forming a lower bed, 4 in. broad, where the plane runs, and an upper bed 6 in. broad, where the fillet for shooting is fixed, and the triangular piece in the centre, where the mitreing is done. The sole or under-side of the board must be made up at the end by two fillets 4 in. long, 2 in. broad, and 1 in. thick, screwed on, which gives the board a level bearing surface 10 in. broad. Now the fillet or stop at the front on the upper side is made of mahogany and sunk into a shallow groove an inch from the fore end, and at exactly right angles with the edge or shoving direction of the plane. Now the triangular piece is made, having its two adjacent edges at right angles to each other, and it must be placed upon the board about the middle of the length, with the right angle corner pointing toward the sole of the plane, and the two edges exactly at an angle of 45 deg. with the edge of the board or sole of the plane. It should be sunk into the board for about ⅛ in., and fixed with two screws. It has occasionally to be taken off, to admit of using the whole length of the board as a shooting board. This board is used for mitreing all mouldings of a thin description, such as those planted on the face of wardrobe and sideboard dooors, etc. It is also used for small picture-frame moldings of all kinds. When it is used exclusively for picture frames there is sometimes a light bar fixed along the side of the plane, and a groove in the board where this bar runs in: thus the sole of the plane is held against the board, and ensures the cutting more effectually of some of the harder moldings.

For heavy cabinet moldings there is no more useful tool in the whole category of cabinet appliances than the mitre block. When truly made this instrument mitres the molding generally the exact fit the first time, thus saving a world of fitting, trying, paring, and losing time, and at last not unfrequently cutting away till the molding has become too short and has to be thrown aside. A first-rate one may be made with the outer frame of Bay mahogany and the interior blocks of beech. This outer frame is 18 in. long, 9 in. broad, and 2½ in. deep over all, and the thickness of wood to make is 1¼in. It is dove-tailed at the corners, and one of the sides is about 4½ in. broad for about half its length, this downward projection being to catch in the bench "tug," in which position the instrument is held when being used. Now, the interior block of beech is 9 in. long, 6½ in. broad, and 2½ in. thick. It is to be planed to exactly the inside width of the frame. In each edge of this block two grooves are to be run with a flit-plough, ⅜ in. wide and ½ in. deep, dividing the surface into three equal parts, and two corresponding grooves are to be run in the long sides of the frame. Now tongues of rosewood or box are to be fitted into the grooves in the beech block and to project nearly ½ in.; and they are to be fitted to slide in the grooves in the frame; and, while they slide, they are not to be too loose, to shake or rattle. In other words, the tongues are to fill the grooves exactly. This block is now to be divided into exactly two equal parts by a cut made across it at an angle of 45 deg. on the edge. This is the cut that forms the mitreing face. In marking off this cut, you will make a line with a square across the upper side, 3¼ in. from the near end, where the screw is attached. Now, a line drawn on the edge of the block to meet these two will have an angle of 45 deg. with the upper or under face. This is to be cut and both pieces planed truly to the angles given, for on the accuracy of this depends the usefulness of the instrument, and if not truly made in this particular, it is quite worthless.

Now the one half of this block is to be fixed hard and fast in the off end of the frame, while the other is to slide backwards and forwards by the action of the screw. This screw is ⅝ in. diameter, and the screw part 9 in. long. The end rail of the frame is tapped for it to work in, and the end of the screw is attached to the movable block by means of a plate and collar. This consists of a piece of ⅝ in. brass tube, with a ring soldered on one end, which forms the collar. A piece of brass or iron plate is made 2½ in. long 1½ in. broad, and ⅛ in. thick, with a screw hole in each corner. In the centre a circular hole is made ⅝ in. in diameter to allow the tube to pass through. This plate and tube is now sunk in the end of the moving block, the collar being at the back and the open of the tube standing out to receive the wood screw. The various parts being ready to fit together, the grooves should be coated with moist black lead. The dove-tailed corners should not be glued, but put together dry, and screw nails put into them. When fitted up the screw is inserted and made to enter the brass tube, where, several holes being previously made, it is fixed with short screws. This screw should also be black-leaded; by turning the screw the block should move easily in the grooves. The moving block is now to be pressed up close to the other, and the face of the instrument planed level and true, and the tool is complete. In mitreing with it, as much of the molding is allowed to project above the sueface as will make a full mitre. This is sawn off nearly flush with the mitre block, and the remainder planed until the plane will take off no more of the molding, taking care at the same time to plane nothing of the surface of the mitre block. Two pieces of molding thus mitred and placed together, mitre to mitre, should form an exact right angle, if the mitre block is truly made.

In veneering gabled surfaces the gable is placed upon the bench, veneering side up, and the veneer teethed placed upon it teeth side down. Now, the glue must be boiling, or at any rate the water in the boiler, the room very warm, by means of a stove or hot plate. An ordinary laundry smoothing iron, or better two, are kept very hot, not red, on the stove. Now, all things being ready, we dip a sponge in the hot water, and wet the upper side of the veneer all over, and laying it aside, we quote the ground work freely with the hot glue, begi ning at the centre and coating one-half of the gable only. Now we place thé veneer carefuly in its place, and rap it smartly all over the glued half with the veneering hammer, but it is not yet laid. We now begin in the centre which is the extremity of the glued part, and with the sponge we give it a copious supply of the hot water; then with the hot iron we iron it rapidly, the portion ironed each time being about I ft. broad, and quite across the gable, which gives about two square feet of surface to be gone over with the hammer. The iron must not be allowed to rest for an instant on the veneer, or it will stick and lift a piece out—a few rapid strokes, adding more water wherever a portion appears dry. Now we apply the hammer, which is held with the handle in one hand, the other pressing upon the head; we give the handle a motion from side to side, at the same time pushing forward the glue in front of it. When the iron portion has thus been gone over the glue should run out at the edges. A few rubs are given to it with the hammer, giving long strokes instead of the zigzag. In order to find if it is lying it is tapped lightly all over with the hammer. By this means the smallest blister can be detected in a moment. When a blister is detected it may at once be laid by a little more rubbing, but, if obstinate, a little bit of paper placed over it with a piece of wood and a weight over all will in most cases effect a cure.

There is a thick body of glue lying just where we left off rubbing. Again we opply the water and iron, doing a portion quite as before taking care not to go over on the portion already finished, at the same time taking care that we are quite at it. Again we commence rubbing, always taking care that the glue carried before the hammar is retreating away from the portion already finished. In this way the rubbing and ironing are continued till we arrive at the end of the glue half. Now, to glue the other half, we turn the veneer up and apply the glue to the ground. Taking care that we cover all the surface not previously glued, we rub down the veneer as before, and begin sponging and ironing in the centre, just where the first portion was finished, and cause the glue to travel away towards the end. A surface of this area will thus require six or seven ironings. If the glue runs out freely all round, then there is a surety that the heating eas been sufficient, and if free from blisters, the work may be said to be satisfactory. The two gables thus veneered may be placed face to face with a large sheet of paper between and a few small hand screws fixed on them; thus they must stand for twenty four hours or so, before any attempt is made to plane the veneer, as having imbibed much water in laying, they take long to dry. Veneers laid with a caul may be cleaned in half that time.

We must now notice the process of veneering curved surfaces. The hollow part is roughenedwith a rasp and the round part teethed; then it is glue-sized. A caul has now to be made to fit exactly in every part. This caul has to be saturated with oil, or, what is much better, it may be covered with a sheet of zinc, made to assume the proper curvature; it is tacked lightly to the wood at the edges. Before applying the veneer, it, (the veneer) must be made to assume the desired form. To effect this, mark the veneer as it is to lie; then take the sponge and hot water, and wet the veneer on the outside the whole length and but the breadth: then turn it over and wet the remaining half on the opposite side, it will immediately assume the form. Before veneering, we place the caul and the ground together, and set the largest hand-screws to the required width to be ready. Now the caul is made very hot, the ground is copiously glued, and the veneer laid thereon. To prevent it shifting, a tack is usually driven through it at each end into the ground, which is generally a little longer than required in the finished job. A piece of thin cloth which is placed over the veneer, and then the hot caul, which is pressed down with the hand-screws, those about the centre being tightened first.

In the section of a half pillar or cushion molding, the process is exactly the same as in the preceeding example. The veneer to make it assume the curved form would be wetted entirely on the outside. An instrument with which forms having one curve may be veneered by the wet or hammering process consists of a piece of hard wood, a little longer and not quite so broad as the work to be veneered. Through the centre of this piece a series of wood screws pass at intervals of six or seven inches, next a piece of stout canvas is tacked to the hard wood so as to form a bag with open ends. Now to veneer a section of a semi-circle the ground with the veneer on it would be placed in the canvas bag, the flat back parallel or in a plane with the board above it, and the veneer consequently next to the canvas. The screws are now brought to bear upon the back of the ground, which tightens the canvas and forces the veneer close to the ground. Now the canvas is well saturated with hot water, and held to the fire, all the screws receiving an occasional turn. The glue now runs out at the ends, the canvas is rubbed all round with the veneering hammar, and a little more pressure -pplied to the screws when it is laid aside for twenty four hours to dry. This a very simple, effective, and expeditious method of veneering many of forms used in cabinet-making. As the canvas accommodates itself to the form placed in it, it matters not whether the form be circular or elliptic, or a combination of both, and it will veneer anything from a little over a semi-circle or semi-ellipse down to the smallest arc of either. By having several boards with canvas of a width to suit the various requirements, the screw pins of the one will fit the others, provided they are all tapped alike.

GILDING, INLAYING AND VENEERING, AND MARQUETRY.

Whatever may be the value of a philosophy of furniture as a key to the typical Man, there is no doubt that in modern days a better clue to a man's character is obtained from his furniture than from his clothes, or than even from his house. The majority of those who have to live in towns or cities must dwell in houses more or less objectionable, and in the form of his garments a man has to follow his neighbours. But within a house the "significance of the individual" can be asserted, and any one who cares for beauty in form or in colour, may, if he wills and can afford it, fill every room he possesses with such objects as will give him pleasure without much fear of incurring that punishment to which all who differ from a majority are liable. One of the most hopeful signs of our day is that people are again recognizing that furniture may serve other purposes than mere utility, that the upholsterer no longer retains his former supremacy, and that, here and there, buyers are to be found who are indifferent to the spiritless productions of machinery, or of men who differ little from machines, and who believe that art need not be dissevered from every-day life, but that it is possible to exhibit it in a curtain, a carpet, or a chair, as in a painting or a statue, and that a similar pleasure may be derived from the possession of the former as of one of the latter objects. As pertinent to this subject, we give the following description of some of the processes employed in the decoration of furniture and other woodwork, taken from a recently published "Catalogue of Ancient and Modern Furniture:"

GILDING.

Wood has been decorated with gilding from the time of the ancients to our own. Much of the modern furniture, both during the Middle Ages and since the Renaissance, has depended mainly on gilding for its effect. The processes have varied, but more in the careful methods of preparing the ground and the purity and thickness of the gold than in any essential difference of method or appliances.

The gilding of the Florentine and Venetian furniture in the Museum collection is the richest we can point to. The oldest and most effective of this gilt work, such as may be seen on the coffers, stands, etc., is laid on a bed prepared with white chalk and size or animal glue made from parchment. The richness of the gilding depends on the care with which this ground or bed has been prepared. The gold, when laid over this bed, if thick enough to admit of a certain stretching of, or malleability in the metal, can be either burnished by rubbing with a polished agate tool, or indented to a slight depth with various patterns, such as were made in the Florentine work.

We may here give in a few words the most approved modern method of gilding wood for "burnish" or distemper gilding.

The wood surfaces to be gilt are first primed with hot size and whiting very carefully ground. These are mixed with a decoction of garlic and wormwood, to which are added vinegar and common salt. These materials are said to preserve the wood from the worm. The salt, however, must not be used with gilding on any other material, such as plaster having a tendency to attract damp, and so produce efflorescence on the surface. When dry, holes or deficiencies are made good with the same material in a tough state. Four or five coats are then applied one after the other, each coat being carefully dried first. As many as ten or even twelve coats are applied in the most careful work. The surface is polished with pumice-stone and cold water, and the work is carefully cleansed and dried by rubbing with a cloth and shave grass. The size is next applied; this consists of Armenian bole, to one pound of which are added two ounces of hematite (bloodstone) and the same quantity of galena, each ground in water separately. These materials are mixed and ground with a small quantity of olive oil. This substance is tempered with parchment size or glue. It is applied hot with a very fine brush. The ground is coloured, in some cases yellow with a preparation of yellow ochre, in the Florentine and Venetian work with vermillion, to give colour to the thin gold. The surface when dry, is damped with cold water to give it the required "tack" or stickiness, and the gold laid on with the gilder's "tips" or flat long-haired brush in the usual way. In modern gilding the vermillion tint is sometimes added by way of a delicate wash after the gilding is completed.

Oil gilding, a simpler process, consists in preparing the wood with white lead and linseed oil, or two or three coats of clear colling or glue preparation. Over this is laid the size, a mixture of boiled linseed oil and ochre, and the leaf applied when the surface is nearly but not quite hard. This process does not allow of burnishing or rubbing with polished stones, but it is a shorter and less costly operation.

According to Vasari, the richer and harder compositions used as a preparation for gilded reliefs or cypress wood of Italian manufacture, were made of pounded brickdust, chalk, and stucco or gypsum, liquified with animal glue. With this composition much manipulated, the relief ornaments were made by impression of a matrix or mould of wood. The more important figure portions were modelled up with tools in the same way as in clay modelling.

Similar decorations were executed in the north of Europe. Besides the coronation chair there is an altar-front preserved at Westminster (south aisle), decorated with careful modelling in relief, gilt. To this have been added plates of coloured glass, gilt on the back, with crystals, imitation stones, etc. The composition in which the reliefs are executed is fine parchment glue and gypsum in repeated layers. Then films of parchment were also laid over and again coated with composition. The stones or glass were laid in a bed of this material, sufficiently soft to rise and lap over the edges, so as to hold the inserted work firmly. The soft material in the portions left for modelling was impressed, while of a tough consistency, with matrices or stamps made of lead, wood, agate or other pebble, slate or iron.

It will generally be found that painted wood panels of the fourteenth and fifteenth centuries, wooden images, etc., have been covered carefully with parchment, sometimes with canvas, previous to gilding and painting. This covering has been well prepared with gypsum or chalk, so as to form a solid bed for the gold pigments.

According to Vasari, Margaritone of Arezzo used "to cover the whole surface (of his wood) with canvas, which he secured by means of a strong glue made of the boiled shreds of parchment; over this canvas he next applied a layer of gypsum, as may be seen in his pictures, as well as those of others; on the gypsum, which was mixed with the glue above described, he then formed diadems and other ornaments in relief. He was also the inventor of grounding in bol-armoniac, whereon he laid leaf-gold, which he discovered the means of fixing and burnishing."

INLAYING AND VENEERING.

Inlaid wood is held in by the tightness and completeness with which the inlaid parts are morticed into the main body or bed of the wood. They are also held in by pins or pegs when the pieces are large and the hold given by the sides of the mortices is insufficient, when thick slices, or masses of ivory or metal, or even thin metal are used, as in Boulle work, in which case the metal has the help of small pins at intervals But the chief agent in connecting surfaces of wood together when coated with veneers, or slices of ivory, bone, horn or shell, with wood, is glue.

Glue is made from the scraps that are pared off the hides of animals before they are subjected to the tan pit for conversion into leather. The inferior kinds of glue are often contaminated with a considerable portion of the lime used for removing the hair from the skins, but the better sorts are transparent.

Glue acts in a double manner; first by a simple adhesion and secondly by excluding the air, so as to bring into action the pressure of the atmosphere. The latter, however, alone, is an insufficient explanation, as the strength of a well-made glue joint, even of veneered surfaces glued to softer woods, is very frequently greater than the known pressure of the atmosphere; indeed, it often exceeds the strength of the solid woods, as the fracture does not at all times occur through the joint, and when it does it almost invariably tears out some of the fibres of the wood; mahogany and deal are considered to hold the glue better than any other woods.

