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ELEMENTARY SCIENCE IN SCHOOLS.

THIS we have, more than once, strongly advocated in the columns of this Magazine, and it has lately been the subject of an interesting debate in the House of Commons, on the motion of Sir J. Lubbock. The motion was an essentially simple one, being merely the addition of three words to the Code of Education, but Lord George Hamilton, by some strange misconception, regarded the matter as one of vast importance, and, opposing the motion, it was rejected by a vote of 68 against 37. Sir J. Lubbock thought it would be desirable to modify the Code by adding elementary natural science as one of the subjects paid for, and the question, whether such should or should not be added, scarcely admits of much argument.

At present, in England, the sum of 4 shillings (equal to about $1) per scholar, is granted for passing creditably in grammar, history, elementary geography, and plain needle-work, and these are, no doubt, necessary subjects to take up in any scheme of education; but surely no one will say that an elementary acquaintance with a phenomena of every-day life is not as well worth $1 as geography or grammar, or even history, and, in fact, in a country like Canada, is of more importance than in England, for the simple reason that, if not taught in schools, children in this country have not the same opportunities of acquiring instruction in natural sciences as in England: we have neither the advantage of libraries from which to obtain books of instruction, as pointed out in the last number of this Magazine, nor philosophical instruments to illustrate the subjects.

History, geography and grammar are, no doubt, necessary subjects to take up in any scheme of education, but it is strange to find a motion for including in the Code on Elementary Education acquaintance with the phenomena of every-day life rejected, as if it was not as well worth 4 shillings as geography or grammar, or only history.

If less mathematics and classics were taught in our schools, and the better class of school-teachers who are competent to take up science, gave elementary lectures occasionally to their pupils, on astronomy, electricity, sound, light, heat, as well as on technical subjects, which admit of the performance of a few attractive experiments, it would be the means of making these studies delightful and instructive, and create a taste for study and a yearning after further knowledge; such lectures have always been found to promote discipline, and by bringing the school-teacher more in familiar contact with his pupils, a feeling of attachment grows up between them, of which the teacher knows full well the benefit. In cases where teachers have, of their own accord, taken up at irregular times lectures on these subjects, they have proved so attractive to the pupils, that it has been found exclusion from a science lecture has had a more deterrent effect on bad behaviour than even the cane.

Sir J. Lubbock told the House he could prove, by abundant testimony from many of the best school-teachers, and most able inspectors, that science, properly taught, was most instructive and delightful to children. It was not the intention to teach electricity, astronomy or any advanced science, but merely to bring to the notice of the children the received explanations of the phenomena of nature—why it rains, snows, hails; the cause of night and day; of summer and winter; how a plant grows; the cause of lightning and thunder; in short, as Germans call it, the *Naturkunde*, a knowledge of nature; and yet, it was most extraordinary the opposition Sir J. Lubbock's motion met with, so difficult it is to introduce new subjects into established rules and codes of Great Britain.

Nothing very profound can be expected from children, but it is surely as useful for a boy to know that an eclipse of the moon is caused by the earth passing between our satellite and the sun, and to know what a satellite means, as it is for him to be able to give off hand the latitude of a place or an historical date. We trust the day is not far distant when elementary science and technical instruction will be taught in all Canadian schools, and illustrated by such attractive experiments as will leave a lasting impression on the minds of children never to be obliterated in after years, and create a taste and love for study, and a yearning to increase their store of knowledge, instead of leaving school with a mind disgusted with the dryness and severity of studies of little service to them hereafter in practical life.

HARDENING AND TEMPERING.

By Joshua Rose, M.E.

Since the hardening of steel consists of first heating and then rapidly extracting the heat, it follows that this latter part of the process may be performed otherwise than by the use of water—such, for example, as by placing the article in a current of cold air, or, if it is thin, by placing it between two cold plates of iron. In these processes, however, the heat is not extracted quickly enough to give a great degree of hardness; hence, cold plates are rarely used, unless in cases where straightness and truth are of primary importance, and where straightening processes to be applied after hardening, are inadmissible.

When extreme hardness is required, it is not uncommon to quench the steel in mercury, which will harden to a much greater degree than water.

To increase the efficiency of water, it is not unusual to boil it, which draws off the air contained in it, and there is no doubt that the superiority of water which has been long used for hardening, is largely, if not altogether, due to its comparative freedom from air.

The considerations which determine the most desirable degree of hardness or temper are whether resistance to abrasion, the capability of sustaining great pressure upon a fine edge, or elasticity, are the qualifications sought to be imparted.

When elasticity is sought, tempering is absolutely necessary, because the degree of hardness accompanying elasticity is that represented in the color test by the shades of blue. But when the requirements include the elements of strength (as is always the case in cutting tools, and is sometimes the case in articles hardened to resist abrasion), then the degree of temper is modified to accommodate the strength, for steel hardened right out, that is, made as hard as fire (without burning it) and water will make it, is sometimes brittle and comparatively weak, but it resumes its normal strength as its normal softness is restored. Hence if a cutting tool is of strong section, it is, in the best practice, hardened right out, but if it was found that the edge was, from excessive duty, liable to break off, it would be tempered to a straw color, or still lower, even down to a blue if the requirements for strength demanded it. It is self-evident, however, that since the cutting capability of a tool is mainly dependent upon its degree of hardness above that of the material to be cut, the harder a tool can be made to stand the duty without breaking, the more and the better duty it will perform.

There is, it is true, a great difference of opinion with regard to the propriety of tempering many strong tools to a straw color, especially in the case of planer tools for iron. Some of our most expert mechanics will temper such tools to a straw color, while others, equally expert, will give them all the water—that is, harden them right out and not lower the temper at all. There is among them all, however, a common practice of using the full degree of hardness in the tool when the metal to be cut is hard, as is sometimes the case in even common unchilled castings, and, since the harder the metal, the more force it requires to sever it, it would seem that a tool strong enough for the hard metal should be sufficiently so for the soft metal. On the other hand, the tool is sometimes made less keen for the hard than for the soft metal, and the difference in the tool shape may give as much increase of strength as the increase of its hardness tends to weaken it.

Here let it be noted that the difference of opinion referred to is not in any way due to a difference in the steel, for, of two men operating the same tools in the same machine and upon similar work, one will simply harden and the other harden and temper the tools. Let he who would excel, however, never use tools of a lower temper than that which he finds will safely withstand the strain, and never rest satisfied until, under equal conditions, he can use tools as hard as the best of others engaged upon similar work, for in most cases it will be found that an advantage of shape is the cause of being able to use a tool of increased hardness.

Under equal conditions, and under any given process, steel hardened with the outer or forged skin removed, will be harder, though tempered to the same color, than if that skin remained, which appears an anomaly, since it is universally conceded that the forged surface is the closest-grained and most refined steel. An explanation, however, may be found in the probability that the forged skin, or scale, operates as a separating film or lining between the metal and the water, retarding the extraction of the heat from the steel; but, be this as it may, it must always be allowed for in tools in which the temper is drawn to give strength. Suppose, for example, the conditions require that a tool be filed to exact shape before being hardened, and that the proper temper for that class of tool, if hardened with the forged skin on, would be a pale straw, the temper with that skin off would require to be about a coffee-colored brown; or if, in the first case, a deep reddish brown, then, in the second case, a clear reddish purple.

The surface of a piece of steel that is thoroughly hardened always appears white, provided that its surface was not covered with any substance during the heating process, and if any dark places or patches appear, it is an evidence that in those parts the steel is not so thoroughly hardened. For most color tempering, except it be for springs subject to excessive duty in proportion to their size and shape, the presence of such dark spots upon good refined cast steel, such as tool steel, is not of sufficient importance to appreciably impair the value of the tempering. If shear steel, blister steel, machine steel, or any of the common qualities of steel are used, the whiteness of the surface is, however, a sure indication of the hardness of the steel, providing it was heated with its surfaces uncovered and quenched in water; but if the surface of any steel be coated with any of the substances sometimes used (and to be hereafter specified), to prevent decarbonisation, black or dark spots will not be an indication of local softness.

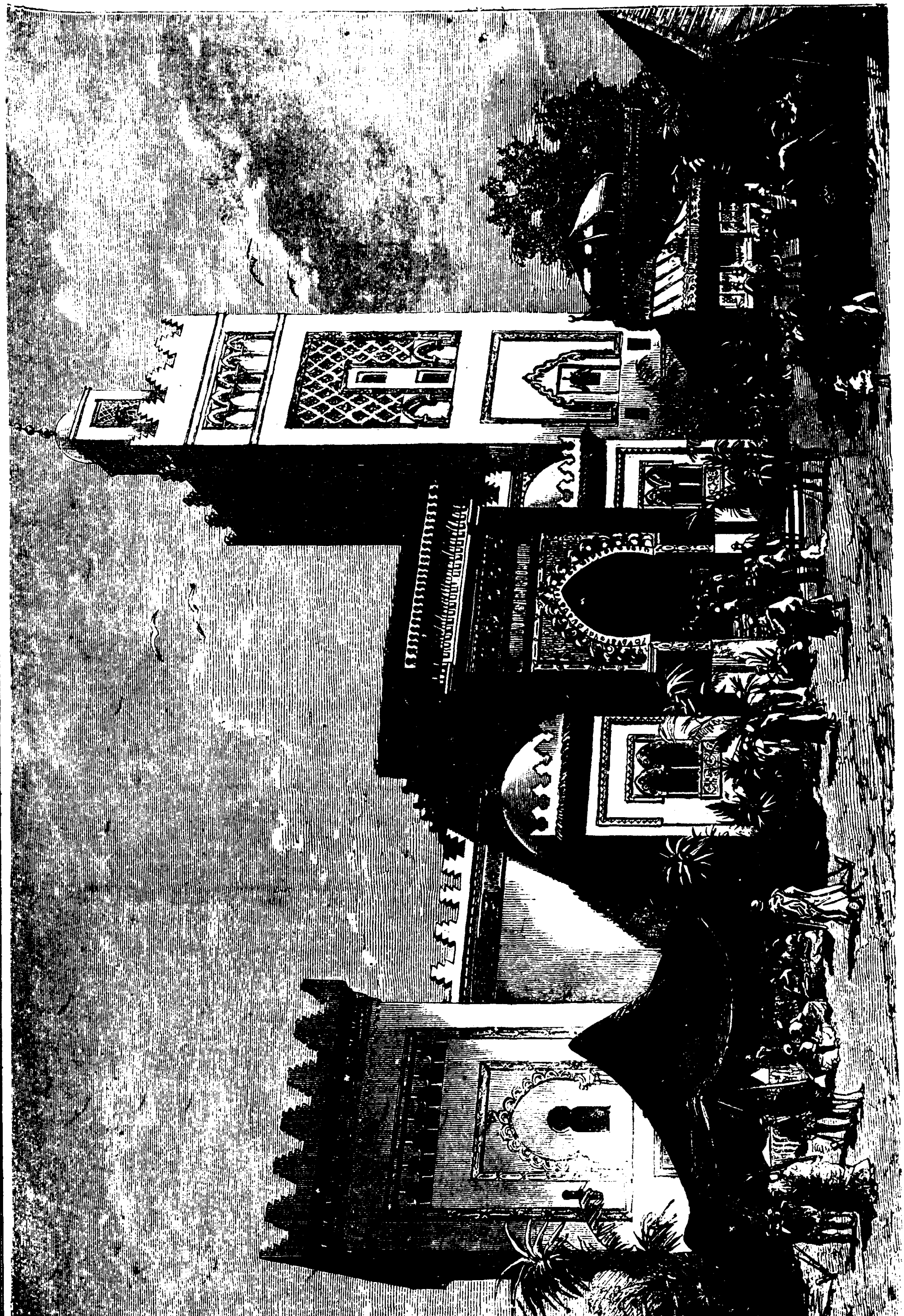
In large bodies of steel, the heat is not extracted from the internal metal sufficiently quick to harden the interior to the same extent as the exterior. Furthermore, it is often necessary to have a free current of water in order to extract the heat sufficiently rapidly to harden the exterior, because the internal metal supplies heat to the external, thus partly counteracting the cooling effects of the water. In such cases, however, the coldest of water under pressure, and, if practicable, with salt added, may be employed.

In such sizes of steel as are used for cutting tools and instruments, it is not found that the internal metal is appreciably softer than the external, provided that the steel was heated equally all through.

In articles tempered to any degree not lower than a red purple under the color test, it is not found that removing the surface after hardening alters the temper, or, in other words, articles not tempered (by color) to a lower degree than a very light purple, appear to possess their degree of temper equally all through the metal; hence, subsequent grinding and polishing does not impair the hardness, unless the operation should heat them. But in all the degrees of temper represented in the color test, the blue purples and blue, removing the surface of the metal after tempering, will sensibly reduce the temper; the amount of the reduction depending upon the depth to which the surface was removed. The difference, however, will be found to be less in the case of refined cast steel than when the quality of steel is that ordinarily used for springs. It is stated to have been found by experiment that the bare removal of the blue tint from a pendulum spring by immersing it in weak acid, caused the chronometer to loose nearly one minute in each hour. It is also stated as a well-known fact, that such springs get stronger in a minute degree during the first two or three years they are used, from some atmospheric change; while springs plated with gold, silver, or nickel, remain constant, though the covering or plating may be so thin as not to compensate for the loss of the blue surface removed for the plating process. Be that, however, as it may, certainly is it that the elasticity of tempered steel is rapidly affected by various conditions. Thus the springs of engine pistons partly loose their elasticity in the course of time, whether from the heat or from rusting, it is hard to say. Springs operating under dry heat get harder, but whether this is not due to the crystalisation of the metal, is an open question.

It does not appear that the method of tempering affects the durability or elasticity, since the deterioration mentioned applies to springs tempered either on hot plates of iron, in sand, in heated fluxes, or by burning oil, or blazing as it is termed.

On page 305 of this number will be found an article by the same writer on "The Cooling of Steel during Hardening."



PARIS EXHIBITION.—THE ALGERINE PAVILION, TROCADERO PARK.

THE LIFE OF THE MAMMOTH.

Prof. Henry A. Ward, of Rochester, who recently mounted the celebrated Stuttgard mammoth, speaks as follows, in a letter to the Rochester *Democrat*, of the habits of the animal: But by far the greater mass of the great herds have left us nothing except their bones, teeth and tusks. The number and volume of these remains, which are dispersed over this entire region, is something almost incredible. Certain islands in the Siberian sea have the soil crowded full of them. This is particularly the case at the Laichovian Isles, north of the mouth of the River Seva. The tusks are so numerous and are in a state of such excellent preservation that they form an important article of commerce and are annually shipped in large quantities to Russia and to England, there to be employed by the ivory turner in the same works as is what may be termed the living ivory of Asia and Africa. The preservation in Siberia of these countless large bones, buried under ground and frozen in the ice, has long been a wonder to the inhabitants of the country, who had no reasonable explanation of their source or origin. With absurd credulity they attribute them to a gigantic mole, which they thought burrowed in the ground, living on roots and only appearing at the surface during the darkest nights. To this creature they gave the name of mammoth, which in their language is a term applied to any burrowing animal. This name has been universally accepted in Europe, but limited to the species studied by Cuvier, and described by his friend Blumenbach as *Elephis primigenius*. Cuvier showed the near relation of the mammoth to the modern Indian elephant, its degenerate successor, while another fossil species called *Elephis priscus* was more closely allied to the African animal. Bones of these and still a third species of mammoth are abundant in nearly every part of Europe from England to Spain and Southern Italy, although, strange to say, they become less and less abundant as we approach southern lands, the present home of the race.

In short, the mammoth was once an inhabitant of northern temperature and frigid zones; now his descendants inhabit the tropics. Its remains occur chiefly in beds of gravel, clay and other loose material of the post-pliocene age. In Europe, at least, it seems to have lived coeval with early man. In the bone caverns of England, France and Germany, those great charnel-houses of early animal life, there are found scores and hundreds of the remains of the mammoth commingled with those of the rhinoceros, hippopotamus, aurochs, cavern bear and other animals now quite extinct, or living in other continents. It is clear that the mammoth did not themselves crawl into these caves, often with an extremely narrow opening, and die there, nor do the surroundings allow the idea that they were brought there by the flow of waters. In many cases the abundant marks of teeth and gnawing of the bones show that they were dragged to the cave by wild beasts who made it their den and fed upon them. But in a few special cases the cavern has been the home of early men, who brought there remains of the animals which they had hunted and killed. In these caves there are found, with those of other animals, many bones of the mammoth, and of these every long bone, as those of the leg, has been carefully split open to obtain the marrow from the central cavity. Mingled with these bones are found here and there the flint knives and stone hatchets which served as utensils at these early feasts. On a tusk of a mammoth, found in one of these caves in Dordogna, in Southern France, was a rude engraving of the animal itself, scratched thousands of years ago, with the sharp point of a flint. These troglodytes are now no more. They and their giant neighbor, the mammoth, have perished one after the other in the lapse of infinite ages by those changes of circumstances in the organic and inorganic world which are always in progress.

JABORANDI IN BRIGHT'S DISEASE AND ŒDEMA.—In a report from Bellevue Hospital, in the New York *Medical Journal*, it is stated that a woman, aged thirty, entered the hospital suffering from acute nephritis, with general œdema and symptoms of uræmic poisoning. The value of the remedy was very decided. Within three days the dropsy had in great part disappeared. In cases of œdema of the lungs decided benefit resulted from the use of the drug, and a sufficent number of cases were observed to test its value.

THE TRINITY BOARD have determined to undertake the building of the new lighthouse at the Eddystone themselves, the tenders sent in being much above the estimate of the engineer. That is the wisest plan, as of necessity it must be a great risk for a contractor to run.

