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ARE MECHANICS' INSTITUTES IN ONTARIO A FAILURE?

THE NECESSITY OF A GOVERNMENT ENQUIRY TO ASCERTAIN IF SUCH IS THE CASE, AND HOW THE FUNDS, WHICH ARE VOTED ANNUALLY FOR THESE INSTITUTIONS, ARE DISPOSED OF.

SOME few months since the writer, in an article published in the SCIENTIFIC CANADIAN AND MECHANICS' MAGAZINE, endeavored to draw public attention to this matter, setting forth that these institutions, as at present constituted and governed, had failed to realize the good results that were expected to follow the annual provincial grant in their aid. His article was followed up by another, which appeared in a public journal, signed " Economy," and which supplied the following information.

In referring to the Government report on these Institutes, for 1879, the writer stated :

" I was surprised to find that 58 institutions, with a " membership of 8,627, whose subscriptions amount to " $11,073.38, have received grants from Government to " the amount of $17,988.92, or over $2 for each mem-" ber. Some of our larger Institutes, such as Toronto " with 1,152, and Hamilton with 1,047 members, re-" ceived a gaant of $400, whereas Berlin with 80 mem-" bers, Brantford 99, Collingwood 76, Dundas 93, " Kingston 53, and others averaging from 53 to 400 " members received the same grant."

We wish the writer could have given further information and said how many of these members were actually working mechanics. We venture to assert that for the actual number of mechanics for whose instruction $17,988.92 is annually donated, does not exceed 2,000 members, which, if correct, would be something over $9.98 for each member who is a working mechanic ; that the whole amount granted is producing no good results whatever, nor promotes the special purpose for which it is voted. In fact the greater portion of the mechanics who are members of these Institutes are a well-to-do, and a better-educated class, and they subscribe more for the general reading the libraries afford for their families than for self-culture.

That Mechanics' Institutes in Canada have proved a failure, and have not tended to produce the beneficial results contemplated, there cannot be a question of doubt, and if any should arise as to the accuracy of these remarks, let the Provincial Government of Ontario call for a certified return of the number of working mechanics, in every city and town that receives the annual grant, who are subscribers, and the nature of the trades they follow. Also, require a statement of the titles and class of books purchased annually for the libraries, and whether a discount had been obtained by all the Institutes on the publishers' prices, as is customary to allow to public libraries, or, if it has gone into the hands of stationers, who take an interest in them for their own especial benefit. Let an investigation at once be made into the details of the application of the annual grants towards these institutions, and it will soon be discovered that, almost without exception, the bulk of the grant is not spent, as it should be, upon scientific and technical works, such as should be found on the shelves of a mechanic's library, but that it is laid out mostly on books of fiction, which are detrimental to technical study.

These (so-called) Mechanics' Institutes are, in fact, mere reading-rooms and libraries for the convenience of merchants, their employees, and professional men, and these are the classes who derive the benefit of the annual grant and not the mechanics.

When a sum of money is annually voted for a special purpose, it would be wise for the Government to ascertain that the money has been applied for the purpose intended, and not diverted from its proper channel, and it would be prudent, before renewing such grants, to obtain such information, and if it has not been found of benefit to mechanics in the support of the Institute, the money might be applied more usefully in some other form, from which more direct results would follow : for instance in the support of Industrial Schools. It may be said that if the mechanics themselves do not care to profit by the donation, the fault is theirs. To some extent this may be true—but it has to be borne in mind that the mass of our young mechanics have not been taught those elements of practical technical education that would create in them a desire for further knowledge. In fact the greater number of them leave school for the workshop with a very superficial knowledge of even common arithmetic, and having, in small towns and villages, no evening classes at which they could improve their deficient education, nor books of instruction to read, they soon become careless and apathetic. This class of the community being often thrown out of employment, from no fault of their own, have no resources within themselves for occupying their time, and idleness soon begets evil and dissipated habits. There is no class more to be pitied than that of operatives whose living depends, from week to week, upon the prosperity or otherwise of manufacturers. Their lot is much to be commiserated, and young mechanics require more interest to be shown by the government, manufacturers and employers, in their education and morals.

It may also be asked, is there any other reason why mechanics do not resort to the Institutes? Yes, there is another which has frequently been given to the writer, and that is they are not managed by their own class. This arises from diffidence caused from a deficient education, which makes them feel a want of fitness and competency to take a lead in any public matter—others therefore, not mechanics, and wishing to establish a town reading-room or library, find it very convenient to secure the grant under the pretence that it is for a Mechanics' Institute. As a natural consequence they appoint the majority of their officers from their own class; take the arrangement into their own hands; and buy what class of books they think proper, without regard to the interests and education of the industrial classes, for whose special benefit the grant is given. If there is a reading-room the working mechanic feels that he cannot avail himself of it, for this reason: that after he leaves the foundry, or workshop, where he works until 6 o'clock; gains his home; which may be some distance off, and after partaking of his evening meal; and done some chores, perhaps, about the house, he feels but little inclined to dress as he feels he ought to do, to mix in an assembly of well-dressed men, and that it would be an insult for him to appear there in a working suit. With respect to the library, he finds on reference to the catalogue that even the small selection of technical works it contains have not been judiciously chosen, and that the bulk of the works consists of books of fiction. He would, therefore, sooner spend the amount of a year's subscription upon some work on his own particular trade, and this is another reason why he does not become a member of an Institute. Thus these institutions, which might, under better organization and management, be a boon to the mechanical interests of the country, are, in fact, made use of, to a great extent, to transfer the bonus granted by government to the partial support of town reading-rooms and libraries, got up under the name of Mechanics' Institutes.

Now, it is not because an evil exists that it should not be remedied. The task must fall upon some one to expose it, which we now do, and if, upon full enquiry, the management and working of the Institutes are found to be unsatisfactory, the sooner the evil is remedied the better.

The following suggestions have occurred to us as likely, if acted upon, to bring about good results.

1st. That a return should be called for by the Provincial Government (if the annual reports do not supply such information) of the number of working mechanics who are subscribers in each place where there is a Mechanics' Institute. Also, a statement of the sums actually expended upon scientific and technical books—their names, cost, &c., and if $33\frac{1}{3}$ per cent. has been allowed off the cost by publishers, as is customary to public libraries. Or, perhaps, it would be more satisfactory, if the Government sent a special Inspector to visit these institutions and make a personal investigation into the manner in which they are conducted.

2nd. That the system should be re-organized, and no sum of money granted to any Institute that could not show annually a list of subscribers, being mechanics, whose subscriptions should be equal to two-thirds of the grant.

3rd. That all mechanics in small towns and villages, should be allowed to become subscribers (conditionally), to some neighbouring Institute, on the payment of $1 annually, said sum to be expended for monthly periodicals on their own trades.

4th. That drawing-classes should be formed, and suitable books, paper and instruments be provided.

5th. That a semi-annual inspection should be made by a Government Inspector, who should give lectures at the several Institutes, and be supplied with the necessary apparatus to make such lectures pleasing and instructive.

6th. That prizes should be offered annually to members of the Institutes, being mechanics, for the best specimens of work, drawings and designs.

7th. That a Dominion grant should be voted annually for the formation of a Dominion Reference Library—such library might be under an Inspector of Institutes. To this library all members of Mechanics' Institutes desiring to obtain information, not to be found in the local library, would be entitled to it free of cost, and further, that this library should be available to all others, on payment of a small fee for a clerk's, or draughtsman's time in copying—and further, also, that all postage, to and from this library and the Institutes, should be free, the same as in the United States.

As before stated, it is a lamentable fact that there has grown upon the mechanics of the Dominion, complete apathy with respect to their own mental improvement, and the time that is spent in loafing around taverns, might, under different circumstances, be spent in a more profitable way. It is neither right nor politic that such a state of affairs should be allowed to exist without an effort being made in the right direction to improve the mind and moral status of the industrial classes. We know that where young men are congregated together in masses in towns, they are open to greater temptations to vice than any other class of the community; there exists, therefore, a strong reason why particular efforts should be made to reform and instruct them, not only by Government aid, but by the manufacturers and employers in whatever line of trade they follow, and there can be no doubt but that Mechanics' Institutes, properly organized and directed, would tend greatly towards this end; but, in order to bring about the good results hoped for, these Institutes must not be left entirely to the management of the mechanics themselves. It is necessary that they should be under some departmental head to supervise, direct and instruct them, and to see that the funds appropriated for their use are judiciously and properly expended, and not diverted from their original purpose.

In concluding these remarks we do not mean to assert that they are applicable to every Mechanics' Institute in the Province of Ontario (Toronto and Hamilton are exceptions), but to the majority of them; but even where exceptions do exist, supervision and guidance is necessary. Nor would we in any way desire to exclude from being members professional and literary men or merchants and their employees; on the contrary, we should feel it an advantage that they should work harmoniously together—only, that in lieu of their controlling the institutions, and having the disbursement of the funds in their hands, they should simply be honorary members, and only entitled to control, say two-thirds of their own subscriptions, to be laid out in the purchase of such works as they would like to read, subject, however, to the approbation of an Inspector, so that no works of a light character could be introduced.

We trust that this subject will be earnestly and carefully looked into; it is one in which the interests of a large portion of the community are deeply concerned.

TEETH FOR GEAR WHEELS.

[T. W. McCabe in "American Machinist."]

Rule 1.—As the number of teeth in the wheel plus 2.25 is to the diameter of the wheel, so the number of teeth in the pinions plus 1.5, to the diameter of the pinion. Example. The number of teeth in the wheel =210; the diameter of the wheel =25 inches, and number of teeth in the pinion =30; to find the diameter of the pinion: As 210 plus 2.25 is to 25, so is 30 plus 1.5 to 3.7102, the diameter of the pinion.

Rule 2.—To find distance of centres between two gears (or gear and pinion). Rule: As the number of teeth in the wheel plus 2.25 is to the diameter of the wheel, so is half the number of teeth in pinion plus half the number of teeth in wheel, to the distance of their centres. Example: The number of teeth in the wheel =210; the diameter of the wheel =25 inches; and the number of teeth in the pinion =30; to find the distance at which the centres should be placed. As 210 plus 2.25, is to 25 so is 30 plus 210 divided by 2 to 14.1342 inches, the distance of their centres.

I also give some rules as to velocities. When wheels are applied to communicate motion from one part of a machine to another; consequently, if one wheel contains 60 teeth and another 20, the one containing 20 teeth will make three revolutions, while the other makes but one, From this rule is derived, namely: Multiply the velocity of the driver by the number of teeth it contains, and divide by the velocity of the driven; the quotient will be the number of teeth it ought to contain. Or, multiply the velocity of the driver by its diameter and divide by the velocity of the driven; the quotient will be the diameter of the driven.

If the velocity of the driver and driven are given with the distance of their centres: The sum of the velocities is to the velocity of the driver multiplied by the velocity of the driven as the distance of centres is to the radius of driver multiplied by the radius of driven.

Example 1.—If a wheel contains 75 teeth makes 16 revolutions per minute, required the number of teeth in another to work in it, and makes 24 revolutions in the same time. Here 75 multiplied by 16, divided by 24 =50 teeth; the answer.

Example 2.—If a wheel 64 inches diameter, and making 42 revolutions per minute, is to give motion to a shaft at the rate of 77 revolutions in the same time; required the diameter of a wheel suitable for that purpose. Here 64 multiplied by 42, divided by 77 =34.9 inches; the answer.

Example 3.—Required the number of revolutions per minute made by a wheel 20 inches diameter, when driven by another of 4 feet diameter, and making 46 revolutions per minute. Here 48 multiplied by 46, divided by 20=110.4 revolutions.

Example 4.—A shaft, at the rate of 22 revolutions per minute is to give motion by a pair of wheels to another shaft at the rate of 15½; the distance of the shaft from centre to centre is 45½ inches; the diameters of the wheels at the pitch lines are required. Here 22 plus 15.5 is to 22 as 45.5 is to diameters required. 22 multiplied by 45.5, divided by 22 plus 15.5=26.69, number of inches radius of the driven wheel, which doubled gives 53.38 inches the first diameter required, and 45.5 inches—26.69 inches=18.81 inches, is the radius of the driver, which doubled gives 37.62 inches the second diameter required.

AN IMPROVED ENGINE LATHE.

We copy from the *Mining and Scientific Press* a description and illustration of one of Barnes' patent engine lathes (No. 6), improved pattern. This lathe swings 12 inches on the face plate, 6 inches over the tool carriage, and will take work 44 inches long between centres. It is a very powerful, back-geared lathe, and has all the necessary appliances for the rapid and accurate execution of light or heavy work. This size will best answer the requirements of those who want a lathe for general work of a heavier class than can be done on the No. 5 lathe, and yet within the range of foot power.

The head stock is very heavy, with a hollow steel spindle that will admit a 7-16 rod through its entire length. The boxes are of brass and are accurately fitted to the spindle, with provision to keep them true and take up wear.

The gearing is all cut from the solid metal, and can be combined to make some 500 different leaps of thread; at able is attached to head stock giving the combinations for all threads in ordinary use. The cone has four changes of speed, and is run by a one and a half-inch belt; this, with its back gearing and deferential pulleys, has a greater range of speed than has commonly been offered in a foot-power screw-cutting engine lathe for the price.

The tool carriage is a model of convenience and accuracy; it can be fed positively to either right or left as desired. The tool can be set to work at any position or angle desired; also to bore a taper hole or turn a ball, features not in ordinary movement tool carriages. All wearing parts are jibbed and can be tightened up. The feed screw is under the bed and behind the rack where it cannot be injured; a friction feed rod is also provided, which can be used instead of the screw feed, thus saving that part for accurate use in screw cutting. Either the screw or rod feed may be instantly started, stopped or reversed at will.

The tail-stock can be set over for turning tapers; the spindle is cast steel with a true taper hole for the centre; the centre is hardened and self-discharging.

The patent velocipede foot motion used on this lathe gives a very great power; no balance wheel is required, as the foot motion is reciprocating, and continuous, and there are no "dead centres" to overcome.

This lathe weighs 500 lbs., and the weight is all in the working parts, giving it great steadiness and strength.

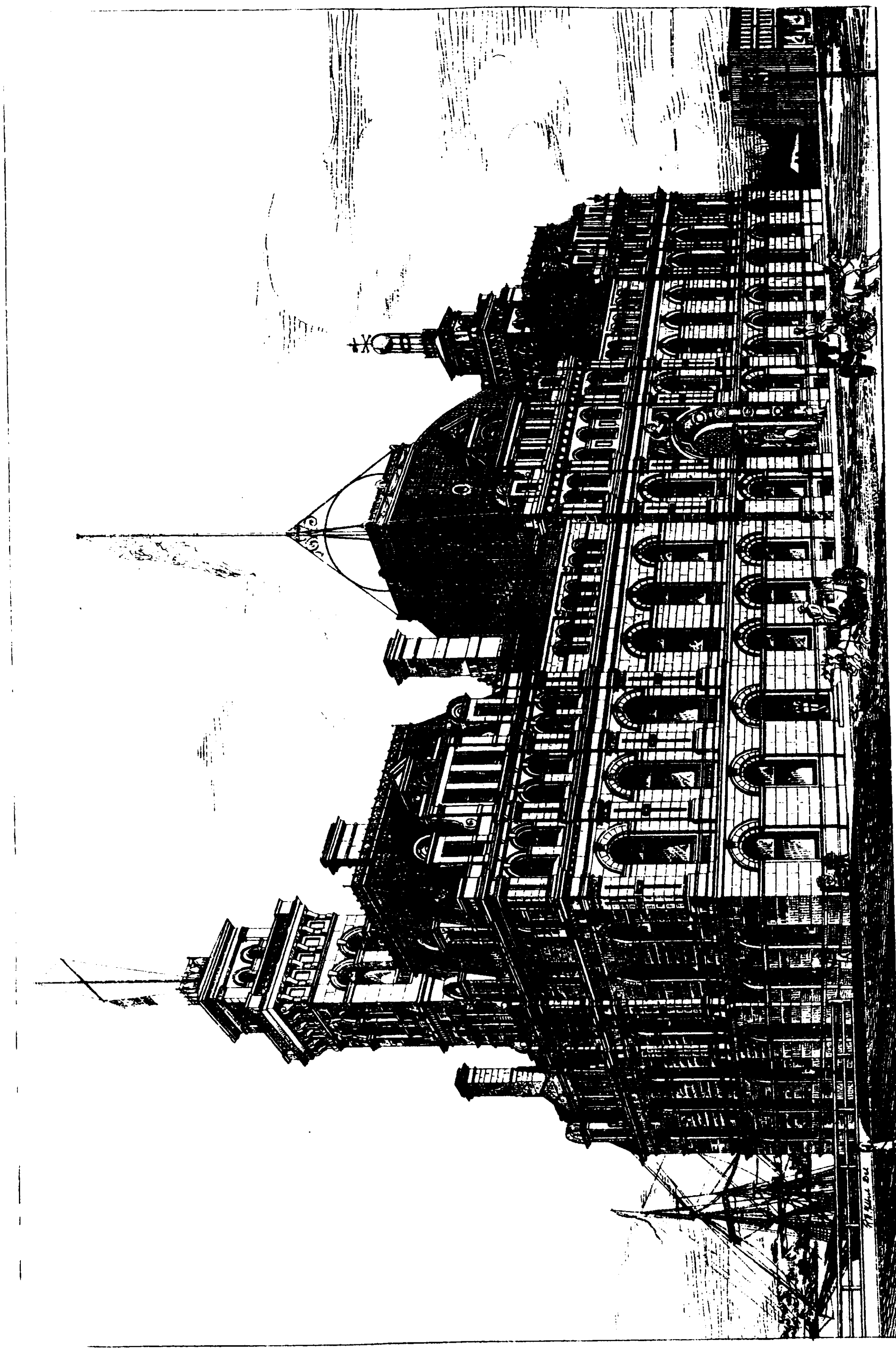
SUBURBAN RESIDENCE.

Those of our readers who desire a suburban residence in which picturesqueness, elegance and simplicity of construction are successfully united will find the somewhat unique and beautiful design herewith presented particularly interesting and serviceable. The elevation has been so carefully drawn that a minute description of the exterior finish is rendered unnecessary. The construction, which can only be intelligently presented in the form of full detail drawings, is of such character as will secure the greatest beauty and durability at the least expenditure of labor and material, and by a careful attention to the importance of proper contrast of colors in the painting, the cottage can be made extremely attractive. A more harmonious and effective combination of curved lines, and a more beautiful range of light and shade, could hardly have been produced.

The excellent internal accommodations are explained by the following letters of reference on the floor plans: A, portico; B, veranda; C, main hall; D, library; E, dining room; F, parlor; G, kitchen; H, cellar stairs; I, servants' stairs; J, closet; K, water closet; L, bay window; M, butler's pantry; N, kitchen pantry; O, sink; P, range; Q, boiler; R, porch; S, hall; T, chambers; U, boudoir; V, balconies; W, bath room; X, closets; Y, roofs; Z, alcove.

This house is estimated to cost $4,500.—*Manufacturer and Builder*.

M. L. Collott has discovered the true *Phylloxera vastatrix* upon *Vitis caribbæa*, a wild species of vine found in the forests of Panama, far removed from any vineyards or localities where the true vine (*V. Ninifera*) is cultivated. This strongly confirms the opinion that the *phylloxera* is indigenous in America.



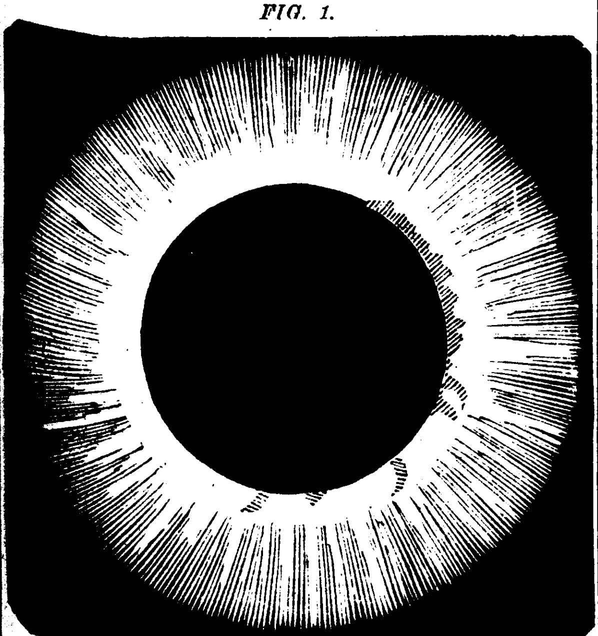
NEW CUSTOM HOUSE, ST. JOHNS, N. B.—S. SCOTT, CHIEF ARCHITECT.

Scientific Items.

REMARKABLE EXPLOSION ON THE SUN.

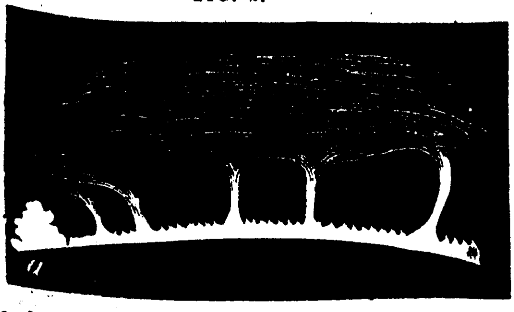
One of the most remarkable of this class of phenomena ever observed by any scientist, occurred some ten or eleven years ago, while Prof. Young, the well-known American astronomer and scientist, chanced to be observing our solar luminary. A description of this phenomenon formed a most conspicuous, and perhaps, the most interesting part of the lecture, and the phenomena itself developed an outburst of solar energy most remarkable for its suddenness and violence, and one which shows what can be done in the way of explosions when all the conditions are on a scale of grandeur commensurate with the magnitude and anomalous physical energy of our great solar luminary. So much interest attaches to this portion of the lecture that we herewith produce several very perfect drawings of the stereoptic views, with which Mr. Proctor most happily illustrated his remarks. Those who where present cannot fail to observe the perfect accuracy, in all the details, with which our artist has reproduced them.

FIG. 1.



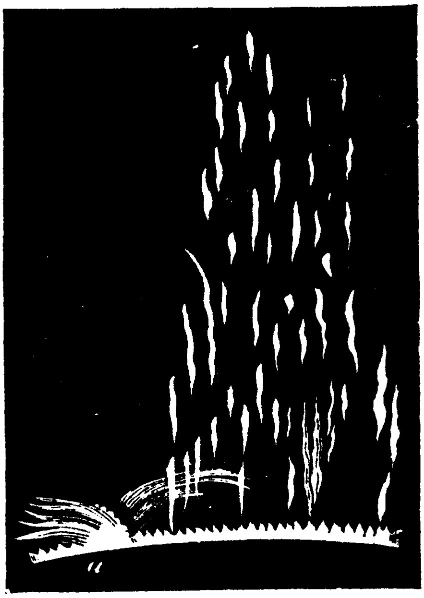
While viewing the sun, and studying a tree-like prominence, shown by the lecturer, but not reproduced here, Prof. Young noticed a smaller mass of cloud to the left, glowing with a brightness quite superior to any other portion. The tree-like prominence gradually passed away and assumed the very peculiar appearance as shown in figure 2—the glowing cloud upon the left still remaining but little changed, as at *a* in the same figure. The length of this cloud, by careful measurement was about 100,000

FIG. 2.



miles, by some 54,000 in height. Just at this moment the Professor was most unfortunately called away and was absent about half an hour. When he returned, the whole thing had been literally blown to shreds by some inconceivable explosion or uprush from beneath. In place of the quiet but threatening cloud which he was observing when he left his instrument, his vision was greeted by the remarkable appearance as shown in Fig. 3 with "the little bright cloud" disrupted, as shown at *a* in same figure. Some portions of the fragments, or fusiform filaments, into which the larger cloud was separated, reached the enormous height of over 200,000 miles. These filaments gradually faded away like dissolving cloudlets while the little disrupted cloud at *a*, Fig. 3, grew and developed into a mass of rolling and

FIG. 3.



ever-changing flame to all appearance. At one time it rose, as in Fig. 4, to a height of 50,000 miles. Then it was drawn out into long filaments, which were most curiously rolled backwards and downwards—something like the volutes of an Ionic capital, as shown in Fig. 5. Within the space of about an hour and a-half, it had entirely disappeared.

FIG. 4.

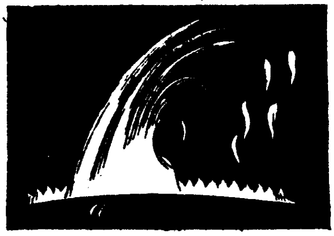
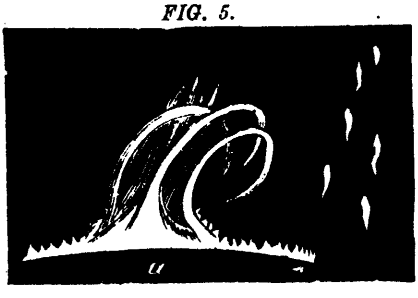


FIG. 5.



It was remarked by the lecturer that the velocity with which the eruptive matter, as shown in Fig. 3, left the sun's surface, was 500 miles per second—a velocity so great that it could never have returned to that luminary. It was thus, no doubt, that the sun was forcing from itself matter which could never return to it—a power which the earth and all the planets, great and small, possessed in their original, incandescent state.

It was remarked that, after all, our best astronomers know but very little about the sun, and, with a singular paradox, all their greatest discoveries have been made while that luminary was in the utter darkness of a total eclipse. In fact, the best knowledge which a man can acquire under any circumstances, is most incomplete and unsatisfying to the earnest and intelligent seeker after knowledge.