No dependence is placed on the quantity or thickness of the glue, as that joint holds the best in which the neighbouring pieces of wood are brought the most closely into contact. In laying on veneers the under surface of the veneer and the upper surface of the body of the wood, both left slightly rough, should first be well wetted with glue, applied very hot, and then pressed together in various ways to exclude as much of it as possible. The parts are screwed down on heated metal beds, or between wood frames that fit all the curves of their surfaces, during several hours, till the glue is quite hard.

The following is the method in which veneering is now practiced, as described by Holtzapfel.

The surfaces of the table or panel, and both sides of the veneer, are scratched over with a tool called a toothing-plane, which has a perpendicular iron full of small grooves, so that it always retains a notched or serrated edge; this makes the roughness on the respective pieces called the *tooth* or *key* for the hold of the glue. A caul of the size of the table is made ready, and several pairs of clamps, each consisting of two strong wooden bars, placed edgeways, and planned a little convex, or rounding, on their inner edges, and connected at their extremities with iron screw-bolts and nuts, are adjusted to the proper opening; the table is warmed on its face, and the veneer and caul are both made very hot.

The table is brushed over quickly with thin glue or size, the veneer is glued and laid on the table, then the hot caul, and lastly the clamping bars, which are screwed down, at distances of three or four inches asunder, until they lie exactly flat. The slender veneer is thereby made to touch the table at every point, and almost the whole of the glue is squeezed out, as the heat of the caul is readily communicated through the this veneer to the glue, and retains it in a state of fluidity for the short space of time required for screwing down, when several active men are engaged in the process. The table is kept under restraint until entirely cold, generally for the whole night, at least, and the drying is not considered complete under two or three days. When the objects to be glued are curved, the cauls, or moulds must be made of the counterpart curve, so as to fit them.

Another method is by pressure with the hands.

The *veneering hammer* is made generally of a piece of wood from three to four inches square, with a round handle projecting from the centre; the one edge of the hammer head is sawed down for the insertion of a piece of sheet iron or steel, that projects about a quarter of an inch, the edge of which is made very straight, smooth, and round; and the opposite side of the square wooden head of the veneering hammer is rounded to avoid its hurting the hand.

The table and both sides of the veneer having been toothed, the surface of the table is warmed, and the *outer* face of the veneer and the surface of the table are wetted with thin glue, or with a stiff size. The inner face of the veneer is next glued; it is held for a few minutes before a blazing fire of shavings to render the glue very fluid, it is turned quickly down upon the table, and if large, is rubbed down by the outstretched hands of several men; the principal part of the remainder of the glue is then forced out by the veneering hammer, the edge of which is placed in the centre of the table, the workman leans with his whole weight upon the hammer by means of one hand, and with the other he wriggles the tool by its handle, and draws it towards the edge of the table, continuing to bear heavily upon it all the time.

MARQUETRY.

We have had occasion more than once to insist on the beauty and originality of the furniture made by Boulle in the seventeenth, and by Reisener and David in the eighteenth century.

The former was an intarifa or surface inlay of various materials, principally tortoise-shell, with brass and white metal, the latter occasionally enamelled with various pigments. This work was afterwards made by laying metal under the shell to increase its redness. The two manufactures are called old and new Boulle.

The shell used is that of the marine tortoise, called *testudo imbricata*, or hawk's bill turtle; the scales or layers of shell overlapping each other, in which respect it differs from other shell of its genus.

The length of a shell full grown is about a yard, by half a yard in width. The plates are thirteen in number—five down the middle of the back and four on each side. The largest plates measure about 13 inches by 8. Some parts are of very dark-brown tints, with light golden marks and spots. Other parts are lighter, but the darkest are considered the best.

The shell is dipped into boiling water for three or four minutes to make it work better. It is also damped and warmed by ordinary laundresses' irons. Heat, however, has a tendency to make it brittle, and boiling to spoil the transparency. Tortoise-shell can be bent and joined. The edges are filed to their feather thickness for three-quarters of an inch. The edges must be absolutely free from grease, and should not be touched after the filing. The edges are dipped in boiling water, held together by the fingers for a time. They are then nipped by a pair of tongs, heated so as to discolor white paper slightly, clean linen damped with cold water being first placed over the junction; this keeps the gelatine moist till the adhesion is complete.

In cutting the patterns of Boulle work, two slices of material are glued together with paper between (to facilitate subsequent separation), and paper is glued outside, on which the pattern or design is drawn. A fine watch-spring saw is introduced into a minute hole in a part of the pattern conveniently chosen, and the patterns are sawed out. The slices are afterwards separated, and the pattern cut out in one slice is fitted into the matrix of the other, so that one sawing produces two editions of the design, the ground and figures being reversed in each. This arrangement is called Boulle and counter. In the earlier productions of Boulle this reciprocity was not attended to. Ebony, also pearl shells, ivory, and white metal, making further elements of decoration, were added in small quantities.

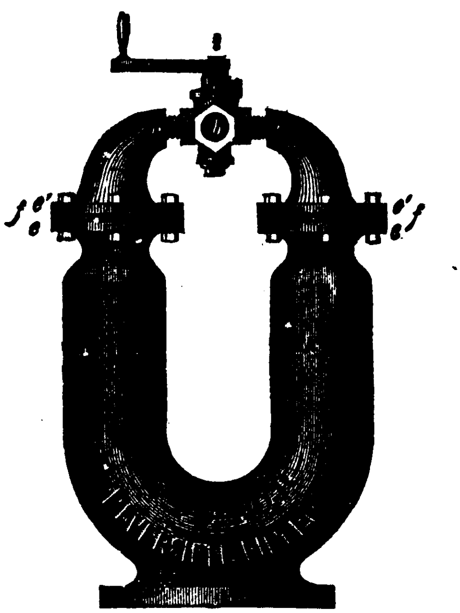
When the various parts have been arranged in their places, paper is glued over them to keep the whole in place, and filings of the material scraped in to fill up any interstices between the parts. The whole, when dry, is toothed over, and laid down as in ordinary veneer, with glue and pressure upon the surface prepared for it.

Marquetry of wood is made in the same way. Dye-woods are used as far as they are available, and greens, blues, and some other tints are of holly stained. "Mr. Cremer, of Paris, used the staining process of M. Boucherie, said to impart a permanent color to a great depth. Shading is given by means of hotsand."

One method of cutting marquetry is by pasting a drawing of the entire design on the ground or counter, and cutting out entirely. The various leaves, etc., are then cut from different veneers and fitted in. Another method is to paste the drawing on the ground, and on it to paste the various leaves or ornaments cut from other suitable veneers, then to cut through the counter or ground, the saw grazing the edge of the leaves. The parts so cut out are then pushed out, the leaves separated from the paper, and laid down in the vacant places.

A third method is thus described in Holtzapfel's "Mechanical Manipulation." The separate leaves to constitute the inlays are cut out from the different colored veneers, and glued in their appropriate positions on a sheet of paper. A sheet of white paper is pasted on the veneer, which is to serve as the ground. A sheet of blackened paper is laid over it, and over this the leaves, "the backs of which are struck at every part with several blows of a light mallet so as" (by means of the intervening black paper) "to print their own impression on the white paper" (which is pasted on the ground). "The printed apertures are then cut in the counter one at a time, so that the outer edge of the saw kerf falls exactly on the margin of every aperture."

The markings of the leaves or other figures are made by cuts of the saw or by a graver, and filled with wood dust and fine glue. —*American Cabinet-Maker.*



THE VICTOR FILTER.

The accompanying cut represents a new water filter recently patented by Mr. Geo. W. Dawson, of Indianapolis, Ind. The hollow iron chamber *h* is filled with some suitable filtering material, such as silex, bone or charcoal, which is confined to this chamber by two screens, *f* and *f'*, securely fastened between the flanges *e* and *e'*. The water enters the four or five way cock *a* on the opposite side to the opening *b*, and flows through the elbow at *d* and the screen *f* into and through the filtering chamber, leaving the sediment and impurities at *g*, near the screen *f*. It returns through the screen *f'* and the opening *c* into the cock *a*, and discharges into the supply pipe or hydrant through the opening *b*. The filter may be cleaned by simply turning the cock by means of the lever *i*. This will cause the flow of the water to be reversed, discharging all sediment accumulated at *g*,

These filters are made in two sizes ; the smaller ones being 18 inches high with a 8 inch chamber, and the larger ones 32 inches high with a 6-inch chamber. The kind of filtering material used depends on the nature of the water to be filtered and the degree of purity required. The best results are said to be obtained by using two filters, one to remove the gross impurities for common use, and the other to purify the water for drinking purposes.

The Victor filters are intended to filter water under pressure. They may be used in connection with pumps, but in that case only a small quantity of water can be drawn through them. Mr. Ewald Over, of Indianapolis, Ind., is the manufacturer.

AN IMPROVED GLAZIER'S TOOL.

Letters patent have recently been obtained by George Frederick Redfern, of 4, South street, Finsbury, London, as a communication from and on behalf of Messrs. Savage and Betts, of Kingston, Ont., Canada, for a novel tool for the use of glaziers, picture-frame makers, and all others having anything to do with setting glass. Fig. 1 is a view of the underside of the tool, and fig. 2 a full plan of the same.

A represents a plunger, provided with a handle at one end having a longitudinal slot *c*, through which is passed a set screw *d*, that enters the bar or plate B. A longitudinal rabbet, *a*, is made to the bar B, extending its entire length, and the plunger moves freely in this rabbet, it being limited in its movements by the screw *d*, which likewise holds it in its place. At the front end of the bar B, is a sliding metallic plate *f*, covering the rabbet so that the plunger moves inside of it when reciprocated. The bar B is also provided with a triangular opening under plate *f*, as shown by dotted lines in Fig. 1. From this opening on the opposite side from plate *f*, extends at right angles the prismatic receptacle or triangular trough C, the angles and sides of which coincide with the angles and sides of the opening in the bar B, from which it extends. This trough is provided with a sliding door E, as shown in Fig. 2. The door E is also provided with a slot, which engages the spring and draws the spring with the follower back with it to the top of the trough, thus allowing the trough to be filled with the points with ease ; the door E is then pushed down, the slot allowing the spring and follower to remain on top of the points, the action of the spring keeps the points pressed down to the end of the receptacle, and the last one on the end opposite the spring bears against the inside of the plate *f*, when the plunger is withdrawn, the space being sufficient to admit one point only at a time. The operation of this tool is as follows :—The receptacle being filled with the points and the trough closed in, the plunger is withdrawn as far

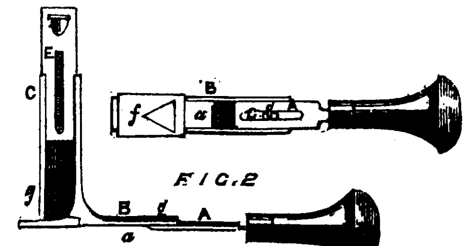


FIG. 2

as it will go. The tool is then placed with the plate *f* bearing upon the wooden back or glass, as the case may be, while the end of the bar B is placed against the side of the frame at the point where the metallic point is to be driven in. The plunger is then driven in, and its end coming in contact with the base of the point (which is towards it, as indicated by the dotted lines in Fig. 1) drives it forward and into the side of the frame or sash. As soon as the plunger is drawn back again another point takes the place of the one driven out by the plunger. In this way, it is claimed, great facility and rapidity in driving these points is obtained, and the trouble and time occupied in picking up the points and placing them and driving them with a chisel is avoided.

RATCHET DRILLS.

The improvements in drills, especially the twist drill, have made it possible to apply more pressure to the drill, made it cut deeper, and, therefore, bore faster ; but at the same time made it necessary to apply a more powerful leverage to the hand than the common swivel.

Fig. 2 represents such a ratchet drill as improved by Mr. Renshaw and manufactured by the Pratt & Whitney Company, of Hartford, Conn. A view of the drill is represented below, while at the top of the engraving a section is given of the spindle, showing its interior details. The handle, 15 inches long, is drop-forged, of tough wrought iron. The spindle, of steel, has substantial ratchet teeth cut in its periphery, engaging with a pawl lodged in the handle, which covers both pawl and ratchet, and protects them from dirt. The feed screw is of steel, 3 inches long, $1\frac{7}{16}$ inches diameter, and hollow ; being hardened, it is not liable to injury in ordinary use. It gives the drill large capacity in small compass, the length from top of feed-screw to bottom of drill-collet being only 5 inches. By transferring the collet and feed screw, as arranged for right-hand drilling, to opposite ends of the spindle, the ratchet may be used for left-hand drilling, a feature that practical men will appreciate. Four sockets are furnished with each drill. Nos. 1, 2 and 3 correspond in size of holes with sockets of same numbers made by the Morse Twist Drill and Machine Co., for drills from $\frac{1}{4}$ to $1\frac{1}{2}$ inches diameter, with shanks of the Morse standard taper. Socket No. 5 is for square shank drills of any size between $\frac{1}{2}$ to $1\frac{1}{2}$ inches diameter, which are the extreme sizes that this ratchet is adapted to carry. Nos. 3 and 5 sockets are held in the spindle by screw-thread. Nos. 1 and 2 sockets have taper shanks, fitting No. 3 socket, and can be forced out of position by turning in the feed-screw until it bears upon their end. The feed-rod, when not in use, is placed in the handle and held by screw-thread. The sockets can be utilized in any drilling spindle that may be fitted to receive them. The price of this drill, with four collets, is $20.

BONE GLASS.—After extracting phosphorus from bones a glass can be formed from the residue, which consists of lime and phosphoric acid ; the ordinary kinds of glass being composed of sand and potash, soda, lime and alumina. Bone glass can be worked as readily as any other glass. It has the valuable property of not being attacked by fluoric acid.—*Les Mondes.*

Mechanics Work.

THE SIEMENS PATENT AND THE PRUSSIAN PATENT OFFICE.

One of the most remarkable and curious cases of a refusal to grant a patent is that by which the Siemens' regenerative system has become common property in Prussia. Mr. Jeans, in his new work on steel, relates that the Patent Office of that country founded its action on the alleged resemblance of that important innovation in metallurgical furnaces with one particular mediæval warming apparatus. This apparatus, the only one of its kind, was found at the palace abbey, or preceptory at Marienburg, in Prussia, which formed the headquarters of the Teutonic knights, and is supposed to belong to the latter half of the fourteenth century. It was used for warming rooms in the building in question. A fire was made in the lower part of the furnace, and the products of combustion, passing through the stones placed in the upper division, escaped into the fire. When the stones had become thoroughly heated the fire was extinguished and the flue closed by a damper. The apertures in the floors of the apartments to be warmed being now opened, cold air was allowed to pass through the heated stones, and, becoming warmed in its passage, entered the floor of the rooms through the registers. Some of the furnaces were tried a few years since, and when they had not been meddled with on the pretence of "restoration." were found to be perfectly effective. This contrivance, the wiseacres of the Prussian Patent Office decided was an anticipation of an invention which has enabled us to melt large masses of metal which had, until its introduction, been quite intractable. It is perhaps no more than just to the present authorities of the Imperial German Patent Office to add that the spirit of its predecessor has vanished with the introduction of the patent law.

SMELTING IRON WITH OIL.

Some elaborate experiments have recently been made at the Fanny Furnace, in West Middlesex, Penn., under the direction of Prof. Robertson. What is considered a final and successful test is described by an eye-witness as follows :

The furnace was not in what would be called first-rate condition ; the gas was bad, and a few other minor matters interfered, with the arrangements and taking it altogether, it was in bad condition for experiments. The feeding apparatus is simple in construction. The main tank contains about four and one-half barrels of crude oil, which is pumped in by a hand pump at present. It stands about a hundred yards from the furnace stack, and the oil is conveyed to the tuyeres by an inch gaspipe, where, by a series of valves and gaspipes, it becomes incorporated with superheated steam before entering the crucible. It passes into the tuyeres through the gate of the blowpipe, about an inch above the plughole. and has a capacity of from ten to one hundred gallons of liquid an hour to each tuyere. * * * Looking through the glass in the gate we saw a beautiful volume of white flame, having all the appearance of a pure hydro-carbon. The flame moved with a very rapid motion that would seem to melt anything with which it came in contact. The volume ignited almost immediately after striking the blast in the blowpipe. The two volumes one of superheated steam and the other of oil, becoming one volume, and that volume burning, proves to any one having the least knowledge of chemistry that the burning volume is a pure bicarburet of hydrogen, which proves beyond a doubt that no water is transmitted into the crucible of the furnace by the oil. That crude petroleum is a de-phosphorizer is admitted by all, and that the oil improved the gases of the furnace is another admitted fact, and we see no reason why the discovery of Mr. Robertson should not be utilized by all blast-furnace owners in this valley.