BARTHOLDI'S STATUE OF LIBERTY.

Bartholdi's statue is pretty well known by this time in America, so many thousands having looked at the hand and torch which were set up in the centennial grounds, and afterwards in Madison Square, in New York city.

The head now adorns, if that be the proper word, the esplanade between the Palais du Champ de Mars and the Seine. On the day of the inauguration of the Statue of the Republic, in front of the Palais, the authorities, the crowd, and the band walked over to the Bartholdi bust, gave the "Star Spangled Banner," three cheers, and then rushed back to repeat the "Marseillaise" around the draped figure of the Republic. The statue is designed to be 105 feet high, on a pedestal of 82 feet additional. The bust is 29½ feet high, and a fraction over 13 feet in diameter. It will be placed, when completed, on Bedloe's Island in New York Bay, facing the City of New York. It is the noble gift of the citizens of the French Republic to the citizens of the United States.

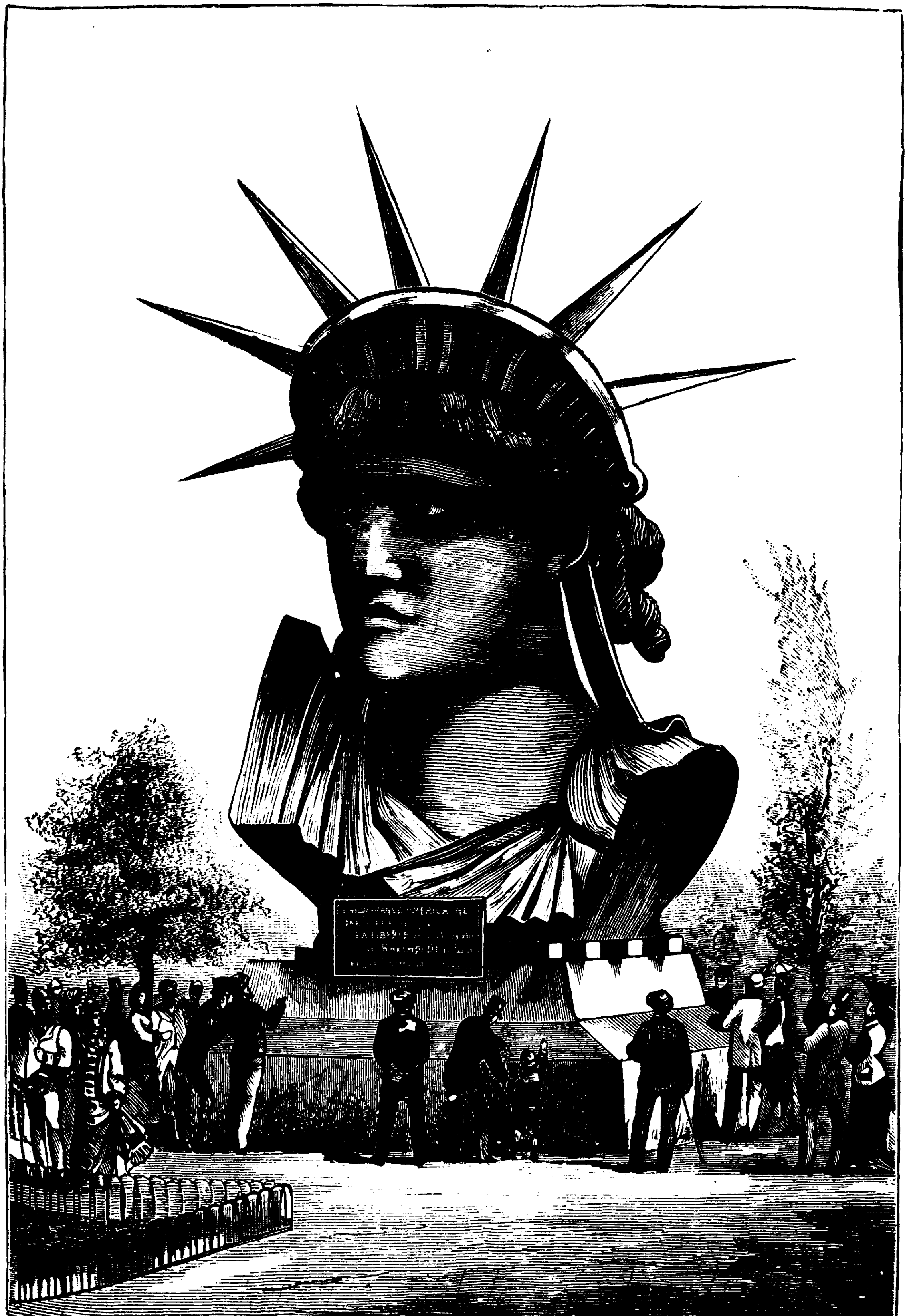
LIBERAL REMUNERATION.

In *The Life and Letters of Lord Macaulay* published by Harper & Brothers, it is mentioned that 26,500 copies of his history had been sold in ten weeks. Longman, his publisher, one day came to him and said they were overflowing with money, and proposed to pay him £20,000 in the following week. The check is still preserved as a curiosity among the archives of Messrs. Longman's firm. "I went to the city," says Macaulay "to give instructions, and was most warmly congratulated on being a moneyed man. I said that I had some thought of going to the Chancellor of the Exchequer as a bidder for the next loan." This payment, large as it is, has been exceeded in this country. Harper & Brothers have paid as copyright to Marcius Willson, the author of their series of school readers, about $200,000; to the late Professor Charles Anthon, about $100,000; to Mr. Motley, about $60,000; to Jacob Abbot, about $50,000; to the late Albert Barnes, $75,000; and to English Authors over $300,000. These are among the largest, and are quite sufficient as a hint and incentive to young persons about to enter upon literature as a profession. The mine is as inexhaustible as ever; or, as one might say, there yet remain in the vasty deep oviparious animals as copius in size and as toothsome in quality as any that have hitherto been adroitly captured by the expert angler.

NOTES ON CONSUMPTION.

Dr. Geo. H. Napheys, an eminent physician, says: A particular kind of exercise is to be recommended for those whose chests are narrow, whose shoulders stoop, and who have a hereditary predisposition to consumption. If it is systematically practised along with other means of health, we would guarantee any child—no matter how many relatives have died of his disease—against its invasion. It is voluntary inspiration. Nothing is more simple. Let her stand erect, throw her shoulder back, and the hands behind; then let her inhale pure air to the full capacity of her lungs, and retain it a few seconds by an increased effort; then it may be slowly exhaled. After one or two natural inspirations let her repeat the act, and so on for 10 or 15 minutes, twice daily. Not only is this simple procedure a safeguard against consumption, but, in the opinion of some learned physicians, it can cure it when it has already commenced.

A correspondent of an English medical journal furnishes the following recipe as a new cure for consumption: Put a dozen whole lemons in cold water and boil until soft (not too soft), roll and squeeze until the juice is all extracted, sweeten the juice enough to be palatable, and then drink. Use as many as a dozen a day. Should they cause pain or looseness of the bowels, lessen the quantity and use five or six a day until better. By the time you have used five or six dozen you will begin to gain strength and have an appetite. Of course as you get better you need not use so many. Follow these directions and we know that you will never regret it if there is any help for you. Only keep it up faithfully. We know of two cases where both of the patients were given up by the physicians, and were in the last stages of consumption, yet both were cured by using lemons, according to the directions we have stated. One lady in particular was bedridden and very low; had procured everything that money could procure, but all in vain, when, to please a friend, she was fully persuaded to use the lemons. She began to use them in February, and in April she weighed 140 pounds. She is a well woman to-day, and likely to live as long as any of us.



BARTHOLDI'S COLOSSAL STATUE OF LIBERTY.

UTILIZATION OF SPARE TIME.

There is probably no more important question one can ask the young man than "What do you do with your odd moments?" Upon the way in which his spare time is employed depends, in great degree, his success in life. We have been in the country where an idle afternoon was spent in playing checkers or 'loafing,' and where the only reading done was of newspaper stories of the cheapest kind. Young men who fall into the habit of wasting the time during which they cannot be at work, are neglecting their opportunities. Sometimes athletic sports take up all the moments that can be spared from labor. It is rare, however, to see a young man busy at such times with anything which can in any way be useful to him. We know of one youth in a shop who, at every opportunity, studied the engine of the establishment, and made it the first chapter of a course in mechanical engineering. Three books on the subject were bought and kept at hand, so that at any time they could be taken up. In a short time he was promoted into the engineer's department—as wiper, if we remember rightly. This gave him more time in working hours, which was devoted to the study of the engine, the theory of steam, valve gears, etc. As wages were increased more books were bought, and in this way the young man obtained a superior knowledge of the trade, which in the end was a source of great revenue to him. The shop is emphatically the place to study the trade at which one is at work. Leisure moments, if improved, will often enable one to obtain a vast amount of practical knowledge. Out of the shop there are thousands of things to distract the attention, the tools are not at hand, and a good share of courage is needed to hold the attention down to work. In a shop it is not nearly so hard. Conveniences are at hand, and everything is favorable to the acquisition of knowledge. It will be found as a general rule that men are quite willing to instruct those who seek after knowledge, and in the shop the older and more experienced are often very glad to take pains with the younger ones, if they only show an interest in improving. Unfortunately, there are too few young men who care much for extra instruction. They only wish for enough knowledge to carry them through the ordinary journey work, to get along in the world and nothing more, while they have not ambition enough to aspire to become superior workmen.

INFLUENCE OF PRESSURE ON COMBUSTION.

M. Wartha has observed the burning of six stearine candles in free air, and in an iron case under a pressure of 1·95 atmospheres. They burned under this pressure with a flame nine to twelve cm. long, and gave much smoke; their luminous power diminished, while the flame assumed a yellowish-red color. The decrease of weight after one hour of burning was found to be less than in burning in free air. This last result is opposed to the observation of Frankland, who has affirmed that the consumption of the burning material of a candle, or the like, is not perceptibly dependent on the pressure of the medium in which the combustion occurs. It is supposed that the difference of pressure in Frankland's experiments (on Mount Blanc and at Chamouny) was not sufficiently great to give a distinct difference in consumption of the burning matter. M. Wartha further put a candle to burn under an air pump receiver with special apertures, and, with increasing rarefaction, the flame was seen to enlarge, and its luminous power to diminish. At a pressure of 90 cm., the greatest rarefaction produced, the luminous power was quite gone, and the flame, which now assumed three-fold size, appeared to consist of three parts, an inner bluish-green cone with a violet sheath, and a weakly violet mantle. The diminution of the luminous power in this case M. Wartha explains by the fact that under less pressure less of the products of combustion are separated in the form of soot.—*Nature.*

A Hand Torpedo.—A new warlike appliance is, it is said, about to be introduced into the service, and will probably be known as the "hand torpedo." Like the grenades of half a century ago, it is intended to be thrown by hand into the enemy's boats, or over parapets or stockades; but instead of being a shell exploded by a fuse, as a grenade, it will consist entirely of guncotton compressed into a cake or ball of 3lb. or 4lb. weight. A long cord is attached to each charge, by means of which the charge may be fired. One such charge skilfully applied would annihilate a boat's crew, and in the hands of daring men might work great destruction by being thrown into large ships.

LIFE INSURANCE.

Persons who have never invested in life insurance may now congratulate themselves on their escape, after seeing how many of their friends practically threw their money away by being swindled out of it by the rascality of many of the officers at the head of these institutions, which, after paying for years enormously large commission to the smooth-tongued agents who procured customers willing to invest money, and appropriating for themselves a disproportionately large amount for salaries and other expenses, at last succumbed, as every sham finally must.

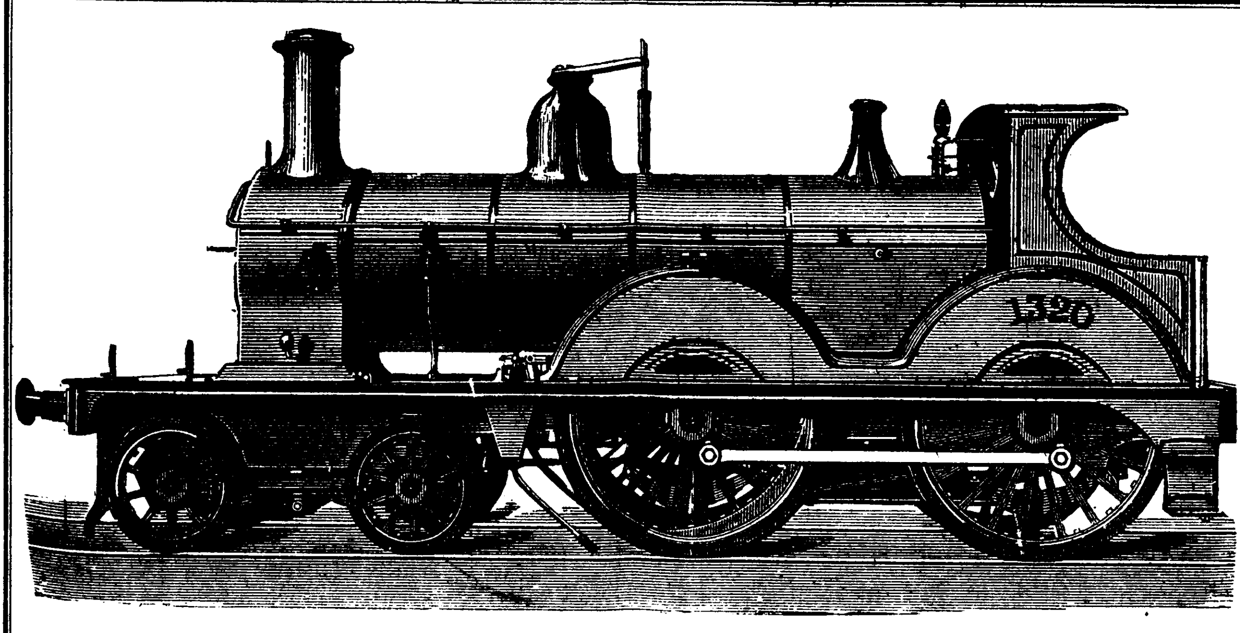
It is not surprising then that the latest statistics show a large decrease in that business, but by no means as large as we might expect. The report of Superintendent Smyth shows a decrease in 1877 of eleven million dollars, and in the number of policies 25 per cent.

Before the recent exposures of the rotten concerns the life insurance business was constantly on the increase, as in its healthy state its losses are more than counterbalanced by its gains. This has not been characteristic of 1877; both the number of policies and the amount of assets having declined.

We will not weary our readers with the array of figures which the daily papers furnish, but simply remark that an analysis reveals some changes that are wholesome and some that may be the results of involuntary transactions. The New York companies have still a larger percentage of their means invested in United States securities than the companies of other States. The total under this head has increased from thirty to thirty-eight and a half million dollars. On the other hand, the bonds and mortgages have undergone a decrease of sixteen million dollars. The ownership of real estate has increased; but the most suggestive feature of the tables accompanying the report is that which brings into comparison the relative strength of the companies, measured by the ratio of their net assets to risks in force. Bearing in mind that the presumption is favorable to their general solvency, an examination of the tables establishes the necessity of a careful balancing of the evidences of strength before jumping to the conclusion that they are alike in the degrees of security offered to the public. It is not our purpose to commend one company and to depreciate another, and therefore we abstain from drawing the conclusions which the comparison suggests. The fact that some large companies are relatively weak, and that some small companies are relatively strong, is brought out very plainly by a moderately careful scrutiny of the proportion borne by assets to liabilities and of expenditure to income. Rigid criticism would find in these accounts good reasons for the application of other tests than those with which the Legislature and the Insurance Department are content. The minute details given under some heads only render more noticeable the systematic concealment which is practiced under others.—*Manufacturer and Builder.*

A Pigeon Living without a Brain.—Dr. McQuillen described before the American Philosophical Society (Feb. 1, 1878), a case of the extirpation of nearly the whole of the cerebrum of a pigeon, operated upon by himself. He desired to place on record the fact that the animal not only survived the operation 24 days, but that it gradually regained its usual powers and habits of flight, and its ability to feed itself and drink. Only one other such case is on record.

For the Last Time.—There is a touch of pathos about doing even the simplest thing "for the last time." It is not alone kissing the dead that gives you this strange pain. You feel it when you have looked your last time upon some scene you have loved—when you stand in some quiet city street, where you know that you will never stand again. The actor playing his part for the last time; the singer whose voice is cracked hopelessly, and who after this once will never stand before the sea of upturned faces, disputing the plaudits with fresher voices; the minister who has preached his last sermon—these all know the hidden bitterness of the words "never again." How they come to us on our birthdays as we grow older. Never young again—always nearer and nearer to the very last—the end which is universal, "the last thing" which shall follow all last things, and turn them, let us hope, from pain to joys. We put away our boyish toys with an odd heartache. We were too old to walk any longer on our stilts—too tall to play marbles on the sidewalk. Yet there was a pang when we thought we had played with our merry thoughts for the last time, and life's serious, grown-up work was waiting for us. Now we do not want the lost toys back. Life has other and larger playthings for us.



MIDLAND BOGIE ENGINES.

I have great pleasure in sending a photograph of one of the Midland bogie engines which the Editor has kindly promised to have engraved for the *English Mechanic*. The cylinders are 17½in. in diameter, and the stroke is 26in. The boiler, which is 4ft. 2in. in diameter and 16ft. 5⅝in. in length, contains 223 tubes, whose external diameter is 1⅝in. Heating surface of tubes, 1,115 sq. ft.; fire-box, 110 sq. ft.; total, 1,225. The driving and trailing wheels are 6ft. 6in., and the bogie wheels 3ft. 3in. in diameter. Total wheel base, 21ft. 6in.; length over buffer beams, 29ft. 4in.; weight on bogie wheels, 13 tons 10cwt.; on driving wheels, 14 tons 10cwt.; on trailers, 12 tons 7cwt.; total 40 tons 7cwt.