THE SUN.

"THE GLORY, NATURE AND MAGNITUDE OF THE SUN."

It is easy, said the lecturer in opening, to estimate in figures the magnitude of the sun and its distance from the earth, but it is difficult to convey to the mind any correct idea of what those figures really represent. The lecturer had in early life endeavoured to gain some idea of the magnitude of the American continent; yet he had but recently been able to form any really adequate idea of it—and that was accomplished only through crossing it by rail. It is easy to say that the sun is from ninety-two to ninety-three millions of miles distant; but a railroad journey that distance would require 500 years. A cannon ball, moving at its initial velocity, would require thirteen years to get there, while the report would not reach the sun until half a year later. Another interesting illustration in this direction has been given by supposing a human arm extending from the earth to the sun; 130 years would be required for the nerves to inform the head that the fingers were burned by coming in contact with the solar surface. The sun possesses a most

WONDERFUL POWER OF GRAVITY.

It controls the entire solar system and keeps all the planets in their order as they continue in their grand, silent progress through space. So great is its powers of attraction, that a half-ounce weight, if raised above the surface of the sun and dropped from rest would acquire a velocity of 435 feet in the first second. Its magnitude is 108 times the diameter of the earth, and exceeds it in volume 1,222,700 times.

THE HEAT OF THE SUN.

To form an approximate idea of the heat of the sun we must remember that it is estimated it would require the heat from 11,700 trillions of tons of coal, consumed in every second, to produce a heat equal to that diffused by the sun in the same space of time. Of all this immense emission of heat, only one part in 230 millions falls upon the earth. All the rest appears to us to be wasted in space. Yet this seeming waste has doubtless a meaning, and is probably subservient of some other kind of work or good, associated with the great whole of the universe. Without the heat which results from solar rays, every form of life on earth would cease. The same is true, relatively, of all stars, which are suns to other systems. A beam of

THE SUN'S LIGHT

Is 120 times more intense than that of the lime-light—such as the lecturer was using to project his illustrations upon the screen. We know this, in degree, from the fact that when the lime-light is placed between the observer's eyes and the sun, the lime-light appears as a black object. Even the intense light of the electric arc is one-third less than that of the sun. The sun is brighter in parts than it appears to the eye. Floating in its upper atmosphere are clouds of intense brightness, many times brighter than the average glow of that luminary. These clouds are technically known as "rice grains," which give to the sun, as viewed through a telescope, a fine mottled appearance. This was beautifully shown upon the screen. These clouds are thought to emit 90% of the sun's light. But instead of being composed of the vapor of water of clouds in our atmosphere, they are the vapors of iron, magnesium, calcium, copper, etc., heated to an intense degree of luminosity. Another class of most important and interesting phenomena is what is known as

SUN SPOTS.

Which was shown in a most strikingly vivid manner from photographs of the sun's face, as taken by Dr. Rutherford. These views were telescopic, and portrayed the lights and shades of the sun's surface in a most striking manner, showing the spots with long, cirrous threads, now radiating *from* the spots and again seeming to reveal an inward draft towards the sun's centre. The physical characteristics connected with these phenomena were briefly alluded to and explained so far as science has penetrated into their mysteries. Every change in one of these spots, said Mr. Proctor, must be accompanied with atmospheric turmoil and disturbance, to which the most terrific phenomena of tornadoes and volcanic eruptions upon earth are but gentle zephyrs and harmless detonations. The terrific noise by which they must be accompanied is such as no human ear could bear; but which is utterly lost by the great void between us and the sun, through which no sound wave can pass. The great advantages of photography in observations of this kind were alluded to by the lecturer, as the constantly and rapidly shifting forms prevented any possibility of accurate study when received directly; while a photograph taken with only one-sixteen hundredth part of a second exposure, fixed permanently any given shape for study at leisure. Until within a few years the spots had to be studied by the aid of drawings only which were generally quite imperfect. The lecturer here jocularly alluded to such exaggerations in a book on the sun, published a few years ago "by a man named Richard A. Proctor." the question,

OF WHAT THE SUN IS COMPOSED?

Was briefly discussed. Some progress has been made in the solution of this question, but only enough to discover that we know but very little about it. The principle of spectrum analysis was explained by beautifully illuminated diagrams in colors; also the manner in which the principle was made applicable to determining the nature and composition of the heavenly bodies. By the use of the spectroscope it has been most unmistakably shown that quite a number of elements known on the earth existed also in the sun, and that some elements existed there which are not known on the earth. Among the elements common to both were sodium, calcium, magnesium, aluminium, hydrogen and several others. The existence of oxygen in the sun was somewhat uncertain in the minds of many; while others including the speaker, Prof. Young and several other prominent astronomers believed that its presence in our luminary had been fully proven. One new metal unknown here was instanced, and had been named by Prof. Young, helium, from *helios*, the Greek for sun,

SOLAR PROTUBERANCES.

Perhaps the most interesting portion of the lecture was that part devoted to solar protuberances. These were most beautifully shown and elucidated by projections upon the screen. This class of phenomena was first observed at times of a total solar eclipse when for a few moments the sun's disc was completely shut out from view by the intervening body of the moon, as shown in the annexed diagram, No. 1. By examining that figure, small jets, shown in shade, just beyond the disc of the moon, will be seen to issue out from the body of the sun in the form of flames. When properly observed, the jets have a red, flame-like appearance, and the spectroscope has revealed to us the fact that they are really tongues of flame or incandescent gas, which are now known to shoot up from all parts of the sun's surface to the distance of fifty, an hundred, and even, in one case, at least, to the enormous altitude of 210,000 miles. Astronomers are now enabled to make their observations at any time, without any regard to the presence of an eclipse. These flames are supposed to be caused by explosions or eruptions from within the more solid portions of the sun's body. The lecturer gave it as his opinion that the flames seen, which are known to consist of hydrogen, sodium and magnesium gases, merely mark the track of more solid, but unseen matter—molten material—just as the flame and smoke which issues from the mouth of a cannon, marks the track of the unseen ball.

ANIMALS OR PLANTS?

In the course of a lecture on "Plants that prey upon Animals, and Animals that fertilise Plants," delivered at Leeds, by the Rev. W. H. Dallinger, the lecturer explained that there were animals—definitely proved to be such, and with which every zoologist was familiar—that were so lowly in their being that they possessed no definite form. They revealed to the most refined scrutiny no organization. They moved, but without muscle; they crept, but without limbs; they felt, but without discoverable nerves; they devoured without mouths; they digested without stomachs; and they had all the properties of life, but were without trace of organised structure. It was their habit to associate with even these lowly creatures, because they were animals, a measure, at least, of consciousness and volition. But, on the other hand, there were plants of the highest and most compact structure in which delicacy of organisation, refinement of mechanical contrivances, and adaptation of means to ends were combined; and yet, because they were vegetables, they were accustomed to assume that they were without consciousness, and devoid of will. But what were the facts? Zoology at the present day was in the highest sense a science. Its facts had a precision and value unrivalled, and from these they were bound to say that the old land-marks were utterly incompetent. The animal and vegetable kingdoms could not be separated, and the two marched on in one organic whole. To the popular mind he had no doubt this would appear arrogant. To common observation the distinction between the plant and the animal was believed to be sufficiently clear. Between an ox and an oak-tree there was an unmistakeable difference. A cabbage and a swallow were not very easily confounded. This was quite true; but if the entire of what was known as the animal world were laid against whole of what was known as the vegetable kingdom it would be seen that there were no features belonging to the one which were not in some sense shared by the other. There were vegetables controlled by movements which in animals would be called instincts. They could intoxicate a plant as they could intoxicate a man or beast; they could paralyze it with pain or chloroform, and could kill it with an electric spark. There were some plants which depended for existence on the animals they entrapped, and to this they were endowed with a susceptibility more delicate than that of the human body, whilst they could distinguish between food which would nourish them and substances which would not. It was not too much to say that the extinction of insects would lead to the extermination of the most beautiful plants existing on the globe; while the extinction of these beautiful plants would, in like manner, be the ruin of the majority of insects.

THE ORIGIN OF BOG IRON ORE.

The roots of trees appear to have power to reduce the peroxide of iron, contained in sands with which they come in contact, to the soluble protoxide. When the water which dissolves this runs into low places, where branches, twigs and leaves of trees are slowly decaying, the protoxide becomes re-oxized and is deposited in the interstices of the vegetable forms left by the decomposition of the woody fibre. Thus, parts of the trees are not petrified, but ferrified; the whole beds of iron ore consist of these roots of dead vegetation. Where the ferruginous waters do not encounter masses of decomposing wood, but merely lie at rest, as in swamps and ponds, the evaporation causes the ore to be deposited in lumps, from the size of a shot to 500 pounds weight. From the bottom of ponds these lumps can be raised with tongs, like oysters. In either form the large amount of vegetable matter which this ore contains makes the melted iron reduced from it exceedingly fluid, so that it runs into every nook and cranny of the casting mold, and reproduces it with sharp and precise outlines. When bog ores can be procured to mix with other iron ores, they produce a highly beneficial effect in the running of the furnace and quality of metal turned out; though, as a rule they will not yield 40% of metal. The pig metal obtained from them is so brittle that it breaks to pieces on being dropped on hard ground. Its weakness is in part due to its containing phosphorus, arsenic, etc. When taken from swamps, the workmen often throw into the cavities loose earth, leaves, bushes, etc., which, often within eight years, leave behind them fresh deposits of ore. The most noted places of supply for bog ore in this country are: Monmouth county, New Jersey. Piscataquis county, Main and Snowhill, on the eastern shore of Maryland. In the early part of the century much was obtained from the ponds of Plymouth county, Mass., and from Egg Harbor, New Jersey.

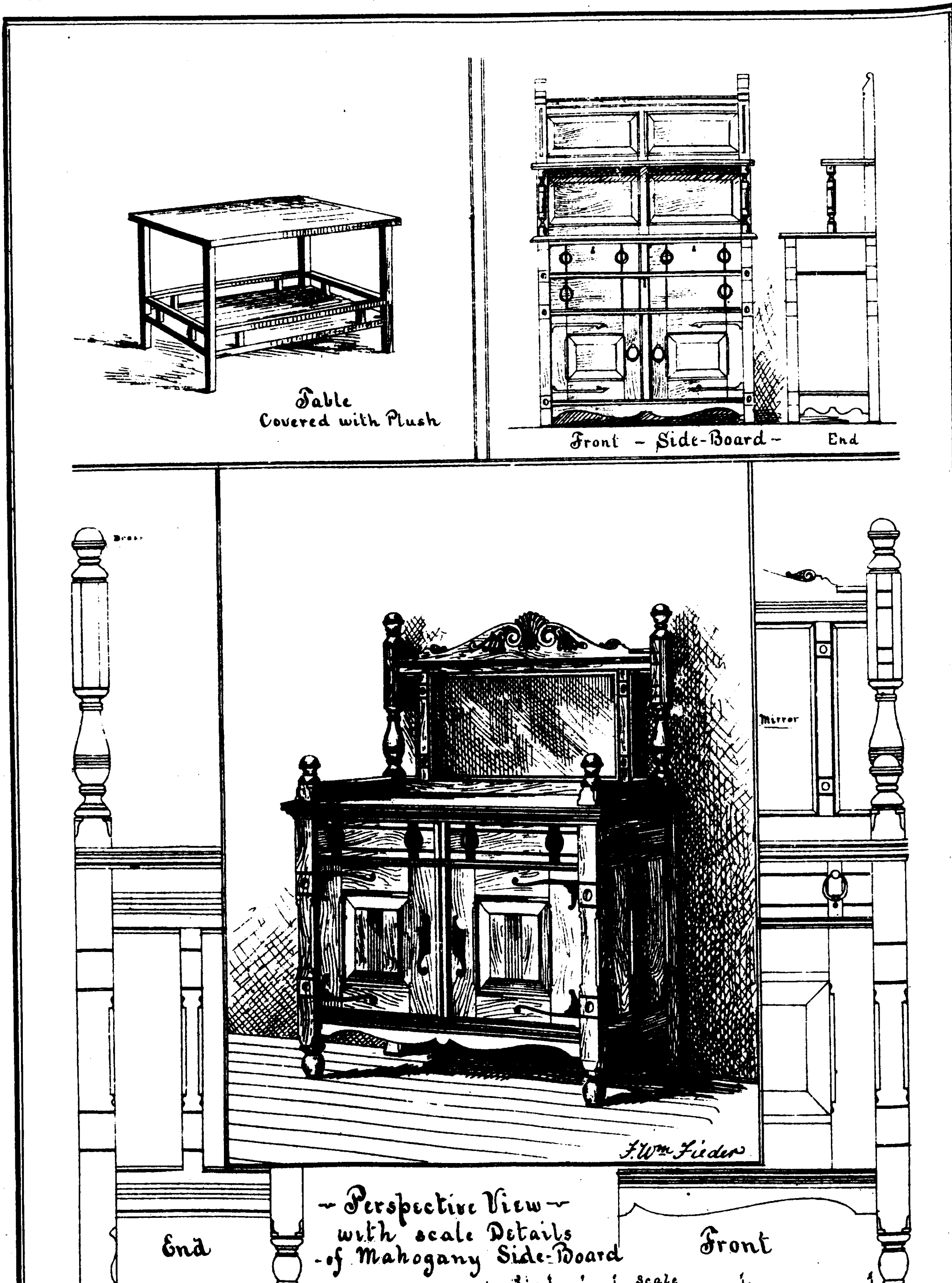
WHY THE SKY APPEARS BLUE.

"Why is the sky blue?" is a question, says a recent number of the *Academy*, which has often been asked, but never satisfactorily answered. Helmholtz offered an explanation which depended on the reflection of solar light by the air particles in the atmosphere. These particles, being very minute, would reflect preferably the shortest waves of light, namely, blue waves, while they would allow the longer waves, corresponding to green and red light, to pass through them; just as a log of wood floating on the surface of still water would throw off the tiny wavelets caused by a falling drop in its neighborhood, while the same log in long ocean swells would be tossed to and fro without noticeably impeding the progress of the waves.

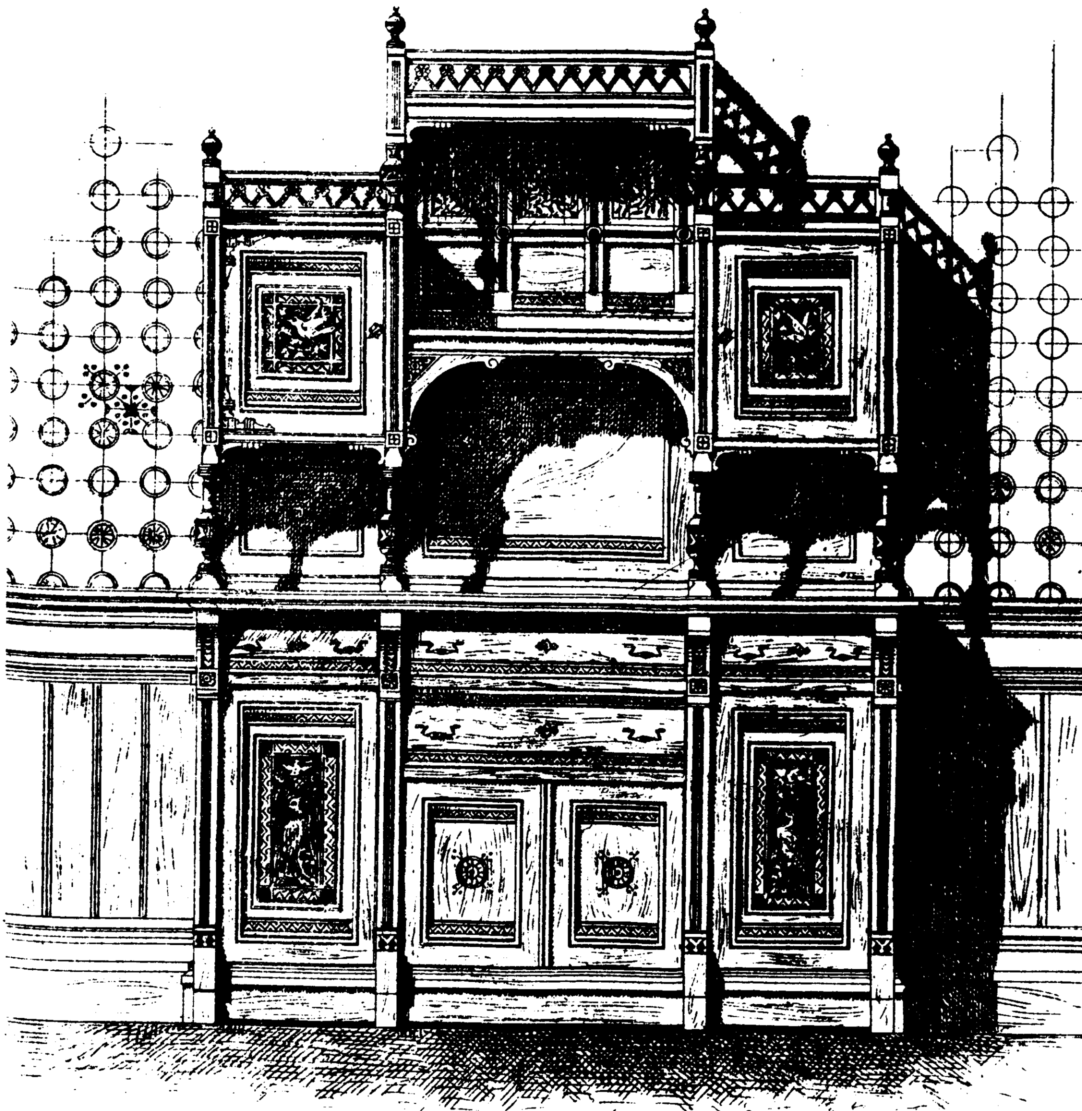
Dr. E. L. Nichols (in the *Philosophical Magazine*, for December) has pronounced another view, which has much to recommend it. According to Young and Helmholtz's theory of colour-impression there are in the eye three sets of nerve-termini, one set chiefly influenced by the red, another by the green, the third by the violet rays. The impression of color is the resultant of the intensities of these three effects. The impression upon these nerves is not directly proportional to the intensity of the ray, the different nerve-termini being subject to different laws. For very feeble rays the "violet" nerves are very sensitive, while the "green" and "red" nerves scarcely act at all. As the light increases in intensity the "red" and "green" nerves increase in activity, while the "violet" nerves become tired and dazzled. For rays of dazzling brilliancy the "red" nerves are in their most sensitive condition. Thus, of the simple colors, as the brightness increases, red and green change to yellow, blue becomes white. Daylight at ordinary intensities affects the three sets of nerve-termini equally; the resultant impression is whiteness. Now daylight is simply the light of the sun weakened by manifold diffuse reflections. The direct rays of the sun, as we let them fall upon any colorless object, appear also a white light; but on attempting at noon on a clear day to gaze into the sun's face the impression is of blinding yellow. It is not that the direct rays differ in composition from diffuse daylight, but that the "violet" nerves cannot transmit the action of such strong light. The moon, with enormously less illuminating power than the sun, seems bright, and is far brighter than the open sky. In passing from the intensity of the moon's rays to those reaching us from a corresponding bit of the open sky, we may, perhaps, take a step as great as that between the brightness of the sun and moon. In general, white light will appear bluer and bluer as its intensity diminishes, and this law will apply to the skies; as the light they reflect becomes fainter and fainter they will increase in blueness, even though the light by the process of reflection suffer no change in composition.

Destruction of the Pyramids.—A correspondent of the *Egyptian Gazette* writes: "I have just returned from a most interesting series of excursions to the Pyramids. They were made from a dahabiah, and included visits to the great pyramids of Gheezeh, at Sakkarah, to Dashoor, and to Maydoon. I regret to say that in several places we observed the hand of the destroyer at work. Not only was this the case at a remote place like Dashoor, but, so to speak, under M. Mariette's very nose. Some four or five large stones, immediately under the entrance, have been removed from the Great Pyramid; and, incredible as it may seem, I was informed, on what seemed to me trustworthy authority, that this wanton act had been committed by order of the Khedive, the stone being required for the buildings of the new mosque which so greatly overshadows the beautiful mosque of Sultan Hassan. Few people would be sorry to see the hideous new building pulled down, but that the pyramid should be further destroyed to build it is one of the most singular examples of the 'revenge of time' I ever heard. It is well known that, beautiful as is the mosque of Sultan Hassan, we have it at the sacrifice of the Great Pyramid, which was pulled down to build it. That the Great Pyramid should, after the lapse of more than five centuries, be once more put under contribution, and that for the purpose of building a mosque which already, when only half-finished, hides and dwarfs its older neigbour in a way almost destructive of the pleasure of looking at it, is, indeed, a noteworthy example of the vicissitudes of fate and the irony of history. When the Government itself sets an example of this kind, we are not surprised that it is promptly followed by meaner folk. At Dashoor, a place seldom visited by the tourists, and where consequently the marauder thought himself safe, three camels were during our stay being loaded with the square white limestones of the casing of the larger pyramid. Few of these stones remain. The upper part of the pyramid has long been stripped. But, in spite of the remonstrances of our party, and the threat, promptly carried out, of a complaint to the Government by letter, these few relics were being ruthlessly pulled away, every removal of a stone insuring the destruction of two or three of its neighbours. The adjoining pyramid, which is so conspicuous from Helouan, and so remarkable from being built in two different slopes, had till lately its casing nearly complete. This casing is of the greatest importance, for the alteration of the angle will almost disappear when it has been removed; and I regret to say, though I did not actually see the work in progress, there can be no doubt that here also the destroyer has been recently busy. Stones, loosened from the top of the building, have been rolled down the side, tearing and smashing the smooth surface. Three or four large stones have also been removed from below the entrance, which is now inaccessible without a ladder. It is in little-known places like Dashoor that such destruction as I describe is most easy to perpetrate and most difficult to prevent. But there cannot be much difficulty in watching the Great Pyramid of Gheezeh."

New Remedy for Burns.—An iron foundry man recommends as "a never-failing speedy remedy" for burns and scalds powdered pine wood charcoal.



FURNITURE DESIGNS.



FURNITURE DESIGNS.

Mechanics.

DIAMETERS AND NUMBER OF TEETH FOR GEAR WHEELS

Rule 1.—As the number of teeth in the wheel + 2.25 is to the diameter of the wheel, so the number of teeth in the pinions ÷ 1.5, to the diameter of the pinion. Example: The number of teeth in the wheel = 210; the diameter of the wheel = 25", and number of teeth in the pinion = 30; to find the diameter of the pinion: As 210 ÷ 2.25 is to 25, so is 30 + 1.5 to 3.7102, the diameter of the pinion.

Rule 2.—To find the distance of centres between two gears (or gear and pinion). Rule: As the number of teeth in the wheel + 2.25 is to the diameter of the wheel, so is half the number of teeth in pinion + half the number of teeth in wheel, to the distance of their centres. Example: The number of teeth in wheel = 210; the diameter of the wheel = 25"; and the number of teeth in the pinion = 30; to find the distance at which their centres should be placed. As

210 + 2.25 is to 25, so is $\frac{30+210}{2}$ to 14.1342 inches, the distance of their centres.

I also give some rules as to velocities. When wheels are applied to communicate motion from one part of a machine to another, their teeth act alternately on each other; consequently, if one wheel contains 80 teeth, another 20, the one containing 20 teeth will make three revolutions while the other makes but one. From this the rule is derived, namely: Multiply the velocity of the driver by the number of teeth it contains, and divide by the velocity of the driven—the quotient will be the number of teeth it ought to contain. Or, multiply the velocity of the driver by its diameter, and divide by the velocity of the driven—the quotient will be the diameter of the driven.

If the velocity of driver and driven are given with the distance of their centres: The sum of the velocities is to the velocity of the driver multiplied by the velocity of the driven as the distance of centres is to the radius of driver multiplied by the radius of driven.

Example 1.—If a wheel that contains 75 teeth makes 16 revolutions per minute, required the number of teeth in another to work in it and make 24 revolutions in the same time.

Here $\frac{75 \times 16}{24} = 50$ teeth: the answer.

Example 2.—If a wheel 64 inches in diameter, and making 42 revolutions per minute, is to give motion to a shaft at the rate of 77 revolutions in the same time, required the diameter of a wheel suitable for that purpose.

Here $\frac{64 \times 42}{77} = 34.9$ inches; the answer.

Example 3.—Required the number of revolutions per minute made by a wheel 20 inches diameter, when driven by another of 4 feet diameter and making 46 revolutions per minute.

Here $\frac{48 \times 46}{20} = 110.4$ revolutions.

Example 4.—A shaft, at the rate of 22 revolutions per minute, is to give motion by a pair of wheels to another shaft at the rate of 15½; the distance of the shaft from centre to centre is 45½ inches; the diameters of the wheels at the pitch lines are required.

Here 22 x 15.5 is to 22 as 45.5 is to diameters required.

$\frac{22 \times 45.5}{22 \times 15.5} = 26.69$, number of inches radius of the driven wheel, which, doubled, gives 53.38 inches, the first diameter required, and 45.5 inches − 26.69 inches = 18.81 inches is the radius of the driver, which, doubled, gives 37.62 inches, the second diameter required.—*T. W. McCabe, in American Machinist.*

THE EFFECT OF IGNORANCE.—A correspondent of the *British Medical Journal* states the diphtheria is raging among the peasant children in Southern Russia. In some localities no child under 12 is to be seen. Filth and ignorance are doing their work. "When a child dies of diphtheria a little cake is put into its mouth and left there a few moments, during which every one present makes the sign of the cross. It is then taken out and administered in tiny morsels to the other children of the family."