RIVETED BOILER JOINTS.

Rivets are usually of ¾-inch diameter, and are pitch at a distance of 1¾ inches, center to center. In thicker plates they are generally increased to ⅞ inch, or 15-16 inch ; while for marine boilers and ship-plates it is at the same time a matter of opinion, whether, with a proportional piteh, increasing the diameter of a rivet is an advantage. From the results of experiments and practice, ⅜-inch and ½-inch plates, riveted with ¾-inch rivets and 2-inch pitch, were found to be as strong as entire plates of the same thickness ; with thinner plates, a shorter pitch of 1¾-inches, with ¾-inch rivets, or 15-8-inch pitch with 11-16-inch rivets, it is proved that it is not only strength of joint, but tightness of seam, as expressed by Mr. Fairbairn. A great deal has been said and written on the superiority of drilled over punched plates, and machines of a costly type have been constructed for the purpose of drilling boiler and ship-plates ; but it can be proved that punched rivet holes, when fairly and truly fitted, are as good as, if not better than drilled holes, for the following reason . As the punched hole is always conical, generally about 1-16 inch to 3-32 inch, when the plates are fitted to with the taper or cone of the holes reversed, the rivet hole has the form of a double cone, causing the lines of strain to converge through the plates and thus shortening the leverage, and so far stiffening the joint. It is well known that slightly countersinking the holes, as is done in Messrs. Beyer and Peacock's boiler, improves the joint ; and on the same principle, Sir D. Gooch anticipated the twisting of the single-riveted joint, so as to have less liability to distortion under pressure and work.

Long rivets are objectionable, and extra work may be judiciously applied to avoid them. At the junction of the fire-box and the shell at the door long rivets were formerly common, the old way in making the fire-box door being to forge a ring of the length and diameter required, and the thickness of the water space, long riveis being fastened inside and outside the shell of the fire-box through the ring. Mr. Beattie constructs the fire-door with a ring of boiler-plate which was flanged and rivetted to the fire-box, and separately riveted to the shell with angle iron short rivets being used throughout. Mr. Beattie also forms the junction of the fire-box and combustion chamber of his coal-burning engines, with a ring turned and flanged out of plate with flanges, one of which is riveted to the fire-box, and the other, for want of access to the rivets, being joined and fastened to the combustion chamber. For the same reason, Mr. Hackworth made his junction of the bottom of the fire-box with a piece of boiler-plate doubled. Separate riveting being a better arrangement than that made with a solid bar, as was formerly done, The last form of junction is also better for the circulation of water and equilization of expansion.

In the seams of the fire-box, double riveting is detrimental, as the long lap required for the double row is liable to burn and produce unequal expansion, which leads to leaking. On the question of strength, the fire-box is so thoroughly stayed that very little tensile strain is thrown on the joint. Mr. Dewrance found that the ends of the stay-bolts made with square heads, projecting 2½ inches into the fire-box, burned off to a projection of only 1¼ inches, at which point they remained.—*Universal Engineer.*

TEMPERATURE OF STEAM AT DIFFERENT PRESSURES.

Steam is much used for both heating and boiling purposes, especially where a uniform and known degree of heat is required, as in the manufacture of celluloid, etc. By increasing the pressure, the temperature is increased : by diminishing the pressure, the boiling point is lowered—that is, the temperature of the steam (or vapor) is reduced below 212°; thus, at a pressure of about ½ an atmosphere, or 7.35 pounds, the boiling point of water is lowered to 180°, and in vacuo it boils at 125°, or even lower. Both these principles are utilized in the arts ; the high temperature of steam under pressure, for example, in the extraction of gelatine from bones, the vulcanization of rubber, conversion of celluloid, etc. ; while the opposite process is constantly made use of in the arts to concentrate vegetable extracts, to distil volatile principles, essences, etc., under diminished pressure (or in vacuo), and consequently at a temperature below that at which they would suffer destruction by heating or contamination from other substances from which they are to be separated.

The following table gives at a glance the temperature of steam at different steam pressures :

Steam Pressure.	*Temperature of Steam.* *Regnault.*	*Nystrom.*
14.7 pounds	212° Fah.	212° Fah.
25 "	240.07 "	241 "
50 "	280.89 "	282.8 "
75 "	307.42 "	309.8 "
100 "	327.6 "	329.9 "
150 "	358.4 "	360 "
200 "	381.8 "	382.6 "
300 "	417.7 "	416.5 "
400 "	445.1 "	441.9 "

BLISTERING OF PAINT AND VARNISH.—Many are the opinions expressed regarding blistering, and although some very sensible theorses are advanced, we are inclined to believe that the bottom of the subject has never been reached. We hold an opinion of the cause of this trouble, and it may that this opinion has been forestalled by others; but as we have never seen the points laid down in print, we present them here. Blistering of a varnished surface, after the varnish has had proper time to harden, is due to the evaporation of moisture which lies confined under the shell of varnish. This evaporation is caused by heat, and it is seldom, if ever, a blister will rise upon a varnished surface without the temperature is raised to an extreme degree, near to that which the varnish received in its manufacture. The accumulation of moisture *under* the varnish may be brought about in several ways; the most particular one being in the closing in of moisture in the rough stuff. During the rubbing of the rough stuff the water used is partly absorbed, and unless due care is taken to give ample time for "drying out" before the application of subsequent coats, a great amount of moisture will be confined within the cells of the rough stuff. Boiled oil contains moisture, as of water, and in cases where steam is used to express the oil from the seed this percentage is increased. Turpentine an extremely volatile liquid, also forms an evaporating substance which is rendered active by slight heat, and in its haste to reach tue air it distu.bs the outer surfoce, either lifting an elastic coating into bubbles or blisters, or bnrsting open a hard and inelastic one into cracks. The primary cause, then, of blistering is moisture either in the form of wet moisture or of evaporating liquids, such as turpentine. The wood may be unseasoned, or it may have been wetted in the course of preparation, such as steaming to bend, etc. The rough stuff water may have been applied before the evaporation of liquids had taken place; either of which would bring about disastrous results.

"Dry blistering" is simply the hasty absorption of the liquids from outer coats by porous putty or paint, which deprives the coating of the requisite amount of binding and adhesiveness. To prevent blistering, close up every lurking-place for moisture, and be careful to have each coat dry before applying another.—*American Coach Painter*.

TO COMPUTE HORSE-POWER.—First find the average pressure on each square inch of the piston; multiply this by the number of feet travelled by the piston per minute, then divide this product by 33,000. The quotient will represent the number of horse-power at which the piston is working. This rule is simple enough to apply, but the difficulty is how to find the average pressure. An indicator applied to each end of the cylinder while working would give a card from which the average pressure may easily be obtained. Without an indicator, the average pressure may be found by the following rule: Let L=stroke of piston in inches; l=piston travel in inches to cut-off; R=ratio=$\frac{L}{l}$; H=hyperbolic log of R; P=initial pressure of steam in pounds per square inch; p=mean or average pressure in pounds per square inch.

Thus $p=P\frac{1 \div H}{R}$

But this calculation involves the factor of the initial pressure—than is, the pressure that starts the piston, and this must be ascertained by some means. A sensitive spring gauge applied to the cylinder while working might show it near enough for ordinary purposes; and the point of cut-off can be obtained by measurement while the engine is slowly turned, observing the valve's and piston's motion—having removed the steam-chest cover for that purpose—and turning the engine round by hand. *Manufacturer and Builder*.

SPEED OF LINE-SHAFTS.—Replying to a query addressed to the editor as to the speed at which a line-shaft should be run in a planing mill, we give the following answer, which may interest others besides our correspondent, namely:

The tendency at the present time is to increase rather than to diminish the speed of line-shafts. Good practice is to run shafts for machine-shops at 120 revolutions per minute; for wood-working machinery at, 250; and for cotton and woollen mills, at from 300 to 400. Hollow or pipe shafting has been made to run satisfactorily at 600 revolutions per minute. This kind of sha t-ing, however, is too costly to be generally introduced. These speeds are not too high for successful practice. Belts can be run safely at 500 to 600 feet per minute, but on six-inch pulleys lose about two fifths of their adhesion by centrifugal force, and are a little uncertain in driving action. Ordinary cast-iron pulleys are also safe at these speeds, if well made and not too large. A four-foot pulley should not be run over 400 revolutions per minute; but with a wooden rim, properly made, a higher speed may be run with safety. We mention speeds in connection with pulleys and belts, because they are more liable to be affected by high velocities than shafts are, the belting losing pulley contact, and the pulleys losing cohesion by reason of the centrifugal force developed by high speeds.

PLUMBAGO AS A LUBRICATOR.—The *Engineer* gives the following example of the value of black lead as a lubricator; "A fly wheel shaft bearing, eight inches in diameter and ten inches long, caried a load of nearly 10 tons. The bearing was supported on a box girder, and was lined with good brass. The engine could not be run, as this bearing inevitably got red hot after a few revolutions, various oils, tallow, sulphur and gunpowder were tried with most indifferent success. By using a mixture of tallow and sulphur the engine could be run half an hour at a time, and once or twice has run a whole day, the shaft making sixty revolutions per minute. It was determined to have a new crank shaft with longer beaing, but as at the last moment the use of black lead and tallow was suggested, a package of the ordinary black lead used for stoves was worked with some tallow, the bearing carefully wiped, and the grease box on the cap filled with the mixture. The bearing never heated again unless oil was allowed to get access to it. The success of plumbago as a lubricator was perfect. It should be added to the foregoing that while the principle of lubricating by graphite, or plumbago, is scientifically correct, and has in thousands of instances been practically illustrated, it has been damaged seriously by use of impure graphite. For perfect success the graphite should be absolutely clean."

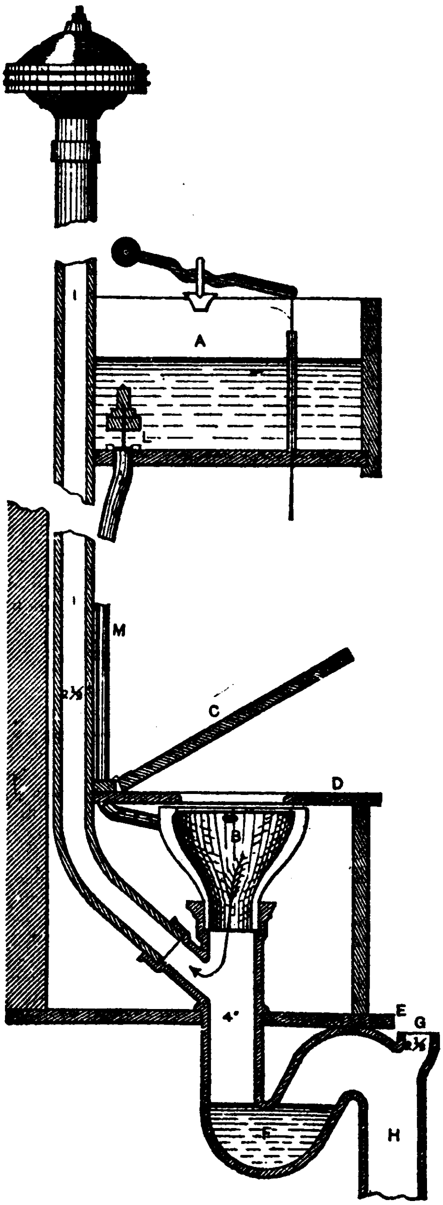
PATHOLOGICAL EFFECTS OF STARVATION.—The autopsy of the remains of the woman who starved herself to death in Cincinnati has not revealed any materially diseased condition of the stomach. The fact that she lived 30 days without using any nourishment whatever, would justify the conclusion that persons possessed of strong will power, and having the hallucination or delusion that they are suffering with some orgenic disease or bodily disorder, may live until the body is entirely consumed. This lady was possessed of great power of will, and she had a delusion that she had no stomach, and, therefore, made up her mind that she would not take food or drink, and continued in this condition until there was a general exhaustion of the nerve centres and mental faculties, when she went quietly into a calm sleep and died without a struggle. The pathological condition of the passages leading to the stomach, all being normal with no obstruction, and all the organs in a healthy state ready to perform their various offices, would warrant the conclusion that this lady would have lived many years if she could have been induced to partake of sufficient nourishment to sustain life.

SPONGE CLOTH.—A Berlin inventor has patented a new kind of cloth, which consists principally or entirely of sponge. The sponges are first thoroughly beaten with a heavy hammer in order to crush all the mineral and vegetable impurities, so that they can be easily washed out. They are then dried and pared, like a potato, with a sharp knife, the parings being sewed together. The fabric thus obtained is free from all the danger which sometimes arises from the absorption of poisonous dyes into the system. It absorbs without checking the perspiration, so as to diminish the danger of taking cold. It is a bad conductor, and therefore helps to maintain a uniform surface temperature. It can be more readily cleansed than the ordinary woollen garments. Its flexibility diminishes the liability of chafing. The ease with which it can be employed in shoes, stockings, underwear, hat linings and other articles of clothing, seems likely to make it especially useful as a protection against rheumatic and pulmonary attacks.

TO MAKE FLORIDA WATER.—Here are two formulas for manufacturing that favorite cosmetic, Florida water: (1.) Oil of bergamot, 4 ounces; oil of lemon, 6 ounces; oil of lavender, 1 ounce; oil of cloves, 6 drachms; alcohol (wine measure) 3½ gallons; water (wine measure), 6 pints. The oils and alcohol must be mixed and allowed to stand a day or two, after which the water should be carefully added. (2.) Oil of bergamot, 8 ounces; oil of orange, 4 ounces; oil of lavender, 3 ounces; oil of cloves, 1½ ounces; oil of cinnaman (true), ¼ ounce; tincture of orris, ½ pint; tincture of Peru balsam, ¼ pint; alcohol, 4 gallons; water, 6 pints. Mix and let it remain quiet for some days, before filtering and bottling.

VENTILATED HOPPER CLOSET.

From J. W. H., *Montreal, Canada.*—Being greatly annoyed by a stinking pan closet in my dwelling, which, in spite of my utmost endeavours, would not stay "fixed," and my purse not permitting the fitting of one of the latest improved closets. I hit upon the following arrangement, which worked well during the cold weather and has continued to do so since the warm weather has set in. I first removed all the pan closet apparatus, and substituted for them a short "Sharpe's Patent Hopper," rising it to the proper height by means of a piece of lead pipe. Into this lead pipe I soldered a 2½ inch ventilating pipe, which I carried up above the roof and fitted it with a 3-inch globe cap. The space between the bowl and the cover was carefully filled



with putty. Instead of the service pipe and the service box I substituted a 1-inch flush pipe with the ordinary closet valve which was attached in a cistern. This worked with the handle formerly used on the pan closet. On pulling the handle a perfect deluge of water is thrown into the hopper, cleaning out both hopper and trap every time. The smell is quite gone, as there is a constant downward current of air into the hopper and out of the ventilator pipe. I feared at the time that there would be a down draft in cold weather, but I am glad to say that my fears were groundless. I send you a little sketch of the arrangement, which shows all the important features of the design.

This is the cheapest and best plan I have yet tried, and although new to me it may not be to some of your readers. If of any interest, you may give it for the benefit of my brother knights of the solder pot.

Note.—The arrangement is a very good one. No down drafts need be feared at any time except in the early warm days of summer. If it works then there need be little fear of a reversed current. Can any one say whether the arrangement is new?

Ventilated Hopper Closet.

A, Cistern.—B, Hopper.—C, Hinged Cover.—D, Seat.—E, Floor of closet.—F, Trap.—G, 2½-inch Ventilating Pipe carried through the Roof.—H, Soil Pipe.—I I, 2½-inch Ventilating Pipe through Roof from above the Trap.—K, Globe Ventilator on top of Pipe.—L, Valve in the floor Pipe.—M, Flow or Flush Pipe from Cistern to Hopper.—The Arrow shows the Direction of the Current.

LESSON IN THE USE OF THE BLOW-PIPE.