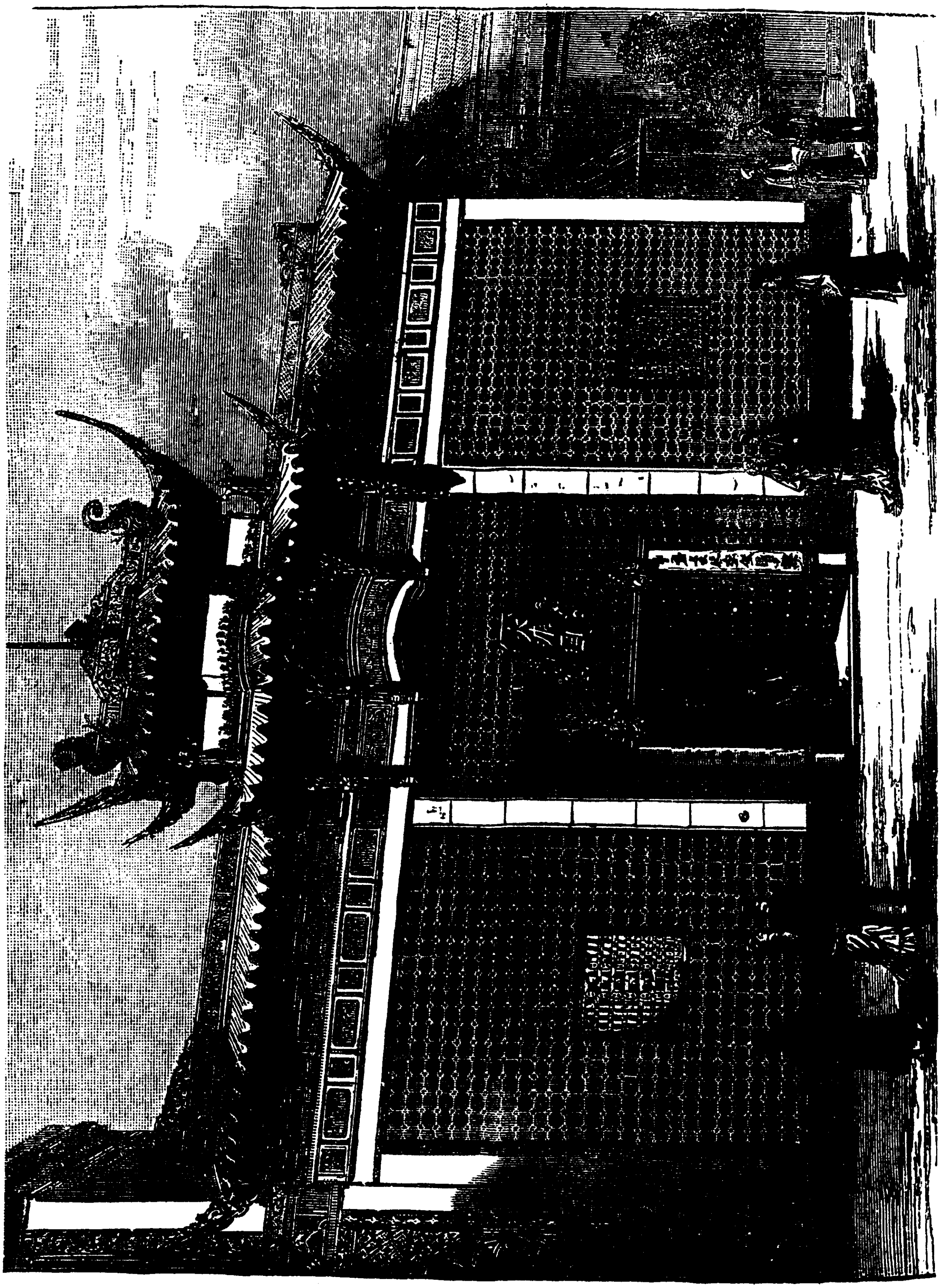
Salt a Preservation of Wood.—In the salt mines of Poland and Hungary the galleries are supported by wooden pillars, which are found to last unimpaired for ages, in consequence of being impregnated with the salt, while pillars of brick and stone used for the same purpose, crumble away in a short time by the decay of the mortar. It is also found that wooden piles driven into the mud of salt flats and marshes last for an unlimited time, and are used for the foundations of brick and stone edifices; and the practice of docking timber after it has been seasoned, by immersing it for some time in sea-water, is generally admitted to be promotive of its durability. There are some experiments which appear to show that even after the dry-rot has commenced, immersion in salt water effectually checks its progress, and preserves the remainder of the timber. We add to this that along the sea-coast of France, Belgium, the Netherlands, Northeastern Germany, and Denmark, the custom prevails of immersing the logs in salt water before sawing, wherever this conveniently can be done, it being a universally acknowledged fact that salt-water-soaked lumber is harder and much more durable than lumber soaked in fresh water. This is especially the case with hard woods, such as oak, elm, ash, &c.

Patent Flour.—Almost everybody knows of the flour, says an exchange, but not every one understands what it is. Stripped of technicalities, this is perhaps the story of its manufacture. The best flour used to be made of winter wheat. Spring wheat yielded either much less in quantity, or else so much of the bran got into the flower in its manufacture that its color was intolerably dark. The wheat would be ground and then bolted. In the refuse—the bran and middlings—would be included a large portion of the weight of the spring wheat, and this would sell more particularly for feed for horses. Now the best of flour, and the most expensive, is made out of this very refuse of the old-fashioned process. It all came out of the discovery of a way to draw out the bran. Under the new process the wheat is ground about as before. The first result is an ordinary flour sold for exportation. Then the remainder is taken and put upon great horizontal sieves, and while agitation is going on there, an ingenious system of draft rushing up through carries off the bran. What is left is the glutinous portion of the wheat, the most nutritious and most productive, and out of this, purified now by the drawing off of the bran, we get our new-process flour. The result of the discovery of the process has been to make the poor spring wheat of Minnesota and upper Wisconsin the most valuable kind of grain, and to make the fortunes of the inventors of the method.

New Volcano in Peru.—A Peruvian newspaper the *Bolsa*, says that extraordinary phenomena have been observed in connection with the "Corpuna" volcano in the province of Castilla, which have caused great alarm among the population. The immense banks of snow which have crowned its summit from time immemorial have suddenly melted away with such rapidity as to cause torrents to rush down the sides of the mountain, washing out immense quantities of stones and earth. The river below, being unable to contain the great body of water so suddenly added to it, overflowed its banks, causing great damage and distress. A great chasm or lateral crater next opened on one side, throwing out volumes of smoke and steam as well as tongues of flame, which were distinctly visible at night, accompanied with loud subterranean rumblings. It had never been supposed that the Corpuna was or could be a volcano, and there is no tradition that it was ever in a state of eruption. Nor within the memory of man has its crown of snow ever been absent.

A New Treatment of Tape-worm.—Malefern oil, kousso, and the bark of the pomegranate root are the anthelmintics usually employed to expel Tæniæ, but their action is violent, and often uncertain. A careful inspection will always enable the medical attendant to discover the ova and fragments of the parasite in the stools, and when this has been done we have a simple and effectual method of insuring a cure. From the results of numerous experiments M. Bouchut has ascertained that not only ascarides, but fragments of tæniæ, when placed in a weak alcoholic solution, containing 1-35th of amylaceous pepsine, are digested by the fluid in the course of twelve hours. We thus obtain an artificial digestion of the animal matter exactly similar to that which ensues when meat is treated by the same process. On submitting the conclusion drawn from his experiments to the test of practice at the Enfants Malades, M. Bouchut found that the solution of pepsine was eminently successful. If his experience be confirmed a valuable addition will be made to adult as well as to infantile therapeutics. In conclusion we may observe that animal food is, almost certainly, the channel through which the parasite is conveyed; and hence that official inspection of suspected dealers in meat would form a useful adjunct to the practice of the physician.

Mr. Thomas Bain has just sent home from Cape Colony a large collection of fossil saurians. There are amongst the bones 308 crania, some apparently new to science. Mr. Bain found the head of a saurian in the matrix of the coal within 2 ft. of the seam. Amongst the known fossils are Dicynodon, Oudenodon, Parieasaurus, Lycosaurus, Galesaurus, and Cynodracon.



THE PARIS EXHIBITION.—THE CHINESE BUILDING.

HOW TO SET SHAFTING IN LINE.

BY JOSHUA ROSE, M.E.

We have already referred to the loss of the driving power which arises from a want of proper condition in the line shafting of our manufactories, and it now remains to give practical directions for setting the shafting in proper line; for no matter how correctly a line of shafting may be set, it is merely a question of time for it to get out of line and require readjustment. Among the main causes for this is, that there is usually more power required to be delivered to machines on one side of the line of shafting and between any two of the shafting hanger-bearings than on the other, and the difference in the sizes of the pulleys and their difference in distance from the hangers or bearing boxes. The farther the pulley is from the bearing, the greater its leverage, and hence, all other elements being equal, the more its tendency to cause the wear of the hanger boxes to place the shafting out of line.

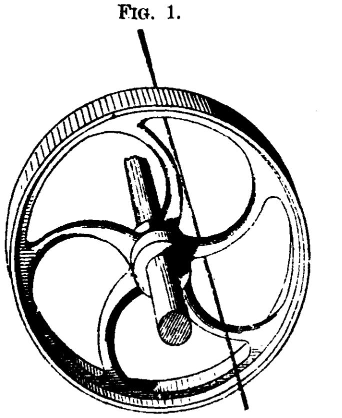
The adjustment of line shafting is a job that it will pay to do thoroughly well; hence, only the most approved methods of accomplishing it should be resorted to.

In some cases it is attempted to line shafting from plumb-lines hung over and suspended from the shafting. This, however, is a decidedly inferior method, because such lines are apt to swing, making the operation a troublesome one. Variations in the size of the shafting, again, are elements rendering the operation difficult, and, furthermore, such lines form no guide for the horizontal adjustment, which is quite as important as the vertical.

In other cases, a horizontal line is stretched below the line shafting, and a staff, with a sort of calipering gauge at the top, is used, but in this case the sag of the horizontally-stretched line is a disturbing element. There is, indeed, but one thoroughly accurate method that I know of that will make a true and reliable job, and that method is as follows:

At each end of the line of shafting we nail a piece of wood, so that it will sustain a tightly stretched and strong, fine, and evenly twisted fine line. This line we stretch as tightly as possible (so as to keep it straight), placing it say 6 inches below and 4 inches on one side of the line of shafting, and equidistant at each end from the axial line of the same, adjusting it at the same time as nearly horizontally level as the eye will direct when standing on the floor at some little distance off and sighting it with the line shaft. In moving either end, however, it must be kept equidistant (with the other end) from the axial line of the shafting. It is a good plan, however, to set the stretched line horizontally true with a spirit-level, taking care not to deflect the line by contact with the spirit level. The line should stand far enough out from the shafting to clear the largest pulley-hub on the whole line of shafting, and it is obvious that the arms of the pulleys must offer no resistance to the natural tension of the line which must pass through those arms as shown in Fig. 1.

FIG. 1.



We next prepare some wooden frames technically termed targets, the construction of which is shown in Figs. 2 and 3. These consist of a vertical piece, planed true on the edge A, and having marked on its side face a line B, Fig. 2, which line must be true with the planed edge A, being marked therefrom by a carpenter's scribing-gauge.

Upon this frame we hang a line suspending a weight and forming a plumb-line, and it follows that when the target is so held that the plumb-line falls exactly over and even all the way down with the scribed line, the planed face A, Fig. 2, will stand

FIG. 3.

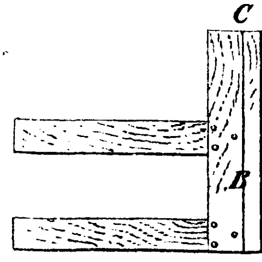
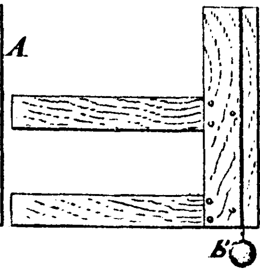
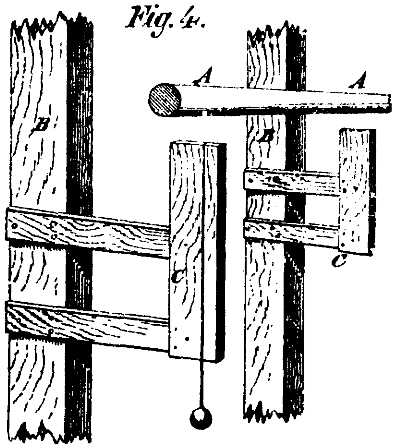


FIG. 2.



vertical. To facilitate this adjustment, we cut a small V notch at the top of the scribed line, as shown at C in Fig. 3, the bottom of the V falling exactly even with the scribed line, so that it will guide the top of the plumb-line even with the scribed line at the top; hence the eye need only be directed to causing the two lines to coincide at the bottom. To ensure accuracy, the planed edge A, Fig. 2, should not be less than a foot in length.

Fig. 4.



These targets we erect beneath the line of shafting as shown in Fig. 4, placing one target alongside of each shafting hanger, the adjustment being made as follows: The planed edge A is brought so as to just touch the stretched line shown in Fig. 1, without deflecting it at all, and at the same time the plumb-line B, Fig. 2, is brought to exactly coincide with the scribed line B, Fig, 3. When so adjusted, the two arms of the target are nailed to the pos carrying the shafting hanger. In making this adjustment, two nails should be slightly inserted so as to sustain the target, the target being tapped with the hammer until correctly placed, when the nails may be driven home, taking care that the adjustment is not altered by driving the nails. Fig. 4 represents two of the targets in position.

We have now in the planed edges A of the targets a rigid substitute for the stretched line, forming a guide for the horizontal adjustment; and, to provide a guide for the vertical adjustment, we take a straight-edge and place it as shown in Fig. 5, in which A A is the line of shafting, B is a shafting hanger, C C C C are targets, and F F is the straight-edge. We first place this straight-edge against the planed face of the end target at D, and, placing a spirit-level upon it, we set it level; we then scribe a plain mark on the edge A of the targets, at each end of the straight-edge—a line as shown at D. Carrying the straight-edge to the next pair of targets, we place one end even with the line already marked on the edge of the second target, adjust the straight-edge level with a spirit-level, and mark a line on the edge of the next target. By continuing this process through all the targets, we shall have marked on their edge faces (A, Fig. 2, and D, Fig. 5) a horizontal line, say 15 inches below the line of shafting.

We next make a wooden gauge or square, such as shown in Fig. 6, the edges A and B being at a right angle, one to the other, and our line on the edges of the targets being 15 inches below the top of the shafting; we mark on the side face of this square the line C in Fig. 6, which must be 15 inches below the edge A. The application of the gauge or square is shown in Fig. 7, it being obvious that if the shafting is parallel we must ad-

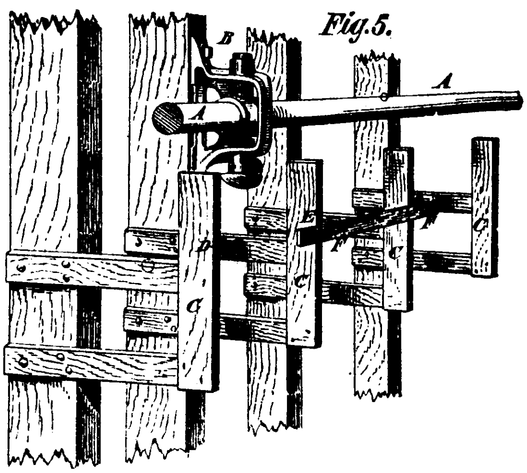


Fig. 5.

just its height so that when the gauge is placed, as shown, the line C, on the guage must exactly coincide with the line D (Figs. 5 and 7) on the targets. By carrying this adjustment along at all the targets, we shall have set the shafting true with the lines marked by the aid of the straight-edge and spirit-level, and therefore level. If there are sections of the shafting of different diameters, we must provide for it as follows: Suppose the line of shafting has sections of two inches, of 2¼, and 2½ inches diameter, and that the line c on the gauge is proper for the 2¼-inch section. All we have to do is to mark on the gauge the lines D and F (Fig. 6), one being ⅛ inch above the line C (Fig. 6), and the other ⅛ inch below it, because the section of 2½ inches would lift the gauge ⅛ inch higher, and the section of 2 inches would let it fall ⅛ inch lower than the 2¼ inch section. Hence, for the large section we use the line F (Fig. 6), and for the small section of shafting we use the line D as the one to be set fair with the line on the edges of the target. To facilitate setting the line on the gauge with that on the target, we may, with a try-square and scriber, carry the line on the target edge around on the side face a short distance, as shown at D (Fig. 7).

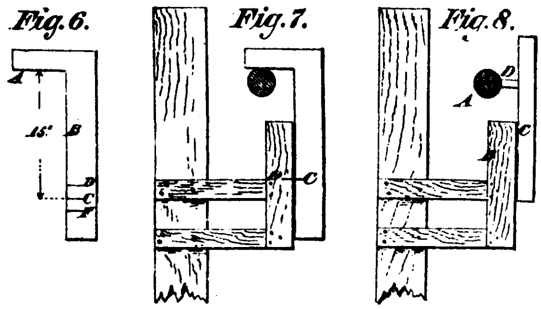


Fig. 6. Fig. 7. Fig. 8.