SUCCESSFUL DEVICE FOR GRINDING CHILLED IRON CAR-WHEELS.

The desirability of having car wheels perfectly round is conceded by all railway men. As a matter of fact, it is doubtful if any of the chilled iron wheels in use are perfectly round, and new wheels will often be found to vary 1-16 to 1-8 of an inch, and even more, from being perfectly true. Wheels in service, also, are far too frequently flattened by being slid, as a result of carelessness on the part of the brakeman or of the engineer in control of the air brake. Of course, when a wheel is not perfectly round, there is much more danger of its being held by the brake and flattened.

On the Virginia & Truckee road, in Nevada, it has been found that 85% of the chilled wheels condemned as unfit for service were flattened wheels. This, of course, is an unusually large proportion, as the curves and grades are extremely severe and numerous on this road, but on even the most level roads the number of wheels flattened in a year is astonishing.

A process of trueing wheels by grinding, invented by Mr. J. H. Gowan, formerly master mechanic of the Virginia & Truckee Railroad, and owned by the Chilled Car Wheel Grinding Company, has been adopted by the road named, and 16 pairs of wheels trued by this process were placed in operation on October 1, 1877. These wheels have made upwards of 100,000 miles, and still appear in perfect order, although subjected to unusually hard service. This is a remarkable showing, and indicates the possibility of a very great economy in railway operations. If flattened wheels, instead of being melted up for old iron, can be trued and again placed in service, it is evident that the saving will be enormous—the inventors of this device claim nearly 50%. The grinding is done by placing a pair of wheels, after being fitted on the axle, upon solid bearings and slowly revolving them while a solid emery wheel, 18 inches in diameter, is revolved in the opposite direction against the face of each iron wheel at a speed of 600 revolutions per minute.

One of these machines has just been put in operation at the shops of the Chicago, Rock Island & Pacific road. It proves that the best new wheels are very much out of true, and the company now proposes to have all its passenger car wheels ground down, being satisfied that the process will add to the smoothness of the cars in riding, will be easier on the springs and on the track, and will do much to prevent the flattening of wheels by the brakes. They will also have the flattened wheels ground, and expect to save a large number in this way which are now condemned as old iron.

It is expected that one machine will grind from four to six pairs of wheels per day. The royalty charged for the use of a machine is 50 cents for each wheel ground. A machine will cost about $750, and the cost of the emery is from 8 to 25 cents per wheel, according to the condition of the latter.

The invention has been in use over two years on the Virginia & Truckee road, and is also used by the Central Pacific road with very satisfactory results.—*Railway Age.*

ON DRILLS AND DRILLING.

The attention of many professional men and others interested in mechanical operations has for a lengthened period been directed to this subject. As must be well known, there are a great many descriptions of drills now in use—some good, some indifferent. The American twist-drills are now sold in large quantities, and for some purposes answer exceedingly well; but at the same time there are points to be reckoned against them. Firstly, it is very difficult to grind both edges at the same angle, and if this is not done, the result will be that the hole will not be the true size of the drill used; this will deceive a workman, and may probably spoil good work. And another objection to them is, that when the drill is about to come through the hole being bored, the quick twist causes it to worm through at such a speed that, in many cases, the drill is either broken, or the work forced up to the end of the twist, thus spoiling what might otherwise have been a smooth hole. We consider that the best description now in use is the straight-fluted drill, which was originally introduced by a Mr. Martin, of Charlton; but this gentleman having for some long time ceased to make them, there arose a difficulty in procuring them. They are now, however, to be had more readily, and a set of these drills should certainly be found amongst the tools in every workshop.

With all the improvements that have from time to time been introduced in the various drills, in most factories, we have frequently noticed, that except for very large work, every workman prefers to make his own drills, and from personal experience we have found no better drills than those thus made, to do which is a simple process. For example, a drill-chuck being fitted to the lathe, with a round hole one-fourth inch in diameter, and a fixing-screw ; have always at hand a bar of round cast steel of the correct diameter, to fit the hole, and cut off a length as required. If the drill is to be made of a large diameter, it must be flattened out at the forge to the desired size, and then finished with a file. Most workman, nowadays, simply forge their drills and grind them into shape ; this answers every purpose for work that does not require any finish, all that is necessary is that the tool should run pretty true in the lathe and cut well. In boring a hole in thin work it becomes necessary to make it flat at the bottom. To do this a small half-round bit placed in the same chuck answers the purpose. This is essential where the hole has to be topped, as it allows of one or two more threads being made by the top. If the drill is required to be smaller in diameter than the steel from which it is made, it is a simple matter to turn down the end and then file it flat on both sides, to the same shape as the larger previously mentioned. A great point with regard to drilling is the hardening of the drills. * * * In using all drills for boring a hole between the centres of the lathe, it is a most essential thing to let the work turn round occasionally in the hand. A certain way of boring a true hole of large diameter, say three-fourth to one inch, is to fix in the chuck a well-made cylinder-bit, and carefully fix the work on the saddle of a self-acting lathe, and place on the change-wheel used for a fine finishing cut. * * * For very small work the bow drill is a very useful tool. Bows are made in many ways, and from different materials. Those for sale are of steel, with a hook at the end, over which a thin catgut is looped, with another hook near the handle, and to alter the tension a small toothed wheel with a detent is used. * * The Archimedian drill is also used for many small pieces of work. This is made from pinion-wire carefully twisted into the form of a very quick screw ; and to tap the nut for it a similar short piece must be made and the end tapered off to the bottom as if it were of the thread. This done a hole must be drilled in the pieces of metal that is to form the nut, and the tap, as we will call it, be driven through it. This will form a corresponding screw for the long one to work in. * * * To know how such a thread is put into a piece of metal may be of service for other purposes.—*Forge and Lathe.*

BLACKSMITHS' HAMMER SIGNALS.

When the blacksmith gives the anvil quick, light blows, it is a signal for the helper to use the sledge, or to strike quicker.

The force of the blows given by the blacksmith's hammer indicates the force of the blow it is required to give the sledge.

The blacksmith's helper is supposed to strike the work in the middle of the width of the anvil, and when this requires to be varied the blacksmith indicates where the sledge blows are to fall by touching the required spot with his hand hammer.

If the sledge is required to have a lateral motion while descending, the blacksmith indicates the same to the helper by delivering hand hammer blows in which the hand hammer moves in the direction required for the sledge to move.

If the blacksmith delivers a heavy blow upon the work and an intermediate light blow upon the anvil, it denotes that heavy sledge blows are required.

If there are two or more helpers, the blacksmith strikes a blow between each helper's sledge hammer blow, the object being to merely denote where the sledge blows are to fall.

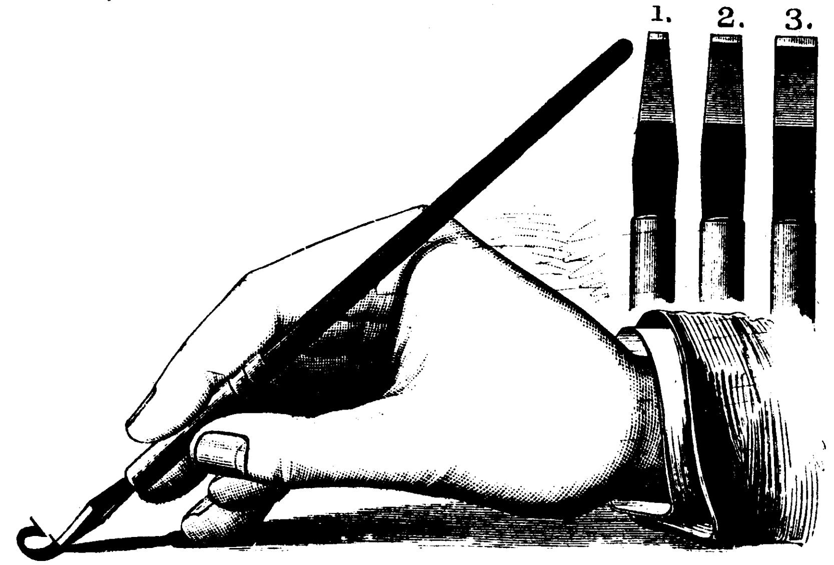
When the blacksmith desires the sledge blows to cease, he lets the hand hammer head fall upon the anvil and continues its rebound upon the same until it ceases.

Thus the movements of the hand hammer constitute signals to the helper, and what appears desultory blows to the common observer constitute the method of communication between the blacksmith and his helper.

Welding Cast Steel.—There are so many grades or tempers of cast steel now in use (from steel rails to surgical instruments) that there is a great difficulty in understanding what is meant by cast steel. The old system of steel-making was the converted or cemented process ; the converted bars were welded once or twice, then called single or double sheer-steel, according to treatment received. In the Huntsman or crucible process, the converted bars were broken up into small pieces and charged into crucibles along with oxide of manganese, &c., and when melted, cast into ingots, hence the "term" cast, to distinguish from shear-steel. We have three methods by which cast steel is produced, *i.e.*, Bessemer, Siemens, and Huntsman (crucible) processes, and the various qualities and tempers manufactured by these are legion. Some of these steels will weld without any difficulty, and some with only the greatest difficulty ; some kinds will harden very hard when plunged into water at a red heat, and others, when subject to the same treatment, will bend over and over without showing any signs of a fracture, the sudden cooling having made no perceptible difference ; yet both are cast steel, and probably may have been made from the same process. Cast-steel rails are sold at about $9 per ton, cast steel for tools at from $60 to $140 per ton. This will show "Panourgia" at once that there is a great difference in cast steel ; and if "Panourgia" will only specify the kind of steel he has a desire to weld ; what purpose he bought it for ; what class of steel it is, tool, Siemens', or Bessemer, I will advise him as to treatment of the same to accomplish his desire. Some kinds of cast steel will weld as easily as wrought iron, notwithstanding the assertions of "Hartlepoolian," who says "Steel may be stuck together, but, in my opinion, cannot be welded ;" and quotes, in support of his theory, the rolling of tires in lieu of welding. In the manufacture of wrought-iron tires, they are first piled, fagotted, then built up, consequently this is a welding process from beginning to end. These tires are fast being replaced by steel ones ; steel being considered a more suitable metal for tires, axles, &c., but no attempt has been made (that I am aware of) to weld cast-steel tires as yet. But steel axles are welded and built up in the same manner as iron ones. Steel cranks are made at the Mersey Iron and Steel Forge, Liverpool, by welding slabs or blooms of steel together, and when complete weighs several tons (see Mr. Ratcliffe's paper before the Iron and Steel Institute at Liverpool last autumn). Now, this steel is cast a certain temper for the purpose, and let me here inform "Hartlepoolian" that in the hands of a man who knows its requirements, this metal will weld as easily as either Leeds or Government iron, and is "stuck" together with as much certainty as ordinary wrought-iron.—*English Mechanic.*

Welding Cast Steel. "Panourgia" asks, can it be successfully welded ? Yes, it can, as far as welding goes, but the success depends on the use it is put to after. For cutting tools or rods for machinery no use whatever. For welding into iron for bricklayers' chisels, digging forks, and similar tools it answers very well ; I have had practical experience in each case, but remember nothing but practice will give the required results what the flux used. What I use is 10 parts of borax to 1 of sal-ammoniac fused together in a sheet-iron pan, and when cool crush fine and use as sand. Or 2 parts of borax to one of saltspernella with sand process as above. Now prepare to weld, having the anvil in a close and convenient position. 1st. Upset the ends to be welded, and have plenty of stuff to work upon and scarf a little longer than for iron ; if more than one, prepare them all in this way first, as you can keep the colour of the heat better in your eye when welding close one after the other. 2nd. Blow up a nice, clear fire, free from sulphur as possible, and heat the pieces to a peculiar yellow, then dip in flux lightly and heat till you see it flow, and it becomes a light yellow without sparkling. 3rd. Take out and strike with a light sharp blow, and follow up with quick sharp blows (not heavy) ; if the scarves are buried pene over, take light heat, and work to proper size.—*English Mechanic.*

To Galvanize Small Articles of Iron.—A correspondent of the *Manufacturer and Builder* describes, as follows, the difficulties he encountered in trying to galvanize some small iron hooks : "I could not make the zinc take to the iron. I used a pint of sulphuric acid, pint of muriatic acid, pint of sal-ammoniac, and zinc enough to cover the hooks. I first dissolved the zinc with muriatic acid, then I reduced the sulphuric acid with water. I then dissolved the sal-ammoniac, then I dipped the hooks into the sulphuric acid, then after washing it off I then dipped it into the muriatic acid ; after taking it out and letting it stand for some time I then dipped it into sal-ammoniac ; after taking it out and letting it stand some time I then dipped it into the zinc, but on taking it out the zinc would not stick to it. Can you tell me where the trouble is ?" The editor answers his query as follows : Clean the metal by pickling in the dilute acid, and scouring (or tumbling) with moist sand, if necessary. Rinse quickly in pure water, pass through the chloride of zinc solution, and then transfer to the zinc pot. Keep the melted metal covered with dry sal-ammoniac. Moist iron rusts very quickly when exposed to the air, and unless the surface is perfectly freed from this oxide it will not take the zinc.



STOAKE'S AUTOMATIC SHADING PEN.

A NOVEL SHADING PEN.

The annexed engraving represents a new instrument for plain and ornamental lettering, and is adapted to the use of bookkeepers, artists, markers, clerks, and penmen generally. The manipulation of the pen being purely mechanical and automatic, any person writing an ordinary hand can use it successfully and with satisfactory results. Its use familiarizes the eye with uniform design, so that the regular handwriting is rapidly improved. Shaded letters may be produced as readily as the plainest, and of such quality as to compare favorably with lithographic work. Several widths of this pen are made—one eighth, three sixteenths, and one fourth—each of which will make any width of line, from that of a hair line to the full width of the pen. They are made entirely plain throughout their entire width, or arranged to shade one side of the line produced according to the taste of the writer.

These pens are inexpensive and must prove very useful in nearly every branch of business. Bookkeepers with slight practice, can make ledger headings so uniform and artistic in appearance as to be quite beyond the comprehension of persons unfamiliar with the simple manner of their production. Any kind of ink may be used. The inventor informs us that more than seventy distinct and brilliant shades of colour may be produced with the several coloured inks adapted to this pen and in common use. The construction of the pen will be understood from the engravings, the larger view showing the pen in actual use, the smaller views showing the different sizes of pen.

Further particulars in regard to this useful invention may be obtained by addressing the patentee, Mr. J. W. Stoakes, Milan, Erie County, Ohio.

PAPER LEATHER.

The *Paper World* describes a new kind of paper sizing which promises to be exceedingly useful. It is considerably cheaper than ordinary size, and it has the merit of making the paper waterproof without discoloration. In one experiment one hundred and eighty-five pounds of leather board were manufactured from hemp, which was made nearly fine in the engine, and then the new sizing added, mixed, precipitated, and beaten fine. The thin, endless sheets were woven around a cold cylinder, and when of sufficient thickness, cut, removed, and dried in the sun. Strips one-fourth of an inch thick, when dry and before rolling, were as pliant as most sole leather, and could be bent square over without cracking. This leather board can be made insoluble in either hot or cold water. A piece of it not perfected, and not wholly impervious to water, one-fourth of an inch wide, cut lengthwise of the fibre, held up seventy-seven pounds stone. By rendering the same board insoluble, the strength was increased from seventy-seven to two hundred and eleven pounds. Leather paper of less thickness, made in the same manner, is described as pliable, somewhat elastic, apparently durable, and suitable for the uppers of shoes.

ARTIFICIAL FUEL.

In France they use for fuel a material which is ostensibly tablets of pressed peat, but which is more generally made of stable sweepings, it is said. Similar *mottes*, made of camel's dung, are used for cooking in Algeria and all over the oasis of Sahara, for wood is there too scarce to be used for fuel. The motte makes a clear, odorless, sootless, and almost smokeless fire. All early overland emigrants to California must be familiar with the "buffalo chips" which formed such excellent material for fuel —they were natural mottes, similar to those above referred to.

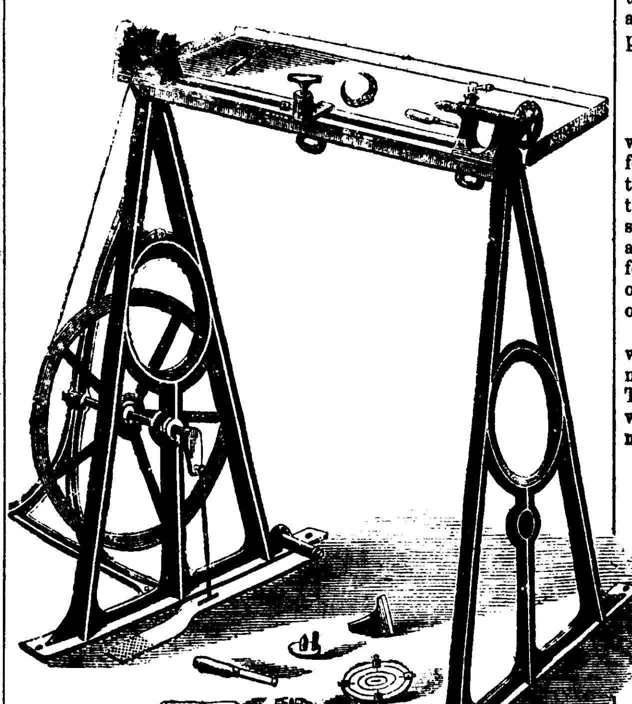
Compressed peat in London, and indeed in all the large towns of Great Britain and Ireland, is rapidly coming into use. The cakes there are made in great blocks, while the French mottes are only about six inches long by four wide and two thick. On the Belfast and Northern railway of Ireland the compressed peat has been tried with great satisfaction. The engineers report that 21 pounds of peat raises steam for a mile of transit, 26 pounds of coal being required to do the same work. They prefer it, moreover, because so clean to handle and so light compared to coal. Its cost is less than one-half that of coal. "In the manufacture of gas," says our *Scientific American*, "as compared with coal, its illuminating powers are tested and put down at 342 to 100. So the rich and practically inexhaustible bogs of Ireland promise to bring back prosperity to that country. The drying and compressing of this substance render its transportation cheap and easy, as it is superior to wood in many respects, and less expensive, there is no apparent reason why it should not be very extensively used. A charcoal is also manufactured of the Irish peat, and the compressed cakes are in great demand for land fertilizing."

A Glacier in the Rocky Mountains.—The Leadville *Herald* reports, on the authority of "a gentleman who has, during the past two years, traversed the mountains in the vicinity of Leadville, and penetrated almost every one of their recesses," the fact of the existence of a veritable glacier, presenting all the characteristics of the Swiss glaciers, both in magnitude and motion, within 25 miles of that city. When first discovered several years ago, the report affirms, it was nearly a mile in length, and at the bottom of the "gulch" presented a sheer precipice of ice about 150 feet in height. Later in the season it had been considerably reduced both in length and bulk; but earlier in the following year it had regained first dimensions. The rocks on the sides of this immense mass of moving ice are said to show all the characteristic signs of glacier action. The location of this interesting natural curiosity is said to be in the Mosquito Range, about fifteen miles north of the Pass; and, being very inaccessible and out of the ordinary line of travel, the fact of its being discovered at this late day is accounted for.

To Remove Ink Stains.—Take of muriate of tin two parts, water four parts. To be applied with a soft brush, after which the paper must be passed through cold water.

BATEMAN'S "ECLIPSE" LATHE.

This lathe has been brought out by Mr. Bateman, of Holborn and the Strand, to assist those mechanics and others interested in the science of turning to have more completely within their reach the means of turning and working up the castings of small-sized steam engines &c., &c., which nearly fifteen years ago he brought out. His desire was to accomplish the three most important *desiderata* which he considered necessary to the success of such a tool, viz., to achieve efficiency, cheapness, and portability. As will be seen from the illustration, it is of the vertical standard or a frame type of lathe, 3ft. 8in. high, and weighs about 70lb., and entirely complete in itself; it is perfectly fixed and bolted together; it is sent out with crank-shaft and fly-wheel keyed on in position ready for work, except putting on a band. The motions are steel and iron, as also is the mandrel headstock; the height of centre from bed is 3in. in the smallest size, which makes it capable of turning a diameter of 6in. The bed is furnished with a T rest and socket complete, so that large or small work can be executed. The mandrel is hollow so that long pieces of brass tubing, spindles &c., can be passed through and secured while being turned; the cone pulley, which is turned bright, has three speeds; the fly-wheel is heavy, and V groove; the crank, spindle, and treadle hook are both of wrought iron; the standards are of best cast-iron with facing plates at bottom for standing level and the treadle is girder-fashioned, with chequered foot-plate. The price of this lathe is £2 15s.



On the Probable Temperature of the Primordial Ocean of our Globe.—According to the latest hypothesis as to the quantity of water on the globe, its pressure, if evenly distributed, would be equal to a barometric pressure of 204.74 atmospheres. Accordingly water, when first it began to condense on the surface of the globe, would condense at a much higher temperature than the present boiling-point under ordinary circumstances. The first drops of water formed on the cooling surface of the globe may not impossibly have been at the temperature of molten iron. As the water was precipitated, condensation of the remaining vapor took place at a lower temperature. The primordial atmosphere would be more oblate and less penetrable by solar heat than the present, and the difference of temperature between polar and equatorial regions would be greater; so that, in the later geological times, ice may have formed in the one, while the other was too hot for animal or vegetable life.—*Phil. Mag., Jan.* 1880.

TESTING IRON AND STEEL.—I.

BY P. F. MCCALLUM.

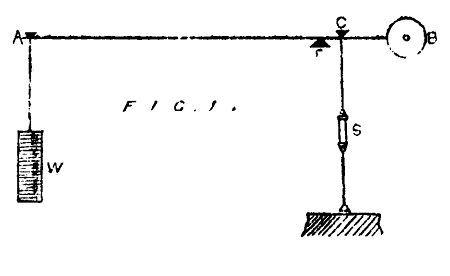
The economy of material necessitated by modern requirements in the fabrication of machinery, structures, &c., renders an accurate knowledge of the strength and other properties of the metals employed a matter of great importance to the engineer. As a consequence, the practice of testing materials by actually subjecting them to destructive experiment, is becoming daily more common. The investigations of numerous noted experimentalists during the last 30 years have supplied a large quantity of data relating to the properties of all the commonly-used materials, and the information thus afforded is being continually supplemented by new facts. The rapidly-extending use of mild steel has caused a great increase in "testing,"—this material having the character of being more variable in quality than iron. Steel, in fact, is seldom employed in any quantity without a considerable portion being tested, to ascertain that the strength and ductility are within the limits of some required standard. An acquaintance, therefore, with the usual ways of testing the strength of materials becomes useful or at least interesting, to those engaged in mechanical pursuits.

The intention of these papers is simply to explain the appliances used for, and the general method of, conducting experiments on the mechanical properties of iron and steel, special attention being given to those small but not unimportant points upon which a novice in this branch of mechanics is most likely to feel himself at a loss, and on the due regard to which the accuracy of the results obtained in a considerable measure depends.

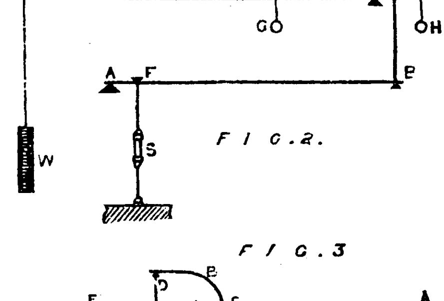
TESTING MACHINES.

Testing Machines form a natural commencement, but more will not be attempted under this head than to explain the leading features of one or two representative types, partly because a detailed description would occupy too much space, and also because the more interesting machines have been from time to time described and illustrated in the various technical journals. It is also probable that those readers who may undertake experiments for themselves will not in the majority of cases have the choice of a machine, but will be under the necessity of using whatever one may be at hand.

A simple and convenient testing machine consists of a lever with unequal arms, mounted on knife-edges, with its fulcrum near one end. The diagram Fig. 1 will explain the arrangement. The line A B represents the lever, the short arm being weighted with a mass of metal at B, so that the lever and its attachments may be balanced accurately upon the fulcrum F.

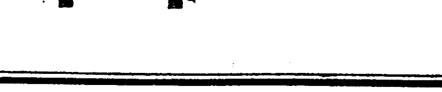


F I G. 1.



F I G. 2.

F I G. 3



Sanitary.

MATERIALS AND METHODS OF DISINFECTION.

(*From the Metal Worker.*)

As the season is approaching in which those connected with sanitary work, plumbing included, have more or less occasion to employ methods of disinfection, we present below an able treatise on this subject by Dr. E. M. Hunt, Secretary of the New Jersey State Board of Health, which will be found worthy of preservation for reference :

The design of disinfection is to remove from the air about us either those infective particles which are the cause of specific diseases, or to correct any deterioration of air which is unfriendly to general health. The air, for instance, may have in it atoms floated off from a scarlet fever patient. If so, we seek by scattering them to diminish the probability of infection. Or, by active ventilation, we may drive them completely away. Or it is possible that we may so neutralize them by some chemical or other action, or so absorb them as to remove their infectiveness. Or, it may be, that by a treatment of the person we may place him, or the parts of him which come in contact with the air, in such a condition as to be refractory to the reception of the floating particle. Practically, it is found that free and continuous dilution of the air greatly limits its infectious power. It is probable that this is more than mere dilution or driving away. Where air is actively in motion, it is so brought into contact with infected particles as the more rapidly to change them, so as to deprive them of their power to impart a special disease. At any rate, no fact is more fully established than that ventilation is favorable to the limitation of the infective diseases.