By C. J. Muller.

ON THE TREATMENT OF MINERALS WITH BORAX AND MICROCOSMIC SALT.

Borax or biborate of soda acts as a powerful flux to most minerals. The oxides of many metals impart to it characteristic colours, which serve to indicate their presence. The utility of this test is, however, limited, because a mixture of different metals in an assay often modifies the result to such a degree as to render the diagnosis uncertain, and some of the oxides impart little or no colour to a bead of borax. The examination is most useful in the case of copper, cobalt, manganese, chromium, iron, and nickel.

The mode of proceeding is to fuse a little borax into a clear bead on platinum wire made into a small hook at the end. The bead while hot is applied to a minute portion of the mineral which will then adhere to it. The bead is then submitted first to the oxidising and afterwards to the reducing flame. It is convenient to use borax which has been deprived of its water of crystallisation by fusion.

The wire should be about 2 in. long and not too thin. It may be held in the fingers, or more conveniently in a little instrument called a platinum holder.

Arsenides and sulphides before treatment with borax should be well roasted to deprive them of arsenic and sulphur, as these elements interfere materially with the results of fusion in borax.

EXPERIMENTS WITH BORAX.

Smaltine, Glance cobalt, Cobalt pyrites, Cobalt bloom, Earthy cobalt.—In O. F., clear blue glass; in R. F., blue glass.

The assay should be roasted. The colour of the bead is characteristic of cobalt.

Red oxide of copper, Atacamite, Malachite, Libethenite, Olivenite.—In O. F. the glass is green while warm, greenish-blue when cold. In R. F., with a proper dose of the metal, the bead becomes colourless while hot, but on cooling assumes a red colour and becomes opaque.

The behaviour is characteristic of copper.

Manganblende, Pyrolusite, Manganite, Psilomelane.—In O. F. the glass bead is amethystine while hot, and of a violet tinge when cold. In R. F., when there is not too much metal in the bead, it becomes colourless.

The behaviour characterises manganese. Mangan blende should be roasted first.

Crocoisite.—In O. F. the glass is brilliant green when cold. In R. F. the glass is grey.

Crocoisite is a chromate of lead; the lead is reduced in the R. F., and destroys the colour of the oxide of chromium. When a chrome mineral contains neither lead nor copper, the green colour is heightened by the R. F.

Bichromate of potass (artificial).—In O. F. and R. F., brilliant green.

Chrome iron.—In O. F. and R. F. green.

Iron pyrites, Magnetic Pyrites, Mispickel, Hematite, Ilmenite, Gœthite, Vivianite.—In O. F., there is a very small quantity of the assay, the bead is yellow while hot, and colourless when cold; when there is a larger quantity, the glass is red while hot and yellow when cold. In R. F. the glass becomes of a bottle-green colour.

The reaction of iron is very characteristic, and seldom misleads. Iron pyrites and mispickel should be roasted first.

Millerite, Copper nickel, Nickel glance, Emerald Nickel.—In O. F. the glass is of a violet colour while hot, and of a reddish-brown when cold. In R. F. the glass becomes opaque and of a turbid grey.

The presence of cobalt and other metals often seriously interferes with the reaction of nickel in borax. It is impossible to detect by this test nickel in many ores which contain it in small proportion. Millerite and copper nickel should be previously roasted.

Molybdenite.—Take molybdic acid—that is, the white crystalline deposit obtained by heating molybdenite on charcoal in the ox. fl.—In O. F. the glass is yellow while hot, opaline, or enamel blue, changing to white as it cools. In R. F. the bead is brown and opaque. In a strong flame, oxide of molybdena, in the form of black flakes, appears in a glass tinted yellow.

Wulfenite.

Rutile, Anatase.—In O. F. the glass is yellow while hot, colourless when cold. In R. F. the bead is dark yellow to brown. A saturated bead becomes enamel blue under an intermittent flame.

Only two titaniferous minerals, anatase and rutile, give this reaction of titanium with borax.

These experiments with borax may be performed on a charcoal support, but not so conveniently as on a platinum wire.

ON THE USE OF MICROCOSMIC SALT, OR PHOSPHATE OF SODA AND AMMONIA.

This salt, when heated on charcoal, becomes converted into metaphosphate of soda, which is a powerful flux. Characteristic indications of the presence of certain substances in an essay are obtained by this means, when borax does not afford them.

In using it, it may be fused into a glass on charcoal, which, when clear and fluid, may be taken up with the hook of the platinum wire. The salt is so extremely fluid when undergoing first fusion that it is difficult to keep it on the wire, an inconvenience avoided by fusing it first on charcoal. If fused on wire, the wire should be rather thin, and very clean. Only a small quantity of salt should be taken at a time, and be fused with a very gentle heat, at a distance from the flame. More may be added until the bed is of sufficient size. If much salt be taken in the first instance the bead is sure to drop off the wire in the act of fusion.

In making the following experiments, the results should be compared with the reactions of the same mineral in borax.

Uran ochre, Pitch blende, Zippeite, Uranite.—In O. F., a clear yellowish glass, becoming yellowish-green when cold. In R. F., a brilliant green glass. In borax, similar to iron.

Rutile, Anatase.—In O. F., a clear glass, yellow while hot, colourless when cold. In R. F., yellow glass, while hot; a beautiful violet when cold. In borax, similar, but not so satisfactory.

Scheelite.—In O. F. a colourless glass. In R. F., a beautiful blue, when cold. If iron be present the glass becomes blood-red. In borax, a clear glass, yellowish-brown when cold.

Scheeletine.—In O. F., a colourless glass. In R. F., dusky blue to opaque. In borax, grey and opaque in the R. F.

Molybdenite.—In O. F., on platinum-wire, a yellowish-green glass while hot, nearly colourless when cold; on charcoal, the bead is a pure green when cold. In R. F., a brilliant green glass, similar to that of oxide of chromium. In borax, the bead is brown and opaque.

Red Oxide of Copper.—In O. F., the glass is green while hot, blue when cold. In R. F., green while hot, opaque reddish-brown when cold.

Similar in borax.

Leucophane and other Silicates.—In O. F. and R. F., an infusible skeleton of silica floats in the hot bead. In borax the silica is generally dissolved.

In all works on the blow-pipe, a very elaborate table is given of the reaction of the pure oxides of the metals in borax and microcosmic salt. Though this is extremely valuable as a standard—and as an ultimate test in chemical analysis—it is of very limited use in ordinary blow-pipe qualitative analysis, because in such operations we rarely meet with the pure oxides, but with mixtures of various metals which interfere (except in a few instances) with the colorific reaction in the fused salts. A table which gave with *precision* the behaviour of the principal metallic ores in borax and microcosmic salt would be of greater utility, but still would never be sufficient for the determination of the name of a mineral, for which purpose other proceedings, to be hereafter pointed out, will be necessary.

ON THE USE OF METALLIC TIN WITH BEADS OF BORAX AND MICROCOSMIC SALT.

Metallic tin, from its power of abstracting oxygen from some oxides, and reducing them thus to a lower state of oxidation, is sometimes useful in confirming other indications of the presence of a metal. Thus, a bead of microcosmic salt, containing only a very minute quantity of oxide of copper, so that in the reducing flame it does not become reddish-brown, will, on being treated with tin in the reducing-flame, show the desired reaction. The experiment should be made on charcoal, as tin would combine with the platinum wire and form an alloy. A bead of borax, containing only a very little iron and much manganese, may in this manner be made to show the reaction of iron, the tin reducing the oxide of manganese to such a degree as to destroy the colour due to manganese, and leave that due to iron only. The application of this re-agent is very limited, but in particular cases may be very useful.

A thin rod of tin-foil is brought into contact with the fused bead, which is then treated in the reducing-flame.

A small particle of zinc, fused into a bead of microcosmic salt charged with oxide of titanium, renders it blue or violet.—*English Mechanic.*

MECHANICS' INSTITUTES.

We are pleased to inform our readers that, by our past efforts, we have drawn the serious attention of the Honorable the Minister of Education, under whose department Mechanics' Institutes are now placed—and, also, the Association of Mechanics' Institutes, Toronto, to the importance of more vigorous action being taken to induce mechanics to support them. The subject, upon our representation, has been most promptly taken up by both the Government and the association, and the government inspector is now visiting the Institutes to find out where the hitch lies, and to suggest the best means of uniting the industrial classes into harmonious action. The government is most anxious to do everything reasonable to promote techinical education among the industrial classes, but, if, after the new effort about to be made, mechanics fail to avail themselves of the government aid so liberally given for their sole advantage and that of their children, we much fear that the annual grant will be discontinued. In our next number much interesting matter on this subject will appear in our columns.

DESIGN AND WORK IN CABINET FURNITURE.

The present design is a telescope table leaf-case or holder. It is of oak, like the other furniture, and made to match in design. It consists of a front, with shelves, for bric-à-brac. The enclosed part of this front is a press for containing table napery, and has a drawer at bottom 8 in. deep, and a shelf midway in the remaining space. Over the door of this is a drawer, divided off and lined for knives, forks, etc. The back portion contains the leaves of the table. It is 5 ft. high inside, and the leaves are disposed in the manner shown (fig. 2) to economize space, their edges running on hollow fillets, the hollow lined with cloth. In fig. 2 the door is shown open. It is usual to have a door on both ends, so that the article may stand in any suitable part of a room, and the door most suitable may be opened when in use. As to dimensions this article is 2 ft. across the face, the front corner pillars 3 ft. 2 in., and 3 in. square; the four back pillars are 2½ in. square. The spaces between the shelves are filled with bevel-edged mirror plate. On the top above the leaf space is a flat top about 2 ft. x 1 ft. 3 in. This space is balustered on the ends and front between the pillars, and affords an excellent stand for a large bust. The back next the wall is finished with the pointed pediment, as shown in fig. 1, and the whole is decorated similar to sideboard previously shown. Our next article will be a sofa or settee, to match the above, followed by chairs, which will complete the present suite.—A. Cabe *in Design and Work.*

Photographs of the Moon.—Mr. George Berwick, it is stated, has taken a series of photographs of the moon on very sensitive plate—the bromo-gelatine. One of the plates shows three well-defined rings around the moon. Whether the rings are due to cosmical, atmospheric, chemical or optical causes has not been determined.

A NEW PUZZLE.

Over the length and breadth of America, writes Mr. R. Proctor in the *Newcastle Weekly Chronicle*, a new puzzle is exercising the minds, and apparently also trying the temper and taxing the moral energies, of the American people. It is called the Fifteen Puzzle, and may be thus described: The numbers from 1 to 15 are printed on fifteen square blocks, which are placed in any order in a square space capable of holding sixteen such blocks. The problem then is to arrange these fifteen blocks without removing them from this space—that is by merely sliding them one by one to whatever square may at the moment be vacant—until they are in the order—

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

A very little practice suffices to bring the numbers from 1 to 12 in the required position—and then the numbers 13, 14, and 15, will be in one or other of six positions—viz., 13, 14, 15; or 13, 15, 14; or 14, 13, 15; or 14, 15, 13; or 15, 13, 14; or 15, 14, 13. After a little further practice it will be found easy to reduce the positions 14, 15, 13 and 15, 13, 14 to the position 13, 14, 15; that, is, to complete the solution of the puzzle. It is equally easy to bring the positions 14, 13, 15 and 15, 13, 14 to the position 13, 15, 14. But here comes in the really trying part of the puzzle—to resolve the position 13, 15, 14 into the position 13, 14, 15. And it is over this task that (so far as I can judge from the papers) hundreds of thousands of Americans have lost their characteristic coolness, and that some of those hundreds of thousands have departed, in some degree, from the strict path of truth. At any rate, I have seen not a few announcements in the journals that this difficulty has been solved, whereas it is mathematically demonstrable that it cannot be solved. When any one says he has seen the thing done, he does not necessarily tell an untruth, for the hand is quicker than the eye, and he may readily have been deceived; but when a man says he has done this thing, he most unquestionably says the thing which is not. If any reader should wish to try this puzzle, let me give him a word of caution, suggested by the maddened aspect of American puzzled ones, whose movements I have noted. Let him assign to himself at starting a certain definite interval of time, during which he will continue his efforts to solve the insolvable, and when that time has elapsed let him set aside the puzzle for some other time—if he can. There is, however, a certain amount of interest in discussing the mathematical relations involved in this puzzle, and I would commend that problem—always within reasonable limitations as to time—to the attention of readers who may possess mathematical tastes. It is, perhaps, hardly necessary to say that the problem is one depending on the properties of numbers.

INTERIOR OF THE MODEL ROOM OF THE PATENT OFFICE, WASHINGTON, D. C. MESSRS. CLUSS & SCHULZE, ARCHITECTS, WASHINGTON.

After protracted discussions on the reconstruction of the Patent Office, it was decided by Congress that the external architecture should not be changed; that the reconstruction should, as nearly as possible, approach absolute fire-proof work, and that there should be full latitude given in the disposition of the space, as well as in the architecture and decorations within. Footing on these premises, Congress adopted the plans of Messrs. Cluss & Schulze, architects, of Washington, and the work under the superintendence of the architects, controlled by a board of supervision, whose members are Mr. W. E. Paine, Commissioner of Patents, Lieutenant-Colonel T. L. Casey, U. S. A., and Mr. Edward Clark, the present architect of the Capitol, approaches completion very rapidly. Absolute fire-proof construction was construed to imply the absence of all combustible matter and the protection of all exposed metal-work by thick castings of fire-proof material. In explanation of the new design, it is necessary to state that the windows in the old side walls do not reach above half the height of the model-rooms, since they are arranged to suit the exterior architecture of the building. This necessitated recourse to skylights. Hence, continuous double skylights are provided along the centre of the halls, with an intermediate space from which side-light is thrown on and through the galleries. The outer skylight is covered with heavy hammered glass, laid on ropes and cork, the inner one with ribbed glass. The space between the skylights is ventilated so as to prevent sweating by condensation of vapor. The objects on exhibition requiring close inspection, alcoves were arranged on the main floor and on two galleries, with well-holes in the centre of the gallery-floors for the transmission of light to the darker portions of the rooms. False ceilings were carefully avoided. Safety and hygienic advantages were insured by the use of roofing arches formed of hollow fire-proof blocks. By such construction the whole cubic contents of the rooms were secured for useful occupation, and galleries are introduced where formerly there was but one. To obviate the injurious effects of expansion and contraction experienced with metal roofs of wide span, the halls have been arranged for a central nave and two aisles, by two rows of solid piers which are carried up for the support of the roofs. These piers are spaced transversely, as well as longitudinally, to suit the *points d'appui* in the lower stories, and are built of bonded brickwork laid in Portland cement. The piers are tied, in pairs, by fire-proof, wrought-iron girders stretched across the central nave; these are surmonted by decorated pediments. The wide spaces between the piers of each row are subdivided by double wrought and cast iron columns with intermediate fire-proof filling; these support the galleries, which are constructed of rolled-iron beams with ceilings formed of hollow, fire-proof blocks, and floors of huge slabs of slate. In order to retain the entire space between the middle piers and outside walls, for the fire-proof model-cases, balconies were designed on the first gallery, which project into the nave. The floors of the balconies have not the full thickness of the gallery floors, and even their reduced thickness has been lightened by panels in their underside, seen from below. The interior architecture of the model room is in modern Renaissance.

The floors of the central naves and communicating passages are laid with marble tiles. The ceilings of the galleries are kept plain, since the model-cases abut against them, and all the spaces between the cases are again relieved by the light-wells. Style is imparted to the piers along both sides of the central nave by facings of the fire-proof equivalent of statuary marble—Keene's marble cement. Substantial pilasters, with raised work, are formed of Egyptian and verdantique marble under the first gallery. Upon the floor of the first gallery a tier of loftier and more elaborate pilasters is raised with pedestals of verd-antique, fluted shafts of polished Sienna marble, and capitals with superincumbent consoles of Parian marble, the effect of which is enhanced by a moderate amount of gilding for the prominent parts. The merits of Keene's cement have induced an extensive use of it for plastering and floors under the model cases. The ceilings of the hall rest upon coved cornices, and mark the rafter construction of the roof by sunk compartments between moulded styles. The whole coloring of the halls, with the exception of the prominent features in polished and plain marble, is kept in gray; the ceilings in shades of cold gray the side walls and plain parts of piers in greenish grays, and the finish of windows, doors, and galleries, in warm grays, all with sparing applications of gold. The balustrades of the galleries, as well as the railings of the well-holes and stairs, are bronze. The outside window sashes—the only wood in the halls—are of mahogany. It is to be noted as evidence of the fire-proof condition of the work that no carpenter was on the pay-rolls, nor was any carpenters' work furnished under contract up to the time of hanging the sashes. The fire-proofing is intended to be carried to its legitimate consequences by building the model-cases of light rolled-iron frames and doors, with shelvings of heavy fluted glass.