To effect the horizontal adjustment, we proceed, as in Fig. 8, in which A is the shaft, B the target, c a straight-edge placed against the edge of the target, and D a guage, and it follows that the edges of the targets being set true from a stretched line, this adjustment must be, when thus made, accurate. The thickness of the gauge D must be varied to suit any variations in the size of the shafting; thus sections of 2½ inches diameter would require D, in Fig. 8, to be ⅛ wider than it would require to be for sections of 2¼ inches diameter (the difference being one half of the difference in the diameters). It will be noted that in this process any sag of the stretched line does not affect the accuracy of the adjustment, which is a decided advantage over processes in which this is not the case. If the line of shafting is suspended from the joists of a ceiling instead of from posts, the shape of the target must be varied, the only prime necessity being that it shall have the edge A standing, in the positions shown in our illustrations, plumb and true with the stretched line.

The advantage of this system is, that after the targets are erected and the gauges made, we may go over the whole line of shafting and ascertain exactly how much alteration it requires, and then consider how much alteration shall be effected. Suppose, for instance, one end of the line is higher than the other, lifting the low end unaffected; again, lowering the raised end of the line of shafting might entail the necessity of cutting a piece out of many of the belts. It is best therefore to go over the whole line of shafting with the gauges and to mark near or upon the targets in chalk the amount the shafting is out and an arrow-head denoting the direction in which it requires to be moved, and then to decide how the adjustment may best be made to serve the requirements of the belts, taking into consideration their number, location, and degree of tension. As a rule, the adjustment is best made to tighten rather than to loosen the belts; but where there are belts above, below, and on both sides of the line of shafting, this becomes an important consideration.

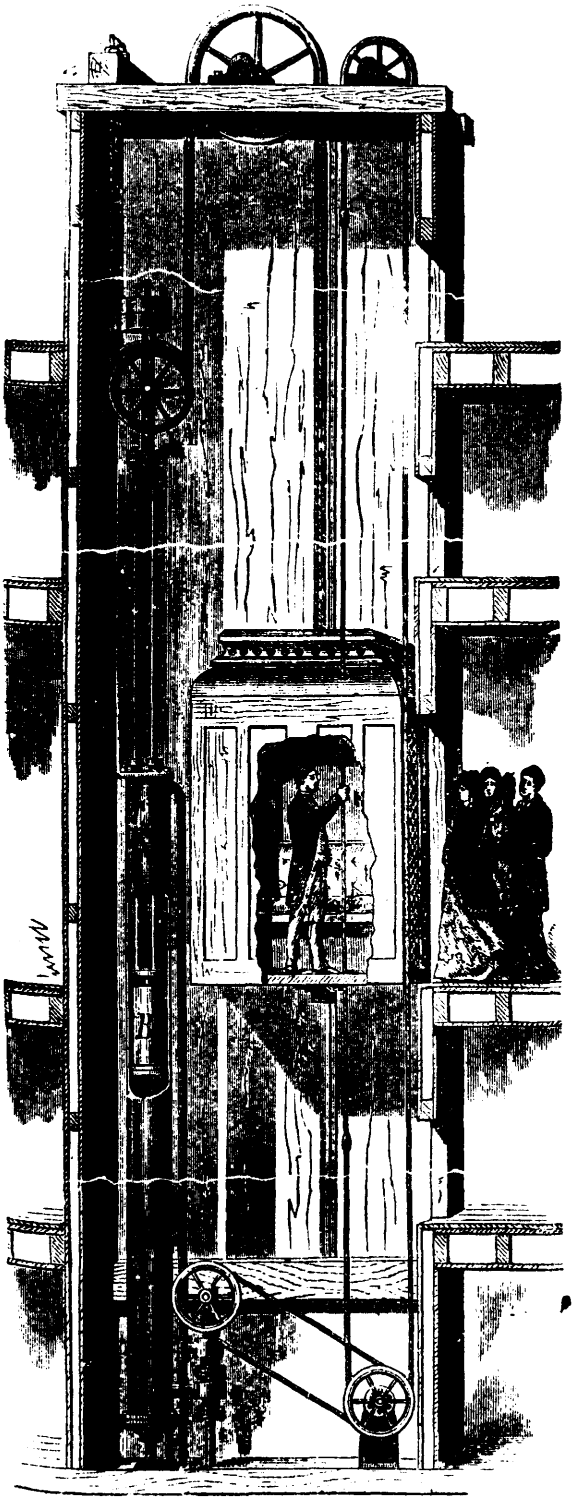
In putting up a line of new shafting, the hangers may first be set to a stretched line passing through the boxes of the hangers; and if this line is a very long one, it will be necessary to fasten it here and there to prevent currents of air from affecting it. After the shafting is put in place as near as may be, the targets should be erected and the process described carried out, the targets being stored away for future use.

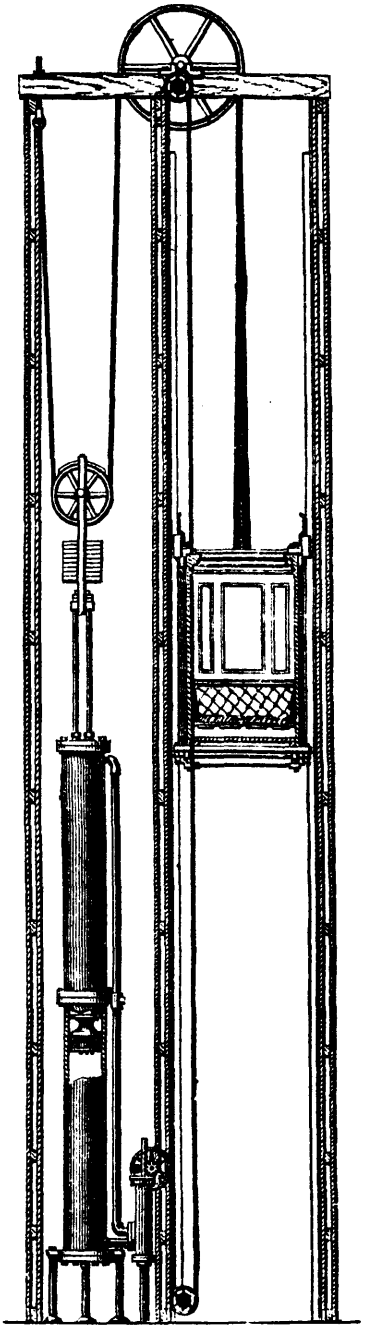
THE SIZE OF THE GLOBE.

Its size has been determined, I have no doubt, to within a very few miles, in what appears to us now a very simple manner. In the first place, every section of the earth is bounded approximately by a circle, and mathematicians divide all circles into 360 degrees. Hence if we can measure accurately the 1-360th part of this great circle, and if, when we have got that measure out into miles, we multiply it by 360, we get the circumference of the earth, that is to say the whole distance around it. Then by dividing this result by something a little over 3 (3,1416 the ratio of the circumference of the circle to its diameter) we find out how far it is from one side of the earth to the other. This gives us the diameter of the earth. As a result of a long series of observations, it has been found that a degree measures as near as possible on the average 69½ miles. It can be stated in inches, but it is near enough for me to give as a first statement of result that it is about 69½ miles, and if you take the trouble to multiply 69½ miles, the average length of one degree, by 360 degrees, the number of degrees that there are all round the earth, you will find that the circumference is something like 8,000 miles. Mark well the words "on the average." In truth, the earth is flattened at the poles, so that the length of the degree varies from the pole to the equator; and hence the diameter in the equatorial plane is in excess of the diameter from pole to pole. These two diameters, expressed in feet, are as follows: Equatorial, 41,848,389; solar, 41,708,710.

WAYS OF WASHING THE FACE.—There are several wrong ways of washing the face, and but one right. Towel, flannel-sponge are all out of place where the face is concerned. The hands only should be used. Doctor Wilson's directions are: "Fill your basin about two-thirds full with fresh water; dip your face in the water, then your hands. Soap the hands well, and pass the soaped hands with gentle friction over the whole face. Having performed this part of the operation thoroughly, dip the face in the water a second time and rinse it completely. You may add very much to the luxury of the latter part of the operation by having a second basin ready with fresh water to perform a final rinse." But the care of the complexion requires that not only the face, but the whole body shall be daily subjected to the bath. The sponge-bath is, perhaps, the best, and the temperature of the water must be regulated by the sensations of the bather and by the season of the year. No one can deny the charm of clear, soft color in the cheeks and lips—and it must be an incorrigible complexion indeed that will not yield to the measures that I have recommended.

A FATAL case of poisoning by peach kernels is reported from Paris. The child is stated to have been less than six years old, and yet he had sufficient strength and perseverance to obtain enough kernels to kill him. We doubt the story as we receive it, but it cannot be too widely known that the flowers and kernels of the majority of peaches are poisonous, and even the leaves. Of late years some sweet-kerneled varieties have been obtained from Syria, and been put into cultivation in this country, and it is doubtful whether one ounce of these kernels contain so much as a grain of hydrocianic acid. All members of the genus Amygdalus contain more or less prussic acid in their flowers and fruits (the latter, of course, being the stone); the sweet almond possesses a very infinitesimal quantity, but the bitter almond and the peach and nectarine contain notable quantities in their kernels. The apricot is a Prunus, and has, like the plum, a bland and harmless kernel.





HYDRAULIC FREIGHT AND PASSENGER ELEVATOR.

The attention given of late years by engineers to the improvement of hoisting apparatus is very noticeable and has largely contributed to the extension of their use. As a motive power steam has necessarily taken the lead, but hydraulic power, as almost everywhere available and essentially economic, so recommends itself that ingenuity has been taxed to render it serviceable in this line, with the result of many failures and for the most part indifferent success. The large engineering firm of Messrs. Otis Brothers & Co., whose reputation is well established as manufacturers of effective hoisting apparatus for hotels, stores, mills, mines, blast-furnaces, etc.—appliances characterized by great certainty of action, ease of control, and automatic stoppage in case of breakage or disarrangement of gear combination, as well as economy in working—have studiously kept in view all that has been done in the way of failures and approximations to utilize hydraulic power for elevators, and have largely experimented themselves in the same direction. They have finally decided that the invention of Mr. Cyrus W. Baldwin, of Brooklyn, of a passenger and freight elevator, the result of a series of years of investigations carried on under the patronage and supervision of Messrs. W. E. Hale & Co., of Chicago, and known as Hale's Standard Hydraulic Elevator, answers every requirement for the purposes to which it is suitable, and they have accordingly secured the manufacture for the Eastern States.

An examination of the construction of this elevator, and of its working in large edifices in our chief cities, is amply confirmatory of their judgment. It will be interesting to many of our readers to indicate its main features, including the safety appliances superadded to the several working parts by which the platform is protected from all descriptions of disaster that have occurred in the use of elevators.

The motive power being water, the weight and pressure are obtained by drawing it from a tank in the upper portion of a building, or from the city mains, the water flowing into the cylinder. The carriage is raised by drawing the water from the cylinder below the piston, the valve leading to the exit pipe being opened by the operator drawing the rope. In this operation the normal pressure of the atmosphere on the water of the piston is a contributory power. In the descent of the carriage, the cylinder, which is always full, rises to the upper end. The system is one analogous to the compensation balance. The counterpoise of the cage exists in the continued weight of the block and piston, so that the resistance to be overcome is simply the load and the inertia of the working parts; but these are reduced by the weight of the air (15 lbs. to the square inch), gained by the escape of water, the absolute weight of the water acting on the piston and the pressure with which it is conveyed from the city main, or, where a tank is used, that varying pressure arising from difference of level between it and the cylinder.

It will be seen that the carriage is secured to the piston by several ropes, which pass up over a fixed pulley-wheel, thence to a weighted ginblock, their standing parts being firmly secured. The ease of control is obvious. The elevator is so constructed that it can not fall more than a few inches; for its course will be almost instantaneously arrested should the wire-lifting ropes part. In a large building requiring several elevators, all can be connected with one system of pump and tank supply; just as, in case of the steam elevator, several are operated by steam from one boiler.

There is to be, we are confident, a large demand for the Hydraulic Elevator for use in private residences in this and other cities, as they can be connected with the usual pump and tank system by simply increasing its capacity to meet the requirements of the elevator.

We here furnish an illustration of Messrs. Otis Brothers & Co.'s Elevator.

To extreme simplicity Hale's Standard Hydraulic Elevator adds the advantages of stability of construction, extreme economy through the minimum of water and water-power employed, the setting aside the necessity of engineering skill in its management, its readiness for use at all times, its absolute safety, and freedom of the cylinders from any the least possible friction as regards the gearing and light-running qualities. *Scientific Amer.*

DIETING FOR HEALTH.

Dieting for health, says *Hall's Journal*, has sent many a one to the grave, and will send many more, because it is done injudiciously or ignorantly. One man omits his dinner by a herculean effort, and thinking he has accomplished wonders, expects wonderful results, but by the time supper is ready he feels hungry as a dog, and eats like one, fast, furious and long. Next day he is worse, and "don't believe in dieting" for the remainder of his life.

Others set out to starve themselves into health, until the system is reduced so low that it has no power of resuscitation, and the man dies.

To diet wisely, does not imply a total abstinence from all food, but the taking of just enough, or of a quality adapted to the nature of the case. Loose bowels weaken very rapidly—total abstinence from all food increases the debility. In this case food should be taken, which, while it tends to arrest the disease, imparts nutriment and strength to the system. In this case rest on a bed, and eating boiled rice, after it has been parched like coffee, will cure three cases out of four of common diarrhœa in a day or two.

Others think that in order to diet effectually, it is all important to do without meat, but allow themselves the widest liberty in all else. But in many cases, in dyspeptic conditions of the system particularly, the course ought to be reversed, because meat is converted into nutriment with the expenditure of less stomach power than vegetables, while a given amount of work does three times as much good, gives three times as much nutriment and strength as vegetable food would.

SCIENTIFIC ITEMS.

All sorts of vessels and utensils may be purified from smells of every kind, by rinsing them out well with charcoal powder, after the grosser impurities have been scoured off with sand and potash.

The paper sheathing invented by Capt. Warren for preventing the fouling of ships' bottoms proves to be a success, as the *Serapis*, after a voyage to India and back, and two months in dock, was found to be quite clean, except where the jelly fish had attached themselves to portions of the cement from which the paper had been removed by abrasion.

Polishing Veneer Wood.—After scraping up veneer, first give a coat of size for stopping up grain, then colour or stain, and proceed to polish. It is a great mistake to use too much oil. For all hard woods the polishing is the same, but not for stopping, as size is generally used for dark woods, and plaster or chrome for light. Putty-lime is a good stain for Honduras mahogany, chestnut, and other woods.

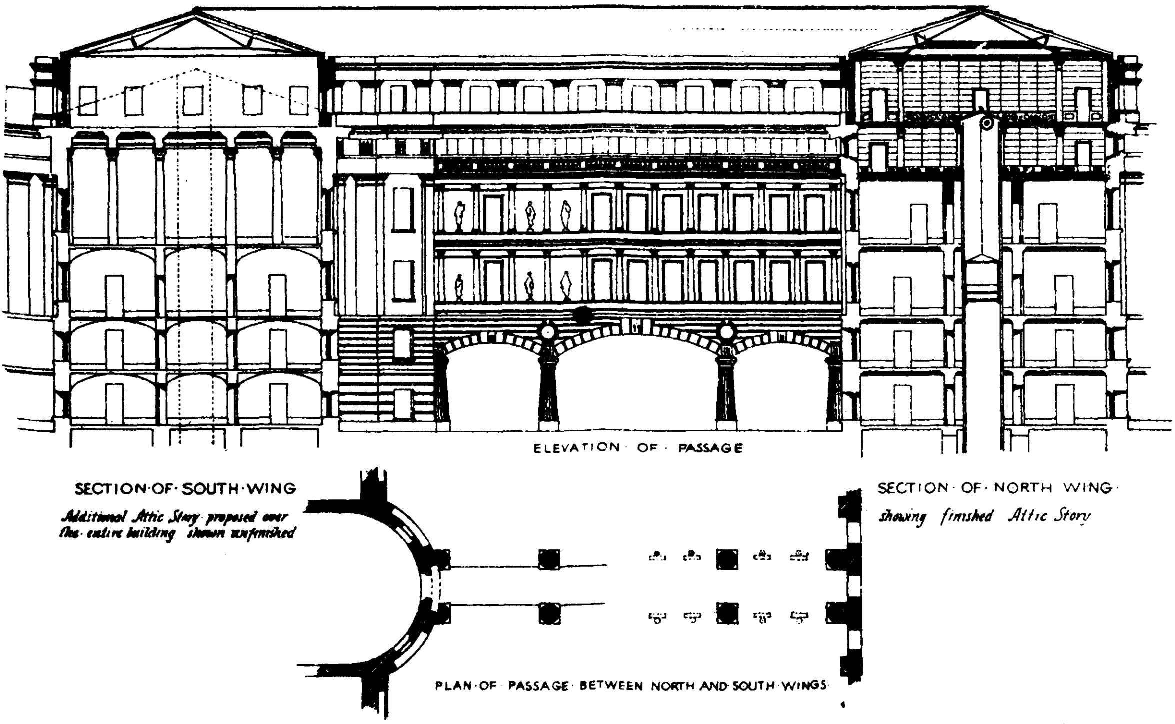
Prof. W. Hoffmann directs attention to the spontaneous ignition of hydrogen. The phenomenon has been noticed in works where large quantities of chloride of zinc are prepared. Fragments of the zinc, when very porous, are lifted above the liquid during the violent evolution of the gas, and act in the same way as spongy platinum in the presence of hydrogen and air. He, therefore, recommends the preparation of zinc chloride out of doors. The ignition of the hydrogen can be shown by treating a few kilogrammes of finely divided zinc with acid. The zinc dust may even ignite upon contact with water.