There is also demand for disinfection of such air as may not be laden with specific infective particles like those of scarlet fever or small-pox, b[illegible] which, nevertheless, is befouled by organic matters of various kinds. Such air is generally prejudicial to health by causing a lowering of vitality or an irritation of important organs, and so often gives rise to consumption, stomach and bowel affections, and to other maladies affecting the whole system. So much is this the case that foul air is believed to be generally the most potent excitant of disease. Mere dust in the air may irritate mechanically, or its conditions of heat and moisture may favorably or unfavorably affect those who breathe it or are surrounded by it. These, however, do not come within the remedial agency of disinfection. Neither does odor necessarily demand sanitary disinfection, since all odors are not infectious, and all apparently odorless atmospheres are not the safest. As, however, bad odor is so often a result of the gases of decay, it is usually an indication for the use of disinfectants, and the cessation of the odor is an indication that the disinfectant used has been effective. We must not confound the substitution of a new odor with the destruction of a former one. When any article having no odor of its own uniformly counteracts foul odors, we may safely value it as a disinfectant.

AIR AS A DISINFECTANT.

Even in so elementary an outline, it is evident that we can never vacate or supersede air as a disinfectant. Air, above and beyond all other things, is the material on which we must rely to purify air. It often needs to be air in perceptible motion, and without draft upon persons, and yet moving at a rate to cause draft. Its condition of heat or moisture will have some bearing on its effectiveness, as well as its condition of purity or impurity when introduced. There is room for plain common sense and thought, as well as for scientific study on the subject.

We do not always purify a room or disinfect its air by opening a window. The direction of the wind, the condition of moisture, the unraised curtain or the distance of some corner in the room may leave the child in its bed breathing a very different atmosphere from that which exists just at the crevice made at the open window. Many a room so needs flushing with air in every corner and crevice that it can only be done when unoccupied. Five minutes of such airing is often a greater disinfectant than a window raised for a day. While it is not our plan to discuss ventilation, we cannot properly advert to disinfection without an endeavor to impress the availability of air as a disinfectant, and the imperfect method in which it is sometimes applied, even when its general importance is recognized. In some states of the atmosphere, and in some conditions of crowded houses or close rooms, there is such necessity for rapid and general diffusion of new air, in cases of sickness, that we are ever to be on the alert to secure a thorough ventilation. Often there is far more risk from closeness than from draft. Where there is danger from draft we often get help, but never complete substitution, by the use of disinfectants. When the air is warm faster currents can be borne. The value of natural light, too, is not to be lost sight of, since it also aids in the purification of air.

WATER AS A DISINFECTANT.

Water cannot be said to have a direct chemical action as a disinfectant, yet it has an important service to perform. Moisture may so locate infective particles as not to leave them flying about in the air to be readily inbreathed. To this end, oiling or wetting the skin in scarlet fever has been recommended as a method of fixing the particles which are shed from the skin in what is called the desqaumative process. Water itself, with the air it contains, has some power of oxidizing infective particles. It is chiefly, however, as a promotive of cleanliness that the use of water is advocated for disinfection. Either in solution or suspension it conveys away organic material or promotes those chemical changes which render them inoccuous. Yet it is to be remembered that moisture sometimes seem to promote the infectiveness of particles, by dissolving or suspending them so as to be more easily absorbed. If heat is added to moisture, it awakens decay and stirs matters into activity, and so may render it more hurtful.

It is to be borne in mind that constant dampness is not favorable to cleanliness. In hospitals during an epidemic, it is not usual to scrub the ward floors and walls, as water fastens some particles to surfaces, and together with heat, seems to promote their active and deleterious agency. This does not apply to the usual working of households, or to that agency of water by which surfaces can be better cleansed than in any other way, if only for a little time the sick can be removed during the dampness or evaporation incident to the drying process. For the cleanness of the skin, of the clothing and of much of the surrounding material for our homes, there is no substitute for water.

Neither can any system of artificial disinfection take the place of the time-honored house-cleaning so common with good house-wives. The thorough cleansing of floors and walls, the overhauling of closets, bureaus and corners must be occasionally done in this formal inspecting way, while the scrubbing, and wiping, and carpet shaking and removing into the open air and lime-washing make up a process too important to be superseded. In many cases of sickness there needs to be the same methods, as applied to rooms, which should be adopted as soon as they can be vacated by the sick. Garments, which are often the vehicles of infective particles, are best cleansed by shaking in out-door air or by immersion in boiling water.

To those who will not thoroughly cleanse the house, the bed clothing, and furniture and all garments at stated intervals, frequent movings are blessings in disguise, as they afford some opportunity for pure air to come in contact with soiled materials.

OZONE.

It is claimed by some that nature has provided in the atmosphere an element in a state ready of appropriation by which disinfection can be secured, and that when not sufficiently found in the atmosphere it can be made available by artificial methods. It may be called an extra atom of free oxygen, a little more ready than the usual oxygen of the atmosphere, and holding itself ready to compensate for any defilement of pure air for which its services are desirable. It is defined as three atoms of oxygen, occupying the same space as two atoms of ordinary oxygen, capable of yielding up one atom of oxygen, and yet ordinary oxygen remains. So it is a powerful oxidizer. The exact availability of this agent is not yet fully defined, but it is attracting so much of scientific attention, experiment and hopefulness, that we need thus to make reference to it.

SULPHUROUS ACID OR SULPHUROUS ANHYDRIDE.

This substance stands at the present at the head of chemical disinfectants. It is made by burning roll sulphur, which, coming in contact with the moisture or aqueous vapour in the air is changed into sulphurous acid. The vapor thus formed is destructive to insect life and to man himself, if continuing to breathe it for a length of time. It is, therefore, only applicable to the thorough disinfection of ships, rooms or houses from which all persons can be removed. But its great penetration even into trunks, clothing, &c., and its power of neutralizing the gases of decay and destroying the infective power of atoms, make it of great and essential service. Athough the odor is unpleasant in clothing and other articles subjected to it, this is dissipated by airing.

A house or room is disinfected with it thus : Close the chimney and all access to the outer air, except the doors for egress. Break in small pieces the sulphur to be used, and place it on an iron plate or in a metallic dish or pan, and set this on a pair of tongs or cross-bar over an iron pot in which there is water, or over a large box of sand, so as to avoid any danger of fire from small particles of the burning sulphur. A little alcohol placed in the pan and set on fire, or a few burning coals from the stove, will light the sulphur. A pound and a half of sulphur will be needed for each 1,000 cubic feet of air space. Thus a room 10 feet wide and 10 feet long, and with ceiling 10 feet high, 10 x 10 x 10 = 1,000, would need this amount; or a room 8 x 8 x 8 = 512, about half as much. As soon as the sulphur begins to ignite, the person should leave and close the door tightly. The burning will continue until the sulphur is consumed, which, if the room is properly closed, should mean until the oxygen of the inside air is converted into sulphurous acid. If the room at the start is not below 50° the change is more rapid. It should be kept closed for from four to six hours after the burning has ceased, and then should be well aired for hours before occupancy, but should not be slept in until eight or ten hours after being opened and aired. It will hasten the disappearance of the odor of sulphur to wash the woodwork and cleanse the walls. Although the sulphur process is a little troublesome, yet it is also troublesome to catch disease from an infected building or room. We may improve the air of a room in usual cases by other methods, but we cannot rightly disinfect an infected room with the people in it. Sulphurous acid thus formed, by its pungency, its penetration and its active oxidation is now believed to be of the greatest value for this purpose. The penetration of sulphurous acid fumes is shown by the fact that test litmus paper, placed under the carpet and between the leaves of books, is turned bright red. It was not found that colored silks or bed and bedding were injured, while feather beds, pillows or clothing hung up and in the room are penetrated with the sulphur fumes. Where there has been a disease like small-pox, or any infection which has shown great virulence, or which is actively transmissible, this mode of cleansing is to be advised. Chlorine gas has been used in the same way, but is no better, and is destructive of metals and colors.

The sulphurous acid fumes, although they will, by long continuation, affect vegetable colors, attack iron and be absorbed by cloth, leather, &c., do not seriously injure these in so short a time, unless it might be some very unstable colors of cheap prints.

CHLORINATED SODA AND CHLORIDE OF LIME.

As it is very frequently desirable to purify the air of a room when the sick person or a family cannot remove from it, we have, in some of the preparations containing chlorine, articles of much utility for this purpose. It is said that the value of chlorine as a disinfectant came to be noticed first by the exemption from cholera of the Lancashire districts, where the chlorides were used by the operatives for bleaching purposes. Its value is no longer questioned. It is most available for sanitary uses in two forms.

The *Liquer Sodæ Chlorinatæ*, or solution of chlorinated soda, is a liquid generally offered in the market under the name of Labarraque's Solution, from the Parisian apothecary who introduced it. It is convenient for washing or bathing, and if of proper strength, is a quick and valuable disinfectant. This can only be known by purchasing it from reliable sources. Saucers containing two or three tablespoonfuls should be used until there is no other odor perceptible in the room, and should be replenished as indicated by this criterion. At present prices a pint bottle is worth 25 cents.

Chloride of lime (*Calcic hydrochlorite*) is cheaper and valuable for most disinfecting purposes. The lime itself has some value, but in this preparation it is chiefly of service as a means of holding and giving off chlorine gas, which, being readily liberated, any organic matters are seized upon and changed as to their constituency. Commercial chloride of lime contains from 30 to 35 per cent. of chlorine ready to be thus liberated under proper methods of use. Where it is to be produced in large quantities it should be tested, as it varies in its charge of chlorine, and so in its corrective or disinfecting value. But it is less variable than many other preparations, and as put up by reliable dealers in pound packages at from six to eight cents per pound, is very available. In quantities it can be had at two cents per pound. It is a most excellent disinfectant, and, even in a sick room, can easily be borne in moderate quantity, unless there is a special irritation of the breathing apparatus.

Two tablespoonfuls of the dry powder is placed in a saucer here and there, in the room, and just moistened with a little water and stirred with a penholder or small stick. If the atmosphere is already perceptibly bad it is best to moisten it with vinegar and stir briskly, and to add more of the dry powder when the odour lessens. There should be frequent stirring and replenishing of two or three teaspoonfuls each day, enough to keep a slight odour of chlorine perceptible in the room. If left unstirred it becomes encrusted with a carbonate of lime, and the air is not brought into contact with it sufficiently. The nurse soon comes to judge of the amount needed by the odour. When the saucers come to emit much smell of chlorine their contents should be thrown into any place where disinfectants might be of service. The chlorine should not be kept in closets among china or steel ware, as it slowly tarnishes and corrodes these. It should also be kept, when not in use, in a dry place, or in a sealed fruit jar. Chloride of lime, either alone or mixed with recently slaked lime, may, with advantage, be scattered about drains or any places where there are foul smells. In common use the indication of amount can only be measured by frequent repetition, until there is a cessation of foul odours.

Oxide of calcium or quick lime is that prepared in lime-kilns. When broken in small pieces or recently slaked in its usual preparation for land, or for mortar, or for lime-wash, it is valuable as a disinfectant, both as an absorbent and as neutralizing some of the gases of decay. It may be used in all cases where there is exposed filth, and where a powder can be scattered upon it. It should be freely strewn about, day by day, until all odour is corrected. Since, in large masses of filth, it may hasten the escape of gases faster than it neutralizes them, powdered charcoal or an equal amount of common plaster may be added.

The popular "Calx powder" is made by powdering one bushel of dry, fresh charcoal and two bushels of stone lime and mixing them. Common lime and crushed charcoal may be thus mixed, but are not quite as effective. Ivory black or animal charcoal made from bones, and thus pulverized, presents with the same weight a larger surface than wood charcoal, and is a more active absorbent.

The value of this and other absorbents is in the fact that they can take up many times their volume of gaseous products.

If, for instance, fresh powdered charcoal is mingled with a liquid or semi-liquid decomposing matter, the gases of decay will be condensed in its pores and rendered inactive until changed. If, instead of being mingled, the charcoal is placed over the mass so that escaping gases have to come in contact with it, a septum is furnished between the decaying mass and ourselves. As it does not act chemically, and we cannot measure the amount of gases emanating from the mass, one chief test must be the removal of odour. Gypsum, or plaster of Paris, dry coal ashes, dried peat, lime and well-dried earth have similar qualities. Not only as absorbing the foul gases, but as absorbing moisture they suspend or take away one of the conditions of putrefaction. It is important to secure for any thing that is foul, air deprived of moisture. There are many house disinfectants, such as dry, sifted ashes, soot, charcoal and dried earth, which are quite available and well suited for drains, cess pools and out-houses and for all that kind of disinfection which seeks the entire removal of odour.

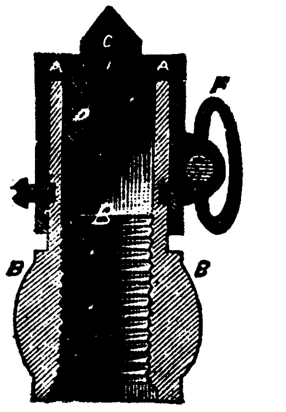
HARDENING SMALL TOOLS.—It is said that the engravers and watchmakers of Germany harden their tools in sealing wax. The tool is heated to whiteness and plunged into the wax, withdrawn after an instant and plunged in again, the process being repeated until the steel is too cold to enter the wax. The steel is said to become, after this process, almost as hard as the diamond, and when touched with a little oil or turpentine the tools are excellent for engraving. and also for piercing the hardest metals.

A MILL-OWNER says: Eelskins make the best possible strings for lacing belts. One lace will outlast any belt, and will stand wear and hard usage where hooks or any other fastenings fail. Our mill, being on the bank of the river, we keep a net set for eels, which, when wanted, are taken out in the morning and skinned, and the skins are stuck on a smooth board. When dry, we cut them in two strings, making the eelskin, in three hours from the time the fish is taken from the water, travel in a belt.

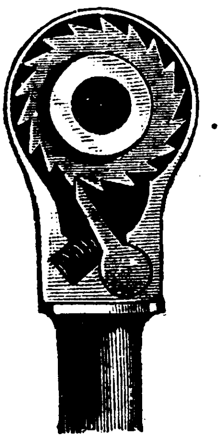
INCREASED USE FOR GLASS.—Considerable has been written about toughened glass as a material for railway sleepers, and now Mr. Bucknall, of England, intends to manufacture toughened glass pipes for water and gas works, for drains and chemical purposes, as well as transparent bricks, telegraph insulators, etc.

LATHROP'S SELF-FEEDING RATCHET DRILL.

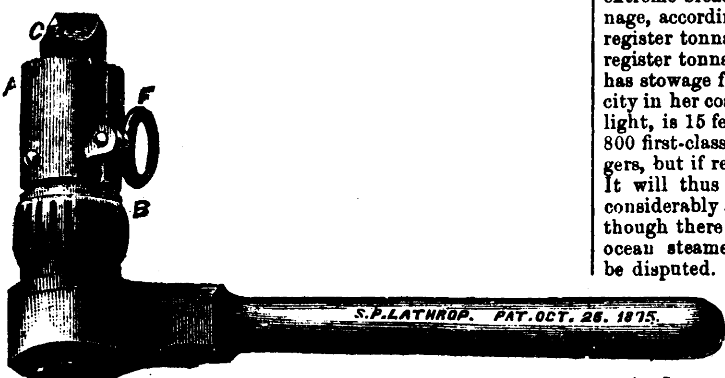
S. P. Lathrop, of Newark, N. J., is the inventor and manufacturer of a self-feeding ratchet drill which is claimed to be equally adapted to light and heavy work, being capable of instant adjustment to any required cut. The tool is simple in construction, and its operation will be readily understood from an inspection of the figures. The inner or feed-sleeve B, Figs. 1 and 3, screws upon the drill spindle, and is provided with a friction or outer sleeve, A, in the head of which is secured a steel chisel-shaped pin, C. The lower end of C is pointed and rests upon a hardened steel bearing, D, fixed in the head of the inner sleeve B. This sleeve, with its bearing D, revolves upon



Self-Feeding Ratchet Drill.
FIG. 1.



Lathrop's Self-Feeding Ratchet Drill.—Fig. 2.



Lathrop's Self-Feeding Ratchet Drill.—Fig. 3.

the point of the pin C, and within the friction sleeve A. The head of the pin C being chisel-shaped prevents the pin and the outer sleeve A from revolving. If the friction screw F is unscrewed, B is free to rotate upon the bearing of the pin C; but by tightening F the friction on the inner sleeve B may be increased causing the sleeve to remain stationary, and, consequently, causing the screw on the drill spindle to feed the drill until the friction on the drill becomes greater than that on the sleeve B. When this occurs B again rotates within the outer sleeve, and continues to do so until the drill has finished cutting the chip, when the operation is again repeated. The feed may, of course, be readily adjusted by tightening or loosening the friction screw F.

WELDING TUBES AND TIRES.—Herr Krupp, of Essen, has recently patented, in Germany, a method of welding tubes and tires, which is based upon an excellent idea. He draws the tube over one of a pair of ordinary rolls, and then heats the whole length of the portions to be welded by a special contrivance, which is a portable fire-box, into which air is so blown that the heat is directed against the weld. After the necessary heat is attained the rolls are set in motion and the place to be welded is repeatedly drawn through them.

GIANT STEAMSHIPS.

For some years it has seemed as if the limit of size in ocean steamships was to be fixed at about 5,000 tons. It was clear that the *Great Eastern* was a gigantic failure, a costly elephant on the hands of her owners. She could not be run as an ordinary passenger or freight steamer, and found only temporary employment in the work of laying submarine cables. Whether she can be utilized as a transport for cattle to European markets, as recently proposed remains to be proved; but it is certain that such a ship would not be *built* for that purpose—or indeed for any other at the present time. She may, therefore, be left out of the account, except as a warning that there *is* a limit of size, at least so far as economy of construction and working is concerned.

Steamships of 5,000 tons have been running for some ten years or more, but their number has increased very slowly, and until within a year or two there has been no disposition to build larger vessels. Then came the *Gallia* of the Cunard line and the *Arizona* of the Guion line, the former being 5,200 and the latter 5,300 tons. The *Orient*, for an East Indian line, soon followed, with a measurement of 5,386 tons. The success of these great ships, especially in regard to speed, coupled with the ambition of companies to outdo their rivals, appears to have given a new impulse to this branch of naval architecture, and two ships are now building which are to be much bigger than the biggest of their predecessors. One of these is a Cunarder, and is to be of 7,500 tons and 10,000 horse-power, her dimensions being 500 feet in length, 50 feet in breadth, 41 in depth. No sooner had the Cunard Company announced their intention to build a vessel second in point of size only to the *Great Eastern* than the Indian Company determined to have a steamship of even larger dimensions. The vessel is to be built at Barrow, and is to be of about 8,000 tons, but her exact dimensions have not been published as yet.

It may be interesting to compare these ships with the *Great Eastern*. The length of the latter on the water-line is 680 feet, extreme breadth 82 feet, 6 inches, and depth 58 feet. Her tonnage, according to builder's measurement, is 22,627 tons; her register tonnage, including engine space, is 18,914 tons; and her register tonnage excluding engine space, is 13,343 tons. She has stowage for cargo to the extent of 6,000 tons, and the capacity in her coal bunkers is 10,000 tons. Her draft of water when light, is 15 feet, and loaded 30 feet. She has accommodation for 800 first-class, 2,000 second-class, and 1,200 third-class passengers, but if required for troops alone she could carry 10,000 men. It will thus be seen that the *Great Eastern* is in point of size considerably ahead of anything yet ventured by ship-owners, and though there is an evident desire to increase the size of the great ocean steamers her position as the largest afloat is not likely to be disputed.

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 (say 1,000 c. c. m.), 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 disturbing, however, 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 calculating the percentage of vapor that the air has carried can be readily ascertained. The method is said to give very accurate results, and the operation makes a good lecture experiment.

HEAVY LOCOMOTIVES.—The tendency at this time seems to be to increase the weight and draft of railroad locomotives, and to decrease the weight of cars in proportion to the load which they are designed to carry. The Pennsylvania Railroad Company are now building at their shops in Altoona a new fast passenger engine, to run between Philadelphia and New York. It will have drivers five feet eight inches in diameter. If it works satisfactorily nine more of them will be immediately constructed for the same road. They are also building 60 locomotives of the Modoc pattern, recently described in these columns—the heaviest ever built. The engineers do not like these heavy engines, but the company appears well satisfied with their pulling capacity.

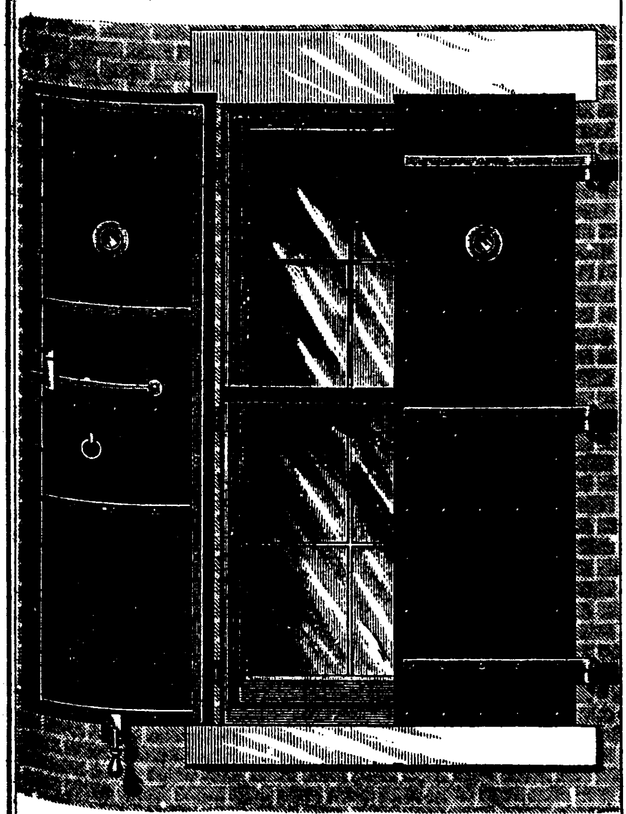


Fig. 1.

IMPROVEMENT IN SHEET IRON SHUTTERS.

In competition with the many ingenious devices in the way of sheet-iron shutters, the old style of shutter, consisting of a simple frame of bar iron, covered with plain or slightly corrugated sheet iron, still remains, popular, and is likely to be used until something very much better, and, at the same time, quite as simple and cheap, is devised. Fig. 1 of the accompanying engravings shows this style of shutter in all its essential features. The manner of attaching the iron to the frame, and also of attaching hinges, is so clearly represented that no detailed explanation is necessary. While under certain circumstances such shutters are not likely to resist fire as well as some of those in which an air space between the inner and outer surface is provided there is still a justifiable feeling of security in the mind of any one owning a store or warehouse which is provided with them. Insurance companies discriminate in their rates in favour of buildings furnished with iron shutters of almost any construction.

One of the most important considerations in applying shutters to a building for the purpose of protecting it from fire is the method of attaching them to the walls. Outside of the large cities, in which the subject has received special attention, expedients are sometimes resorted which are entirely inadequate. We believe there is no device entirely satisfactory save those which are provided at the time of the construction of the building. Belting through or digging out bricks to insert shutter eyes, which we have sometimes seen done in some of the smaller towns, is a construction not to be recommended. It is safe to say that in all cases provision for attaching the shutters ought to be made as the walls are carried up. By building in the eyes in which the shutters are to hang, solid construction is provided and an accuracy of fit obtained which is very necessary.

Fig. 2 of the accompanying illustration shows a very desirable, and, at the same time, quite common form of shutter eye, in which great care has been taken to provide for all the strains likely to come upon it and at the same time to give it a shape not likely to be easily pulled from the walls. Withal it is light, there being no surplus metal employed in any part of it.

Fig. 3 shows what is known as a turnbuckle, and which in its general features resemble the eye just described. The pivot catch, which is counterbalanced by the weighted handle, holds the shutter in position whenever it is thrown back, and the arrangement of parts and construction is such that the shutter is easily disengaged whenever it is necessary to close it. This turn buckle should be properly located and built in the wall during the progress of the building, the same as the shutter eye.

So far in our description we have referred both to the shutter and trimming for shutters in a general way. In Fig. 1 is shown an important improvement which has been added recently to shutters of this kind, and which may be applied to shutters of almost any description, to which we desire to call particular attention. In the upper part of each fold is placed a small cast-iron double ring, containing a piece of ground glass, say 3 inches in diameter. The presence of this glass forms a porthole which lets in a sufficient quantity of light to guide a person to the window for the purpose of opening the shutter, or in safely moving about the room while the shutters are still closed. Since the glass may be easily removed by a stroke of a hammer or other instrument, these portholes afford firemen an opportunity for inverting the nozzle of their hose in case of fire within. By this means the disastrous effects sometimes attending the opening of shutters while a building is on fire and the delay which is almost unaoidable under such circumstances is entirely avoided while the firemen themselves are protected from the flames durIug the time they are pouring water into the building. The porthole also serves to indicate the presence of fire in the building to those outside of it, a provision not contemplated in the ordinary construction of iron shutters. The improvement has been recently patented, and is now being put on the market by the Ætna Iron Company, of this city. We believe it is of a character to be appreciated by all who use shutters, and since it is very simple, easily applied and comparatively cheap, we think it is likely to come into quite general use.