On March, 3, 1879, the funds necessary for the reconstruction were appropriated; they netted $245,800. This sudden revival of the iron industries made it difficult to obtain the heavy quantities of rolled-iron required, but still the building will be restored to its uses by the early part of next summer. Nearly 1,100 tons were consumed; it required twenty-two tons of copper to cover the roofs; the skylights require about 21,000 square feet of hammered or fluted heavy glass; the galleries will be floored with 40,000 square feet of rubbed slabs, and the main floor with 33,000 square feet of marble tiles and Keene's cement.

ANT-BATTLES.

I have within the past few years witnessed several battles between ants, and in some instances, the curious conduct of the captors towards their prisoners, which I think is worth mentioning. The most noted battle took place July, 1878, between two colonies of red ants. The victorious army were medium in size and numbered many thousands; those captured were a much larger ant, but not so numerous. The large ants, after a desperate resistence, were forced out of their fort, four or five small ants holding on to the antennæ and legs of the prisoner. The captives were usually taken a few inches from the fort and liberated. All the ants returned to the fight except one, who would stand facing his captive for a few moments, then taking hold of the antennæ of the prisoner give three or four pulls; after waiting a short time the pulling was repeated with more determination; the big ant not responding, he was savagely jerked, then he would lean forward, and a drop of sweet issuing from his mouth, the little ant would approach and drink the nectar, then pick up his captive and hurry home. This was repeated many times during the battle. Some of the prisoners gave up their sweets without so much pulling. I think this battle was for no other purpose than to secure the sweets supposed to be in the stomachs of the captives. These ants were kept prisoners just one week, when they were liberated, marched off in a body and never returned. They were probably kept confined until their sweets were exhausted, and then allowed to go free.—*American Naturalist.*

THE STRONGEST MAN IN THE WORLD.

At Reno, in Nevada, according to Mr. R. A. Proctor, there now lives a man who is probably the strongest man in the world. His name is Angelo Cardela. He is an Italian, age 38, 5ft. 10in. in height, and weighing 13st. 8lb. He is a labourer, of temperate habits, but not objecting to the moderate use of malt liquors and light wines. In personal appearance he is not remarkable, but "merely a good-natured-looking son of Italy, with a broad heavy face, a noble development of chest and shoulders, and large fleshy hands." His strength was born with him, for he had no athletic training. His strength does not reside in his hair by any means, but apparently as much in his bones as in his muscles. At any rate, he differs from other men chiefly in his osseous structure. Though he is not of unusual size, his spinal column is double the ordinary width, and his other bones and joints are made on a similarly large and generous scale. He has been known to lift a man of 200 pounds weight with the middle finger of his right hand. The thing was done as follows:—The man to be lifted stood with one foot on the floor and arms outstretched, his hands being lightly grasped by two friends, one on each side, to preserve the balance of the body. "This slight assistance," we are assured, "had no tendency to raise the body, being merely to keep him from toppling over." Cardela then stooped down and placed the third finger of his right hand under the hollow of the man's foot, on which he was balancing, and with scarcely any perceptible effort raised him to the height of 4ft. and deposited him standing on a table near at hand. It is said that two powerful Irishmen living near Verdi, in Washoe County, Nevada, waylaid Cardela with intent to thrash him, but he seized one in each hand, and beat them together till life was nearly hammered out of them. He is, however, of a quiet and peaceable disposition. His strength seems to have been inherited, for he states that his father was even more powerful than he is himself.

A FOSSIL SEA-SERPENT.

There is evidence, writes Mr. R. A. Proctor in the *Newcastle Weekly Chronicle*, that "long, long ago" a great sea rolled its waves over the region which now forms the Eastern States of America, and that the land rose and sank several times before attaining its present position. The State of New Jersey was in this way part of an ancient sea-bed; and it is not doubted that the marlpits of Monmouth County, N. J., were formed from the skeletons of marine animals which found a burial in remote times in the mud of that ancient sea. In these marlpits the bones of large animals have frequently been discovered. Recently Mr. Charles McCue found there certain bones which were pronounced by Professor Lockwood to be those of a fossil sea-serpent known as the pythonomorpha. This creature had a body of great size, the most exposed parts of which were protected by small boney plates or scales. It had two paddles in front and two behind, the size and solidity of the bones of which indicated extraordinary propelling force. Extending far behind was the tail,—stout, long, and serpentine, but somewhat flat, so that it could afford great aid in propulsion, when used with a sculling movement. The neck was long, yet thick, and sufficiently powerful to sustain the great high head out of the water. When we consider the bony frame of the lower jaw, we note in the skeleton a sort of elbow attached to the jaw-bone, which is very significant. It would seem that the pythonomorpha had to swallow its prey entire, and often this pray would be a fish of considerable size. By means of the elbow-jointed jaw the monster could enlarge the opening over the gullet. Now, the upper jaw was provided with an auxiliary contrivance, which exactly met the necessities of the case. This was what may be described as, in reality, a jaw with small curved and very sharp teeth, and had the appearance of a grapnel. Professor Lockwood, in describing this, said:—"As the great jaws, with their formidable teeth, gave a hitch, and thus forced the struggling prey a little way down the mouth, to get another hitch they had to open wide again, and then the prey would fall out. At this juncture, down came the little grapnel-jaw, and held the struggling prey in place. So the movements of the great jaws, and of the small grapnel-jaw, alternated until the prey was safely down the great maw. It is plain that during this snake-like process of swallowing, so slow and labourious, the wedging up of the throat would in ordinary animals stop the breathing. This difficulty was met, in the case of the great sea-serpent, by the position of the great air-tube, which, instead of being at the back of the mouth, was near the front teeth of the lower jaw. In other respects the sea-serpent resembled its congeners who live on land. The tongue was cylindrical, bifurcated, and retractile. Professor Lockwood considers that the animal whose bones have been discovered in New Jersey was not less than forty feet, and may have been as much as sixty feet long. "On another occasion," he says, "I demonstrated the existence of one that was not less than eighty feet in length, but it had teeth of twice the size that the present specimen had." The animal whose bones have recently been found must have met with some accident. He certainly did not die of old age, Professor Lockwood remarks, for in the examination of the skeleton he found the remains of the secondary teeth. The bones show marks of fishes teeth, which would seem to show that while the dead monster lay like a great wreck on the ocean bed, the fishes tore the flesh from off his bones.

BOY AND TOBACCO.

A very large proportion of the boys of the present day use tobacco in some form. Their favorite method of poisoning themselves is with the paper cigarette. Boys of very tender years may often be seen with lighted cigarettes in their mouths, puffing away with more industry than would in most cases be shown if they earned their living by it. The effects, in the first place, are not usually pleasant, but during the process of tobacco seasoning, the average boy exhibits considerable fortitude. We presume very few of these lads realize the inevitable consequences of smoking during the growing period, when bones and muscles are developing. All boys want to be strong and vigorous—to have sound limbs, hard muscles and rich blood. But if medical science can establish any fact, it is that the use of tobacco in youth checks growth, arrests muscular development, and impoverishes the blood. A physician made test cases of 38 boys, from 9 to 16, who had been in the habit of smoking, and in 27 of the 38 he found obvious injurious effects. In the remaining 11 the consequences were not so pronounced, but it by no means followed that the seeds of premature debility were not sown. The impairment of nervous force, which inevitably results from the use of tobacco, involves a long list of disorders, which take one form or another, according to the constitutional tendencies of the individual. One of the most common and prominent effects is the impairment of growth. This is a misfortune from which there is no remedy. The system may be cleansed and purified, after having arrived at maturity, but the human structure cannot be set to growing again if development is arrested in the latter years of the growing period. Many boys do not know the consequences of their habits, and others, with the disregard of future penalties peculiar to the boy period, do not care what the consequences may be so that their present pleasure is enhanced. There are but few boys, however, who would remain insensible to appeals to their reason and to their pride in manhood. It is better, as a rule, to convince a boy that the use of tobacco is injurious, than simply to convince him that physical chastisement will follow his being caught using it.—*Call.*

Scientific Items.

ROTARY STEAM ENGINES.

We illustrate in the accompanying plate from "Knight's American Mechanical Dictionary," a series of views of rotary engines, which will be useful for reference to many of our mechanical readers who have not the advantage of an encyclopedia for consultation. We give the plate and accompanying explanations by special request.

A rotary engine is one in which the piston rotates in the cylinder, or the cylinder upon the piston. The varieties of engines of this class are numerous, comprising engines with one, two, three and four on single axes; pistons working in pairs on several axes; wheels driven by steam injected against them, or working by reaction, emitting steam longitudinally. Engines of this class was first suggested by inventors and introduced about the beginning of the present century.

The annexed plate shows quite a variety of forms of this class of machines which will be understood from the following descriptions: *a* has a single piston keyed to the hub, and rotating in an annular chamber, which has the functions of a cylinder. In the middle, on the right, is the abutment, which slides radially to allow the piston to pass. Above and below the abutment respectively are the induction and eduction ports.

b, Has a single piston which passes a crescent-shaped rocking abutment situated between the induction and eduction ports.

c The piston revolves on a hub concentric with the cylinder, and the annular steam space between the hub and cylinder side is traversed on each side alternately by sliding abutments, connected together and operated by a segmental cam on the piston shaft which impinges against anti-friction rollers of the frame.

d, The steam issues from the piston at * and is educted at +, passages being provided through the tubular shaft. The abutments swing out of the way, for the passage of the piston, being actuated by connected rods and levers operated by a cam on the main shaft.

e The piston wheel is arranged eccentrically within the cylinder, and has two buckets, which are expanded radially by springs, and withdrawn to pass the abutment by contact with the cylinder. Packing segments on the piston wheel and the edges of the buckets confine the steam.

f, Has an elliptical piston the working faces of which are expansible by screws to pack it against the side of the annular chamber in which it revolves. It has a rocking abutment, which oscillates in a chamber.

g, Has two pistons, with vibrating abutments, which retract into recesses to allow the pistons to pass.

h, The pistons are situated upon the extremities of the hollow arms. The steam ports in the hub of the main shaft serve as induction passages for the steam, the eduction ports being located upon the periphery of the enclosing case of the engine. The steam is admitted to a chamber in the shaft through a pipe which revolves therewith.

j, Has three pistons, which has a certain freedom of motion in seats in the inner cylinder, which rotates in an eccentric drum.

k, Has three pistons on a wheel keyed to the main shaft. Inclines on the advancing faces of the piston push back the swinging abutments which then closed the eduction. The induction ports are above and below.

l, Has three pistons, two valve abutments, and two induction and eduction ports.

m, Has three pistons on one shaft, set at angles of 120°. Steam admitted at one side of the casing, and departing at the other, presses against a flexible band, which drives the pistons before it.

n, The eccentric hub revolves in the annular cylinder, and has pistons arranged on yokes, traversing at right angles to each other and provided at their ends with spring packing plates, which accommodates themselves to the interior surface of the cylinder. The induction openings are also covered with flexible plates, which accommodate themselves to the surface of the hub and permit the passage of the piston. The engine runs in either direction, and exhausts at the bottom.

o, Has also diametric pistons which are equal to the diameter of the casing, and slip to and fro in slots in the eccentric hub.

p, Has four distinct pistons, which slip in and out in radial slots in the circumference of the eccentric hub. Steam is admitted and educted by flexible pipes. The abutment, as in the last two mentioned, is formed by the contact of the hub with the inside of the cylinder.

q, In the Scheutz (a Swedish) engine. Its hub and cylinder are eccentric, and the abutments are formed by double inclines, which force in the pistons as they come in contact therewith. Steam is introduced and discharged at ports leading through the inclines on the respective sides of the abutments.

r r', Has two pair of pistons, each attached to a core, which occupies but half the length of the cylinder in the direction of its axis. Each pair of pistons is thus attached to its own core for only half the pistons length, while the other half projects over the core belonging to the other pair. Neither pair of pistons can therefore, pass the other, though they may come into contact.

s s' s'' Are three views of an American engine (Behren's). The views show three positions of the pistons, which work in opposition. It has two cylinders, the spaces of which overlap each other, and in the centre of each is a solid cylindrical core. Each piston is firmly attached to an axis, and is part of a solid ring fitting to the core and to the interior of the cylinder. The axes are externally connected to gear wheels, to ensure simultaneous and equal action.

t, Is the Pillner & Hill engine (English), with two cylinders, overlapping chambers, and two systems of rotary pistons which may be compared to cog wheels. These wheels by the close contact of their cogs prevent the passage of steam between them, and they are adapted steam-tight to the interior of their cylinders by metallic packing to the tips of their teeth; *u* is a somewhat similar form; and in *v* a jet of steam is forced against the vanes of a wheel as they are presented in turn in a steam-tight case:

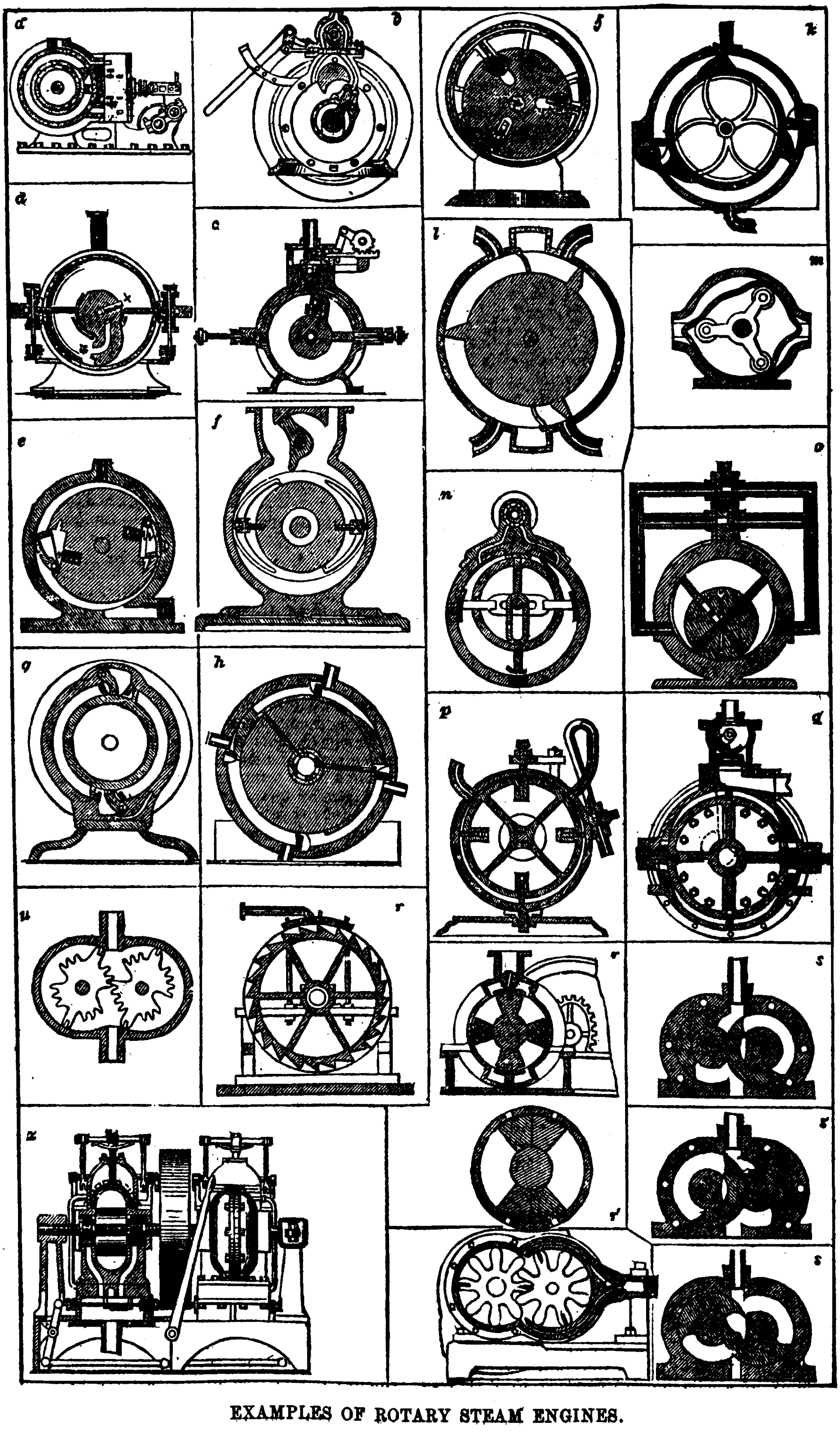
The above by no means includes all the multifarious forms of rotary engines, since the name is legion; but the description will fairly illustrate the more pronounced types of this class of machines.