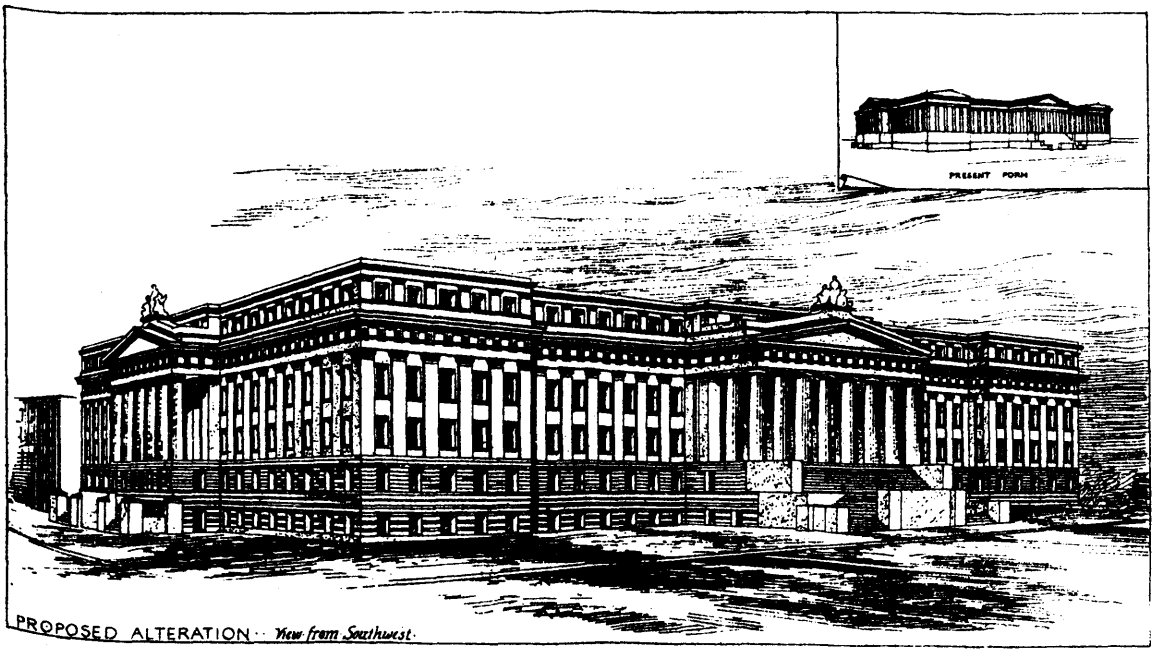
Long Fasts.—Business men are apt to fall into a very dangerous habit of dispensing with their lunch in the middle of the day. The pressure of engagements makes minutes important, and the few required to eat a lunch cannot be conveniently given. Frequently nothing is eaten between breakfast and six o'clock dinner. The fast is too long. Hardly any constitution can stand it permanently. The consequence is dyspepsia, with its low spirits and all its other accompanying horrors. It is not necessary to live to eat; but man must eat, and eat often, to live and be well.

Copy by Photography.—Mr. H. Pellet, a French chemist, has invented a new process for the purpose of making photographic copies of machinery, drawings, plans, maps, &c., in blue lines on a white ground. This process (according to *La Nature*) is based upon the peculiar property of perchloride of iron, by means of which it is changed into protochloride on exposure to light. The inventor prepares a sheet of paper by first dipping it in a solution composed of 100 parts water, 10 parts of perchloride of iron, and 5 parts of oxalic acid. This process renders the paper very sensitive. The paper can be sized as desired by the addition of isinglass, gelatine, or other substances. M. Pellet calls paper so treated cyanafor paper, and when dried in the dark may be kept for almost any length of time. When it is desired to make a drawing on transparent paper, the drawing is stretched over a dry sheet of the cyanafor and a plate of glass placed over this, after which it is exposed to the light. When the full rays of the sun in summer are allowed to fall on the glass it requires from one-fourth to one-half minute to decompose the perchloride of iron. The parts, however, directly under the lines of the drawing, being protected, do not become affected by the light. In winter double this time is required, and in cloudy weather from two to six minutes. The paper is now dipped in a bath of prussiate of potash, the solution being in the proportion of 16 or 18 of the prussiate to 100 of water, and the perchloride where unchanged becomes blue, the changed surface remaining white. The surface of the sheet is then freely washed in water, and dipped in a solution composed of chlohydric, 8 to 10 parts, and water 100 parts, and again washed off in water when the drawing appears in distinct blue lines.

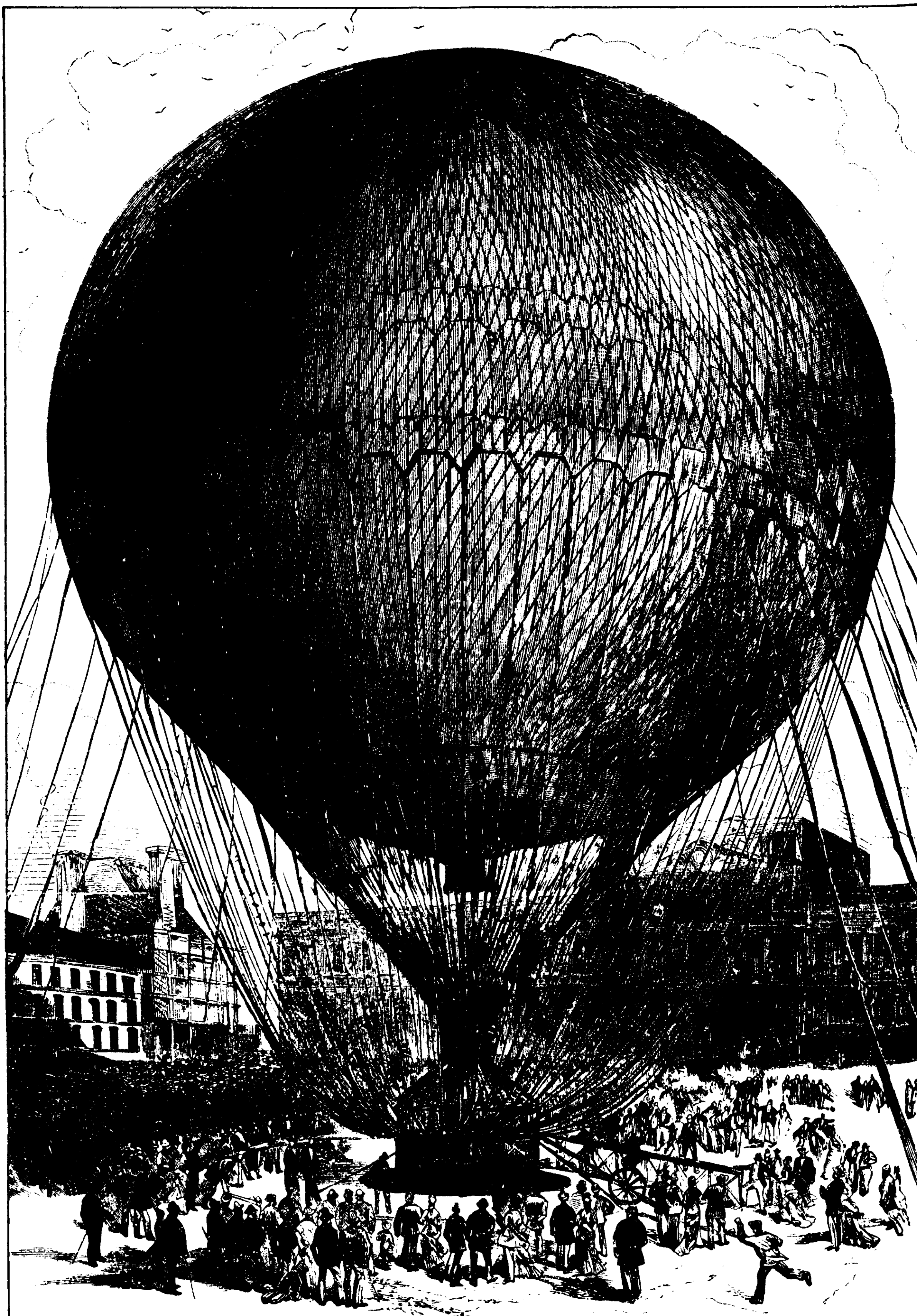
THE PATENT OFFICE, WASHINGTON.

We here copy from the *American Architect and Building News*, the designs which show the proposed alterations as submitted to the committee by the successful competitor, Mr. J. A. Voydagh. The description of these arrangements are printed in the paper above named dated August 31st, 1878.

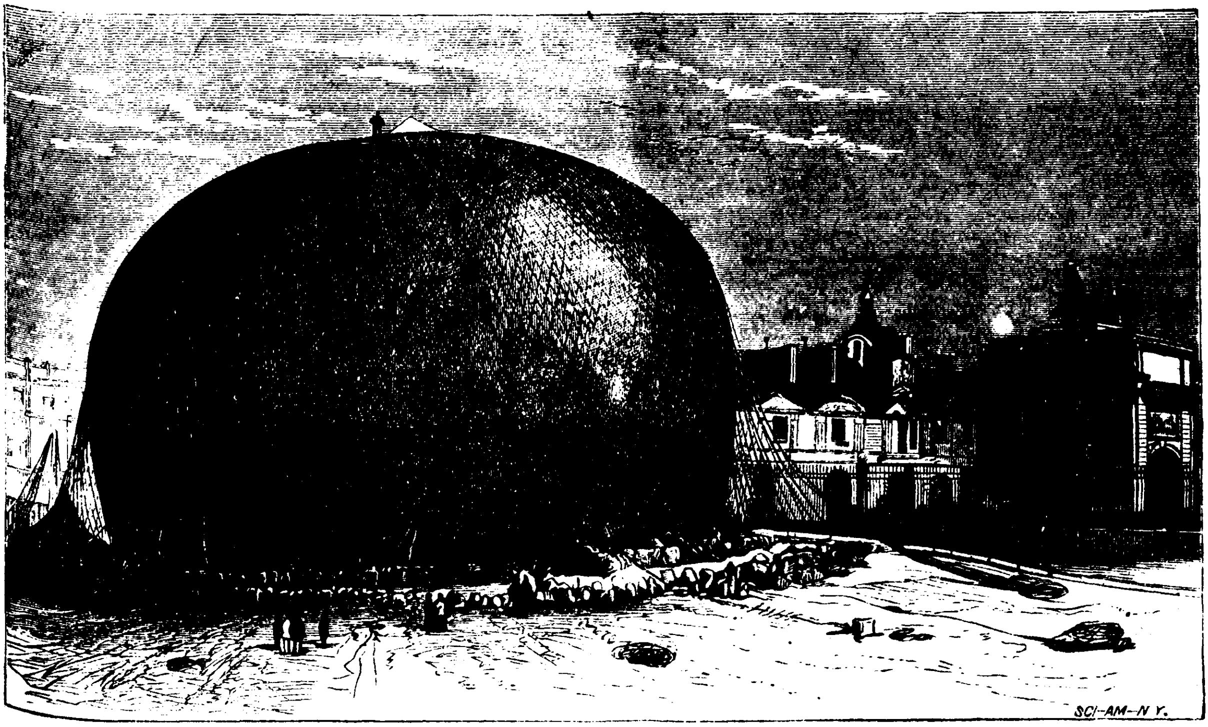




THE PATENT OFFICE, WASHINGTON.



GIFFARD'S CAPTIVE BALLOON OF 1878.



THE INFLATION OF THE BALLOON.

CAPTIVE BALLOON OF 1878.

The "captive" balloon now inflated in the Place du Carrousel of the Tuileries is an object of wonder to Paris at the present time. Viewed from the Arc de Triomphe or any part of the main drive of the Champs Elysée, half of its full height shows above the western façade of the Tuileries, and we observed it plainly in view a day or two since when at Petit-Bourg, 30 kilometers (19 miles) from Paris, when attending the trial of plows at that place.

Its size is something extraordinary, and we shall merely give the figures, omitting the glowing description of the appearance of this remarkable city, which shows better than most others at a bird's-eye view, owing to the size of its main streets, the large buildings and parks, the green avenues, and the winding course and wide quays of its beautiful river.

The balloon has a diameter of 118 feet, and stands, when inflated, 180 feet high. It has 43,057 square feet of surface, and the weight of the envelope is 8,800 pounds. It has eight superposed adherent tissues, of alternating silk and caoutchouc, the outer fabric being varnished and painted with zinc white; 4,000 meters of material which is 1·10 meter wide, are used for each layer, the excess of 0·10 meter being overlap for sewing the silk or uniting the gum goods, as the case may be. Each meter of surface costs 14 francs. The cord netting is 11 millimeters in diameter and weighs 6,600 pounds.

The cubic contents are 847,598 cubic feet, and the cost of the whole enterprise a little over $100,000. The height of ascension is 600 metres (1,968 feet), and the charge for each person 20 francs. The car is annular, being 6 meters in diameter, forming a circular gallery 1 meter wide, with partitions, around a central aperture of 4 meters. It carries 50 persons at a trip, estimated at an average of 60 kilos each; total living burden 3,000 kilos (6,600 pounds).

The cable traverses an underground tunnel in its passage from the winding engine to the balloon. The inflation takes a week of time, at a cost of 62,000 francs, the gas being hydrogen, obtained by the chemical reaction of 100,000 kilos. of iron, 200,000 kilos. of acid, and 500,000 liters of water. The gas traverses a series of purifiers, and is collected in a large reservoir and thence passes to the balloon.—*Scientific American.*

A REMARKABLE FOSSIL.

The August number of the *American Naturalist* contains a description by Prof. E. D. Cope, of this city, of a new Saurian, from the Rocky Mountains, which even exceeds in proportions the monsters already discovered in any region of the earth. A vertebra of this beast has been received in Philadelphia which, when complete, measured over six feet in elevation, which gives a thigh-bone of twelve feet in length. The construction of this vertebra is astonishingly light; the walls and processes being as thin as pasteboard and paper. In fact, such a structure was clearly incapable of sustaining the weight of the muscles, so that it becomes an interesting question as to the mode of life of such a being. As the bones are somewhat like those of deep-sea fishes, Prof. Cope suggests that this and similar species walked on the bottom of the sea and browsed on the algæ and other vegetation which grows on the shore or banks. This animal is called *Amphicœlias fragillimus.*

A MASSIVE DRAIN PIPE MACHINE. — Prof. E. V. Gardner lately delivered a lecture in London on "Clay and the Potter." We find therein a description of what is called the plunger drain-pipe making machine. It occupies two floors of a large building, and consists of a steam cylinder 3 feet 6 inches by 4 feet; within the cylinder is a piston. The piston-rod is attached at its lower end to a plunger. This plunger stands over and fits a dough chest. The bottom of the dough chest has a mold attached, which forms the socket of the pipe. At one time the cylindrical portion of the pipe and the socket were made in two distinct operations, and were afterwards luted and joined together. The dough chest is first filled with dough, then the engineer actuates a steam lever, when with a mighty blow down comes the plunger, and forces the clay into every crack and cranny of the socket mold. The next motion of the machine removes the socket mold and raises a table to support the pipe in its passage out of the machine. A second blow from the plunger delivers the pipe socket complete, a wire cuts off the pipe to a proper length, and a travelling table removes it from the machine. This machine will turn out from 12 to 50 drain pipes a minute, according to their diameter. Pipes of 18 inch or 2 feet diameter are manufactured at the rate of 40 or 50 an hour.

THE ACTION OF BRAKES.