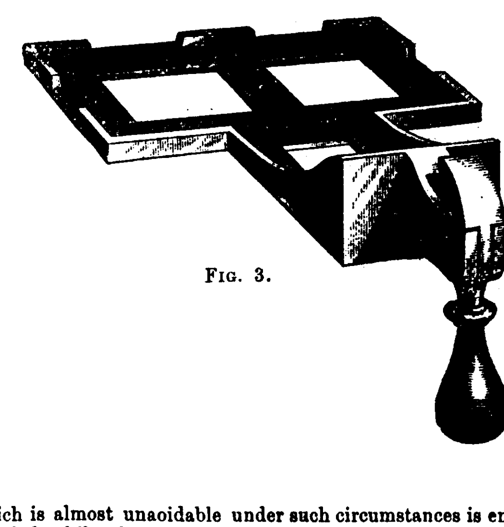


Fig. 3.

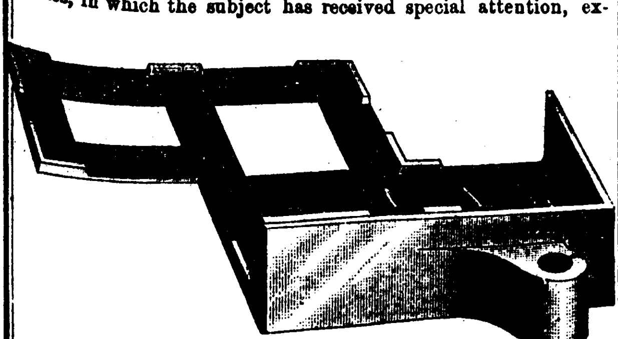


Fig. 2.—Shutter Eye for Walling in.

White gutta-percha is obtained by precipitating a solution of ordinary gutta-percha in chloroform by alcohol, washing the precipitate with alcohol, and finally boiling it in water, and moulding into desired form while still hot.

Miscellaneous.

PRACTICAL HINTS.

AMERICAN PRODUCTS ABROAD.—Our consul at Geneva reports large importations of American anthracite into Switzerland, where it finds a ready sale at present low prices though he considers it doubtful whether it can permanently compete with French coal and coke. He states that American stoves, which have followed in the wake of our coal, are very popular there, and holds out the prospect to our manufacturers of a large and profitable trade in these goods, if they are made to conform to Swiss ideas of taste. London *Truth* makes the following very gratifying statements respecting another successful American industry, to wit: "American clocks and watches are sold for less than those of English and Swiss make in England and in Switzerland. And yet the skilled labor in this business is not cheaper than with us. Therefore, by sheer superiority of intelligence, and by the perfection of machinery, we have been cut out, by the American, of a trade in which we formerly held our own." * *

Another London journal, referring to American cotton goods, says: "Much surprise has been lately expressed at the continually increasing exports of cotton goods from New York to this country. * * * It has been entirely the fault of our manufacturers that the import of American calicoes has been so large and that it has continued so long. The one feature which recommended them to the British public was their purity."

SHELLAC.—This resin may be obtained pure by treating it with alcohol, and filtering the solution in order to separate a yellow gray pulverulent matter. When the alcohol is again distilled off, a brown, translucent, hard, and brittle resin remains. It melts into a viscid mass by heat and diffuses an aromatic odor. Pure alcohol dissolves it in all proportions. Shellac dissolves with ease in diluted hydrochloric and acetic acids, but concentrated sulphuric acid is not a solvent. The resin of shellac has a great tendency to combine with salifiable bases, as with caustic potassa, which it deprives of its alkaline taste. This solution, which is of a dark red colour, dries into a brilliant transparent reddish brown mass, which may be re-dissolved in both water and alcohol. By passing chlorine in excess through the dark-colored alkaline solution, the lac resin is precipitated in a colorless state. When this precipitate is washed and dried it forms with alcohol an excellent pale yellow varnish, especially with the addition of a little turpentine and mastic. With the aid of heat, shellac dissolves readily in a solution of borax.

HINTS ON THE USE OF PLASTER OF PARIS.—The plaster may be made to "set" very quickly by mixing it in hot water to which a little sulphate of potash has been added. Plaster of Paris casts, soaked in melted paraffine, may be readily cut or turned in a lathe. They may be rendered very hard and tough by soaking them in warm glue size until thoroughly saturated, and allowing them to dry. Plaster of Paris mixed with equal parts of pumice stone makes a fine mould for casting fusible metals; the same mixture is useful for encasing articles to be soldered or brazed. Casts of plaster of Paris may be made to imitate fine bronzes by giving them two or three coats of shellac varnish, and dusting on fine bronze powder when the mastic varnish becomes sticky. Rat holes may be effectually stopped with broken glass and plaster of Paris. A good method of mixing plaster of Paris is to sprinkle it into the water, using rather more water than is required; when the plaster settles, pour off the surplus water and stir carefully. Air bubbles are avoided in this way.

DANGEROUS CURIOSITY.—It is the most natural thing in the world, when you have gone to bed, to get up, run to the window, hoist it and look out at an alarm of fire or any unusual noise or clamour going on outside. A lady was roused from her sleep by a cry of "fire;" her chamber was as bright almost as day when she opened her eyes. She went to the window, and soon saw that it was her husband's cotton factory. She felt on the instant a shock at the pit of the stomach; the result was a painful disease which troubled her for the remainder of her life, a period of nearly 15 years. A young lady just budding into womanhood, was called by the sound of midnight music to the window, and in her undress leaned her arm on the cold sill; the next day she had an attack of inflammation of the lungs which nearly killed her. She eventually recovered, only to be the victim of a life-long asthma, the horrible suffering from the oft-repeated attacks of which, during now these twenty years, is the painful penalty, to be paid over and over again as long as life lasts.

DANGERS FROM THE ELECTRIC LIGHT.—It appears that the electric light is not without its dangers. Some time ago a red-hot morsel of carbon dropped from one of the lamps at the British Museum to a table usually occupied by readers. Measures were at once taken to prevent the recurrence of such an accident, but not with complete success, for a few days later a similar piece of red-hot carbon fell from the centre lamp to the table of the superintendent of the reading room, upon a piece of loose paper, which began to kindle into flame. This, however, was speedily extinguished. It is conceivable that a single spark might do irretrievable damage to some unique manuscript or other priceless example of literary production. Large transparent glass or talc saucers have been suspended below each lamp, so as to intercept any stray piece of carbon which may happen to fall in the future. It is even proposed to try the experiment of lighting the room from outside, in which case the glass of the central part of the dome would offer a most effectual protection.

HARD VERSUS SOFT WATER.—Dr. Tidy, an English chemist, gives, in the London *Medical Examiner*, the result of his observations on the use of hard water for culinary and domestic purposes: 1. Hard water is the best dietetically, because of the lime. 2. It makes better tea, although not so dark coloured, owing to the fact that soft water dissolves the bitter extractive matters which colours the tea, but ruins the aroma. 3. It relieves thirst, which soft water does not. 4. It does not dissolve lead or organic matter, which soft water does. 5. It is generally good coloured, soft water being, as a rule, dark coloured and unpleasant looking; hence, in places like Manchester, supplied with soft water, they always put it (in hotels) in dark bottles to hide the colour. A soft water, however, is a better detergent, and requires less soap. For a residential town a water which has over 10° of hardness would be best. For a manufacturing town a soft water would be the most advisable, for commercial considerations only.

THE SHADOWLESS REFLECTOR LIGHT.—Messrs. Barwell, Son and Fisher, gas chandelier and oil lamp manufacturers, of the Worcester Works, Birmingham, are introducing some decided novelties in lighting apparatus, which are of such an important character, as to in a measure, revolutionize the trade in this class of goods. As a first instalment of what this enterprising firm are doing in this direction, we this month describe and illustrate their new "Shadowless Reflector Light." This consists of a highly-polished concave metal reflector suspended over regulated argand burners of improved construction. As will be seen from our engraving the chimneys of the burners are carried right through the reflector, thus allowing it to retain the reflector power of its polished surface, undimmed by the products of combustion as is the case in other reflecting lights, where naked flames are employed underneath silvered glass reflectors. This system can be carried out in either one, two, three, four, or five lights.—*Martineau & Smith's Hardware Trade Circular.*

COLOURLESS VARNISH.—1. Boil parchment cuttings in rain water for six or seven hours, strain through muslin, and bottle for use. A quicker mode is to dissolve isinglass in warm water, and lay on with camel's hair brush; but if you do not object to a slight tint on drawings, buy a small quantity of paper varnish. This is nearly colorless. Apply with camel's-hair brush. 2. Dissolve 2½ oz. of shellac in 1 pint of rectified spirit of wine with 5 oz. of well-burned and recently-heated animal charcoal. A small portion of the solution should then be filtered, and if not colorless more charcoal added. When all the color is removed press the liquid through a piece of silk, and afterwards filter through fine blotting paper. It dries in a few minutes. 3. Canada balsam and clear white resin, of each 6 oz.; oil of turpentine, 1 quart; dissolve. Another: Digest gum sandarack, 20 parts; gum mastic, 8; camphor, 1; with 48 of alcohol. The map or engraving must previously receive one or two coats of gelatine.

IRON PAINT.—The *Photographisches Wochenblatt* mentions that a Herr Chr. Spangenberger has patented in Germany a paint composed of pulverized iron and linseed-oil varnish. It is intended for painting damp walls, kettles, outer walls, or, in short, any place or vessel exposed to the action of the open air and to the weather. Should the article to be painted be exposed to frequent changes of temperature, linseed-oil varnish and amber varnish should both be mixed with the paint intended for the first two coats, without the addition of any artificial drying medium. The first coat should be applied rather thin, the second a little thicker, and the last in a rather fluid state. It is not necessary to free iron from rust, grease, &c., by means of acid before applying the paint, as a superficial cleaning is sufficient. The paint is equally adapted as a weather-proof coating for iron, wood and stone.

THE importance of personal habits as affecting health can hardly be over-estimated. Hundreds of cases can be cited of noted persons of the most feeble constitution who, by care, were able to prolong their lives and accomplish wonderful labors in spite of almost continuous illness. The Jews are said to be the longest-lived people, because of their strict attention to hygiene as directed in the Mosaic law. If a man by taking thought cannot add a cubit to his stature, he may at least lengthen his days very materially by prudence. Any one can prolong his or her life beyond the average term of years by simple attention to hygienic laws. In our own generation, we have remarkable examples of mental activity continued to a great age in the case of Gladstone, Bismarck, Thiers, Emerson, Bryant, Vanderbilt, Charles O'Conor, Peter Cooper, Bancroft and Dr. Willard Parker, not to mention others. Many of these men were of frail constitution originally, yet they have performed herculean tasks, and their example should be encouragement to all—"What man has done, man can do."

HOW TO PRESERVE SIZE AND GLUE.—When size is kept for several days, or when it is used to size several layers of paper, one upon another it emits a bad smell, arising from decomposition. This can be avoided by pouring over it occasionally a little carbolic acid; and the same effect may be obtained as regards the disagreeable odor of glue. For the preservation of size, glue, gelatine, or gum, salicylic acid is prescribed, as it arrests all fermentation or the formation of mold in adhesive substances. To prevent decomposition, it will suffice to mix a small quantity of salicylic acid, say about 1 per cent. This acid is used either in its dry or liquid state. If, however, it is desired to make glue, gelatine, or gum resist water, add about 20 per cent. of solution of bichromate of potash. The glue after being dried becomes quite insoluble in water.

HUNTING BY ELECTRICITY.—A new application of the Ruhmkorff coil has been made in the neighborhood of Marseilles. Instead of using bird-lime on trees which are frequented by birds of passage, a copper wire is wound around the trunk and a decoy is attached to a neighboring staff. When a numerous flock has been attracted by the decoy, a shock is sent by the commutator, and they are more surely stunned than by a rifle. Experiments of a similar kind have also been made by M. Dalmas upon the vines at his country-seat, and powerful shots are said to have destroyed the parasites together with their eggs. If this statement is confirmed, the ingenious inventor may reasonably expect the prize of 100,000 francs, which has been offered for the destruction of the phylloxera.—*Les Mondes.*

ARTIFICIAL STONE.—Artificial stone can be produced by the following process, recently discovered by Ternikoff: A mortar of equal parts of lime and sand is exposed for a few hours to a temperature of 150 degrees centigrade in the presence of water vapour. The paste having been taken out of the furnace, is now placed under the cylinders of a machine like that for manufacturing bricks, and it comes out in the form of cubes, which, on being exposed to the air, become dry and hard. In the course of eight or nine hours these cubes are as hard as good building stones, and are fit for use. This artificial stone is, in fact, a sort of brick of mortar baked at a low temperature, and the cost, too, is about the same as that of bricks.

DRAWING ON PHOTOGRAPHS.—Mr. Robert Grimshaw, Ph. D., recommends the following procedure, where it is desired to obtain an India-ink drawing from a photograph, without resorting to tracing. Very nice results are obtained thus: Prepare a print in the usual manner. Instead of toning as usual, fix immediately in "hypo." Wash well in running water to get out all the hypo. Draw directly on the print with India-ink. This finished, bleach with a saturated solution of corrosive sublimate (bi-chloride of mercury) in equal parts of water and alcohol. Flowing is better than brushing for applying the bleach, as it avoids smearing.

A ROSEWOOD STAIN OF A BRIGHT SHADE.—Take 1 gallon of alcohol, 1½ lb. of camwood, ½ lb. of red sanders, 1 lb. of extract of logwood, and 2 oz. of aquafortis. When dissolved, it is ready for use. This makes a very bright ground. It should be applied in three coats over the whole surface. When it is dry, sandpaper down to a very smooth surface, using for the purpose a fine paper. The graining is then to be done with iron rust, and the shading with asphaltum, thinned, with spirits of turpentine. When the shading is dry, apply one thin coat of shellac, and when this is dry, sandpaper down, as before, with fine paper. The work is then ready for varnishing.

PASTE, FOR PAPER-HANGING.—Mix 1 tablespoonful of wheat flour with ½ pint of cold water, adding the latter gradually, and thoroughly stirring in each portion before pouring in more, place the vessel over the fire and stir the whole assiduously until it boils, great care being taken to prevent caking or burning on the bottom. An addition of ½ teaspoonful of powdered alum will strengthen the product. The addition of a few grains of corrosive sublimate or a few drops of creosote will prevent it from turning mouldy, and preserve it for years. When too hard or dry it may be softened by beating it up with a little hot water.

HOW BRIC-A-BRAC SHOPS ARE SUPPLIED.—The *American Art Review* mentions that a man was lately caught in the garden of the Tuileries trying to break a statue. He stated that he was a dealer in *débris*; that it was his occupation to break statues, statuettes, bas-reliefs and to sell them for export. He affirmed that the English are the best customers for wares of this sort. An advertisement in the London *Times* having offered for sale "the materials of the cloister of the Carmelites of Pont l'Abbé, built in 1383," the municipality of that place has contributed 1,500 and the French Government 2,000 francs in order to gain possession of the property and keep it in France.

RICE GLUE STATUARY.—Mix intimately rice flour with cold water, and gently simmer it over the fire, when it readily forms a delicate and durable cement, not only answering the purpose of common paste, but admirably adapted to join together, paper, card, etc. When made of the consistency of plastic clay, models, busts, basso-relievos, etc., may be formed, and the articles when dry are very like white marble, and will take a high polish, being very durable. In this manner the Chinese and Japanese make many of their domestic idols. Any coloring matter may be used at pleasure.

FRESHENING UP STAINED WORK.—Scrape all the varnish, etc., off till you come to the wood, then stain and varnish again. The best tool for scraping is one which is ready for the purpose; but if you don't possess a scraper, and cannot get one, a plane iron will be the best substitute. Finish with sand-paper. Vandyke brown makes a very good dark oak stain, if ground and mixed with a little beer. Put this on evenly with a brush, and when dry varnish.

GREY HAIR.—The causes of grey hair are numerous. One that is fundamental is inheritance; another is weakness of constitution; another is improprieties of life, or bad habits, while climate also has something to do with it. Where it is constitutional for the hair to turn grey early, the effect upon the health is nothing. It is the opinion of a good medical authority that most of the cases of premature grey hair are due to the "fast" or dissipated habits of young people.

WRITING ON WOOD.—Well strain the color, and mix it in linseed oil with the addition of a little boiled oil to give a gloss. Before writing on the wood wash it clean with water. If it be for gold letters, and the wood is sticky from being recently painted, mix equal parts of white of egg and cold water, and apply it to the surface with a sponge. Leave it to dry, and then dust it over with powdered whiting; afterwards brush it.

PACKING FOR STEAM PIPES.—J. Kathe makes a packing, which also may be used as a non-conductor for wrapping the pipes, by grinding twenty parts of hemp-refuse and mixing it in a Hollander with forty parts asbestos, twenty parts wool-waste and twenty parts wood-pulp. The mass is then saturated with soluble glass and dried.—*Dingler's Journal.*

AN OLD DISTICH.—A writer in *Notes and Queries* says that there yet remains to be seen on a pane of glass at Little Moreton Hall, in England, the following distich, cut with a diamond, and dated 1621:—

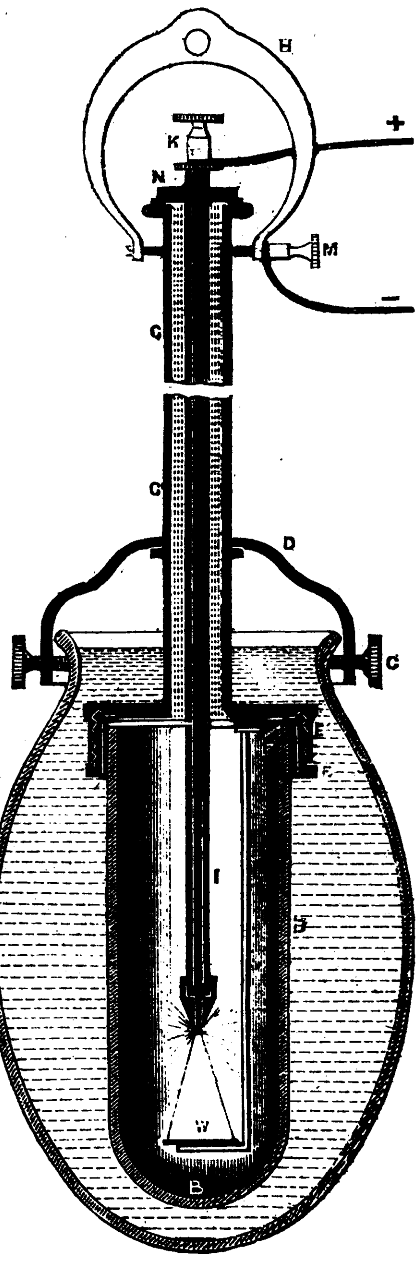
> "Man can noe more knowe woman's mind by teares
> Than by her shadow judge what clothes shee weares."

A CRIMSON SPIRIT STAIN.—Take 1 quart of alcohol, 3 oz. of Brazil-wood, ½ oz. of dragon's blood, ½ oz. of cochinneal, and 1 oz. of saffron. Steep to full strength and strain. It forms a good stain for violins and other wooden musical instruments, work-boxes and fancy articles.

POLISHING MAHOGANY.—Either stain the wood before polishing with logwood, or spirit stain; or mix 1 oz. dragon's blood in ½ pint French polish, shake well, then strain through muslin for use. If for superior work, and expense is no object, use carmine mixed with the polish.

THE ANDRE-BROUGHAM ELECTRIC LAMP.

In the annexed engraving is a representation of, probably, the best electric lamp yet invented. While some other electric-light men have been inventing lamps on paper Prof. André has been quietly pursuing his way, and now, with the assistance of the Hon. R. T. D. Brougham, he has devised a lamp which by common consent is acknowledged to be the best yet seen. We take the following description from the *Engineer*:—



The value of the improvement will at once be seen when we state that it reduces the carbon consumption to about ·125in. per hour, whilst a similar carbon burnt in a lamp open to the atmosphere burns about 6in. per hour, the cost in carbons being thus reduced to 1-48th of what it would be in an ordinary lamp. This is, probably, a maximum reduction, inasmuch as the carbons in ordinary lamps are of a larger diameter, these used in the André-Brougham being only 2mm. diameter. The improvement consists in surrounding the lamp, or a portion of it, with a separate vessel of glass containing water or some other suitable liquid. In the accompanying diagram BBB is the glass globe of the lamp proper, AA the surrounding vessel containing the liquid. The shape for these vessel is immaterial. It may, perhaps, conduce to simplicity if the lamp is first described. Two concentric tubes (G G, I I)' are separated by a non-conductor, such as Plaster of Paris. These tubes are connected to the two terminals of the battery by the binding screws K M. The outer tube G G is in electrical contact with the pyramid-shaped piece of metal W. The inner tube, I, contains the carbon rod, which rests upon the metallic wedge and falls down by its own weight, and that of a small weight placed on the top of the carbon, but within the tube. No doubt the light is due partially to incandescence of the carbon, and partially to the formation of an arc. The cap N on the top of the tube G G, through which the inner tube passes, is of vulcanite or other non-conducting material. Round the top of the lamp globe B B B is a metal cylinder to be screwed into the corresponding cylindrical E¹ E¹. The ring E E has a sharp edge at the top, whilst E¹ E¹ has a corresponding recess. Between the two is an India-rubber washer F F. so that on screwing E E the India-rubber is jammed into the recess in E¹ E¹, and a good water-tight joint made. The lamp is fitted with a cap D D, to which, by means of binding screws C C and clamps, the vessel A is fixed. This vessel is partially filled with water or other liquid, so that when in its proper position the liquid rises above the cap E¹, thus rendering the permeation of air into the lamp an impossibility. So long as the liquid in A is above the cap E¹ no atmospheric air can enter the lamp globe B, a tight joint is obtained, and at the same time the heat from the lamp is carried off or dispersed, and the light more or less diffused.

Mexican Antiquities—Proposed Exploration.—It is announced that Mr. Lorillard, the great tobacconist of New York, has entered into an agreement with the French Government to assist in a scheme for a thorough exploration among the ancient ruins of Mexico. Mr. Lorillard himself gives $20,000 at the start, and promises more when needed. M. Charnay, the French scientist and explorer, will have charge of the expedition, and his report will appear in the *North American Review*, but whatever relics are secured will go to Paris. This, however, will not be so very unfortunate for our own country, from the fact that there is a stringent law in Mexico which forbids the exportation of Mexican relics, so that only casts can be taken abroad, which may, of course, be duplicated for our own museums. The field to be explored is rich in relics, and the hope is that some key may be found by which the hieroglyphic language of those ancient races may be translated. This ancient people were, undoubtedly, great architects, possessing the power of moving immense masses of stone, and were quite lavish in their architectural ornamentations. It is altogether probable that M. Charnay may do much towards reaching a solution of the interesting questions of historic and pre-historic interest which the explorations thus far, in these fields, have secured.

The Fracture of Cast Iron.—At a recent meeting of the Civil and Mechanical Engineer's Society of London, the President read a very interesting paper, by Mr. James Love, on the above subject. In the paper the author went at considerable length into the matter, and described experiments on the peculiar form of fracture of cast iron, and showed its similarity to the fracture of other materials such as glass and sealing-wax. The author further showed, by his experiments, these lines to be nearly at right angles to the lines of equal stress, demonstrated by the Astronomer-Royal some years back. Arguing from this stand-point, Mr. Love proved the viscosity of many materials, and its connection with heat and regelation, which he has found in many substances, including iron, and showed that the ordinary process of welding iron was due to regelation, and the cast iron could not be welded in consequence of the presence of carbon in the form of graphite. A short discussion ensued in which several gentlemen expressed that the facts (many of them original) demonstrated by the author were of sufficient importance to require a special evening devoted to their consideration, accordingly the discussion was adjourned.—*Engineering*.

To Remove Old Paint from Wood.—A strong aqueous solution of caustic potash softens oil paint, which in this state may be removed by scraping. The potash is, however, liable to injuriously affect the wood, and must be used with great care, as to the strength of the solution.

SOME NEW ENGLISH CHAIN PUMPS

Our readers will be much interested in the accompanying cuts, which illustrate some new forms of chain pumps and pump details recently brought out by Messrs. Appleby & Co., of the Reinshaw Iron Works, Eckington, Derbyshire, England. Taken all together, this pump is a decided novelty to an American. Fly-wheel, sprocket wheel, chain tube, spout, bearings, and bell-mouthed tube are all of a pattern unknown to this country. The pump barrel or tube is of cast iron, flanged at the bottom, and carrying a bell mouth, to which a shoe or stirrup is attached, and upon which, apparently, it is intended to rest. The spout seems to be a modification of the well-known American pitcher spout. It carries two journal boxes, in which the shaft is held. The sprocket wheel, apparently, consists of two flanges, with sections cut out at intervals to hold the buckets. A heavy fly-wheel, with a handle for the crank, completes the apparatus. This, although adding to the expense of the pump, has really diminished the labor of turning, or, rather, it adds to the comfort of using the pump. The chain appears to be decidedly different from the kind employed in this country on chain pumps. The engraving shows it to be either trace chain or what a sailor would call a topsail halyard chain. These pumps are especially designed for irrigation or for lifting sewage, and, we presume, are intended to be worked by more than one man. The pipe is, we think, bored out from end to end, like the barrel of an ordinary pump, and the buckets upon the chain turned to fit. It would seem, however, from the number of buckets placed upon the chain that the fit is not as good as is desirable, or else that the makers do not understand the principles upon which a chain pump's best action depends. Fig. 2 represents an improved form of bucket introduced by Messrs. Appleby & Co., and Fig. 3 a diagram showing the arrangement of the valve and its seat in this new bucket. The valve, it will be seen, is of such shape as to afford a very easy water way, and, at the same time, make a simple valve. The leather is put on by slipping it over the cone shown in Fig. 3. If necessary, the valve seat and valve face can both be of brass or bronze without the necessity of casting the whole piece of this metal.