DESCRIBING LINES ON BRIGHT SURFACES.—Many workmen find it somewhat difficult to describe the pattern of work upon iron or steel, especially after the surface is finished. Yet it is necessary to have an outline of the intended form. For instance, if a pattern of a hammer for a revolver be required to be made on a piece of iron or steel that has been faced down, the general practice would be to drill the hole for the screw or pin on which it turns, then fasten the pattern to the work by driving a piece of wire in the hole, and with a scribner mark around the pattern which is then removed and the work filed away to this line. To obtain a more permanent line and one that will show very distinctly in all its tracings, coat the surface on which the line is to be made with a film of copper. To do this take a lump of sulphate of copper sometimes called bluestone, wet it with water and rub over the bright surface of the work. the moisture will dry in a few minutes, when the pattern may be put in place and the outline described. The line will be clear and show very distinctly through the coppery surface. Three or four light rubs with the sulphates are sufficient to produce this surface, which is so very thin that it may be easily removed, when the work is done, with a fine file, or by rubbing with a bit of emery cloth.—*Blacksmith and Wheelwright.*

RULES FOR FINDING THE HEATING SURFACE OF VERTICAL TUBULAR BOILERS.—Multiply the circumference of the fire-box in inches by its height above the grate in inches; multiply the combined circumference of all the tubes in inches by their length in inches, and to the sum of these two products add the area of the lower tube or crown sheet. Divide by 144, and from the quotient subtract the combined area of all the tubes, and the fire door. The remainder will be the number of square feet of heating surface.

PHONEIDOSCOPE.—M. Guebhard describes a method of projecting the coloured rings which are produced on the surface of mercury by the breath or by a drop of volatile liquid. He also obtains membraneous rings by substituting a drop of cullodion or of varnish for the volatile liquid. These rings may be fixed upon a card and preserved indefinitely. Phoneidoscope figures may be obtained by pronouncing different sounds so that the breath may be intercepted by the mercurial surface.—*Soc. Franc. de Phys.*

THE COMING COMET.—Star-gazers are anxiously scanning the northern skies in anticipation of the coming comet, which has already been seen in the southern hemisphere, and which may make its appearance in the north at any moment. This comet is supposed to be the reappearance of the famous comet of 1843, which blazed out at that time with a most intense brilliancy.



EXAMPLES OF ROTARY STEAM ENGINES.

Scientific Items.

PROGRESS IN SCIENCE AND THE ARTS.

Balmain's luminous paint is attracting considerable attention, in consequence of the reading of an excellent description of its capabilities by Mr. C. W. Heaton, F.C.S., before a recent meeting of the London Society of Arts. This novelty, which seems to be susceptible of many valuable uses, consists substantially of the sulphide of calcium, prepared according to a patented process. The inventor, who has devoted considerable time and study to the subject, from all accounts has succeeded in producing a luminous paint which far excels anything of a similar kind hitherto manufactured. Its applications, however, are what specially interest us. Mr. Heaton, in his paper, divided them roughly into the ornamental and useful. He exhibited pieces of statuary and busts and ornamental tiles, covered with the paint, which gave striking and beautiful effects in the dark. He also showed clock-faces so prepared as to show the time all night, and watch-boxes, which enabled the wearer to do as much for his watch. Lucifer match-boxes painted in the same manner, obviated the difficulty of hunting for matches in the dark in an emergency. He suggested other more important applications; for example, painting the roofs of railway carriages, the names of streets, direction of post-offices, sign-posts and advertisements, and notices of infinite variety.

A special field of utility for this new product is its application for various marine purposes; as, for example, for mooring and signal buoys, which are often of the greatest service, and which would be visible, if painted with the luminous paint, throughout the darkest night for a considerable distance. Equally important will be its use for life-buoys; when an ordinary life-buoy is thrown out to a man overboard at night will be of no use save by the most fortuitous combination of circumstances, the luminous buoy will not only show him where to swim to, but will serve a rescuing party as well by giving them the proper direction. For diving and other submarine apparatus, the paint will prove equally useful. The diver's dress can be painted all over with the luminous paint, and by carrying his own light with him, will assist his labors very materially. The experiment was actually made at Southampton, and with very satisfactory results. On the whole, the invention will doubtless find a wide field of application.

A NEW SUBSTITUTE FOR IVORY, coral, leather, caoutchouc, etc., lately patented in England under the name of *Vegetaline*, is prepared as follows; Cellulose (woody fiber) from any source whatever, is treated with sulphuric acid of 58° B. (=sp. grav. 1·676) at 15° C. (=59° Fahr.) then washed with water to remove excess of acid, dried and converted into a fine powder. This is mixed with resin-soap, in a mortar, and the soda of the soap is removed by treatment with sulphate of aluminium. The mass is now collected, dried again, and pressed into cakes by hydraulic pressure. These cakes are again cut into thin plates, which are shaped by again subjecting them to pressure. By adding castor-oil or glycerine to the mass before pressure, the product may be made transparent. Colors may be imparted by the use of vegetable coloring agents. Facts respecting the strength and elasticity of this product are wanting.

THE ELECTRIC LIGHT IN FACTORIES.

Although the electric light has not yet come into use for domestic purposes, its success for lighting large spaces, such as depots and factories seem assured beyond question. The Riverside worsted mills, at Providence, R. I., have used the light for over a year, with an estimated economy of $14,000 over gaslight. Five dynamo-electric machines with 80 lamps are employed lighting all the principle rooms. An extract from the report of the Treasurer of the company is as follows:

They could not have a severer test than we give them, as our mills runs night and day the year through, and we have not had a moment's delay from, or a dollar's worth of repairs on, any of the machines or lamps. The light is all we expected. It is strong and steady, clear and white. It is universally liked by both overseers and helps—so much so that we doubt if we could get along now with the helps if we were to return to the old gas-lighting. Certainly we should not get so good work, nor so much of it. We use porcelain globes prettty generally throughout the mill, and we have less complaint of trouble to the eye-than we used to have with gas. The air of the room, too, shows a marked difference. In our weaving-room with its 250 gas-lights, the air became almost unbearable after midnight in summer, and the faded appearance of the men showed how they felt it. With the electric light there is no such trouble, as the air at night is as good as in the day time, and noticeable cooler. The 80 electric lamps takes the place of 578 gas burners and effect a saving in cost of $4.73 an hour, or $15,000 a year, as stated above.

A NEW DIVING SYSTEM.—We alluded some time ago, in this department, to a remarkable improvement, invented by Mr. H. A. Fleuss, which had been attracting much attention in London, by which a diver is enabled to remain under water for several hours together without receiving his air supply from above, as has hitherto been necessary. In other words, the diver by some ingenious method succeeded in taking some portable form, thus making himself practically independent of the air-supply from the surface, the only connection required being the signal-rope. Our chemical readers, will, no doubt, have struck upon the general features of the new invention; but the details are so ingeniously worked out that a brief account of them will be of interest, especially as the new system bids fair to greatly extend the utility of sub-marine work, and is even claimed to be applicable, with decided advantage over existing methods, to life-saving purposes, in fiery mines, and the like.

In this new apparatus, the helmet, which is outwardly no larger than the ordinary diver's head-gear, is provided with a tight compartment, having about ¼ of a cubic foot capacity, in which is stored (from previously-provided cylinders containing it under the needful pressure) a quantity of oxygen gas, under a pressure of say 240 lbs. per square inch. This quantity represents about 4 cubic feet of oxygen at normal pressure, and has been found ample to afford air-food for the diver sufficient for five hours' consumption.

The metallic yoke (or collar) to which the helmet is attached, and which serves to fasten the outer rubber suit of the diver to its place, is provided with two curved shields, one in front and the other at the back of the wearer. In the space included in these shields are two vulcanite receptacles filled with masses of spongy rubber, saturated with strong caustic soda solution. The object of this provision is to effect the immediate absorption of the carbonic acid exhaled by the diver, by filtering the expired breath through the receptacles of soda.

The mouth and nose of the divers are fitted with an inhaler not unlike that used by dentists. A valve on each side is so arranged that it opens during inspiration, and closes tightly during expiration. The expired air is passed, by suitably attached tubes, to the bottom of the receptacles containing the soda, through which it is filtered, and finally finds its way, purified of its carbonic acid, and containing therefore chiefly nitrogen, to the inner helmet, where it receives a fresh complement of oxygen in place of that which was lost by consumption, and is once more breathed into the lungs. It should be added by way of explanation, that the air in the wearers' lungs and about his capacious garments, when he first dons the diving costume, contains sufficient nitrogen for indefinite use; for, as it is not absorbed by the soda, it is breathed again and again, serving the necessary purpose of diluting the oxygen which is constantly supplied from the store compressed in the helmet.

This apparatus is much less cumbersome than that commonly used, and less expensive in operation, as only one attendant to the signal-cord is required, in place of three required in the old system. The air is supplied through the valves at normal pressure, so that at whatever depth the wearer may be working, he breathes easily and naturally, without being subjected to the distressing pressure which limits the usefulness of the old system. It is claimed that with this apparatus divers will be able to descend to, and work safely in, greater depths than have hitherto been possible. It will be possible, too, for one provided with it to penetrate with impunity into fiery mines to the rescue of unfortunates; to enter burning buildings and smoke-filled apartments. It has even been suggested that aëronauts might avail themselves of it to ascend to far greater heights than it has hitherto been possible to attain.

A LARGE immigration of Scandinavians to the Canadian Northwest is expected this season, and arrangements are being made by the Government for the transportation overland from Thunder Bay of such of them as may wish to work upon the Pacific Railway. It is thus hoped to evade the wiles of Minnesota and Dakota land agents, who, according to one section of the Manitoba newspapers, have, so far, managed to divert a large number of the immigrants expected to reach that province.

A POPULAR ASTRONOMICAL ERROR.

One of the boldest speculations in astronomy, and one that has a peculiar fascination for most intelligent students of science, is the hypothesis suggested by the great astronomer, Mädler, that the stellar universe has a motion about a great central sun, the latter being Alcyone, the brightest member of the star group known as the Pleiades. The great reputation of Mädler, caused his announcement at the time to be received with general acceptance; but subsequent investigation of the subject made it apparent that the hypothesis was founded upon such very slender evidence that it has been rejected by astronomers as unproved, though, like most attractive errors, it still holds its place among popular beliefs.

Prof. Proctor, in a late publication, dwells particularly upon this hypothesis of a central sun, and makes it the text of some reflections as to the tenacity with which certain errors retain their hold upon men's minds. From his criticisms of this hypothesis, it would appear that Mädler's idea never received much credence among astronomers, as the evidence that he presented in support of it was exceedingly feeble. It appears that Sir John Herschel pointed out how very unlikely it was that the centre of the Milky Way—if such a center there really is—could lie so far away from the mean plane of the Milky Way as the Pleiades. And Proctor, on the same subject, has shown that the only piece of positive evidence advanced by Mäller—namely, the drift of the stars of the constellation Taurus in one direction—was really no evidence at all, for the excellent reason that a similar drift, in other directions, can be recognized in other regions of the starry heavens.

Proctor asserts that no astronomer of repute would now venture to maintain the theory that Alcyone of the Pleiades is the central sun of the stellar system, and that scarcely any one of them would admit the probability of there being any central sun at all. In spite of all this, however, the belief is still widely spread among the general public that Alcyone is the central sun; and, as Proctor remarks, the theory seems to excite far more interest than most of the real discoveries—many of them of vast importance—that have been made during the past half century.

It may be well, therefore, in view of the attitude of the learned world towards the speculation of Mädler, and the pointed declararions made on high authority, that the hypothesis never had anything but a species of tolerance among astronomers by reason of the great reputation of its author, and the fact that the only piece of positive evidence in its favor has been completely nullified by similar evidence of a contradictory nature—to consider the idea to be an unfounded speculation.

FRENCH BREAD.

As a rule, French bread is always sweet and good, and two things contribute in a great degree to this—that is, the manner and form of baking. They never make a thick loaf; no matter what the size or shape, it is always thin, and more than two-thirds crust. They bake their bread until it is perfectly cooked. The loaves being so thin, the heat strikes through them very soon after they are placed in the oven; hence all the fermentation is stopped while in the case of large loaves fermentation continues to go on after the bread has been in the oven for some time, and of course, much of the sweetness is lost. Then in baking so long and having so much crust, there is a peculiar sweetness given which can be attained in no other way.

BATHING.

Once a week is often enough for a decent white man to wash himself all over, and whether in summer or winter, that ought to be done with soap, warm water and a hog's-hair brush, in a room showing at least 70 degrees *Fahrenheit*. If a man is a pig in his nature, then no amount of washing will keep him clean, inside or out. Such an one needs a bath every time he turns round. He can do nothing neatly.

Baths should be taken early in the morning, for it is then that the system possesses the power of reaction in the highest degree. Any kind of bath is dangerous soon after a meal, or soon after fatiguing exercise. No man or woman should take a bath at the close of the day, unless by the advice of the family physician. Many a man, in attempting to cheat his doctor out of a fee, has cheated himself out of his life; aye, it is done every day.

The safest *mode* of a cold bath is to plunge into a river; the safest *time* is instantly after getting up. The necessary effort of swimming to shore compels a reaction, and the effect is delightful.

The best, safest, cheapest and most universally accessible mode of keeping the surface of the body clean, besides the once-a-week washing, with soap, warm water, and a hog's-hair brush is as follows:

Soon as you get out of bed in the morning, wash your face, hands, neck and breast; then, into the same basin of water, put both feet at once, for about a minute, rubbing them briskly all the time; then, with the towel, which has been dampened by wiping the face, feet, etc., wipe the whole body well, fast and hard, mouth shut, breast projecting. Let the whole be done within five minutes.

At night, when you go to bed, and whenever you get out of bed, during the night, or when you find yourself wakeful or restless, spend from two to five minutes in rubbing your whole body, with your hands, as far as you can reach, in every direction. This has a tendency to preserve that softness and mobility of skin which is essential to the health, and which too frequent washings will destroy.—*Journal of Health.*

BREAD.—The indigestion and dyspepsia so rife in the United States can be traced almost to the use of alum in bread-making. Alum is an astringent, and taken into the stomach daily cannot fail to produce chronic constipation, followed by a train of serious complaints. The high price of cream of tartar tempts dishonest manufacturers to substitute alum for it in the preparation of the innumerable baking or yeast powders in the market. It is said that there are 500 different brands of powders, and 499 of these have been declared adulterations. Thus the people continue to be poisoned by mercenary merchants, while the authorities sit still and see the work go on. In California we have what is called a State Board of Health, which is kept up at a considerable expense to the State. What good results from the commission, the public have no means of knowing. It would seem that the examination of the yeast powders in the market, and the punishment of the culprits, would properly come under its province. Let them move in the matter.—*Cal. Medico Literary Journal.e.*

An ingenious method of measuring the quantity of moisture in the air has been devised by Herr Rudorff, who lately announced it to the German Chemical Society. It consists in admitting to a measured volume of air, contained in a suitable glass chamber, a small quantity of sulphuric acid from a graduated tube with stop-cock. The acid absorbs all the aqueous vapor contained in the air, thereby reducing the pressure in the chamber. This diminution of pressure is shown by means of a manometer connected with the vessel. Sulphuric acid is then admitted in drops until the original pressure is restored. The absorbed aqueous vapor is thus replaced by an equal volume of sulphuric acid, and by calculation the percentage of vapor that the air had carried can be readily ascertained. The method is said to give very accurate results, and the operation makes a good lecture experiment.