The remarkable and unexpected results obtained during the elaborate experiments with railway brakes, made a few weeks ago on the London and Brighton line, formed the subject of the paper read by Capt. Douglas Galton, at the meeting of the Institution of Mechanical Engineers held in Paris. These experiments form the first of a series which it is intended to make with the view of ascertaining (1) the actual pressure required to produce a maximum retardation of the revolving wheels at different volocities; (2), the actual pressure exerted by the different forms of continuous brakes now in use; (3), the time required to bring the brake-blocks into operation in the several parts of the train; and (4), the retarding power of the existing continuous brakes, tested on trains running under similar conditions of weight and speed. From the enumeration of these heads it will be readily understood that, when completed, we shall have the most important contribution to the literature of the brake question which has hitherto been made; and the first instalment, contained in Capt. Galton's paper, is sufficient evidence of the probable value of the series. The experiments described were undertaken to ascertain the co-efficient of friction between brake-blocks and wheels, and between the wheels and rails, both when the wheels are revolving and when skidded. It is scarcely necessary to insist on the importance of ascertaining by actual test the exact value of a co-efficient upon which the whole system of brakes depends, and the engineering world is much indebted to the London and Brighton Railway Company for the manner in which they have taken up the question, and facilitated the carrying out of the experiments. The experimental van, with the recording apparatus, were designed and constructed by Mr. Westinghouse and Mr. Stroudley respectively, but for our present purpose it is unnecessary to give a description of the means taken to obtain the results. The latter are unquestionably as correct as ingenuity and care could make them, and if they are remarkable, they serve to show that it is the unexpected that always happens. The experiments under notice were made at the end of May near Brighton, the first day being dry, the second stormy and the third fine, with showers. There was thus a sufficient variety of weather to render the experiments of more value than they might have been if made under uniform conditions, but there was not time to collate all the results before sending in the paper. Capt. Galton, therefore, exhibited only a few of the diagrams taken, but these were of so remarkable a character as to excite the keenest attention of the engineers present. In experiment No. 15, May 28th, the brake-van was slipped when travelling at the rate of 40 miles an hour. The pressure on the brake-blocks remained nearly constant during the experiment, and being greater than that required by the co-efficient of friction between the brake-blocks and wheels, due to velocity, the friction increased so rapidly as to cause the wheels to skid immediately. The friction at once decreased rapidly, but rose again as the speed diminished, attaining the maximum as the train came to rest, which it did after many jerks in 12½ seconds. In experiment No. 16, May 28th, the van was again slipped—the speed being 46 miles. The pressure of the air was less than in the previous experiment, and it was gradually diminished during the experiment; consequently the pressure on the blocks was correspondingly reduced. At first the friction between blocks and wheels decreased slightly, but, when the velocity diminished, the friction increased rapidly, and the van came to rest without a jerk in 12 seconds. Thus the quicker stop was made by the revolving wheels which originally were travelling at a higher speed than in the case of the skidded wheels. This effect was exhibited in a decided form by experiment No. 3, May 28th, in which the speed was 44½ miles. The pressure applied to the blocks was sufficient to skid the wheels at once, and the diagram shows that the co-efficient of friction between the blocks and the wheels decreased immediately after the skidding, and did not rise until the end of the experiment, while the tractive force on the draw-bar, at first increased by the act of skidding, largely decreased as soon as the wheels were held by the blocks. In experiment No. 4, May 29th, the engine and van were brought to rest from a speed of 39 miles an hour. The air was allowed to escape from the cylinder through a small hole after the brakes were applied, so that the pressure decreased during the whole experiment. The diagram in this case shows that the retarding force due to the pressure of the blocks was at first diminished until the reduction of velocity reached the point where the increase in the co-efficient of friction was sufficient to overcome the effect of the diminished pressure applied to the blocks. At this point the retarding effect was increased, and the wheels were skidded. The curve immediately rose in a nearly vertical line, showing that the co-efficient of friction became very great as the wheel came to rest—the time during which the wheel was partly rotating, partly slipping, being almost inappreciable. Immediately after the rise the curve fell to a point far below its original position, thus showing that with skidded wheels there is a great diminution in the retarding effect of the brakes. As the velocity continued to decrease the curve steadily rose, thus showing that the co-efficient of friction between the rails and skidded wheels increases as the velocity diminishes. At the moment of coming to rest the co-efficient of friction became very great. The results obtained in these experiments may be taken as a fair sample of the series; from which we learn that the application of brakes to wheels does not appear to retard the rapidity of their rotation, but when it falls below that due to the speed at which the train is moving, immediate skidding is almost inevitable. The resistance resulting from the application of brakes without skidding is greater than that caused by skidded wheels. During the moment of skidding, the retarding force increases enormously, but immediately afterwards falls to less than what it was before skidding. The pressure required to skid is much higher than necessary to hold the wheels, and appears to have a relation to the weight on the wheels themselves as well as to their adhesion and velocity. On this point Capt. Galton says: — "It would seem that the great increase in the frictional resistance of the blocks on the wheels, just before and at the moment of skidding, due to the increase in the co-efficient of friction when the relative motion of the blocks and the wheels becomes small, is what destroys the rotating momentum of the wheel so quickly." With constant pressures the friction between the blocks and the wheels increases as the velocity decreases, until, as the experiments proved, the wheels are skidded. But it was also discovered that in order to obtain the maximum retarding effect the wheels ought never to be skidded, but the pressure on the wheels should at all times be just less than is required for skidding. In order to effect the desired result, then, the pressure between the blocks and wheels ought to be very great when first applied, gradually diminishing as the train comes to rest. Such an outcome from these experiments discloses the fact that all the hand-brakes, and most of the continuous brakes, have been designed to suit conditions which do not exist in practice. The old saying—you can do no more than skid—is shown to be utterly erroneous, and the most successful brake is that one, the inventor of which has unconsciously, as it seems, grasped the true principle.

That the skidding of wheels is not the best way to stop a train has been known and urged persistently by some railway men, and the drivers and guards on most lines have orders to release the brakes when the wheels skid; but, until these experiments demonstrated the fact, not a few drivers and others, engineers amongst them, firmly believed that the skidding of wheels was the readiest method of stopping. It has been objected to mostly because of the wear of the tires—flat places being highly objectionable. So long ago as 1846, Mr. Gooch, while connected with the South-Western Railway, issued a rule to his men that wheels were not to be skidded, and if skidding did take place the brakes were to be immediately released and applied again. Mr. Tomlinson said that every practical engine-man knew that the skidding of wheels was a great mistake; but we venture to think that Mr. Tomlinson need not travel far to find plenty of practical engine-men who would argue the point with him. The gentleman who preceded him in the discussion, Mr. Haswell, expressed his surprise at the results of the experiments described by Capt. Galton, as the Newark trials had led the commissioners to form a contrary opinion as to the value of skidding. Mr. Brown, of Winterthur, speaking from practical experience on lines of heavy gradients in Switzerland, declared that if the wheels were skidded much of the retarding force was lost. Mr. Yeomans said that when the vacuum brake was first applied on the Metropolitan, a vacuum of 15 in.(?) was found to skid the wheels. The drivers were, therefore, ordered not to exceed 12 in. He controverted the opinion that the greatest pressure ought to be applied first, and thought that a sudden application of brake-power destroyed the wheels. Unfortunately no reasons were offered for these opinions, save that Mr. Yeomans had seen wheels that had been destroyed by the sudden application of the Westinghouse brakes. He considered that Capt. Galton's experiments had only confirmed what was well known, and that, to obtain any useful information, experiments extending over many years of actual service were necessary. The companies, however, it must be remembered, have had the hand-brake in use for many years, and it has been left to persons not specially connected with railway work to point out that the hand-brake is radically wrong—for, as every one knows, it is impossible to always avoid skidding with it. In view of that fact, and of the statement that the evil effects of skidding were well known a quarter of a century ago, it does not say much for the inventive skill of the profession that hand-brakes were not long ago improved off our trains. The explanation of the diminished retarding force when the wheels are skidded is most likely that given by Prof. Kennedy, though it might be worth while to study the question experimentally by means of heavy weights resting with a small surface on a metal rail. As long as wheels revolve, says Prof. Kennedy, the surface in contact with the brake is continually changing, so the tire does not become highly polished, but directly the wheels are skidded there is theoretically only a point, and practically only a very small surface, taking all the friction between the rail and the wheel. This surface must be almost instantaneously polished, and the wheel consequently slips along with the least friction possible between it and the rail; for, as is shown by the experiment, the friction increases as the velocity decreases. The paper has now, however, drawn attention to the subject, and it is to be hoped it will be worked out in a thoroughly scientific manner. Capt. Galton deserves thanks for what he has already done, and it is not too much to expect that the companies generally should afford facilities for carrying out further experiments.—*English Mechanic.*

THE COOLING OF STEEL DURING HARDENING.

By Joshua Rose, M.E.

One of the most serious losses common to our tool and implement manufactories is that of the cracking and splitting of steel during the hardening process. Not only is the article or piece lost after having incurred the cost of its manufacture, but in many cases the completion of the machine of which it forms a part is arrested until the lost piece is replaced. In many cases this is done at increased expense, because the piece has to be made singly instead of with a number of others, involving as much setting of machine and adjustment of tools as would be required for a large number of pieces. Successful hardening and tempering is indeed, even under ordinary and unvarying conditions, considered and kept as a trade secret. Visitors are excluded from the hardening and tempering room. In some cases the method of heating, in other cases the material used for heating, in yet others the cooling mixtures form the supposed secret. As a matter of fact, however, some of the very best tool manufacturers employ the simple open fire or furnace and water, and it is probable that with these two simple agents good cast steel can be as successfully and properly hardened for any purpose as it can be under any other process, and the advantage gained by heating in fluxes consists in increased expedition and the necessity for a less expert manipulation.

The splitting or cracking of steel occurs during the cooling part of the hardening process, and is to be easily avoided even with the most unfavourable of steels, if the conditions of cooling are made to conform to the form and size of the article. The cooling is, in a majority of cases, performed by dipping the heated steel in water; and the manner in which the dipping is performed may be made at will to crack, warp, or straighten the article.

The instant the surface of a piece of red-hot steel enters the water a rapid contraction of the submerged portion takes place, and unless this contraction is kept equalised to suit the shape of the article, the side or part most contracted with bend hollow, causing the diametrically opposite metal to bend to accommodate the inner curve. Suppose, for example, we heat a piece of steel, an inch square and 12 inches long, to red heat, and dip it *slowly* in water, so that one side of the square will strike the surface flat and evenly, then that surface will contract while the diametrically opposite or upper surface will remain expanded; the lower face will curve to a concave, the upper one to a convex. If, then, such a bar were curved during the heating process we may help to straighten it by dipping it slowly in the water with its convex side downward. If it was bent at one end only we may dip at that end first diagonally and with the convex side downward. If, however, we dip it with the length lying either diagonally or horizontally, we are apt to warp it, no matter how quickly it may be dipped, and the reason is, in addition to the above, as follow:—Experiments have demonstrated that the greater part of the hardness of steel depends upon the quickness with which its temperature is reduced from about 500° to a few degrees below 500°, and metal heated to 500° must be surrounded by a temperature which renders the existence of water under atmospheric pressure impossible; hence so long as this temperature exists the steel cannot be in contact with the water, or, in other words, the heat from the steel vapourises the immediately surrounding water. The vapour thus formed penetrates the surrounding water and is condensed, and from this action there is surrounding the steel a film of vapour separating the water from the steel, which continues so long as the heat from the steel is sufficiently great to maintain that film against the pressure of the water and the power of the water which rushes towards to the steel to fill the spaces left vacant by the condensation of the vapour as it meets a cooler temperature and condenses. The thickness of the vapour film depends mainly upon the temperature of the steel, but here another consideration claims attention. As the heated steel enters the water the underneath side is constantly meeting water at its normal temperature, while the upper side is surrounded by water that the steel has passed by and, to a certain extent, raised the temperature of. Hence the vapour on the underneath side is the thinnest, because it is attacked with colder water and with greater force, because of the motion of the steel in dipping. Suppose, now, we were to plunge a piece of heated steel into water, and then slowly move it laterally, the side meeting the water would become the hardest, and would be apt to become concave in its length.

From these considerations we may perceive how important a matter the dipping is, especially when it is remembered that the expansion which accompanies the heating is a slow process compared to the contraction which accompanies the cooling (although their amounts are of course precisely equal), and that while unequal expansion can only warp the article, unequal contraction will in a great many, or, indeed, in most cases cause it to crack or split.

After an article is dipped to the required depth it should, if straightness is of importance, be held quite still until reduced to the temperature of the water, because, if taken out before so reduced in temperature, it is especially apt to crack; and it is better to have a deep tank of water if the body of the metal is great, so that the steel may be dipped slowly downwards, and become cooled sufficiently rapidly to harden without any lateral movement, except it be after the steel has lost its redness.

When a piece of steel requires to be hardened at one end only, the dipping must be performed with a view to make the graduation from the soft to the hard metal extend over a broad section of metal, for if the junction of the hardened with the soft metal is abrupt, the hardened end is apt to break short off. The method of dipping, therefore, is in this case to plunge the end of the steel vertically into the water to a depth a little more than equal to the depth it requires hardening, and, after holding it still there until it is black hot (that is, as soon as its redness is gone), dip it slowly a little deeper, and then raise it up to the amount of the increased dipping, and slowly immerse again.

When a piece of metal requires hardening and tempering at one part only, we may heat the steel back of the part to be tempered to redness, and dip the article so as to harden the required part, and leave sufficient heat in the contiguous metal to raise the temperature of the hardened part enough to temper it. This plan is always followed in the tempering of lathe and planer tools, flat drills, etc. If, however, the method of dipping is to hold the steel in the water at an even depth, after the immersion the temper-colour will be very narrow, while, if the steel is raised and lowered in the water, the colour-band will be broad.

Restorative Soup for Invalids.—Take one pound of perfectly fresh beef or fowl, chop it fine, add eight ounces of soft or distilled water, five or six drops of pure hydrochloric acid, 30 or 40 grains of common salt, and stir well together. After three or four hours the whole is to be thrown on a hair sieve, and the fluid allowed to pass through with slight pressure. On the flesh residue in the sieve pour slowly two ounces of distilled water, and let it run through while squeezing the meat. There will be thus obtained about 10 ounces of cold juice, possessing a pleasant taste of soup, of which a wineglassful may be taken at pleasure. It must not be warmed, at least not to a greater extent than can be effected by filling a bottle with it and standing this in hot water, since it is rendered muddy in heat, and deposits a thick coagulum of albumen with the colouring matter of the blood. If from any special circumstance, such as a free secretion of gastric juice, it is deemed undesirable to administer an acid, the soup may be well prepared by merely soaking the minced meat in plain distilled water. Children will frequently take the raw meat simply minced when they are suffering from great debility. One teaspoonful of such meat may be given every three or four hours.

REPAIRING WATER PIPES.

When water pipes are burst by the frost, it is easy to repair them in the following manner. The break is usually as seen at *a*, and is caused by the expansion of the water in the pipe when freezing. In repairing such a break in a lead pipe, first bring the edges near together by hammering, then scrape the surface around the broken part, and solder it; or the piece may be cut out, and a new piece inserted. But for iron pipes, and for lead pipes, when it is not convenient to solder them, a different plan may be followed. A strip of stout canvas soaked in a melted cement, made of pitch and brick dust, is wrapped around the pipe, as shown at *b*, until the injured part is covered, or a piece of sheet rubber may be used as at *c*, taking care that the edges do not meet over the break. If the broken edges of the pipe are sharp and likely to cut the covering, file them down. After the wrapping is placed, it is "served" over with copper wire or tarred hemp as illustrated at *d*. A "serving" mallet is used for this purpose; it is made of a piece of wood hollowed to fit the pipe, and with a hole bored through from the center of the hollowed part to the top of the handle. The wire or hemp is passed through the hole, and as the mallet is made to rotate around the pipe it lays the cord or wire in an even coil upon it. The wrapping may be laid tightly by pressing upon it as it enters the handle of the mallet, or by twisting it once around the same as it comes from the ball. When it is firmly bound, the end may be fastened in any secure manner, and the whole covered with a coating of the pitch and brick dust. These directions will apply to all sorts of pipes where the pressure is not very great; otherwise the wrapping will need to be made stronger to resist the greater pressure.

AMERICAN STEEL.

Only sixteen short years ago the converting of iron into steel was virtually an English monopoly, and Sheffield defied the entire civilized world with her Jessop and Sanderson steel. Our agricultural implements, our tools, our cutlery, required the constant importation of that English metal. To Pittsburg alone belongs the credit of having in a remarkably short space of time reversed the picture, and no industry, perhaps, in these entire United States has made such rapid progress, especially during the last two years, as the manufacture of steel. It may sound strange, but it is nevertheless true, that the manufacture of steel teeth for horse-rakes is received at Pittsburg from England, and the steel now made there is more and more sought for in Europe, as the better quality of our material better suits certain purposes. The letter book of one of the leading steel manufacturers who sells steel to cutlery and agricultural-implement makers all over the country, shows that the latter invariably acknowledge that, though their orders were to make tools from English steel, they would no longer submit to that prejudice, as tests made over and over again proved that the Pittsburg steel was equally good, if not superior in quality. The very fact that such an abundance of it is made in Pittsburg now, and made fit to be used for rails as well as for the fine springs of clocks, is claimed as sufficient evidence that the city has reached that eminence in steel manufacturing which would enable this country to get along easily if there was not a pound of steel imported. The prejudice for the English material only keeps as yet the importation business alive, but day by day it is growing less. Our hammers, our axes, our saws, in fact all our tools, are now being made of the American metal, and the steel manufacturers are continually experimenting with still better ore, which they begin to draw in large quantities from North Carolina.—*N. Y. Herald.*

CURE FOR SUNSTROKE AND APOPLEXY.—A New York physician says: I believe sunstroke and apoplexy can be cured almost surely, if taken in any kind of time.

1. Rub powerfully on the back, head and neck, making horizontal and downward movements. This draws the blood from the front brain, and vitalizes the involuntary nerves.

2. While rubbing, call for cold water immediately, which apply to the face and to the hair on the top and side of the head.

3. Call for a bucketful of water as hot as can be borne, and pour it by dipperfuls on the back, head and neck for several minutes. The effect will be wonderful for vitalizing the medulla oblongata; it vitalizes the whole body, and the patient will generally start up into full conscious life in a very short time.

A SUBURBAN VILLA.

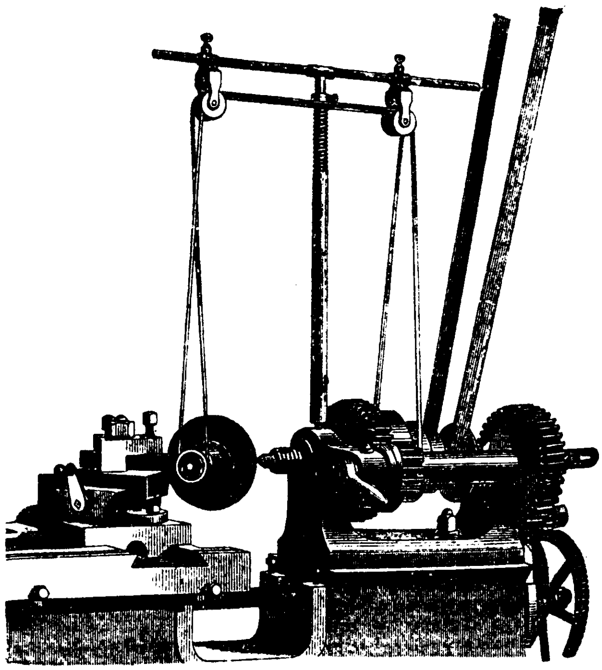
(See page 307.)