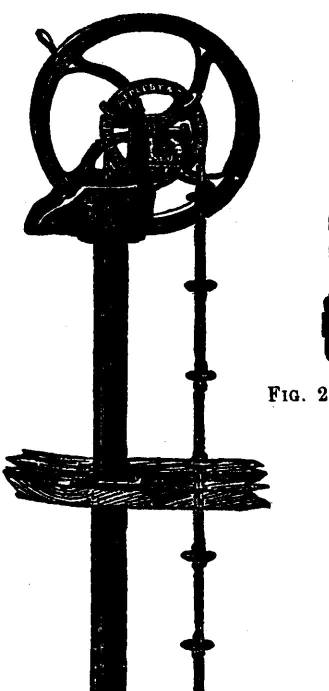


FIG. 1.

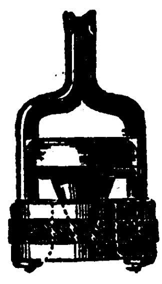


FIG. 2. FORM OF BUCKET.

FIG. 3. VALVE AND SEAT.

TECHNICAL NOTES.—Prof. O. N. Rood sustains the objection of Von Bezold against the designation as "indigo" of the *tint of the spectrum lying between blue and violet.* Prof. Rood considers that artificial "ultramarine" corresponds more nearly to the true tint of the spectrum at the point usually termed indigo, and he, therefore, proposes to substitute the term ultramarine in its place.——A French physicists suggests, as a *new lecture experiment,* the following: Quicksilver may be frozen very readily by placing a small quantity of it along with anhydrous ether in the caraffe used for freezing water with the Carré ice-machine.——A process lately patented in Germany for *utilizing waste rubber,* of which many hundred tons are yearly thrown away as useless, is described as follows: The rubber waste is subjected to distillation in an iron vessel over a free fire, with the aid of superheated steam. The lighter oils which come over first are separated from the heavier products. The latter, when thickened and vulcanized in the usual manner, are found to possess all the good qualities of fresh rubber.——Preparations have already been made to colonize the magnificent tract of country on the Fitzroy River, which has recently been discovered by Mr. Alexander Forrest and noticed in this department.——The latest advices inform us that the *St. Gothard Tunnel* will be ready for traffic by the end of September of the present year, and the entire system of which it is the centre, in the summer of 1882.——A regular item of the performance of a band of Zulus, now exhibiting in England, is the frequently-described and much-doubted savage method of producing *fire by the friction of wood.*——It is reported that the *iron piers* built last spring at Coney Island and Long Branch are proving that they are fully capable of withstanding the storms of winter that prevail along our coast. Their success, it is believed, will lead to the construction of similar works at many other points.——Dr. Kedzie, of the Michigan State Board of Health, in a recent address, remarked that *cotton clothing could be made practically uninflammable* by the simple addition of a teaspoonful of borax to each pint of starch, after the latter has been made ready for use. The suggestion, though not a novel one, is nevertheless very useful and valuable, and if it were practically acted on, would put an end to the many distressing accidents that occur through the taking fire of cotton clothing.——There is talk of a rebellion of the nickel-platers throughout the country against the United Nickel Company, which controls the Adams' patent, lately declared to be valid by the United States courts. The direct causes of the impending trouble are said to be—first, the exactions of the company in the matter of royalties; and second, the discovery of methods of nickel-plating with acid solutions, which Adams pronounced to be impossible, and which are, therefore, held to be infringement of the Adams' patent.——The new rules of the Patent-Office dispose of the vexed question of models in a manner that must be very satisfactory to the inventors of the country. Models are now only required when specially demanded by the Examiner.——The initial number of a new journal, called *The Sugar Beet,* devoted to the cultivation and utilization of the sugar beet, and, generally speaking, to the advocacy of the introduction of the beet-sugar industry in this country, has just appeared. It is published as a quarterly by Henry Carey Baird & Co., Philadelphia.——The *Chemiker Zeitung* warns its readers against a *spurious vermillion* now in the market, and which consists of red-lead, with a small percentage of eosine. It has a flaming red color, but the eosine may be extracted with alcohol leaving the red-lead behind.

CORKS are made both air-tight and water-tight by being plunged into melted paraffine and kept there for about five minutes. Thus prepared, they can easily be cut and bored, and may be inserted in or withdrawn from bottles with great facility.

PARAFFINE.

The most distinguished mechanics of the present day are in the habit of accumulating, in some convenient place, a great variety of chemicals and substances which are used in the arts or in chemical investigation, or by mechanics. Note is made of the properties and uses of these substances, and all are arranged so that they can be made available at a moment's notice. A man thus prepared with a well-filled laboratory is ready for any emergency which he may meet in the workshop. Although the tinsmith, plumber or ordinary mechanic cannot afford to stock laboratories, and would not find it profitable even though he might attempt to do so, he can have a few useful substances always within reach. Better yet, the mechanic may, with little expense, accumulate in a note or scrap book a great store of facts in regard to different substances which may be of use to him in the absence of a well-stocked laboratory.

Among the substances which should have a page to itself in the note book is paraffine. This is so useful and valuable, and at the same time so cheap, that a small supply may well be kept in the shop.

Its name is derived from the fact that it has little or no affinity for other substances, the term paraffine being composed of the Latin words *parum* (little) and *affinis* (affinity). The material was discovered in 1830 by a German chemist named Riechenbach. It was first obtained from beechwood tar, but the petroleum oils are now the common source of supply. It has also been obtained from the distillation of shale. It is a hard, white, waxy substance, without taste or smell. It is composed of hydrogen and carbon, in about the proportions of 85 carbon to 16 hydrogen. It is not decomposed by chlorine, strong acids or strong alkalies. The paraffine derived from wood tar melts at about 112° Fah.; that obtained from petroleum is harder or softer, according to circumstances. We have seen "soft paraffine wax" that would begin to show signs of melting at about 98 degrees, and other pieces that would stand, probably, 140° Fah.

Paraffine unites, by melting, with sulphur, phosphorus, wax and resin, and dissolves freely in hot olive oil, in turpentine, in cold essential oils and in ether. Alcohol, even when pure, acts but slightly on it. Chemically speaking, however, it forms no known compound. For a long time the substance seemed to have little value, but it has since been found that for the mechanic it has a great value. The paraffine candle gives the best of all flames for fine blow-pipe work. If it is desired to put a drop of solder in a place where no soldering copper can reach, the solder pellet may be placed in position cold, and a fine point of flame made to melt it just where it is wanted.

Every tinman knows how rapidly corks are destroyed in the bottle in which soldering fluid is kept, and what havoc acids and alkalies make with corks whenever they come in contact with them. Here paraffine comes to the assistance of the workman. By boiling corks in paraffine they not only go in and out of the bottles tightly and easily at the same time, but they resist the action of the acids better even than the more expensive rubber stoppers, and are much more convenient than glass stoppers. Aqua-ammonia is found in almost every house, and in the summer time is difficult to keep, even when glass-stoppered bottles are used. It will give little trouble when the glass stopper has a coating of paraffine, or if the paraffined cork is used.

Paper soaked in paraffine can be used for a great many purposes for which tinfoil is commonly employed. If the paper is to be put around eatables of any kind, it has the great advantage over tinfoil that it is perfectly harmless, while most of the tinfoil in the market contains a large proportion of lead, which makes it injurious if it comes in contact with many articles used for food. Many kinds of candy are now wrapped in paper coated with paraffine. Paper so treated is water-proof and impervious to the air. Plaster of Paris soaked in paraffine is a very different substance from the plaster as it comes from the mould. It is comparatively tough, can be chipped and carved or turned in the lathe, and a smooth, clean surface can be obtained upon it. It then resists water very well, and loses the chalky texture which characterizes it before it is so treated.

If doors, windows or the drawers of chests or boxes stick fast, there is nothing which will make them move so easily as rubbing the sticking parts with paraffine. If it can be melted on by passing a hot flat-iron over the surface to which it has been applied, so much the better. It will then soak into the wood, and, while rendering it smooth and diminishing the friction as though grease had been applied, there will not be the least danger of greasing clothes that may come in contact with it. A common paraffine candle is a convenient form, as it can be rubbed over the surfaces, and, if the weather is not too cold, enough will stick to make the window or stubborn door go smoothly, if it will go at all. We have found paraffine the best of lubricators for all sorts of wood surfaces.

A plastic, semi-transparent compound for making casts of small fancy articles may be made by using a compound of two parts unbaked gypsum (probably whiting, or even plaster of Paris, would answer as well), one part bleached beeswax and one part paraffine. This becomes plastic at about 120° Fah. By varying the proportions it could be made harder or softer, as may be desired.

Wood thoroughly filled with paraffine, put on hot, will resist water, and tanks could, we think, be made in this way which would be entirely water-proof and very durable. This does not appear to have had sufficient attention from those who build tanks for holding water.

As paraffine combines readily with many of the oils, and by their use can be softened, it is a very good substance from which to form etching grounds of various kinds for marking figures upon steel by the use of acid. A thin layer of the paraffine is put on, the figures or letters cleanly cut through the coating, and then the acid (nitric, in case of steel) is applied. Of course, a little ledge or dam of wax or paraffine is built up all around the place where the pattern is to be marked, in order to prevent the acid from flowing off. A thin coating of paraffine is an admirable protection for a tool or any article of steel or iron which it is desired to prevent from rusting. Owing to its softness, it will only answer for articles which are not to be used. The coating peels off readily. It is put on by warming the article till it will melt the paraffine, which is then rubbed upon the surface until the article is covered with a thin coat. Applied to a cloth of almost any kind, paraffine forms a water-proofing substance in the body of the fabric. Even a paper box may be made to hold water by thoroughly filling the paper with paraffine. The paraffine must be well soaked in, otherwise the paper may swell. To apply it, take a pretty warm flat-iron, not hot enough to scorch the paper, and rub a little of the paraffine on the bottom, and apply to the paper or pasteboard. Then, by keeping the iron well supplied, the paper is kept hot and the paraffine soaks in.

The iron rubs it in and spreads it over the surface at the same time. In this way the paper or board may be perfectly filled and made water-proof. Thick or porous paper or board needs a much greater quantity than that which is thin or more solid. Besides these uses, every one who uses it will find out a great many others for himself, applicable only in his own work, and which will be of great advantage.

EARTHQUAKES AND THE PLANETS.—Mr. J. Delauney has presented to the Paris Academy of Sciences, some new results obtained from a study of Perrey's tables of earthquakes from 1750 to 1842. He finds two groups of maxima, commencing in 1759 and 1756 respectively, each with a period of about 12 years; and two other groups, commencing in 1756 and 1773 respectively, with a period of about 28 years. He remarks that those of the first two groups coincide with the times when Jupiter reaches the mean longitude of 265° and 135°; while those of the last two coincide with the times when Saturn reaches the same longitudes; whence he infers that terrestrial earthquakes have a maximum when these planets are in the mean longitudes mentioned. Delauney attributes the increased number of earthquakes in winter, which Perrey has found to reach a maximum in November, to the passage of the earth at that time through swarms of meteors; and in like manner supposes the influence of Jupiter and Saturn to be due to their passing through meteor streams situated in mean longitudes 135° and 265°. As a consequence of this he ventures to predict an increased number of earthquakes in the years 1886, 1891, 1898, 1900, etc.

THE LARGEST OF LAND ANIMALS.—In the *American Journal of Science and Arts*, Prof. Marsh describes the largest land animal yet known to have existed on the globe. Its name is *Atlantosaurus immanis*. The thigh bone of this creature is over 8 feet long, with the thickness at the larger end of 25 inches, though the bone has no true head. A comparison of this bone with the femur of a crocodile would indicate that the fossil saurian, if of similar proportions, had a total length of 115 feet. That the reptile was 100 feet long when alive is at least probable. The other bones of this animal that have been found are proportionately gigantic; caudal vertebra has a transverse diameter of more than 16 inches. All the bones of this reptile yet discovered are in the Yale College museum. They are from the Upper Jurassic of Colorado.

Furniture.

EBONIZING FURNITURE.

We have received within the last few weeks a number of inquiries for *The American Cabinet-Maker*, in which was published an article on ebonizing furniture. Our issue of that date has been exhausted and we are, therefore, unable to comply with the wishes of our correspondents; but for the benefit of those who were thus disappointed we republish herewith a copy of the article.

Use the following stain: Boil ½ lb. chip logwood in two quarts of water, add 1 oz. of pearlash and apply it hot to the work with a brush. Then take ½ lb. of logwood, boil it as before in 2 quarts of water, and add ½ oz. of verdigris and ½ oz. of copperas; strain it off, put in ½ lb. of rusty steel filings; with this go over the work a second time. Stain the work with this stain, adding powdered nutgall to the logwood and copperas solution, dry, rub down well, oil, then use French polish made tolerably dark with indigo, or finely-powdered stone blue.

2. Hold an ordinary slate over gas, lamp or candle, until it is well smoked at the bottom, scrape a sufficient quantity into French polish, and well mix; then polish the article in the ordinary way. If there are any lumps gently rub them down and apply another coat.

3. Prepare a decoction of logwood by adding a small handful of chips to a pint of rain water. Allow this to simmer until reduced one fourth, and while the liquor is hot dress the work to be ebonized two or three times. To the remainder of the liquor add two bruised nut-galls, a few very rusty nails, bits of iron-hooping, or a piece of sulphate of iron the size of a walnut, and as much more rain water as will make about three-quarters of a pint of liquor. Apply this, which will be a black stain, hot as before, giving two coats, and when thoroughly dry, polish with ordinary French polish, to which sufficient powdered thumb-blue has been added to perceptibly color the polish. Use a glazed pipkin in which to prepare the stain. Take care that no oil or grease comes in contact with the brushes used or the surface of the wood until ready for polishing. Let each coat of stain dry before the next is added, and rub down with well-used, fine sandpaper. Sycamore, chestnut and plane tree are the best woods for ebonizing in the above manner.

4. Infuse gall-nuts in vinegar in which rusty nails have been soaked, rub the wood with the infusion, dry, polish, burnish.

5. Stain in the first place with a hot saturated solution of logwood, containing a little alum.

METEORIC IRON IN SNOW.—Observations of snow collected on mountain tops, and within the Arctic circle, far beyond the influence of factories and smoke, confirm the supposition that minute particles of iron float in the atmosphere, and in time fall to the earth. By some men of science these floating particles of iron are believed to bear some relation to the phenomena of the aurora. Gronemann, of Gottingen, for instance, holds that streams of the particles revolve around the sun, and that, when passing the earth, they are attracted to the poles, thence stretching forth as long filaments into space; but, as they travel with planetary velocity, they become ignited in the earth's atmosphere, and in this way produce the well-known luminous appearance characterizing auroral phenomena. Prof. Nordenskjold, who examined snow in the far north, beyond Spitzbergen, says that he found in it exceedingly minute particles of metallic iron, phosphorus and cobalt.

DRINKING BLOOD.—It is said that between 200 and 300 men and women of St. Louis drink daily from a half to a pint of blood piping hot from the veins of slaughtered cattle. More blood-drinking by consumptives and aged persons is done in September and October than during the remainder of the year. The blood of young steers is the best, and should be caught as it comes from the animal, and should be drunk while the foam is still on and the steam rising. Consumptives are advised, in addition to drinking the blood to sit in a slaughter-house for a couple of hours each day at killing time to inhale the "steam" of the running blood.

A CORRESPONDENT of the *Zeitg. f. Blechindustrie* states that alloys of seven to eight parts of lead and one part of zinc protect sheet iron better against rusting than pure tin or lead, and that the plate thus covered is more suitable for certain purposes than ordinary tin-plate. He adds that the addition of a little antimony increases its resistance to oxidizing influences.

Painter's Work.

SUPERIOR PASTE.—To make paste of a superior quality, that will not spoil when kept in a cool place for several months, it is necessary to add dissolved alum as a preservative. When a few quarts are required, dissolve a dessert-spoonful of alum in two quarts of tepid water. Put the water in a tin pail that will hold six or eight quarts, as the flour of which the paste is made will greatly expand while it is boiling. As soon as the tepid water has cooled, stir in good rye or wheat flour until the liquid has the consistency of cream. See that every lump of flour is crushed before placing the vessel over the fire. To prevent scorching the paste, place it over a dish-kettle or wash-boiler partly filled with water, and set the tin pail containing the material for the paste in the water, permitting the bottom to rest on a few large nails or pebbles, to prevent excessive heat. Now add a teaspoonful of powdered resin, and let it cook until the paste has become as thick as stiff gruel, when it will be ready for use. Keep it in a tight jar, and it will last for a long time. If too thick, add cold water, and stir it thoroughly. Such paste will hold almost as well as glue.

IMITATION STAINED GLASS—A NEW IDEA.—A few years ago stained glass windows were rare in this country, even in churches, except among the ambitious and costly of those of two denominations. Now ornamental windows are comparatively plenty, not only in churches, but in other public and private buildings, and would be more common in ordinary dwellings were the cost within the scope of ordinary purses. The growing taste for this sort of color decoration cannot fail to be materially advanced by the cheap and very successful imitation of stained glass effects now coming into use. Thin sheets of silk paper are printed with brilliant oil colors, in varied artistic patterns; and when pasted upon common glass windows they produce all the brilliant effects of costly colored glass. The color sheets can be applied without skilled labor, and show a great advance in decorative effects over ordinary curtain shades or blinds. The invention has been patented, and we predict for the product a large demand.

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.

TO CLEAN WALL PAPER.—Soiled wall paper may be made to look almost as well as new, in most cases, by the following expedient: Take about two quarts of wheat bran, tie it up in coarse flannel and rub it over the paper. It will clean the whole paper of almost all descriptions of dirt and spots better than any other means that can be used. Some use bread, but dry bran is better.

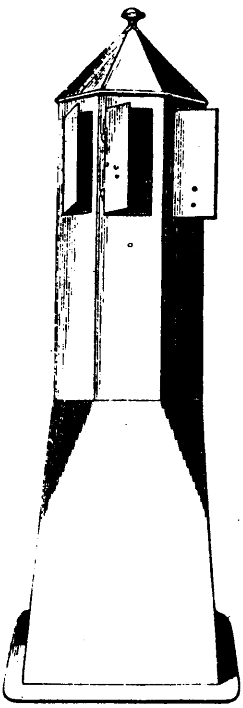
A WATER-PROOF CEMEMT is prepared by a German chemist as follows: Dissolve 5 to 10 parts pure dry gelatine in 100 parts water; then add 10 p.c. of a concentrated solution of bichromate of potash. Articles united with this glue are exposed to the light of the sun, when the bichromate becoming reduced, the gelatine film attains great strength and flexibility. Glass ornaments and utensils, when broken, are said to be readily mended by this cement.

DETECTION OF STARCH IN MILK.—The adulteration of milk by starch can be readily detected by the following method: Add a few drops acetic acid to a small quantity of the suspected milk; boil the milk, and after it has cooled filter the whey. If there is any starch in the milk, a single drop of iodine solution will give a blue tint to the whey. This process is so delicate that it will show the presence of a milligram of starch in a cubic centimeter of whey (1 grain of starch in 2·16 fluid ounces of whey).

CAUSE OF SNEEZING.—Sneezing is occasioned by a clogging up of the capillaries in the nasal membrane, and a partial obstruction of the nasal passages; in which case a sense of irritation is produced which results in sneezing. This is a sort of crisis which tends to restore the functions of the excretory vessels by relieving them of the congestion.

NEW SMOKE PREVENTER AND VENTILATOR.

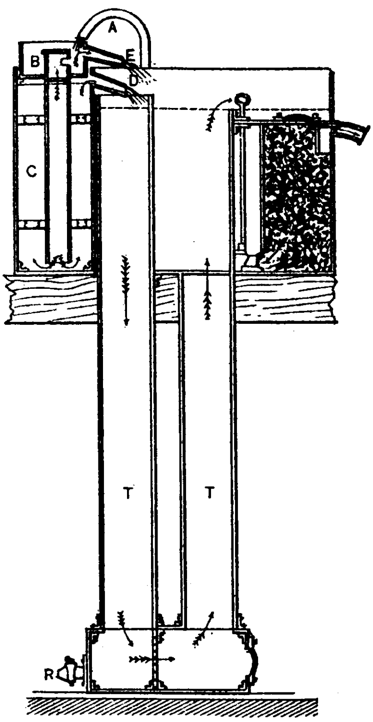
"The Puff" Smoke Preventer and Ventilator is a new patent contrivance in the form of a metal cowl, designed expressly for the cure of smoky chimneys and for the complete ventilation of rooms. It is brought out and manufactured by Messrs. John Badger & Co., of Stephenson Street, Birmingham; its action is without noise, and the chief characteristics is simplicity, efficiency, and economy. As will be seen from our engraving, the new patent smoke preventer is of sexagon shape, the principle of the invention being clearly indicated in the accompanying section. There are six little hinged doors in the upper part of the cowl, each door being connected with the one exactly opposite, by means of an iron



rod, so that which ever way the wind blows, it closes the doors on that side, and automatically opens those on the opposite side, thus giving free vent to either smoke or impure air. It is found that the puff from a hand bellows is sufficient to open and close the doors; and it necessarily follows that when the wind blows on the side to close doors A B C, it must open doors D E F. The action of the mechanism is uniform and satisfactory, and there is nothing about the contrivance to get out of order. Immediately below the hinged doors, in the interior, cross-bars are placed which prevent any damage being done to the cowl by sweeping, &c. The low price at which Messrs. Badger's new smoke preventer is put into the market goes far to recommend it.

DANCHELL'S FILTER.

A new filter is just announced in England, under the name of Danchell's, which, it would seem, is intended to act upon hard water and soften it, as well as to remove the impurities which it contains. To free the water from the organic impurities always contained in it, the animal charcoal is used in a powdered, instead of the granulated state in which it is generally made use of, the inventor having found (according to his own statements) that in this condition it is sixteen times more effective. This powder is not, however, used as a filtering, but only as a purifying medium, the filtering—that is, the removal of suspended matter, being a distinct operation. This powder is constantly moved by the entry of the water with which it is intimately mixed, and thus destroys so much more effectively some of the impurities contained in solution. The renewal of the powder

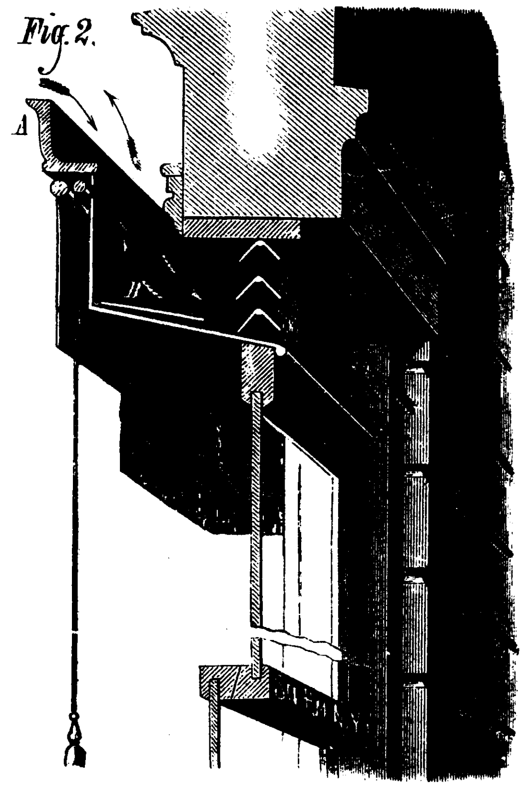


The Danchell Filter.—Vertical Section, showing the Construction.

is very simple, the spent powder being drawn off by a tap at the bottom of the apparatus, and fresh powder being supplied through a manhole at the top.

The filtering is performed by a series of diaphragms, each consisting of two discs, not joined, and formed of any convenient filtering material—such as calico, felt, or other fabrics. These discs are fixed into a central tube provided with holes, through which the liquid passes off, after having gone through the filtering cloths. In this respect it resembles the French filter. The pressure of the water, whatever it may be, can only press the two discs closely together, but cannot injure them, for as there is no solid substance under them, as in the cases where filtering cloths are fixed upon perforated plates, they give easily to any extra strain through their own elasticity. One important feature of the arrangement of this filter is the fact that the water descends in one part and ascends in another, after having deposited its impurities in the lowest level. When the water is very hard, it is softened by placing into this lower part a composition which reduces the carbonate of lime contained in it and causes it to deposit.

The illustration shows the general arrangement of this filter. The water is brought to it by a tap, A, and passes into a chamber, B, situated in the highest level. From this it flows by two channels, whose area can be regulated according to the hardness of the water. One of these streams goes down to the bottom of the vessel C, dissolves a part of the composition placed there, and passes out through the opening D. The other part flows through the opening E into the vertical tube T. A reaction is produced by the mixing of the two waters, and the precipitation of the carbonate of lime insures the latter falling to the bottom. The water then filters through this layer of chalk and rises in the tube T^1 up to the level of the charcoal box out of the apparatus. The inventor, who is from the continent, has but recently introduced the article into England. Owing to the bad quality of water upon the Continent of Europe, the subject of water filtration has received much more attention from inventors than in this country, which may almost be said to be the land of pure water.