HARDENING GRAVERS AND SMALL DRILLS.—An English gentleman who has been famous as an ameteur for the fine work he has done details at some length a method which he has employed for many years for producing a hard, tough temper in graving tools, small drills and other small steel tools. The steel is heated in charcoal dust. Great care is taken, however, that the heat is not too great, as this would probably injure the tool. It is then plunged at once into a box of wet, yellow soap. This renders the point of the tool very hard, and at the same time very tough—so tough, indeed, that it is said that the tools may be bent in many cases without drawing their temper. The recipe was published, we believe, more than 40 years ago, though we have been unable to trace it.

CARE OF MILK.—A writer in a recent number of *Nature* says that milk is especially liable to be affected by the atmosphere about it, whenever it rests in open vessels. In the cleanest pantry or larder, it gathers the effluvia of meat, cheese, onions, bread, fruit and such matters; the result being that it is soured and spoiled. In kitchens, nurseries, living and sleeping-rooms, closets, etc., the case is worse. Nature intended that milk should be drank at once at its source; and it is very likely that exposure and delay impairs its power of nutriment. Milk should be kept as much as possible in close vessels.

HERR RUDOLF FALB, a well-known astronomer, has returned from his travels in South America, and believes he has made important discoveries as to the original language of the human race.

BECK'S IMPROVED LARGE BEST MICROSCOPE-STAND.

The Improved Large Best Microscope-stand has a tripod A, fer its base, upon which is placed a revolving fitting (B), graduated to degrees, by which means the microsocope can be turned round without its being lifted from the table, and the amount of such rotation registered ; upon this fitting two pillars are firmly fixed, and between them the limb (C) can be elevated or depressed to any angle, and tightened in its position by the lever (D). The limb carries at one end the body (E) (binocular or monocular), with eye-pieces and object-glasses ; in its centre the compound stage (F), beneath which is the circular-plate, sliding on a dove-tailed fitting, and moved up and down by the lever (Z), and carrying the supplementary body or substage (G) ; and at the lower end a triangular bar carrying the mirror (H). Each of these parts requires a separate description.

THE BINOCULAR BODY.—The binocular body consists of two tubes, the one fitted in the optical axis of the microsocope, and the other oblique. At their lower end and immediately above the object-glass there is an opening, into which a small brass box or fitting (I) slides ; this box holds a prism so constructed that when slid in it intercepts half the rays from the object-glass, diverts them from their direct course, and reflects them into the additional or oblique tube. To the prism-box is attached a spring-catch, which, when pressed in, permits of the removal of the prism-box ; but it is only needed for cleaning, as, when the box is drawn back to the distance allowed by this spring, the prism in no way interferes with the field of view, and all the rays pass up the direct body, and the microscope is converted into a monocular one.

The upper or eye-piece ends of the tubes are fitted with racks and pinion for varying the distances between the two eye-pieces, to suii the differences between the eyes of various persons ; and arrangements are made for racking out one tube more than the other, to suit irregularities or inequalities between the eyes of the observer.

This body is moved up and down with a quick movement by means of the milled heads (K), and with a very delicate and fine adjustment by the milled head (L). This milled head works against a lever, which moves a slide independent of the rack-movement, and gives an adjustment at once certain and decided.

THE STAGE.—The compound stage is of an entirely new construction : the object is most frequently merely placed upon it, but, if necessary, it can be clamped by carefully bringing down the spring-piece (M), the ledge will slide up or down, and the object may be pushed sideways ; this arrangement forms the coarse adjustment. Finer movements in vertical and horizontal directions are effected by means of two milled heads (N and O), the screws attached to which are kept up to their work by opposing springs, so as to avoid all strain or loss of time. The whole stage revolves in a circular ring by the mailled head (P), or this can be drawn out, and then it turns rapidly by merely applying the fingers to the two ivory studs (Q, Q), fastened on the top plate, which is divided into degrees to register the amount of revolution. The stage is attached to the limb on a pivot, and can be rotated to any angle, which angle is recorded on the divided plate (R), or can be turned completely over, so that the object can be viewed by light of any obliquity without any interference from the thickness of the stage.

Beneath and attached to the stage is an iris diaphragm (S), which can be altogether removed, as shown in the illustration, from its dove-tailed fitting, so as not to interfere during the rotation of the stage. The variations in the aperture of this diaphragm are made by a pinion working into a racked arc and adjusted by the milled head (T)

THE APPARATUS BARS.—Beneath the stage are two triangular bars (U, V), the one revolving round and the other rigid in the optical axis of the instrument. On the former the substage (G), carrying all the apparatus required for illumination and polarisation, fits, and is racked up and down by the milled head (W) ; the mirror also, if desired, slides on the same bar ; the revolving motion to this bar is given by the milled head (X), and the amount of angular movement is recorded on the circle (Y), whilst the whole of this part of the stand is raised and lowered concentric with the optical axis of the instrument by the lever (Z), and the amount of such elevation or depression registered on a scale attached to the limb. This bar can be carried round and above the stage, and be thus used for opaque illumination.

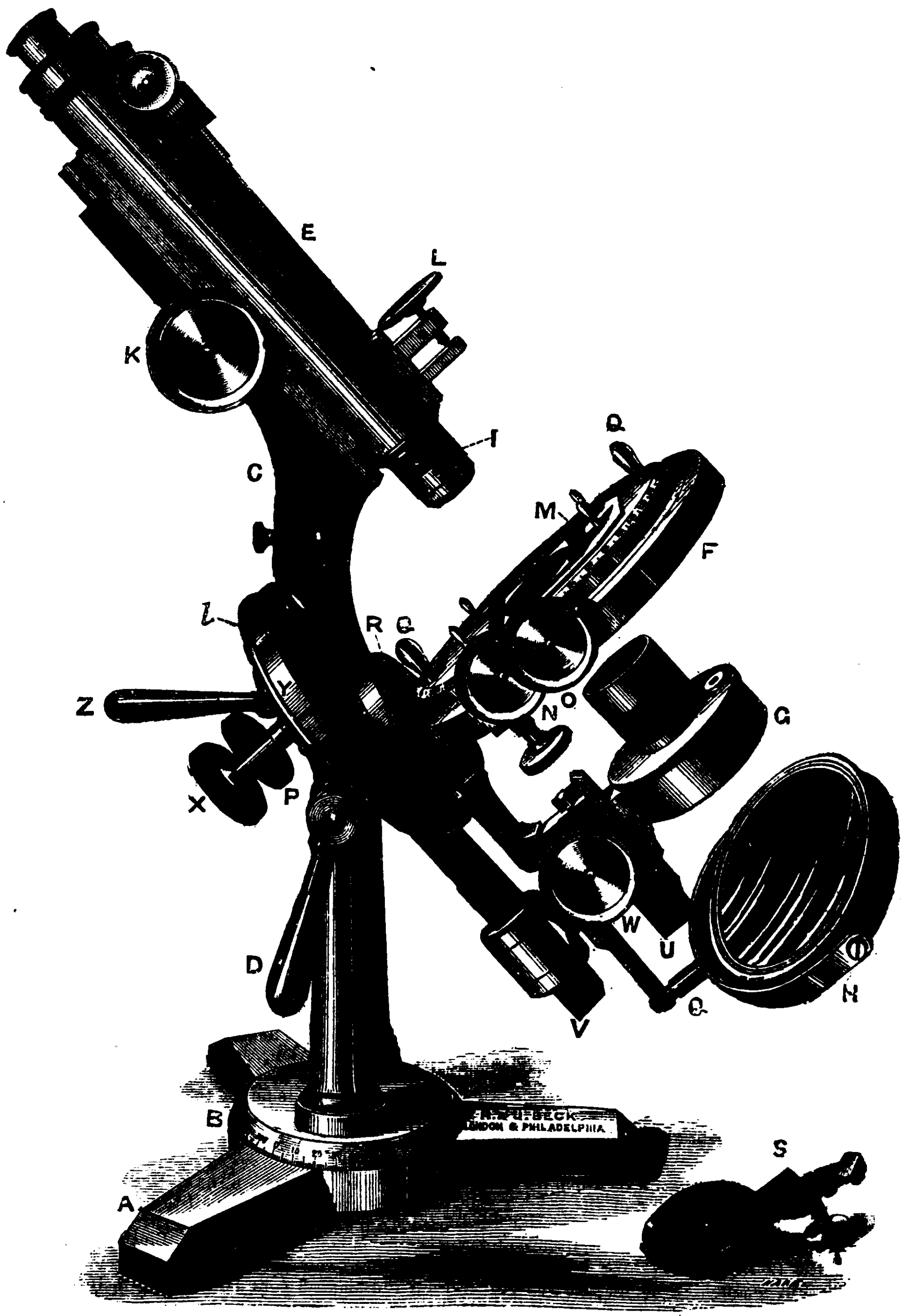
The lower triangle bar (V), or a right angle prism, when the illumination is required to be concentric with the optical axis of the instrument, and independent of the movement of other illuminating apparatus.

THE MIRROR.—The mirror-box contains two mirrors, one flat and the other concave ; it swings in a rotating semicircle attached to a lengthening bar, which enables it to be turned from one side to the other, and revolves on a circular fitting for giving greater facilities in regulating the direction of the beam of light reflected, the whole sliding on either of the triangle bars previously referred to, and made to reverse in the socket so as to bring the centre of the mirror concentric with the axis of the microsocope in either case.

THE SUBSTAGE.—As the mirror alone is insufficient for many kinds of illumination, some provision has to be made for holding various pieces of apparatus between the object and the mirror. For this purpose a supplementary body, or substage is mounted perfectly true with the body, and is moved up and down in its fitting by rack and pinion connected with the milled heads. This substage, to which reference has already been made, is now regarded as one of the most important parts of the Achromatic Microscope ; in it all the varied appliances for modifying the character and direction of the light are fitted. But a few years since it was considered sufficient for this part of the stand to be constructed so as to move up and down perfectly coincident with the optical axis of the instrument, and for that purpose it was racked in a groove planed out on the same limb as that on the upper end of which the optical portions were carried. But lately mircroscopists have shown the desirability of affording every facility for lateral angular adjustments ; and this has led to the substage being attached to an arc (*b*) working in the circular plate (Y), and moved by a rack and pinion (X), whilst the amount of such angular movement is recorded on the upper surface of the plate (Y). Having once fixed the the angular direction of the light, the focusing of it depends upon the lever (Z), which moves the circle up and down, and with it the arm carrying the illuminating apparatus, *in the optical axis of the instrument*. So long ago as 1854 Mr. Grubb, of Dublin, called attention to the advantage of mounting the illuminating apparatus on a revolving arm or arc, which he thus describes in his provisional specification for improvements in microscopes, No. 1,477, 5th July, 1854 :—" My third improvement consists in the addition of a graduated sectorial object '*in situ*,' on which either the aforesaid prism or other suitable illuminator is made to slide, thereby producing every kind of illumination required for microscopic examination, and also the means of registering or applying any definite angle of illumination at pleasure." With but slight modification, this is the plan adopted in this stand.

A BED-BUG TRAP.—Edison may be a chieftain among inventors, but if he had lived 3,000 years before Christmas he never would have dropped on such a family blessing as our mining friend, Tom Orton, did when he accidentally left his cribbage board in the blankets at the foot of his bunk. Tom didn't have bugs, but his bed did, and had 'em bad. After the crip-board had been in the bed all night his eagle eye made the discovery that most of the holes had been located by enterprising bugs, and he instantly "tumbled" to the idea. False head-boards, foot-boards, and side-boards, bored innumerable gimlet holes were provided, and every morning the boards were taken out and the locators scalded. The mortality among the bugs had been fearful since the invention, and the boys down that way, as they roll into their blankets, and drop peacefully into pleasant dreams, pray for blessings to fall on the inventor of the "Orton Thousand-Holed Crip-Board Bed-Bug Destroyer," which has brought peace, rest and comfort to the sleepers of the North Fork.—*Plumas National.*

MANUFACTURE OF LAGER BEER IN SMALL QUANTITIES.—The following recipe is said to make an excellent beer fcr home use : To make 5 gallons of beer, take somewhat more than that quantity of soft water, suspend in the vessel containing it a bag with about two ounces of hops, and boil for about half an hour ; then add about 3 pounds of ground malt, or, if preferred, a quart of thick sugar syrup (or of molasses); allow the whole to boil up several times, then pour the decoction in a tub or vat. As soon as it has become say luke-warm, add to it about a half pint of good brewer's yeast, and allow the whole to remain in a cool place to ferment. At the expiration of six to eight days, it will have become quite clear, and may then be bottled. This beverage may be made stronger or weaker, or more or less bitter, by varying the above proportions ; and, when prepared according to this recipe, is said to make a refreshing and pleasant drink, which will keep very well in a good cellar.



BECK'S IMPROVED MICROSCOPE STAND.

THE WONDERS OF THE BEEHIVE.