The perspective and plans presented to the readers show a design for a villa.

It is a frame building, with cellar walls of brick. The frame is sheathed with matched boards, with sheating over them previous to clap-boarding.

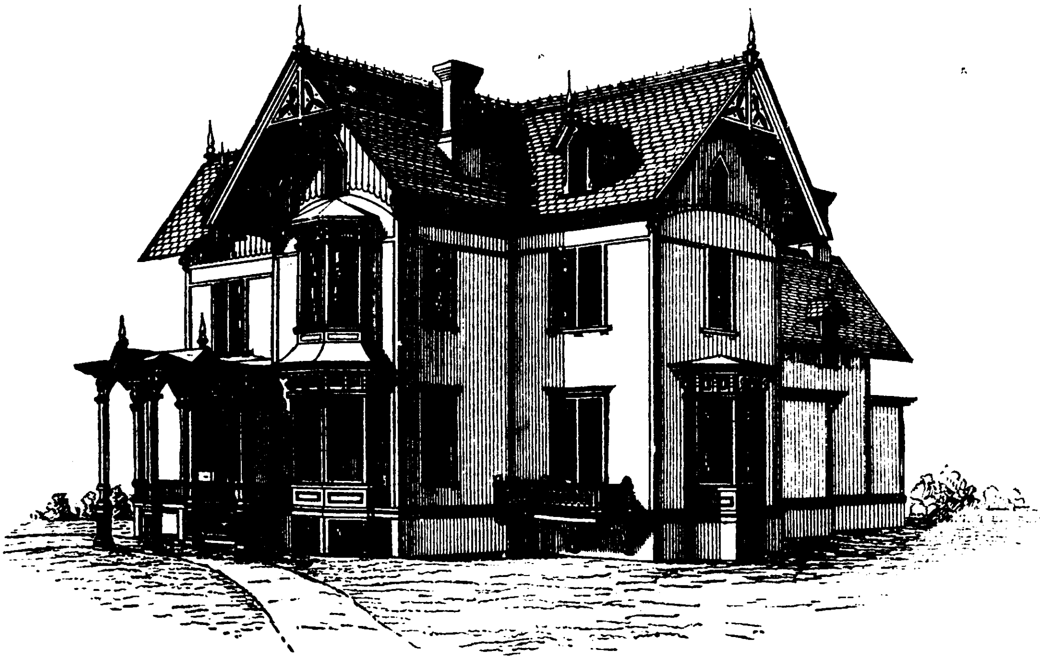
The interior arrangement of the house is good. On the first floor there is a dining-room, 14 x 22 feet; a library, 14 x 18 feet; a billiard-room, 14 x 18.6 feet; a parlor, 14 x 21.3½ feet; and a kitchen, 14 x 19.3 feet. Off the kitchen there is a stôre-room, 7 x 8 feet, while between the latter and the dining and billiard-rooms there is a butler's pantry. A hall extends nearly the entire depth of the house, and at the end of the same there is an office 7.6 x 10 feet. On the front and side there is a large piazza, and there are bay-windows in each of the four principal rooms.

On the second story there are five bed-rooms, one 14 x 19 feet; one 14 x 15.6 feet; one 14 x 19.6 feet; one 14 x 16.3 feet; and one 12 x 14 feet. There is a bath-room 7 x 13 feet, and a dressing-room 7 x 11 feet.

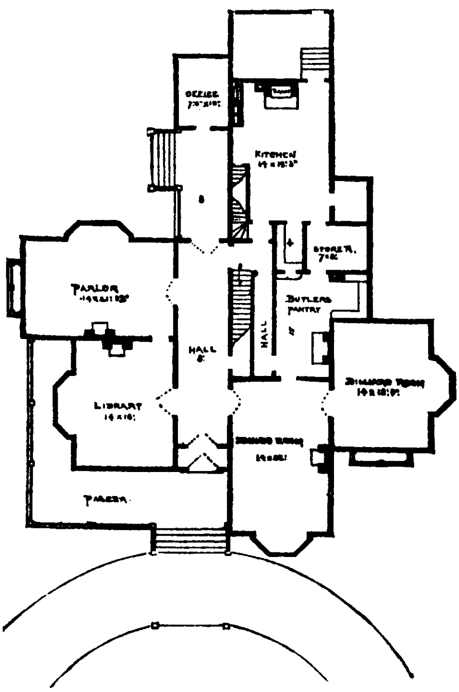


A LATHE-CENTRE GRINDER.

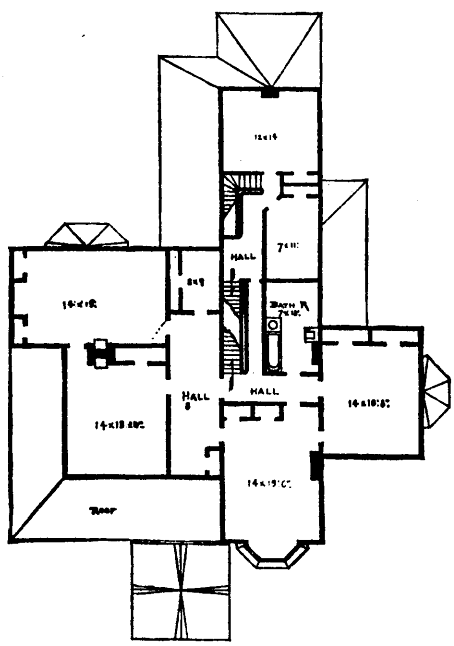
The accompanying engraving shows an ingenious method of applying an emery-wheel for grinding lathe-centres. The usual process occupies considerable time, and is not unaccompanied by a risk of injury, which it is at all times advisable to avoid when possible. The patent lathe-centre grinding machine, manufactured by Messrs. Simon and Co., can be fixed to any lathe in a couple of minutes; will grind the centres true without destroying the temper, and insures accuracy that can only be obtained by the usual means, with the exercise of considerable skill. The holder is held in the slide-rest as shown, the spindle carrying the wheel being conical, so that any wear can be readily taken up by turning a screw. The spindle is surrounded by an oil-chamber, thus obviating the necessity for frequent lubrication, and avoiding the risk of damage from the neglect to which a general tool is usually subjected in a large workshop. To prevent any dust entering the bearing, a leather washer is placed in the holder. The standard carrying the pulleys for the driving belt is made of iron pipe, and is readily adjusted as to height and distance between pulleys. This centre-grinder has been tried for some time at the North London Railway Works, Bow, and, having proved successful, and afforded another instance of the utility of the emery-wheel, is introduced to the notice of machinists.



PERSPECTIVE VIEW OF VILLA.



FIRST-FLOOR PLAN.



SECOND-FLOOR PLAN.

DESIGN FOR A SUBURBAN VILLA,

POISONING WITH ARSENIC.

A recent criminal case in Paris, relating to poisoning with arsenic, presents various features of interest from a scientific point of view.

The facts are briefly these : On the 9th of September last year, the wife of a druggist named Danval died of an ill-defined malady. The first symptoms—vomiting, accompanied by diarrhœa—were followed by a generel wasting away . then the vomitings and diarrhœa recurred with greater violence, accompanied by an incessant cough, night perspiration, and a sensation of burning at the stomach. On the 8th of September, she complained more than ever of this burning sensation, also of her tongue being dry and stiff, and her legs nearly paralysed ; next day she died. She had been eighteen months married.

The doctors who attended her were of very different opinions as to the nature of her illness—Dr. Dervillez supposed muscular and visceral rheumatism ; Dr. Renault, a nervous affection ; Dr. Covin, a commencement of typhoid fever. It should be added that the Drs. Renault and Covin who attended the patient last, prescribed bromide of potassium, bismuth, and finally chlorhydrate of morphine.

The character of this woman's death, and the singular conduct of Danval, excited public attention, so that fifteen days after death an exhumation of the body was ordered, and experts were called in to make a chemical and medical examination of the body—M. L'Hôte for the chemical part, and Drs. Bergeron and Delens for the medical. Danval was arrested, tried in May, and sentenced to penal serviture for life.

The nature and results of this scientific examination (as they are described in *La Nature*) we shall now consider. The experts first noted the remarkable state of preservation of the alimentary canal, which retained the normal colour, and showed no alteration. Having ascertained the absence of all organic poison in the organs, they searched for arsenic, a substance which has, in a high degree, the property of conserving the tissues. They used one of Marsh's apparatuses, taking all possible precautions, and making sure that the reagents used were absolutely free from arsenic. The organs were carbonised with sulphuric acid by the method of Flandin and Danger, then the acid liquid was introduced into the apparatus. The experts observed the formation, on saucers, of spots, which they proved to be spots of arsenic, by means of the usual reagents. Repeating this examination on the various organs of the body, they found that there was arsenic not only in the liver, but also in the stomach and the intestines.

On the other hand arsenic was not found either in the sawdust or in the wood, or in the aromatic preparations mixed with the sawdust round the body. The experts further examined the medicines prepared by Danval, which might have incidentally contained traces of arsenic, also the medicinal wines, and the *vin ordinaire* which the patient drank, but without finding any arsenic. The natural conclusion was that there had certainly been ingestion of arsenic

The defendant, on the request of the judge, designated M. Bonis, professor of toxicology at the Higher School of Pharmacy, for a counter-examination. The portion of the organs that had been left in the body was examined anew by M. Bonis, but by a different method. The liver, stomach, and intestines, analysed separately, were treated with a mixture of hydro-chloric acid and chlorate of potash, to burn the organic matters ; then the liquid was introduced into the Marsh apparatus. M. Bonis thus found that the liver and the intestines contained only a very small quantity of arsenic, and that in the stomach the presence of this substance was doubtful. He estimated the proportion of arsenic contained in the whole body at about 1 milligramme, while (he said) 1 litre of Bourboule water contains 6 to 8 mgr. And, further, he stated that the presence of such a small quantity of arsenic might cause inconvenience, but would not cause death.

The two chemists, while agreeing as to the presence of arsenic, had not the same opinion (as M. Bonis) regarding the amount of it in Madame Danval's body.

Now arsenic does not exist normally in the body. In 1839, Couerbe and Orfila supposed that this metalloid existed in the bones, but since the researches of Orfila, in the works of the Academy Commission designated for the purpose, it has been acknowledged that arsenic does not exist in the system, unless it have been introduced in some form ; and this, notwithstanding the assertions of Raspail, in the Lafarge case, where this chemist maintained that arsenic existed everywhere, and offered to prove to Orfila that his own body contained it.

M. Bonis, then, did not allude to such normal arsenic, but he represented that the arsenic might have been ingested with the medicaments taken by the deceased, especially the bismuth; he also supposed that the arsenic might have come from the curtains of the bed on which Madame Danval lay, as these contained a good deal of it.

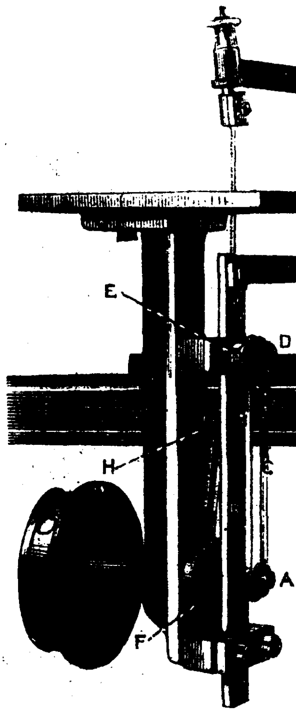
Ores of bismuth, indeed, always contain arsenic, and the first objection was serious. M. L'Hôte met it by analysing subnitrates of bismuth of different commercial origin. Of 22 samples only 3 contained arsenic, and they did not come from those who usually supplied Danval. As to M. Bonis' second observation it was the object of a more ardent discussion. The bed curtains contained about 1 gramme of arsenic per square meter, and there were about 27 m. of material ; particles might, therefore, have been detached and absorbed by the respiratory or alimentary passages. M. Chatin remarked that such absorptions take place, not by the air passages, but by deglutition, with the saliva swallowed. MM. Bergeron and Delens replied that, while aniline dyes and colours, fixed by means of arsenic compounds, had long been used in industry, this substance, engaged in an insoluble combination, was so fixed that it had been impossible to find it either in the fringes or the folds of the curtains, or in the dust gathered near the bed. The lungs contained no trace of arsenic.

The discussion was then transferred to the medical province, where it became more irritating—the experts urging the state of preservation of the alimentary canal, and the whole of the symptoms as characterised by the doctors who attended Madame Danval, which were the ordinary symptoms of poisoning by arsenic ; also the absence of any other cause to explain the death, demonstrated by the normal state of all the organs ; and, lastly, the unexplained presence of arsenic, concluded poisoning. If the arsenic was not found in greater quantity, this was because it had been eliminated by ordinary processes, arsenic being a body which is very rapidly carried off from the system, especially by the urine, and in this respect being unlike some other poisons which are localised in certain organs (*e. g.*, copper in the liver.) To these arguments, M. Gubles added the weight of his high medical authority, in favour of the probability of poisoning; citing exceptional cases, however, where people who had swallowed a coffee spoonful of arsenious acid had escaped all the primary lesions, and got off—an important point, since it concerned the case especially to know whether or not slow poisonings by arsenic necessarily produce organic lesions and fatty degeneration of the liver, as MM. Bonis, Cornil and Gallard affirmed. Mr. Cornil, indeed, remarked in the course of the trial that, unfortunately, all histological examination of the brain, the liver, the pancreas, and the kidneys, had been omitted. In absence of the important elements with such an examination might have introduced, the conclusions of the experts not affirming any lesion, MM. Bonis, Cornil, and Gallard were within their rôle in maintaining that arsenic taken in small quantities always produces lesions. The jury accepted the affirmations of the experts, and condemned Danval as guilty of poisoning by arsenic.

It is rendered evident by such debates that the physiological action of compounds of arsenic is not yet adequately known. A thorough investigation of the effects of this poison on the system would lead to results most useful in the case of trials like that above described.

PAINLESS OPERATIONS.—The antiseptic method of surgery which has but recently been introduced into this country, has been twice successfully tried at the Alexian Brothers' Hospital, Chicago, during the past two weeks. In each case a leg was amputated, and the patient rapidly recovered, experiencing no pain whatever from the use of the surgical instruments. The method of operation is as follows :—The surface of the limb to be amputated is first sponged with a solution of one part carbolic acid to 20 parts water. The instruments are placed in a solution of one part carbolic acid to 40 of water. While the operation is going on, a spray atomizer throws a stream of solution of carbolic acid, one part to 40 of water, into the wound. This makes the operation perfectly painless, and does away with the necessity for using chloroform or ether. The wound is then dressed with oiled silk saturated with sulphate of lead, which indicates the presence of sulphate of hydrogen by turning black, and shows whether the wound is suppurating. Six layers of medicated gauze are then placed over the wound, and the whole is covered with Mackintosh cloth.

THE Lord Rosse telescope is, as compared with the human eye, as 130,000 to 1 ; it has a penetrating power of 500, and can render visible stars whose light would require 60,000 years to reach our earth.



A HANDY FRET-SAW MACHINE.

TRANSPARENCIES FOR WINDOW ORNAMENTATION.

There are certain principles which we would lay down as a basis for this application of our art, the first of these being that the window or door-pane to be ornamented must have its transparency destroyed, by which is meant that it must be so treated as to render it impossible to be seen through. The general function of an ornamental window is to prevent an unpleasant or inartistic scene outside from being perceived by those inside; and it is well known to some of our readers that one of the largest and finest windows of the kind we are describing intercepts and blocks out by such artistic means the view of a coach-house and stable with their accompanying stable-yard. Those whom we have captivated by this choice specimen of the united work of the photographer and painter had no conception of the fact that as a background to this work of art, although unseen by the spectator, the unpleasant erections named stand at a distance of thirty feet. A second principle that should be recognised is that of having the picture of a vignetted, sketchy character. The tone, unless when the nature of the subject otherwise demands it, should be warm and "sunshiny."

There are three mediums which may be made use of, as the bases upon which to print the transparency—namely, paper, opal, and ground glass. It is very fortunate that the first is at once the best, the easiest, the cheapest, the most convenient of these various bases. But if the image is to be formed upon it by silver printing, a method quite different from that employed in ordinary practice must be made use of; for, whereas in an ordinary photograph it is essential that the image be on the surface, it is here one of the conditions of success that it be sunk into and distributed through the entire substance of the paper. The difference between these two conditions may be easily exemplified by dividing a sensitive sheet of albumenised paper into two, and printing one of them with the albumen surface, and the other with the back of the paper next to the negative, the printing being carried out in the second case until the image is clearly visible upon the albumen. Now examine the two prints as transparencies, and it will be seen how much more vigorous is the one than the other. To prepare paper for transparency printing it should be immersed in and not merely floated upon the silver bath. Several very fine window transparencies we have seen are made upon plain salted paper.