A NEW VENTILATOR.

The accompanying engraving represents an automatic house ventilator recently patented in the United States and Canada by Mr. Walter S. Sayers, of Guelph, Ontario, Canada. This invention is intended to overcome in the simplest and most effective manner all the difficulties which have stood in the way of ventilating from the top of windows without draughts of air on the occupants of the apartment. This ventilator is independent of either sash, and does not interfere with lowering or raising them, it does away with the necessity of hanging them with weights for the purpose of ventilation, and does not in any way interfere with hanging the curtains in the usual way. The ventilator is completely hidden from view in the interior of the room by the curtains or lambrequins, and on the exterior of the building it presents the appearance of a neat Venetian blind above the sash, and is an embellishment rather than otherwise.

For windows in public buildings, offices, etc., where curtains are not used, the ventilator affords a good ground for stucco designs or other ornamental work. This ventilator admits pure air into the room without draughts; the air entering the room of the window is directed by the air duct toward the ceiling, where it is distributed, displacing the vitiated air, which escapes by the ventilator. It is entirely automatic and requires no attention; the wind on reaching a certain velocity, closes the pivotted guards, C, and prevents very strong currents of air from entering. The guards also exclude dust, and when the pressure of the wind diminishes the guard swings open automatically. If at any time it is desired to close the ventilator—and this will happen very seldom—it may be done by closing the valve, B, which is worked by a cord hanging down at the middle of the window. The valve opens by its own weight, when the cord is released. To prevent the entrance of flies and insects a netting is placed over the cornice board, A

This ventilator can be used in connection with Venetian blinds or winter sash, as it does not in any way interfere with them. The inventor informs us that he has had this ventilator in use in his own residence for the last eight months, giving the most complete satisfaction. He also states that it is endorsed in the highest terms by physicians who have seen it..—*Scientific American.*

Manganese Bronze.—To the brief notice—lately given in this department, concerning the various applications of this interesting class of alloys—we are able to add the following statements of the special mode of procedure followed in its production under the patents of Mr. Parsons; to wit: The method of manufacture consists in incorporating with any of the copper alloys, whether gun-metal bronze, or brass, a certain proportion of ferro-manganese, the percentage of the latter being varied according to the uses to which the product is intended and the qualities it is designed to possess. The whole procedure, it is affirmed, has been reduced to a system, the special grades of manganese bronze being produced with certainty, and on an extensive scale.

Great care is taken with the ferro-manganese, which is subjected to a special refining process, in order to eliminate its silicon, and at the same time, it is made into four grades, each having a different proportion of manganese and iron, and from each of these a special quality or grade of bronze is made.

The operation consists substantially in melting the forro-manganese in a separate crucible, and adding the same to the copper alloy, the latter also beiug maintained at a very high temperature, to insure that the proper combination shall take place. Immediately after the ferro-manganese is poured into the copper, a very similar phenomenon occurs to that which takes place when it is added to the decarbonized iron in the Bessemer converter; that is to say, the free metallic manganese, by reason of its strong affinity for oxygen, seizes upon and clears out from the copper any oxide that it may contain. The result of this action is to render the metal more dense and homogeneous. A portion only of the manganese is consumed in performing this duty, the rest combining with the copper to play afterwards an important part in imparting to the bronze alloys which result those qualities that render them of special value in the arts, and which it is affirmed, can now be controlled and regulated with the greatest nicety.

We shall not enter into special details of the several grades of these alloys that are now produced, further than to say that four grades of manganese bronze are made, each of which is characterized by well-defined qualities, which adapt it to special uses. For these we refer our readers to our previous brief notice of this interesting metallurgical product. London *Iron* is our authority for the facts contained in the foregoing.

THE VENTILATION OF SEWERS.

BY JOHN G. WINTON.

The furnace system for the ventilation of coal mines has now become obsolete. The plan was a sluggish one, depending on the rarefaction of the air in the furnace or upcast shaft, which was so arranged with those intricate passages in the depths of the earth, that, as the rarefied air ascended, another or downcast shaft supplied fresh air to the workings. The suction fan now takes the place of the furnace system. In some instances air is discharged and supplied by these fans at the rate of 100,000 cubic feet and upward per minute.

Suction fans have been condemned by some authorities as inapplicable for the ventilation of our main drainage systems. I think differently, that the main drainage systems of Great Britain have been constructed in ignorance as regards ventilation. Our forefathers, no doubt, did not experience the want of proper ventilation and dilution of sewer gas which now exists in densely-populated cities. Modern works have been constructed, ventilating shafts have been adopted, forming upcast and downcast, according to the locality; nature has been coaxed to abate these foul receptacles, the sluggish gases have been purified by the charcoal process, and the noxious vapors have been trapped from our dwellings; yet, with all these precautions, very little has been done to create an in-draught into our main sewers, dispersing the vapors from the subways far overhead.

In the first instance, I consider that the sewerage works of towns should be so planned that the low-lying districts are kept separate, as far as practicable, from those of the higher districts; that each district should have a separate sewer, carrying away the sewage and rainfall from that district alone; they should debouch into a main common to all, and should be arranged with large siphon bends, so that the sewer gas of one district may not flow into that of another district; thus I may be able to deal most effectually with the sewer gas. With such an arrangement, I propose drawing the gases out of each district, discharging them into the main common to all, and which eventually would be discharged at the outfall, or made to pass up a chimney, and be dispersed far overhead.

Secondly, that all the existing water-carriage plans for the removal of refuse are defective, in the absence of an abundant supply of flushing water directly applied to the main drainage system. I have advocated pumping up sea water for this purpose for sea-coast towns, and, indeed, for all towns where it could be cheaply and conveniently applied. I consider that, by the application of sea water, the refuse would be pickled, and would find its way seaward before decomposition took place and noxious gases were evolved. In all other towns the fresh-water supply should be sufficient to meet ordinary requirements, as likewise for periodical or continuous flushing. In the application I have simply considered it necessary to flush the house pipes; and when these tributaries are promptly flushed, the mains will likewise be so.

If it is once ceded that continuous flushing is needed for the present system, I consider that a separate system, independent of rainfall, is preferable for the removal of refuse and the effluent water from our dwellings. We should be able to dispense with gullies, and, as there would not be so many air-holes, the gases would be more effectually dealt with. However, there can be no objection to carry away the rainfall, discharging it into the large main already mentioned, which finally terminates at the outfall.

The small jets of water for flushing the pipes leading from the houses need not be more than half an inch in diameter; the water should be made to spread, striking against the side of the pipe, thus tending to prevent in draught, and placed in such a position as not to be affected with refuse. For the sake of illustration, 4,000 of these jets would represent an area of 784 square inches, or a diameter of nearly 31½ inches; so, with the water delivered under a moderate pressure, as from ordinary cisterns, these small tributaries would eventually create a great rush of flushing water in the mains, the delivery being carefully calculated to suit the requirements.

In some recent examples for the ventilation of sewers open gratings have been fitted in the middle of the roadways, in connection with shafts leading from the top of the main sewers. Many towns have such an arrangement. These, no doubt, allow the gases to flow out of the mains, more especially when the sewer gases are compressed by a sudden flow of water. In warm weather, with a minimum flow of water through the sewers, the gases rise very sluggishly, and we know the exhalations are very offensive. The "sun" is the furnace, as it were (as in the plan adopted by the early miner); and the sewers being of lower temperature than the atmosphere, the cold air in the sewers rises through the open gratings; hence the various systems for deodorizing the gases by the charcoal process. In the winter months our houses act as the furnaces, and as we try to make them as snug as possible, by reducing all in-draft through window fittings and doorways to the minimum, the open gratings, fitted to the main sewers, then act as feeders, sweeping a cold current of air through the sewers, which carries the foul gases along, and eventually rushes through faulty fittings into our comparatively warm dwellings. This must take place at all seasons of the year, and more especially during the night, when we cannot open our windows for ventilation, and when our rooms are at a higher temperature than the atmosphere. However, the more the sewers are properly aerated, reducing the indrafts into out dwellings, from these noxious receptacles at all seasons of the year, the more healthful will our habitations become. So I am forced to condemn the plain "Roman" system, and advocate the suction fan method adopted by the modern miner.

The furnace system, for promoting ventilation, we all know to be a very expensive plan, unless we can utilize, as in large manufacturing districts, the numerous furnaces under steam boilers. This plan has, no doubt, certain advantages in being able to deodorize the gases, by passing them through the furnace, and then up tall chimneys, where purified vapors would be wafted away into infinite space.

Next comes the suction fan, driven by the steam engine. Now we have a furnace, and at the same time we create a powerful current of air passing into and drawn out of the sewers, and then through the furnace and up the chimney to the clouds.

When fans propelled by wind we have a power uncertain and capricious. However, I consider Archimedean screw ventilators could be applied with a measure of success in many small villages where economy may be a desideratum. They are very sensitive; the least wind will cause them to revolve, and with such an apparatus placed on the top of a high chimney, the revolving wheel being 6 feet in diameter, we should have an engine of considerable power. These machines are fitted with spiral screw blades for creating an upward current. At times the action is feeble; the gases, however, would be kept in motion. In high winds the revolutions are considerable, and the gases would be screwed out of the sewers more rapidly, and instantly dispersed. Gas engines may be used for driving the fan, as some authorities may object to steam engines and smoke chimneys studded over large and fashionable localities; but when we consider that science has rendered these shafts smokeless, the engine becomes a matter of convenience, and a good gas engine of moderate power requires less skill on the part of the attendant.

Lastly, we have to consider the turbine or water engine for driving the fan. I have shown that, for the removal of refuse, more flushing water becomes imperative, and I propose to take advantage of the effluent water flowing from the turbine to effect a thorough cleansing of our underground netways. And, to satisfy the most fastidious, I propose drawing the gases through an enclosed bed of charcoal of sufficient capacity to suit the requirements.

I will now draw attention to these suction fans. A fan driven by an engine of 20-horse-power discharges 25,000 cubic feet per minute; the suction pipe being 30 inches in diameter, one mile of such pipe contains 25,872 cubic feet, or a little more than the above fan delivers per minute. The mileage per hour drawn through this 30-inch pipe will be 58, in round numbers, and in the 24 hours 1,392 miles of air are drawn through this pipe of 30 inches in diameter, while the total quantity of air expelled by the machine is 36,000,000 cubic feet in the 24 hours, or, in other words, 36,000,000 of cubic feet would be drawn out of a certain sewerage area, the pure air would instantly fill up the void, pouring into the sewers through existing apertures, or properly constructed inlets. To place these fans in immediate connection with the sewers is impracticable. As the numerous gully holes would act as feeders, and the exhaustive power, at a short distance, would become inoperative, we must lay down a system of piping, so that the sewers may be attacked, and the gases gently drawn over a large area. Were we to create a sudden rush of air at one part of the sewerage system, even although with no gully holes, we consider the water traps in the house arrangements would be unsealed, and, as we have already stated, the exhaustive power would be limited.

For the sake of illustration, I will take a straight length of piping commencing with 30 inches diameter at the fan. This line of piping should be graduated to a small diameter at the extreme end of say, one sixth of the area, or 12¼ inches diameter, the end of the pipe being fitted with a blind flange. This being the main suction pipe, branches are cast on at certain intervals and pipes fitted thereto in connection with the main sewer, or still smaller pipes in connection with each drain from the houses. These should be smallest nearest the fan, and varying in diameter to the extreme end of the main suction pipe. We consider that, by this arrangement of graduated main and feeders, the draft would be equalized throughout the entire length of pipe.

When it is desirable to lead a pipe from the main into each house drain, it must be placed between the sewer and the trap, fitted to the drain pipe. These feeders must be small in diameter, so that their combined area does not exceed the area of the suction pipe, as likewise to embrace as many house drains as practicable. For the sake of illustration, we will take all the feeders of a uniform diameter of ½-inch. The area of the 30 inches suction pipe is 706 square inches, and as the area of one-half an inch is .196, it will require 3,600 feeders to make up the area of the 30-inch suction pipe, or, in other words, 3,600 house drains will be in communication with the suction fan. As the fan discharges 25,000 cubic feet per minute, each feeder would be drawing from the sewers, say, 6,94 cubic feet per minute, or 416 cubic feet per hour. Thus it will be seen that the sewer air would be gently drawn out over the entire area to be ventilated.

We will now assume that a street contains 320 houses to the mile, the houses, of course, being on each side of the street. As there are 3,600 house drains to be ventilated, the total length of the street would be 11¼ miles. This shows the capability of a suction fan discharging 25,000 cubic feet of air per minute. We consider this arrangement of small feeders extends the area to be ventilated. Were the feeders 1 inch in diameter, more air would be drawn through each, but there would be only 900 house drains ventilated, and the mileage would be reduced in proportion. In another arrangement, larger feeders are fitted to the main suction pipe and placed in communication with the main sewers. These pipes would be placed further apart than the former arrangement, and graduated from a small diameter at the end nearest the fan, and increasing in diameter toward the extreme end, thereby tending to equalize the draft throughout the entire range of piping.

In some situations the main sewers may be of sufficient capacity so that the suction pipe could be hung from the roof. It should be pierced with holes at certain intervals, which would act as feeders, drawing off the gases immediately over the parts when generated, and we consider all new works should be so arranged when practicable.

In the meantime, we have to deal with existing arrangements. In some towns steam-power would be preferable for driving the fan, and in other towns water pressure may be adopted. In laying down this proposed pneumatic mode of ventilation, a central situation must be chosen. The area to be ventilated we will assume to be four square miles. A powerful suction fan must be erected centrally in that area and placed in connection with a circular suction box, from which the various suction pipes would diverge. These pipes would be arranged through the main streets and cross streets, in a similar arrangement as for the distribution of gas for lighting purposes and the feeders carried into the house drains, or in direct communication with the sewers in the same way as the small gas pipes are taken into our houses. The one system of piping is identical with that of the other; the gas from the gas works is delivered under pressure; the pneumatic method of ventilation supplies air to our sewerage systems by the exhaustion of a large volume of air drawn out of a system of piping, which, if properly arranged, cannot create negative pressure in the sewers, and which we consider would prove a great blessing to the community at large, by the thorough ventilation and purified dispersion of sewer gas carried up high chimneys, far overhead.

The Use of Copper by the Ancients.—Copper is widely spread over the face of the earth, and man, in all ages, has adapted it to his wants. It was one of the greatest articles of commerce with the Phœnicians, who derived a large supply from the mines of Nubia, that at one time supplied the whole of the known world, and combined with it the tin obtained from the islands of Great Britain. It was used by some of the northern nations of Europe in the fabrication of weapons, at a period and under circumstances when steel appears to have been more precious than gold. This has been illustrated in Denmark, by the opening of many Scandinavian tumuli of very remote ages, and from which have been collected specimens of knives, daggers, swords, and implements of industry which are preserved in the museum at Copenhagen. There are tools of various kinds, formed of flint, or other hard substance, in shape resembling our wedges, axes, chisels, hammers, and knives, the blades of which are of gold, while an edge of iron is attached for the purpose of cutting. Some of these tools are formed principally of copper, with edges of iron, and in many of these implements the profuse application of copper and gold, when contrasted with the parsimony evident in the expenditure of iron, seems to prove that at that unknown period, and among the unknown people who raised these tumuli, gold as well as copper were much more common products than iron

Putting up and Running Steam Pumps.—The Dean Pump Works, of Indianapolis, gives the following valuable hints on the management of steam pumps: Never use a smaller pipe on the suction than the list indicates. Avoid right angles in the pipe where it is possible. Where it is practicable, make bends with a large radius. Put a foot valve and strainer on the end of the suction pipe, Do not place the pump more than 29 feet from the water. Where hot water is pumped, the supply must be above the pump. Make all joints in the suction pipe tight. A small leak in the suction is very detrimental. Keep the stuffing boxes nicely packed. Oil the pump before starting it, and keep the oil wiped off where it is not needed. Some engineers seem to think that if their boilers are supplied with water, there is no need of looking after the pump or taking any care of it. A good pump is as worthy of being taken care of as a good engine, and we would suggest to all engineers and persons using or having charge of pumps, that they spend a few minutes every day in cleaning them up, removing all extra oil on them, wiping off the dust and dirt and seeing that they are in good condition and working well.

Cements for Iron Works.—It is sometimes advisable to fix two pieces of iron, as pipes for water or steam, firmly together, as a permanency. A rust cement is frequently used, and the materials are sal ammoniac, sulphur and iron borings. If the cement is desired to act quickly, the proportions should be: Sal ammoniac, 1 part by weight; sulphur, 2 parts; iron borings, 80 parts. If plenty of time can be allowed for setting, make the proportions: Sal ammoniac, 2 parts; sulphur, 1 part; iron borings, 200 parts. The sal ammoniac and sulphur should be pulverized, and the borings of iron tolerably fine and free from oil. The mixture should be made with water to a conveniently handled paste. The theory of its action is simply union by oxidation.

Black Enamel.—If wood is immersed in sulphuric acid it is dyed a jet black, and when dry can be polished by rubbing with a bone spatula; but what would best suit, I think, is the following: Grind up very finely some drop black in water, put the paste in a cup and mix it with a little size or very thin glue, brush the wood over with this, let it dry, sandpaper it and give it another coat, allowing it to dry well, and again apply some worn emery or sandpaper. If well covered you may now use French polish when you will have a brilliant black surface. If it is not a flat surface, brush over with a coat or two of polish varnish, made the same as French polish, only a little thicker.

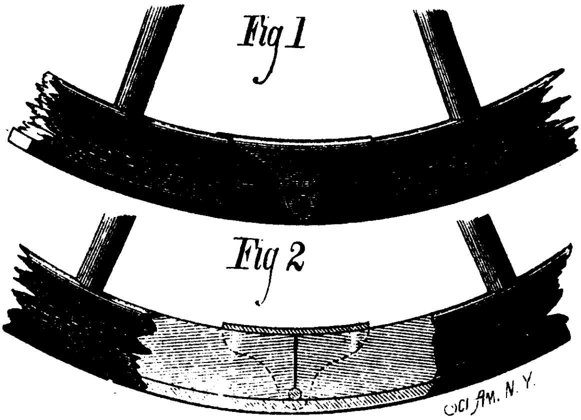
Tempering the Points of Tools.—After being tempered the volume of the tool is slightly increased, and consequently its specific gravity is decreased. As the expansion or increase of volume is so very slight, it is quite immaterial which is plunged into the liquid first; however, every moment the edge is kept out it is cooling, and the tempering may be rendered defective thereby. Mercury tempers the hardest, then water, then salt and water, then oil of various kinds—as whale oil. As oil cools the metal more slowly, it is not tempered so hard, but the tenacity is increased.

Warts.—If they give you no special inconvenience, let them alone. But if it is of essential importance to get rid of them, purchase half an ounce of muriatic acid, put it in a broad-bottomed vial, so that it will not easily turn over; take a stick as large as a knitting-needle, dip it into the acid, and touch the top of the wart with whatever of the acid adheres to the stick, rub the acid into the top of the wart, without allowing the acid to touch the well skin. Do this night and morning, and a safe, painless and effectual cure is the result.

Pretty Experiment.—If seeds (barley, corn, etc.,) be placed between moist pieces of litmus paper, the roots stick to the paper, and color it so intensely red that even on the back of the paper their course can be traced in red lines on a blue ground. If tincture of litmus be repeatedly added the intensity of the red color is increased.

IMPROVED FELLY PLATE.

The annexed engraving shows an improved attachment for vehicle wheels, which is intended to strengthen the felly joints and at the same time keep the tires in place on the wheels. The device is exceedingly simple, being nothing more than a curved plate fitted to the rounded portion of the felly over the joint and held in place by a single bolt passing through the joint near the tire. The extreme ends of the plate project over the edges of the tire and prevent it from running off should the wheel shrink.



THE TAY BRIDGE ENQUIRY.

On reading the evidence given before the Court of Enquiry on the Tay Bridge disaster, it is difficult to say whether the result is more painful and humiliating to those concerned in the designing and building of that ill-fated structure or to the public. We have ever been justly proud of the excellence of the designs of our engineers, and not less so of the stability of the work of our leading contractors. No Englishman could look upon the achievements of our Brunels and Stephensons, nor at the handiwork of our Petos and Brasseys, without a feeling of exultation; but, after reading the evidence as to the design and workmanship of this unfortunate bridge, our pride receives a fall, and we feel as though we must write up Ichabod.

It would be out of place for us to attempt to attach or apportion any blame to any one, but we can at least say that such evidence as has been sworn before the Court ought not to have been possible in connection with any English engineering work. To hear of columns cracked and stopped up with beaumontague, of missing lugs burnt on, of metal so full of cinder that it seemed on stirring it as though it would all turn to scum and dross, of scabbed castings, of bolts and rivets without heads, or even missing altogether; these are not the things we either expect or can tolerate in English work.

As we have before said, it is not for us to attach blame to any one; but we shall not be going beyond just criticism in saying that there must have been something radically wrong somewhere, and that the Court of Enquiry ought not to hesitate in sifting the matter to the bottom. It is for them to judge of the value of the evidence adduced, and form their opinion thereon. We hope they will allow no consideration of feeling or pity to stand in the way, but will mete out such judgment as the case deserves. To do otherwise would be to leave the public to have no faith in other works which may be all that the Tay Bridge ought to have been and was not.

While on this subject, we may observe that there seems to be manifold evils and dangers about the whole modern system of contracts. Contracts are too frequently let at a price less than the honest value of the work if properly executed. Under such a system, sound, honest work becomes almost impossible to obtain; the contractor cannot do his duty except at ruinous loss to himself. Such a system is vicious at bottom, and the sooner it is changed the better for engineers, contractors and the public.

STRUCTURAL CHANGES IN WROUGHT IRON—BRIDGE ACCIDENTS.

A correspondent of the *Railway Age* writes, in regard to a change in the tensile strength of iron as follows: I have collected and sent to you some iron bolts, links, etc., that have been in use a long time (I wish I knew how long); they are broken short off and exhibit in the fracture all the appearance of cast iron, showing that even the very best wrought iron, such as is selected for links and link-pins, undergoes a radical change in structure by long usage in a continuous state of vibration, which seems to be violent enough to rupture the fibres of the iron and to totally destroy their continuity. Now I have reason to believe as the result of observation, that the metal of an iron bridge is subjected to a continual and almost uninterrupted succession of concussions while in a state of extreme tension, precisely similar in effect to those sustained by a link which connects a long freight train with the engine. Lateral jerks, without tension, seem to produce the same effect upon the large vertical bolts which connect the body of the car with the truck.

When you look at these specimens you will think I have some cast-iron bolts made and boxed them up for you, for I believe they can all be broken short off with a sledge. One of them I saw broken myself, opposite the depot with a sledge to detach it from the draw head. It was intended only to loosen the bolt, but it broke like a pipe stem. This bolt or pin of iron from appearances, has been in constant use for 10 years.

It is a singular fact that in the conclusion reached by committees of investigation of bridge accidents, no thought of a possible deterioration in *the tensile strength of the iron*, ever enters their minds. The verdict is, universally, that the plan of the bridge was perfect, and the cause of its fall involved in mystery. They never seem to suspect that the bridge fell because it was too weak to stand, although it would appear to be a palpable fact. How strange that it never occurs to them that, however strong the bridge was originally, so strong as to bear twice the weight that broke it down, its strength must have been impaired or it would never have failed to sustain the usual weight.

It will be acknowledged before long that all iron truss framed bridges are every year impaired in tensile strength, and that their sudden fall is inevitable, especially with the heavy loaded cars now in use.

Damp Rooms, Damp Beds, Etc.—Damp rooms, as those in brick houses—in which the plastering is placed directly on the walls—are the fruitful sources of many of the acute or inflammatory diseases of our changeable climate. Rooms, also, seldom or never properly ventilated or sunned, in damp localities, with houses, the celler of which is wet for any considerable part of the time, are absolutely unfit for human residences. No families can occupy such houses, living on the north side, and ordinarily escape the rheumatism and kindred diseases. It is but little less than suicide to be subjected to such continued dampness. Of course the bedding of such rooms must be not only damp, but to a certain extent mouldy, or have a musty odour—almost certain to produce colds and diseases, especially when the "spare bed" is used by those who are so unfortunate as to visit such houses. Such beds are unsafe, occupied only occasionally, even after having been throughly aired and supplied with fresh and dry blankets. If such localities must be occupied, it is judicious to use bedding that will absorb as little as possible of dampness and foulness—the mattress is superior in this regard to feather-beds—while almost daily airing becomes needful. Dark closets, closed trunks, bandboxes and the like, containing clothing, need often to be aired, allowing sunlight, the prince of purifiers, free access. Some free absorbent of moisture, freshly slaked lime, salt and ashes, and the like, will absorb this moisture, which may be promptly removed, at least arrying off much of the dampness. These absorb more readily cnd more freely than the clothes do, and will obviate a part of the evils of damp houses, and yet nothing can be an adequate stubstitute for the light of the sun—not even a warm fire in the room.

The First Sign of Consuмption.—It is not as extensively known as it ought to be, that, in the large majority of cases, consumption begins with a slight cough in the morning on getting up. After a while it is perceived at night on going to bed; next there is an occasional "coughing spell" some time during the night; by this time there is a difficulty of breathing on any slightly unusual exercise or in ascending a hill.