The following is the substance of a lecture delivered by Mr. F. R. Cheshire, F. S. A., under the auspices of the Devon and Exeter Beekeepers' Association: Mr. Cheshire said, by way of introduction, that a good many people had taken up bee-keeping, believing, from books which they had read, that they would reap large profits without understanding the economy of bee-life. He would treat of the economy of bee-life, and let them know its right basis. It is not merely by purchasing a hive and leaving it to itself that great profits were to be made. If they stood before a hive at the time the bees were gathering, they would notice numbers of bees going in and out, and that those which went in had large pellets on their hind legs. Old writers believed that these pellets were wax, but they were really pollen. If they could watch the bee as it entered the hive, they would find that it ran up one of the combs which hung from the roof of the hive. Could they watch it further, they would find that the bee would settle on one of the cells, and thrust off the pollen into it. In all probability the bee would turn round and butt the pollen down with its head, but that was not all the bee would do. Whilst it had been gathering this pollen with its legs, it had, at the same time, been gathering up with its tongue the honey secreted in the hollows of flowers. This honey had been taken in and deposited in a somewhat capacious sack, or false stomach. If it had been necessary that the bee should eat honey for food that passed into the body, while that which was gathered for depositing in the cells went into the honey-sack, they might ask why it was that the bee went forth to gather pollen on the one hand and honey on the other; and another interesting question was, Why did the flowers present both honey and pollen? Well, one question could be answered in the hive, but they must go into the fields to get the answer to the other. He would first answer the question why the bee gathered both honey and pollen. If they removed the comb from the hive at this time they would find in it numerous eggs and grubs. Those who had studied the etymology of insects knew that they passed through four conditions: first, the egg, then the grub, in which state it ate largely; then the pupæ; and lastly, the perfect insect. The bee passed through all these changes. The egg was deposited at the bottom of a cell by the queen, and the cell was immediately covered over. The germs of the egg developed, and in three or four days it became a grub; the end of the egg was broken and the grub issued. There it lay in a very imperfect condition, and as it was incapable of movement its food had to be brought to it. This was done by the younger bees, who took upon themselves the duties of nurses. These nursemaids, who fed the grubs, took in pollen, honey and water. It was out of this pollen that the body of the grub was built up. It had undergone digestion in the body of the nurse and was ejected on to the bottom of the cell. Now the grub had a very imperfect mouth, but it had the quality of taking in food by the pores of its skin. It laid on one side and took in the food, while the upper side provided it with air. At the end of six days it was a good well-formed grub, and then passed into the third condition and began to spin a web, with which it covered its body. A series of marvellous changes then took place; the grub became more and more perfect. These changes went on for twelve days, and at the end of that time, the grub became converted into a bee, and cut its way out of the cell. The queen bees were wonderful layers. From 2,000 to 3,000 eggs were laid by the queen, in the height of the season, in 24 hours, and in from 20 to 21 days these eggs were converted into bees. Having referred to the wondrous change of the bee-grub, he would next proceed to speak of the formation of the eye. Now, there were certain relations of the bee to the flowers, and the flowers bore certain relations to the bee. The eyes, as they were called, of the bee, were situated on the sides of the head, but each such "eye" consisted of 4,000 single eyes welded together, and, from mutual pressure, it was hexagonal. Each eye was in an independent position, and each had three lenses, like the eye of a human being. These three lenses gave perfect vision, and the two first lenses were achromatic. The bee had also three single eyes on the top of its head, and the sight of these was short, and enabled it to see whilst it was feeding. Next, to the tongue. Honey was so susceptible to water that, if exposed as in the flowers, it would get washed away. But, in the majority of flowers, it was secreted deep down in the bloom, and that being so, it was necessary that the bee should have a long tongue to reach it. The queen bee, which remained at home, did not gather honey, and could not do so, for she had a short tongue and so had the drones. The tongue of the working bee had a singular, hand-like appendage at the end, which enabled it to gather the most minute particles of honey from the recesses of flowers, and where there were large quantities, it had a means of lapping it up, and gathering it into its basket. Next as to the legs. It would be found that neither the queen bee nor the drones had the arrangements on their legs for gathering pollen. The working bees, when they went to the flowers, gathered this pollen on their bodies, and worked it off into the receptacles on their hind-legs. The wings were four in number; why was that? As they knew, the bees were produced in small cells, and if the wings were only two in number, and were large enough to support the bee in his flight, it would not be able to enter the cells. These double wings lapped over each other, but during the flight of the bee were united by a number of hooks, and acted as one. Proceeding to speak of the work done by the bees for flowers, the lecturer pointed out that it was necessary for the fertilisation of the seed of plants that the pollen of other plants of the same order should be transmitted to them. This work, in common with other insects, was done by the bee. The plant, as it were, baited its flower with honey, which the bees went to get, and in so doing took the pollen from the flower. The lecturer first took two varieties of the common primrose, and showed how the bee, in gathering the honey from one, gathered on its body the pollen, which in turn, whilst the insect was collecting the honey from another variety, came in contact with and fertilised seed. Having shown how the pollen served to build up the grub and assist in the fertilisation of flowers, the lecturer proceeded to treat of honey, which, he pointed out, was a great producer of heat. A great deal of nonsense, he said, had been talked of late about thin hives for the winter, but he assured his audience that if they allowed heat to escape from the hive they also allowed honey to escape. Honey was a great heat-producer, and the more heat was allowed to escape, the more honey would be eaten by the bees. In allowing heat to escape, they not only lost honey, but they gave the bees an immense amount of work, which wore them out before the time came for them to commence the labour of collecting honey. He had made experiments, with a view of testing this question of the merits of thick and thin hives, and he urged them not to be led away by dealers to believe that thin hives were the best. Honey was the producer of the heat necessary for the bees, and if they allowed the heat to depart from the hive, they not only lost more honey, but they also wore out their bees. A great deal of nonsense had been talked about bees, and amongst other things it was said that they broke the skin of fruit; but the bee had not the jaw for this, though, when once the skin was broken, the bee would suck the saccharine matter in fruit if it could get nothing else. But the bee had something to do with fruit before this. The raspberry and gooseberry were fertilised by the bee in the same way as flowers, The work of selection and hybridisation had been carried on by the bee, and man was just following on in the work. He had said that a cottager might make £3 a-year by a hive, and that had been questioned in a letter by some one who did not give his name. He was not accustomed to make statements he could not substantiate, and he preferred not to deal with anonymous correspondents. But they knew what a wretched season the last had been, and he might mention that he last year bought a hive for £1 1s., from which, by proper treatment and feeding, he had £5 worth of honey. It was a mistake to believe that in giving bees sugar they were throwing away money. If bees were not fed, the hive was kept thin, and the result was that when the honey season came they began to breed, and a large number that should be out had to stay at home to keep up the temperature and attend to the hive. On the other hand, if they fed the bees, they would have a strong army ready to gather honey at the right season; and it must be borne in mind that sugar could be had for 2½d. per lb., whilst honey was worth 1s. per lb. In conclusion, he explained, by means of models, various improvements in the arrangements of hives, and expressed a hope that he had done something to induce his audience to go in for modern bee-keeping.

—The salt bed at Petrolia lately announced has proved so great that a wealthy company has been formed, and a shaft twelve feet square is sinking, designed to reach the bed. Several hundred feet of solid rock must be gone through before reaching this sea of salt, and it is thought that it will take a year to complete the work. The venture is considered first-class.

RAWHIDE is said to make good journal boxes. A practical machinist says: "I have run a piece of machinery in rawhide boxes for 14 years without oil; it is yet good and runs at 4,500 revolutions per minute. I put it in while soft and let it remain till dry."—*American Machinist.*

"EVOLUTION ADMITTED, WHAT THEN ?"

It is gratifying to note an obvious subsidence of alarm on the part of eminent divines in regard to the acceptance of evolution doctrines, accompanied by the bolder enunciaeion of rational views respecting religion. Dr. E. O. Haven, Chancellor of the University of Syracuse, and now a Methodist bishop, sends a communication to a leading religious journal under the above title, which is full of significant foreshadowings that are worthy of notice.

Dr. Haven utters a very important truth when he says : "Men are prone to associate their religion with its drapery. This becomes obsolete and must be changed, and the looker-on fancies that the very body and soul are gone." This is the view of science. Religion, like other things, is progressive, and proceeds from stage to stage, successively molting its integuments with increasing expansion and a higher life, or, by the figure of Dr. Haven, shedding its worn-out clothing as occassion requires. It is a great point gained in this matter to descriminate between the living body and its accidéntal and temporary wrappings—between perennial truth and its obsolete accompaniments. The credal habiliments are not the vital thing they invest, and to cling to them as if they were is superstition. Dr. Haven's point of view enables us to appreciate the triviality of denominational cuts, fits and styles ; and illustrates the futility of venerating theological rags and tatters instead of the essential religious ideas which require ever to be clothed anew as men grow in grace. And what a pitiful spectacle, moreover, it is to see people so confused and perverted in their notions as to actually worship the heaps of old clothes that have been long ago worn out and cast off.

We are glad to observe that Bishop Haven does not recoil from the conception of creation as a continuous, ever-unfolding work. He wisely accepts the view of God, compelled by evolution, as that of an eternally-creating Spirit. He says, "Is there any reason whatever to believe that God at any past period, large or small, had any more or less to do than now with this earth and all that it contains ?" And again : "Had we all been educated in a theory of gradualism and constancy and improvement, and thoroughly saturated with it, and yet aroused into a profound belief in God, as is certainly conceivable on that theory, and then, should the theory of a Deity sometimes awake and sometimes asleep be suggested, it would shock some feeble minds into atheism." But would not strong minds also be thus shocked, and justly so ; and would not the atheism be real ? When evolution has become an established and familiar idea in the religious world, and the Creative Power is conceived—as far as such conception is possible to finite faculties—as the mighty, ever-energizing spirit of which the boundless universe is but the manifestation, a reversion to present current notions of the method of creation will assuredly be regarded as a lapse into atheistic paganism, analogons to a present backward plunge into fetichism.—*Prof. E. L. Youmans.*

MAKE YOUR OWN TOOLS.

This ambition to individualize tools and to adapt them to their users is a chariteristic of skillful workmen, and makes a broad line of distinction between the mechanic and the mere labourer. A kit of tools made by the mechanic himself is a recommendation of the mechanic. Few intelligent foremen sneer at this professional pride, or ridicule its visible products. And the possession of a kit of his own tools, made by himself, is not only an evidence of the honourable pride of the workman, but is frequently a guaranty of his ability. A workman who can make a good kit of tools, who can shape a cold-chisel, construct a gauge, hang a hammer, or fashion an elegant and handy scratch-awl, and do other good jobs, evidences a pride in his own handiwork that will not be satisfied with half-done jobs.

The desire of the mechanic to have *his own* tools made, or at least adapted, by himself, is perfectly natural. With the knowledge of the fact that individuals differ, comes the evidence that what suits the mass is not adapted to the one ; that what is for all is not for this particular one. How many machinists are at home in handling a strange hammer ? How often the workman drops a hammer he has picked up in haste, antd delays an instant until he can reach for, or go for his own ! This is not foolish fastidiousness ; for those who most stick to their own tools are old, experienced workmen, who have outgrown the false pride which would make them insist on their way as the only right way. The fact is that the workman is the best judge of the adaptability of a tool for himself, and if he does not make and fashion his own, he at least chooses and modifies those produced by others.

This necessity, or the advantage of adaptability, received an illustration recently, when a smith, an expert forger of iron and steel, with 20 years' experience, showed the writer a hammer with a split handle, saying, "This is the best hammer in the shop to finish off a forging handsomely." The fact was that he had dared to shave down the hickory small enough in the neck of the handle to give it the "feeling" spring to his hand, for fear of breaking it in use, when a foul blow in the hand of an apprentice split the handle, and made it the *handiest* one in the shop.—*Exchange.*

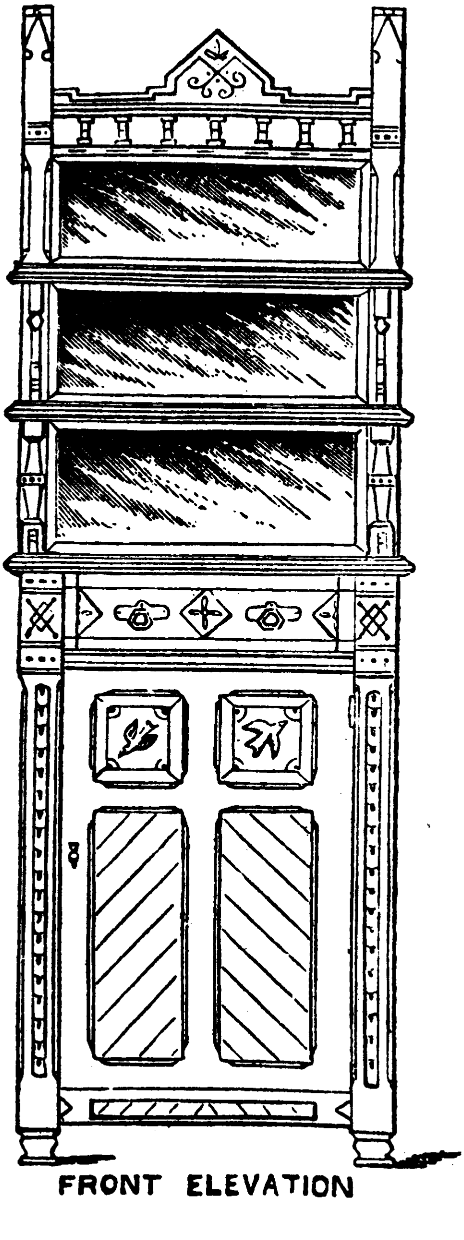
THE FOSSIL MAN.

Prehistoric archæology, the latest-born of the sciences, like her elder sister, geology, has lived through the successive stages of scornful denial, doubt and unwilling assent, and has finally won for herself substantial recognition. The "antiquity of man" is now an established fact. Fven its most strenuous opponents are forced to concede that there are proofs of his existence during a lapse of time far exceeding the limits of the previously approved chronology. For somewhat of the suspicion with which this result has been received, certain of its advocates may have themselves to blame. Where absolute chronological determinations were of necessity impossible, and where, even at the present stage of the investigation, only general approximation can be reached, it was at least injudicious to startle received opinions, and to arouse prejudices, by asserting for mankind an antiquity of hundreds of thousands of years. Moreover, the great name of Cuvier was held up as a barrier in the path of those who claimed to have discovered proofs of man's existence under geological conditions different from the present. Cuvier, however, never denied the possibility of finding "the fossil man ;" he only questioned the sufficiency of the evidence of his existence which had been brought under his notice, and with great reason, in view of the numerous instances in which pretended fossil bones had turned out to be those of animals, or even merely natural formations.—*H. W. Haynes, in Popular Science Monthly.*

RANSOME'S SLAG CEMENT.—Our contemporary, London *Engineering*, devotes some space in a late issue to an account of the experiments for Mr. Federick Ransome's new process for producing hydraulic cement of very superior qualities from blast-furnace slag with suitable mixtures. Our readers will recall the general features of Mr. Ransome's process from our recent references to the subject in this department. Mr. R., it now appears, has obtained even better results by modifying his process by the employment of slags containing a high percentage of alumina, the product given even better results as to strength than in his earlier experiments. The inventor has proceeded on the theory of MM. Fremy, Ruot, and Chatony, that "aluminate of lime is the principle hydraulic agents in cements ;" and that the setting of a hydraulic cement is due to two causes : (1) To the hydration of aluminates of lime ; and (2) to the action of hydrate of lime upon the silicate of lime and the silicate of alumina and lime which exist in all cements, and in this case act as puzzolanas. Our contemporary states that the results arrived at by Mr. Ransome fully corroborate these views, and by attaching full importance to the presence of alumina, the invention in question has succeeded in greatly increasing the strength of the new cement. Samples, it is added, show remarkable hardness and closeness, and the material promises to become an exceedingly valuable one. By the employment of blast-furnace slag-sand (Mr. Wood's process), the greater part of the refuse involved in the production of the clinkers used in the ordinary process of cement-making is avoided, the cost of fuel and grinding is reduced, and a application is made of what has been a practically useless material.

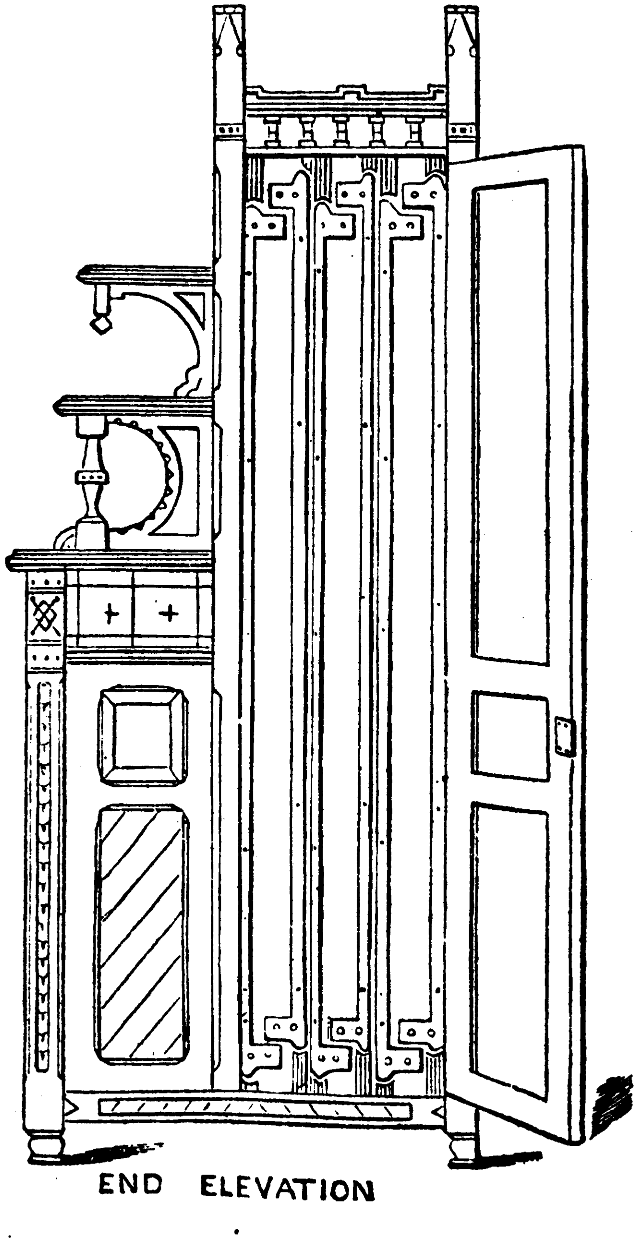
THE *Engineer* says that two Germans have made a new form of machine for separating the turnings and borings of brass and copper from those of iron and steel. The mixed metals falls upon a magnetized drum, to which the iron and steel adhere, leaving the copper and brass to fall into a special reservoir below. There are two cylinders rotating in the same direction, so that the iron which escapes from the first cylinder is retained by the second. The surface of the cylinder is formed by flat bands or strips of soft iron, alternating with strips of copper, and each of the iron bands is in contact with a row of horse-shoe magnets. The adherent metal is removed by revolving brushes.

FIG. 1.



FRONT ELEVATION

FIG. 2.



END ELEVATION

FURNITURE DESIGN.