HOW TO TURN A BALL.

By A. Forrest, in the *American Machinist.*

The turning of a perfectly spherical form in a common hand-lathe, is a feat that few have accomplished who have tried it. Approximate accuracy may be attained by almost any hand-lathe workman. By means of the accompanying diagrams, I will explain a method by which balls of wood, bone, ivory, brass, and other material admitting of hand-tool work, may be readily formed with perfect accuracy.

Fig. 1 shows spindle of common lathe, with cone pulley, face-plate, and back-centre, with piece in place to undergo the first operation. The first process consists in blocking out the material to be used into "blanks," as nearly spherical as possible by the eye alone. When the planks are prepared, a block of some firm, hard wood is fastened on the face-plate and formed into a concave chuck. The convexity of the chuck must have a radius considerably less than the ball to be turned, as shown. When the chuck is truly and accurately formed, the "blank" is placed in it, in position shown in Fig. 1, and the back-centre is brought against it, by which it is forced to a holding position in the chuck; a small metal disc (*a*) being placed between the "blank" and point of back centre. Next turn a groove around the centre of the "blank," defining the desired diameter of the finished sphere, and, with a pencil, make a line in the centre of the

FIG. 1

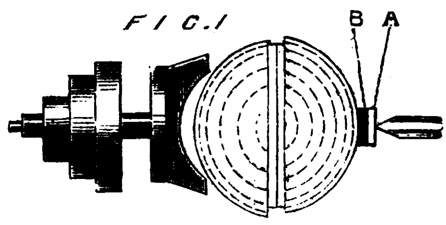
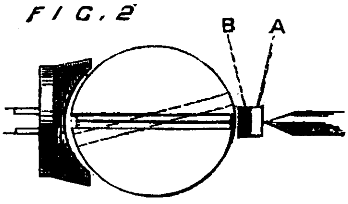


FIG. 2



groove. When this is done, and the "blank" is turned into position, shown in Fig. 2, the pencil line becomes a guide by which to produce the spherical form by means of the tool. The surface may be taken off, to the line, on such portion of the blank as is not embraced in the chuck, and covered by the metal disc *a*; the blank is then reversed or changed ends with, and the other portion turned off to the line. When this is done, only the two ends before covered by the discs will be left. These are readily turned off by placing the ball back to its first position, as in Fig 1.

If great accuracy is required, the ball should be first formed by the method described, a trifle larger than the finished ball is to be, and the process repeated, which will produce a form sufficiently accurate for a billiard-ball; provided care is taken to *true* up the chuck where it bears on the surface of the work, which may be done in a moment by a light handling of the tool.

It would seem as though this method of turning balls would be successfully practical, yet trial will prove how, that so far as described it is impractical, from this fact: In the very best make of hand-lathes, it will be found that the *true axis* of the spindle produced will fall below, above, or to one side of the point of back-centre, which, if the point is held by back-centre will cause the grip of the chuck to be relieved first on one side, and then on the other.

PUBLIC APATHY ABOUT HYGIENE.

Nothing is more discouraging to the benevolent physician than the apathy of the mass of people on these matters. Said a professor, while examining for his degree a student who showed lack of mental activity and great indifference:—"I can stand your ignorance, but not your stupidity." One of the most eminent physicians in a neighbouring State, during an epidemic of typhoid, carefully pointed out to the families he attended while sick the cause of their disease, and yet the great majority neglected to lift a finger to remove the cause, and would even try to deny the most obvious facts. Coming to treat a fatal case of typhoid, a physician went to the pump, examined the water, observed a putrescent odour therein; the well was examined, and a pailful of decayed earth worms was found to be the infecting cause which sent a vigorous young man to his premature grave. On the hills of Berkshire, in one of the most airy and apparently healthy localities, a family was suddenly prostrated with typhoid. Neighbours and friends that came to aid were suddenly seized by exposure, and the pest spread throughout the town. The cause was found in infected water. A family on State street in this city suddenly were infected, and no cause could be assigned until inspection of the well found a quantity of bones with portions of decayed tissues thereon, which children had thrown in while at play.

In the hill towns and rural districts generally typhoid and diphtheria prevail, as well as in the crowded city. The cause is always to be looked for in the careless sanitary habits of the people. The want of cleanliness and ventilation in the cellars, the decaying potatoes, apples and cabbages, old rotten cider barrels and soap and grease tubs, piles of filthy dirt—rags mingled with ashes on which rats and cats have nightly battles, the damp air, and oftentimes collections of water, and a temperature favorable to decomposition—all these are conditions prolific in the formation of infecting poisons, and for increasing the incomes of physicians. "I will not give you," said an applicant for vaccination, "a dollar for that service; it is not worth it!" "Then," replied the doctor, "you will give me fifty for attendance on you for small-pox." Soon after the doctor, indeed, received within one dollar and a half of that amount from the executor of a fool who died according to his folly. Prevention is cheaper as well as better than cure—or death. The medical profession receive more compensation for treating diseases than for their services in prevention. Let the public invert the order, co-operate with them in enforcing sanitary regulations, and public health and longevity will be better secured.—*Springfield Republican.*

Mr. Rawlinson, the chief engineering inspector of the Local Government Board of England, has recently published a series of ten sheets of detailed drawings, which are intended to aid local surveyors in preparing plans and specifications for sewerage and water supply.

Under the Public Health Acts of England, a city can borrow money from the Government, for the purpose of constructing drainage, sewerage, or water supply works, provided the plans are approved by the Local Government Board. It is evident that the sheets of drawings above referred to must be of great practical value to those who prepare the plans which are to be submitted for criticism. Upon the plans *The Building News* remarks:—"Engineering in many of its branches is beginning to become an exact science. No engineer can now question or theorize about the right forms and sizes for sewers, nor the sections of man-holes or flushing chambers. Gradients and out-falls are pretty much the only varying factors, but these admit of only one or two forms, so that the science of sewering can now be reduced to a few easily understood rules."

We are by no means satisfied that "the science of sewering" has become so well settled and unquestionable as this extract would imply, and especially when the proper size of sewers is in question, but there can be no doubt of the interest and value of these drawings of Mr, Rawlinson, who has had more experience in such work than any engineer, living or dead, and we are doing our own engineers a service by calling their attention to these plans. The sheets can be obtained at 2*s*. each, from Harrison & Sons, Pall Mall, or Knight & Co., Fleet street, London.

A File of Novel Construction.—Mr. J. Kirkwood, of Edinburgh, Scotland, has recently invented a new file for soft metals and wood. It is formed of about two hundred separate pieces of steel, connected by an iron bar, which is passed through and binds them together with a screw. The advantage claimed for the file is that filings of soft metals or wood can be got rid of by simply loosening the screw, and thereby separating the plates, this being done with very little delay or inconvenience. Each file will, it is said, last three years, outwearing 30 dozen ordinary files. The cost of the latter would be £36 ($180), and the saving that would be effected by using the new file would be £32 ($160). Mr. Kirkwood's file is said to be capable of performing quicker and better work than the cut files in ordinary use.

"BLUE PROCESS" OF COPYING DRAWINGS.

From X B., *Matteawan, N. Y.*—Can you give me any information about transferring by the "blue process?" That is, by the employment of citrate of iron and red prussiate of potash. I cannot get the blue ground dark enough.

Answer.—The "blue process" for copying may not be familiar to many of our readers, but as it may be useful to some of them, and a matter of interest to many more who may have wondered at the strange drawings in white lines on a blue ground which they have sometimes seen in shops, we will describe the process at length. The operation is really a kind of photographing. The materials used turn blue if they are washed in clear water after they have been exposed to the action of the light. From our correspondent's description of his trouble it would seem that the exposure was not sufficiently long, or the light was not bright enough.

The following directions in a paper by Mr. P. Barnes, read before the Institute of Mining Engineers, at Philadelphia, in 1876, may be found of use, especially those portions relative to the time necessary for exposure to the light.

It may be of interest, and perhaps of importance, to the members of the Institute that specific mention should be made in detail of the great value of this method of copying or photographing all kinds of tracings.

Several samples are laid upon the table, which may serve as illustrations of the results obtained. Some of these show slight imperfections, depending upon the character of the tracing and upon the length of the exposure to the light, but it may be clearly seen that even a faint copy would be quite available for actual use.

The process is believed to be of French origin, and has been used for many years. Special attention seems to have been directed to it recently, and its great value to engineers appears likely to be fully recognized. The manipulations required are of the simplest possible kind, and are entirely within the skill and comprehension of any office boy who can be trusted to copy a letter in an ordinary press. These particulars may be summarized somewhat thus:

1. Provide a flat board as large as the tracing which is to be copied.
2. Lay on this board two or three thicknesses of common blanket or its equivalent, to give a slightly yielding backing for the paper.
3. Lay on the blanket the prepared paper, with the sensitive side uppermost.
4. Lay on this paper the tracing, smoothing it out as perfectly as possible, so as to insure a perfect contact with the paper.
5. Lay on the tracing a plate of clear glass, which should be heavy enough to press the tracings close down upon the paper. Ordinary plate glass of three-eighth-inch thickness is quite sufficient.
6. Expose the whole to a clear sunlight by pushing it out on a shelf from an ordinary window, or in any other convenient way, for 6 to 10 minutes. If a clear skylight can only be had, the exposure must be continued for 30 to 45 minutes, and under a cloudy sky 60 to 90 may be needed.
7. Remove the prepared paper and wash it freely for one or two minutes in clean water, and hang it up by one corner to dry.

Any good hard paper may be employed (from even a leaf from a press copy book up to Bristol board) which will bear the necessary wetting.

For the sensitizing solution take 1⅞ ounces of citrate of iron and ammonia and 8 ounces of clean water; and also 1¼ ounces of red prussiate of potash and 8 ounces of clean water; dissolve these separately and mix them, keeping the solution in a yellow glass bottle, or carefully protected from the light. The paper may be very conveniently coated with a sponge 4 inches in diameter, with one flat side.

The paper may be gone over once with the sponge quite moist with the solution and a second time with the sponge squeezed very dry. The sheet should then be laid away to dry in a dark place, as in a drawer, and must be shielded from the light until it is to be used. When dry, the paper is of a full yellow and bronze color. After the exposure to the light the surface becomes a darker bronze and the lines of the tracings appear as still darker on the surface. Upon washing the paper the characteristic blue tint appears with the lines of the tracing in vivid contrast.

It will readily be seen that the process is strictly photographic in the ordinary sense of the word, the tracing taking the place in the printing of the ordinary glass negative. A working drawing thus made furnishes its own background, and does not require to be placed over a white background, as is often the case with a tracing. If desired, the copy can be made upon common bond paper, which can be mounted upon a board in the usual way. Inasmuch as such copies can be made from tracings only, it may be well to suggest and urge that drawings can be completed, or nearly so, in pencil upon paper in the usual way, and that all the inking can be done upon tracing cloth laid upon the pencil work. In this way the cost of the tracing (in the ordinary sense) can be wholly saved, and the single copy of the finished tracing can thus be made in the "blue way" to the best possible advantage.

It may safely be said that this method of copying can be employed, if only one or two copies per week are needed of ordinarily complex drawings, with excellent results, and with a very important saving of time and money.

WEIGHING AN ELEPHANT WITHOUT SCALES.

An Indian writer relates an interesting anecdote concerning Shajee, the father of the first ruling prince of the Mahrattas of Hindostan, who lived at about the beginning of the seventeenth century. On one occasion a certain high official made a vow that he would distribute to the poor the weight of his own elephant in silver money; but the great difficulty that at first presented itself was the mode of ascertaining what this weight really was; and all the learned and clever men of the court seem to have endeavored in vain to construct a machine of sufficient power to weigh the elephant. At length, continues *Little Folks*, it is said that Shajee came forward, and suggested a plan, which was simple, and yet ingenious in the highest degree. He caused the unwieldy animal to be conducted along a stage, specially made for the purpose by the water-side, into a flat-bottomed boat; and then, having marked on the boat the height to which the water reached after the elephant had weighed it down, the latter was taken out, and stones substituted in sufficient quantity to load the boat to the same line. The stones were then taken to the scales, and thus, to the amazement of the court, was ascertained the true weight of the elephant.

THE USES OF LEMONS.—Lemons are easily raised in the South, and if they possess half the virtues ascribed to them, no one should fail to plant a few trees wherever they will grow. An exchange says: "Lemon juice is the best antiscorbutic remedy known. It not only cures the disease but it prevents it. Sailors make a daily use of it for this purpose. A physician suggests rubbing of the gums daily with lemon juice to keep them in health. The hands and nails are also kept clean, white, soft and supple by the daily use of lemon instead of soap. It also prevents chillblains. Lemon is used in intermittent fevers mixed with strong, hot black tea or coffee, without sugar. Neuralgia may be cured by rubbing the part affected with a lemon. It is valuable also to cure warts, and to destroy dandruff on the head, by rubbing the roots with it. In fact, its uses are manifold, and the more we employ it externally the better we shall find ourselves. Natural remedies are the best, and nature is our best doctor, if we would only listen to it. Decidedly rub your hands, head and gums with it, and drink lemonade in preference to all other liquors." Lemon juice is also said to be an antidote for snake poison by pressing the juice into the bite and by eating the lemons. Many testify to the beneficial effects of lemons in pulmonary diseases, and consumptives have been cured by eating them freely every day. They will give immediate relief to the most troublesome corns and cure them if their use is persevered in. Hot lemonade is the pleasantest remedy known for colds, and lemon pie for hunger.

WOODWORK BURNED BY STEAM.—The *American Manufacturer* says: "At the Crescent Steel Works, in this city, a steam pipe 2½ inches in diameter, carrying from 90 to 100 pounds pressure, was laid under ground about three years ago, encased in common pine boards about one inch thick. A few days since occasion was had to dig up the pipe, and the whole length of the wooden drain was found to be charred and apparently burnt about three-fourths of the thickness of the wood, the other portion being partially rotted. The whole inside of the drain was turned to charcoal, with here and there spots of white ashes, showing that ignition had actually taken place. It seems probable that if the casing had not been excluded from the air by the earth covering it, it would have blazed and been entirely consumed. It is generally believed that a steam pipe cannot set fire to wood, but this case seems to prove the contrary, and it may explain the origin of so many mysterious fires."

EYE-SIGHT.

Milton's blindness was the result of overwork and dyspepsia.

One of the most eminent American divines having, for some time, been compelled to forego the pleasure of reading, has spent thousands of dollars in value, and lost years of time, in consequence of getting up several hours before day, and studying by artificial light. His eyes never got well.

Multitudes of men or women have made their eyes weak for life by the too free use of the eye-sight, reading small print and doing fine sewing. In view of these things, it is well to observe the following rules in the use of the eyes:

Avoid all sudden changes between light and darkness.

Never begin to read, or write, or sew for several minutes after coming from darkness to a bright light.

Never read by twilight, or moonlight, or on a very cloudy day.

Never read or sew directly in front of the light, or window or door.

It is best to have the light fall from above, obliquely over the left shoulder.

Never sleep so that, on the first waking, the eyes shall open on the light of a window.

Too much light creates a glare, and pains and confuses the sight. The moment you are sensible of an effort to distinguish, that moment cease, and take a walk or ride.

As the sky is blue and the earth green, it would seem that the ceiling should be a bluish tinge, and the carpet green, and the walls of some mellow tint.

The moment you are prompted to rub the eyes that moment cease using them.

If the eyelids are glued together on waking up, do not forcibly open them, but apply the saliva with the finger—it is the speediest dilutent in the world—then wash your face and eyes in warm water.—*Exchange.*

A Specific for the Whooping Cough.—It has long been known that exposure to the perfumes of a gas-house produces a speedy relief to persons with the whooping cough; but how or why such a result is brought about has not been shown until of late. In explanation we give the following paragraph, which we clip from the columns of a cotemporary: "A sure cure." This is the language used by George Shepard Page, of Stanley, New-Jersey—not by way of professional advertisement, but simply as an item of information to the people—in reference to that distressing disease, the whooping cough. It is only a short time since the cause of the complaint was discovered. The eminent microscopists, Henry Mott, Ph. D., and Edward Curtis, M. D., find that its seat is at the root of the tongue, where countless bacteria are generated, which produce spasms. Here is what Mr. Page tells us about his sure cure: A scientist in Providence, R. I., examined the liquid hydro-carbon deposited in the bottom of the purifying boxes, used at gas works, and separated cresolene (C6 H5 CH30)—a substance analogous to phenol. He vaporized the cresolene in a closed room, in which there was a patient suffering from whooping cough. Recovery was effected in two days. Many other trials have been made, and with nearly unvarying success. No cough or unpleasant symptoms remain. The patients are restored to perfect health. Eminent physicians have pronounced this discovery of equal importance with that of quinine. If this suggested remedy for whooping cough is found to be effective, Mr. Page will be entitled to the thanks of the public for making it known.

Liquid Glue.—You cannot use mucilage as glue, because it is not glue and does not possess the sticking qualities of good glue. It is made of starch, dextrin, or gum arabic, with some acetic acid, or some equally preservative substance in it to make it keep. If good, it will stick on glass; but to make labels stick on tin cans or on metal, you must mix a few drops of nitric acid with the mucilage just before you are about to use it, otherwise it will come off; this acid on the metal and destroys the polish, which prevents the sticking. It is the same with varnished objects; in order to make labels stick where they have a tendency to come off, mix a little alcohol with the mucilage. This partially dissolves some of the varnish, takes the gloss away under the label, and causes adhesion. Or you can rub the varnish with a little alcohol at the place where the label is to be put on; or you may stick the label on with varnish instead of mucilage. Same kinds of varnishes are good for this purpose; others not. In order to make a better sticking mucilage, you must not use starch or gum at all, but the best quality of glue. Soak it over night in plenty of water, in the morning pour the excess of water off, and put on a gentle fire, so as to melt the glue in the water it has absorbed during the night; but thin it with strong vinegar, or with acetic acid when you want it thick, and you will have a mucilage with which you can glue wood together, but you must not expect that it will be as strong as if you had used hot glue, as cabinetmakers always do.

Vermin Riddance.—Half an ounce of soap boiled in a pint of water and put on with a brush while boiling hot, infallably destroys the bugs and their eggs. Flies are driven out of a room by hanging up a bunch of the Plantain, or Fleawort plant, after it has been dipped in milk. Rats and mice speedily disappear by mixing equal quantities of strong cheese and powdered squills; they devour this mixture with great greediness, while it is innocuous to man. When it is remembered how many persons have lost their lives by swallowing, in mixtake, mixtures of strychnine, ratsbane, corrosive sublimate, which are commonly employed for this purpose, it becomes a mitter of humanity to publish these items. House ants ravenously devour the kernels of walnuts and shellbarks or hickory nuts. Crack some of these and place them on a plate near the infested places, and when the plate is full of the ants, throw the contents in the fire. Cockroaches, as well as ants are driven away by strewing elderberry leaves on the shelves and other places frequented by these troublesome insects.

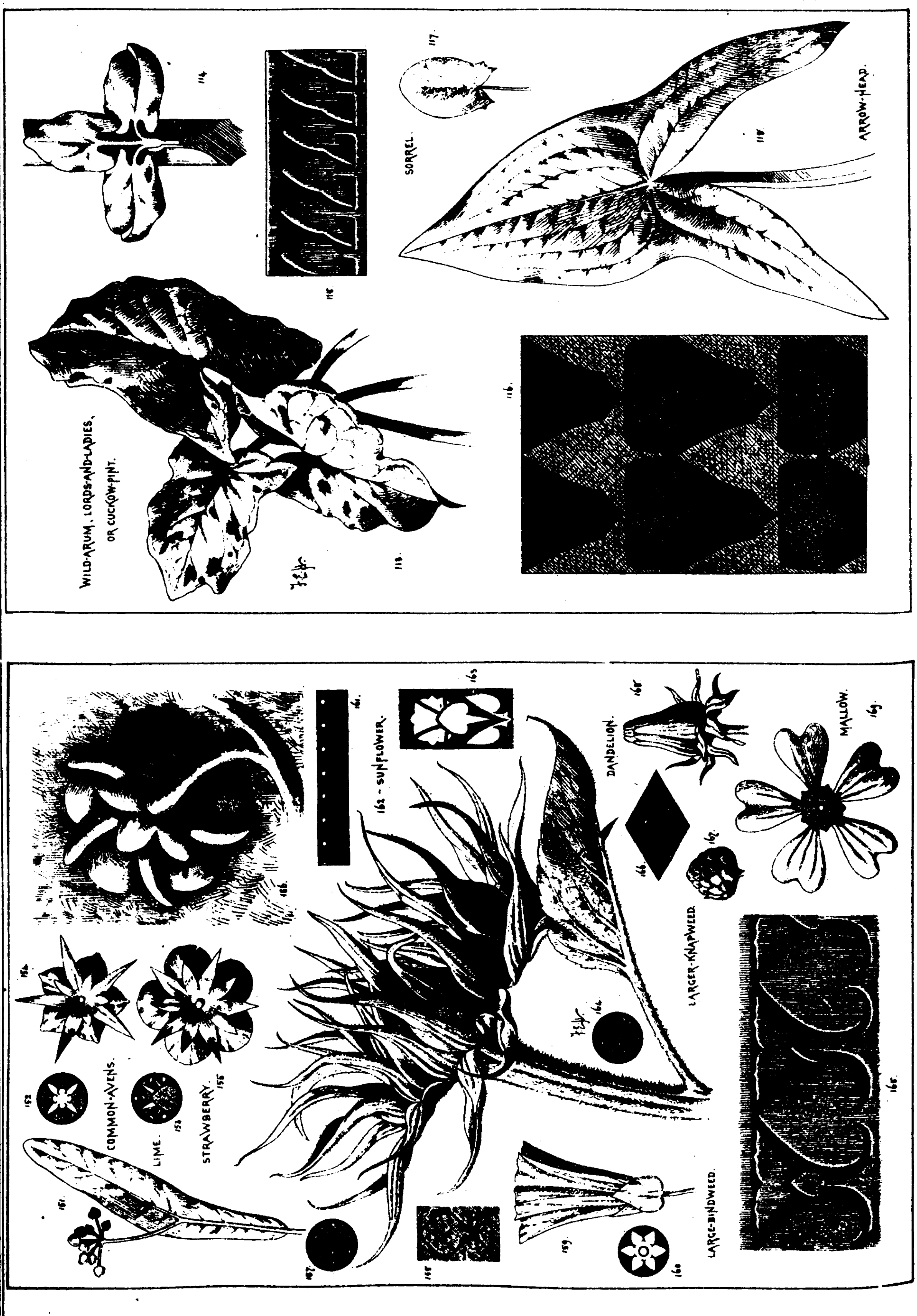
General Antidotes.—The best remedy, no matter what the poison may be, is to take a teaspoonful of mustard and a teaspoonful of common salt, mix them with a teacupful of water, warm or cold, and let the patient drink it down at once. It will immediately cause vomiting, and all that there is in the stomach will be ejected. As soon as the stomach is quiet, give the patient the white of a raw egg, to neutralize what may have passed further down than the stomach; after that give strong coffee by the teaspoonful. Both the white of an egg and coffee are antidotes for many poisons. When a person has overloaded the stomach by eating indigestible food or food not suited to his stomach, or having a good stomach, has overloaded it with excessive eating or drinking, and feels very ill in consequence, the salt and mustard will also give immediate relief by causing the superfluous material to be thrown out.

Leather from Sheep's Stomachs.—An American inventor has devised a new mode of utilizing a waste material of which a plentiful supply exists everywhere, but of which Australia produces perhaps a larger proportion than any other country. He has succeeded in making a very good, light, fine leather from sheep's stomachs, or rather from the middle membranes of the stomach. The mode of preparation, according to *India and the Colonies*, is to carefully remove both the inner and outer coatings, when a thin, white, skin-like material is produced, which is subjected to a mild process of tanning by means of a mixture of alum, glycerine and yolk of eggs mixed with flour into a paste. This paste is spread over the material and allowed to remain for about a day, when it is removed and a small quantity of linseed oil rubbed into the resultant "leather."

A Hint to Mothers.—A lady who expressed surprise at seeing the children of a friend exposing themselves to taking a cold by recklessly wetting their feet, when asked if her children did not do the same thing, answered: "No; I've managed to make my three boys believe that it is vulgar and ungentlemanly either to get their feet wet, or sit in a thorough draft, or bolt their food, or eat goodies between their meals, or go to juvenile parties, poor dears. They're soft, perhaps, but they are twice the size of any other boys of their age, and they've never had an hour's illness in their lives." Such mothers as this one are an honor to the world, and with more of them we should see fewer sickly children and more robust ones.—*Herald of Health.*

Court Plaster.—Soak isinglass in a little warm water for 74 hours; then evaporate nearly all the water by gentle heat; dissolve the residue in a little dilute alcohol, and strain the whole through a piece of open linen. The strained mass should be a stiff jelly when cold. Now stretch a piece of silk or sarsenet on a wooden frame, and fix it tight with tacks or pack thread. Melt the jelly, and apply it to the silk thinly and evenly with a badger-hair brush. A second coating must be applied when the first has dried. When both are dry, apply over the whole surface two or three coatings of balsam of Peru. Plaster thus made is very pliable, and never breaks.

Silvered Ivory.—Ivory immersed in a weak solution of chloride of silver in cyanide of potassium, and allowed to remain until it acquires a deep yellow color, and then removed, dipped in water and exposed to the sunlight, becomes black. Polishing the blackened surface until burnished gives it a slippery appearance.



FLORAL DESIGNS.