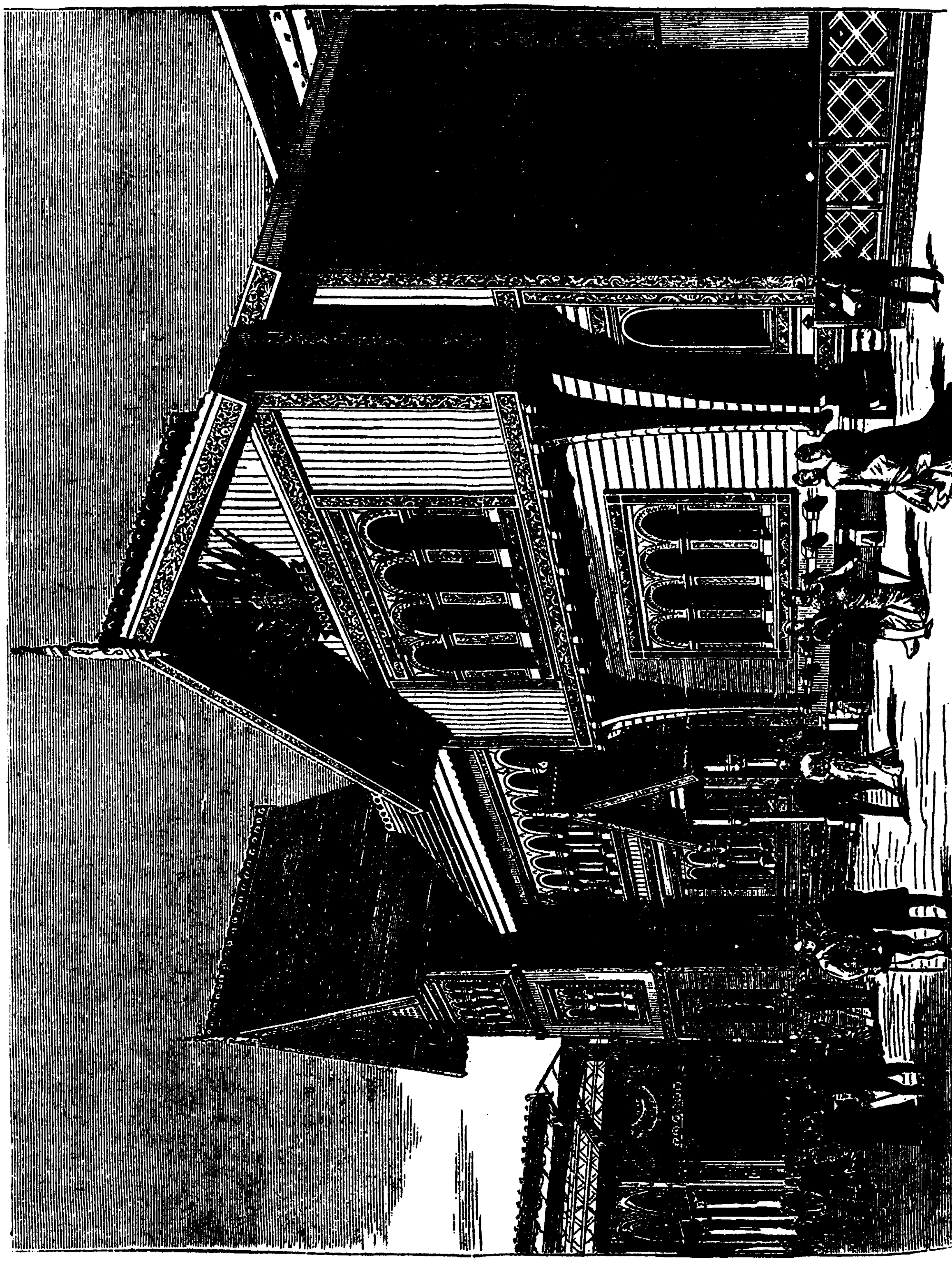
There does not appear to be any special condition required in the selection of paper for this purpose beyond this—that it must be wove and not wire-laid paper. Plain, unalbumenised Saxe or Rives papers answer admirably, and the only preparation required is a primary immersion in a ten-grain solution of chloride of sodium, followed, after drying, by immersion in a thirty or forty-grain solution of nitrate of silver. The printing must be carried to a great degree of depth to allow of the reduction that will ensue upon the fixing; for the gold toning will be so slight as not to interpose any great obstacle to the solvent action of the hyposulphite of soda upon the silver of which the print is composed. It will be borne in mind that what we are now aiming at is the production of a very deep, warm-colored transparency.

This having been obtained, the next step is to render it transparent and attach it to the window pane. It will be understood that the degree of transparency to which the print will be amenable falls far short of that by which objects at a distance can be perceived through the pictorally-ornamented glass; in short, it is the transparence, or, more correctly, the *translucence* of ground glass or of pot-opal that is required. To such end provide a rather weak solution of Canada balsam in benzole, and apply this repeatedly to the picture until the transparency acquired by the first touch of the varnish brush, and which disappears upon the evaporation of the benzole, becomes permanent. Three or four applications of the varnish may be required ere this is attained.

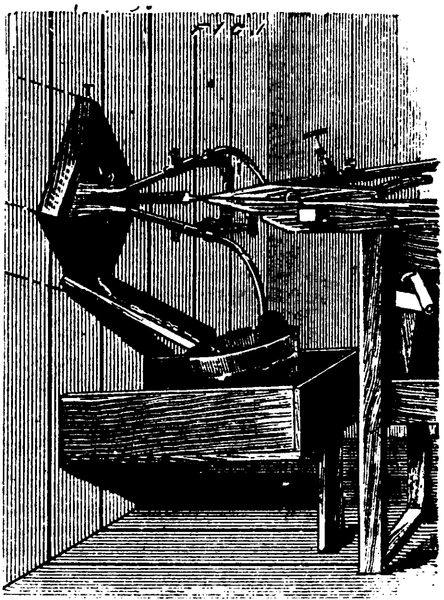
The glass plate having been cleaned is coated with the same varnish, which, for this purpose, thould be strengthened by the addition of more balsam; and a similar coating having been given to that side of the print that is to be placed in contact with it, an attachment is made commencing at the foot, and keeping the outer portion of the print curved outwards so as to admit of a continuous layer of the liquid varnish remaining at the point of junction between the paper and the glass, until the two are brought into contact up to the top. This ensures the avoidance of air bubbles, which, although they may be rubbed out, are yet better avoided. When the whole has become thoroughly dry the services of the artist may be utilised to examine the whole critically, and complete the effect by imparting a little more depth here and there as may appear necessary. In the manner now described have been produced a series of the finest window transparencies we have yet seen.

A friend of ours having a cultivated photographic taste, became the fortunate possessor of a yacht in which were a pair of folding doors with ground plate-glass panes of large dimensions, having a very handsome border, embodying a floral design surrounding each. The centre was adorned with the arms of a previous possessor, for whom the vessel had been constructed. Both the ornate border and the arms were deeply engraved by means of fluoric acid, which, when applied as a fluid, causes the surface acted upon to be of a glossy, smooth texture compared with the matt surface that results from effecting the etching or engraving by fluoric acid *gas*. What was required was the means of removing the arms, leaving the *entourage* intact. This has been effectively accomplished by covering the former with a photographic paper transparency prepared as we have described, with an additional element of colors, the transparent oil colors employed having been those found most effective in the coloring of lantern slides—namely, Prussian blue, gamboge, burnt and raw sienna, with madder and carmine for the reds. By means of these colors every combination of tint may be made. The pictures prepared in this manner possess a very fine appearance, no trace of the still existing arms being visible. It will be understood that although we have described in detail the method of printing by silver, pigmented tissue may be made use of with equal facility and with the further advantage of permanence.—*British Journal of Photography.*

COLOURING BRASS.—The *Polytechnic* translates from a German authority the old recipe for the production of various colours on brass, but which, as it may be new to many of our readers, we reproduce: Dissolve 60 grains bitartate of potassa in a liter of water, to which add 30 grains tin salt (protochloride of tin) dissolved in a fifth of a liter, heat to boiling, and allow the resulting precipitate to settle. The clear liquid is now to be poured, under constant stirring, into a solution of 180 grams of hyposulphite of soda in one-fourth liter of water, and again heated to boiling, during which operation a quantity of sulphur will be separated. The resulting clear solution is now ready for use, and gives to brass articles suspended in it, or when applied on the metallic surface, according to the length of the exposure or the amount of the application, a great variety of shades of colour. First follows a light colour, then all shades successively from red, dark blue, light blue, and finally brown. The sulphide of copper produced similar effects.

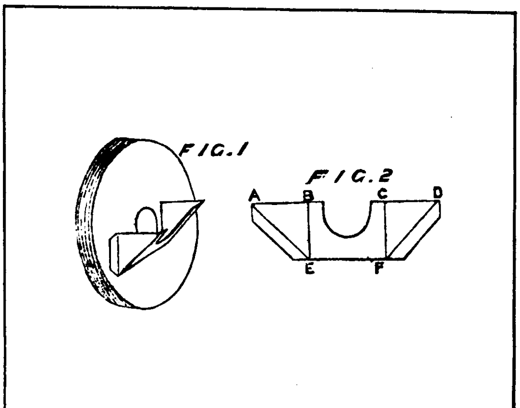


PARIS EXHIBITION.—THE NORWEGIAN BUILDING.



SHARPENING FILES BY THE SAND-BLAST.

A method of utilising the sand-blast for the sharpening of files has been recently devised, and promises to become of no little value in engineering workshops. The patentee in the United States is, we believe, Mr. M. A. Richardson, of Bridgeport, Conn., but the invention is understood to be that of Mr. Tilglumann, the original introducer of the sand-blast. Various methods of re-sharpening new files have been tried, including pickling in acid, but the only satisfactory method is to have them re-cut, and from an economical point of view it is doubtful whether any advantage is obtained by those who send files to be re-cut, over those who either sell or utilise them for other purposes when worn out. In Fig. 1 the general arrangement of the sand-blast re-sharpening process is shown, the bench or table or carriage on which the file is secured, and which supports the gear for moving the file to and fro, and at the same time imparting a side to side motion, being omitted. S is the steam-pipe connected to the branch supplying the injectors, which draw up the sand from the pail and force it against the file held in a clamp, as shown. The steam, sand, and water are received in the tube, T, shown passing through the partition or wall, whence they fall down to the pail or other receptacle. The sand is fine, and is specially prepared for the purpose by washing. It is mixed with sufficient water to form a very thin mud, and after a time must, of course, be entirely renewed. Before describing the results of experiments made with the process, it will be advisable to examine a file as a cutting instrument. No process has yet been devised for cutting the teeth of files theoretically perfect, the tools employed for the purpose invariably producing a burr or backward curve in the teeth, which speedily wears or breaks off in the rough work to which a file is put. Figs. 2 and 3 show the form of teeth actually found in files, and that which is theoretically perfect. In Fig. 2, which is slightly exaggerated, the cutting faces of the teeth, instead of looking straight to the point of the file, appear to be studying the ceiling, as if afraid of looking at the piece of iron they are called upon to scratch. In Fig. 3, on the contrary, the teeth face the work, and are evidently strong-backed. It will be readily understood the teeth of Fig. 2 are more liable to break than those of Fig. 3, but it is not so obvious why the impinging of a jet of sand upon the teeth should improve even a new file. It might be supposed at first sight that the sand would abrade the teeth equally all over, and so leave the file in much the same condition as before; but those who have worked the sand-blast, and know what a very slight covering serves to protect glass from its influence, will readily understand that the angles at which the particles of sand strike the file and the elasticity or resistance of the latter are important conditions in the satisfactory working of the process. The jet of steam and sand is directed against the backs of the teeth at an angle of from 10° to 15° from the face of the file, and the effect is represented with but little exaggeration in Fig. 3, the tops of the teeth being cut away, leaving a sharp firmly-supported edge. The wear of these might be represented by drawing a straight line just below the points or edges of the teeth, and it will then be easily discerned that the effect of a second application of the sand-blast will be to remove the metal from the backs of the teeth until the flat places have given place to a sharp edge. Many workshops in New England, especially in Connecticut, have adopted it, and at least one large manufactory has obtained a license to apply it in the finishing of their files. In a trial of the cutting power of the sharpened files as compared with the ordinary tool, one side of a 10in. bastard was used to file a piece of clean weighed wrought iron, care being taken to make the strokes equal in every respect. The number of strokes and the weight of metal removed were then noted, and the other side of the file, which had meantime been submitted to the sand-blast, was employed to make an equal number of similar strokes. The result was that double the weight of metal was removed by the sand-blasted side. In further experiments, after several re-sharpenings, the one side of the file demonstrated its superiority by cutting as much metal as six sides of files to which the blast was not applied, cutting at the same time about half as fast again. A few seconds suffice to re-sharpen a newly-worn file; but as the file is successively worn down and re-sharpened, the duration of the sharpening process increases, until the blast fails to be effective. The file can then be re-cut in the usual manner. The new process has already attracted some attention, and we shall, no doubt, soon hear of its adoption in this country, with details of further experiments.—*English Mechanic.*



AN EASILY-CONSTRUCTED CAMERA LUCIDA.

For the benefit of those with whom, as with myself, expense is a consideration, I send the following description of an easily-constructed camera lucida, which I made in about ten minutes. I first procured a pill-box lid which just fitted on to the eye-piece of my microscope, and in the centre of it made a circular aperture about the size of the top lens of the eyepiece. I then cut a piece of card to the shape of Fig. 2, in which the angles A E B and C F D are both 45°, just nicked with a penknife along the lines A E, B E C F, and D F, and with a little gum affixed to the lid, as in Fig. 1. A piece of thin covering glass attached to B E C F, and therefore inclined at an angle of 45°, completed the apparatus, which answered remarkably well. G. G.—*English Mechanic.*

THE latest novelty in Paris is reported to be the handkerchief barometer. A design, usually a man with an umbrella, is printed on the handkerchief with chloride of cobalt. The figure in fine weather appears blue; in changeable, gray; and in rainy weather, white. The first washing removes the salt. The idea is the same as that of the flower barometers lately described.

NOTWITHSTANDING the prodigious rapidity with which sensation is transmitted by the nerves to the brain, if a man's arm were long enough for him to touch the sun, it would require more than three years before he would be made aware that his fingers were hot.

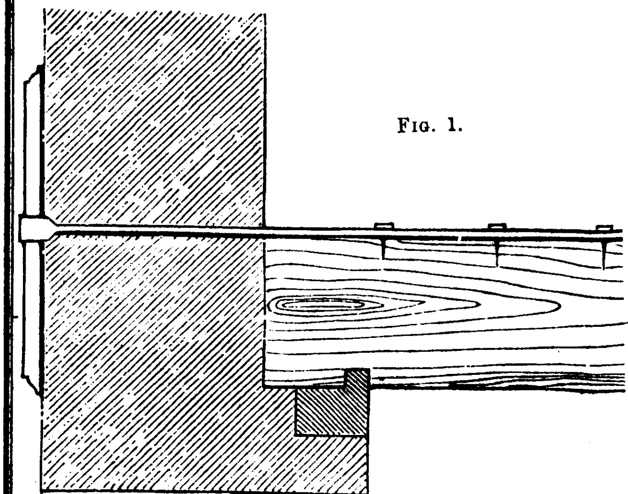


FIG. 1.

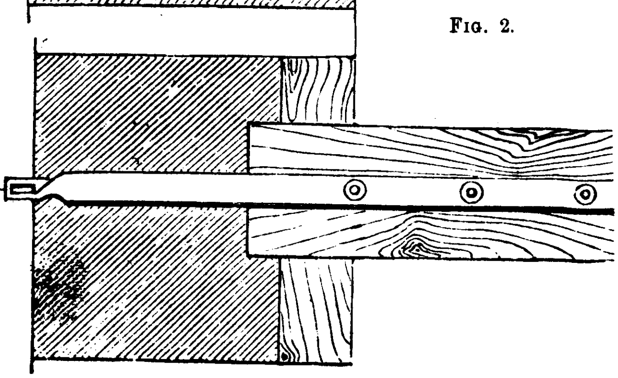


FIG. 2.

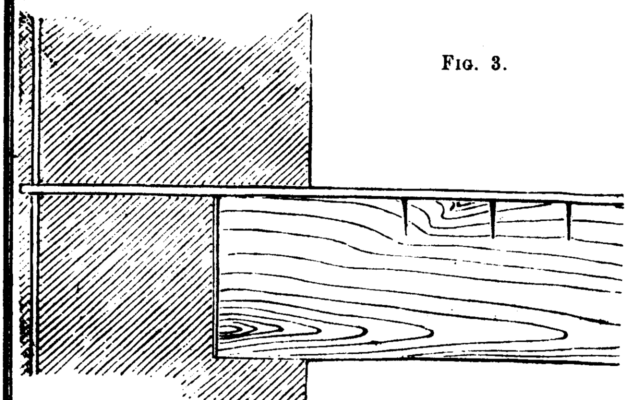


FIG. 3.

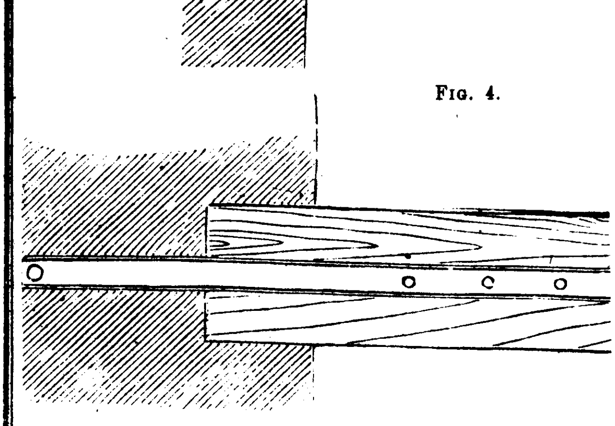


FIG. 4.

CONSTRUCTIVE CARPENTRY

The diagrams shown on the opposite column will be obvious to the student in architecture. The method of connecting the tie beams to the wall either by circular plates outside of the wall, or by S's or by plates or bolts inserted inside the stone or brick-work so as not to be observable outside, are shown in Figs. 1, 2, 3, and 4.

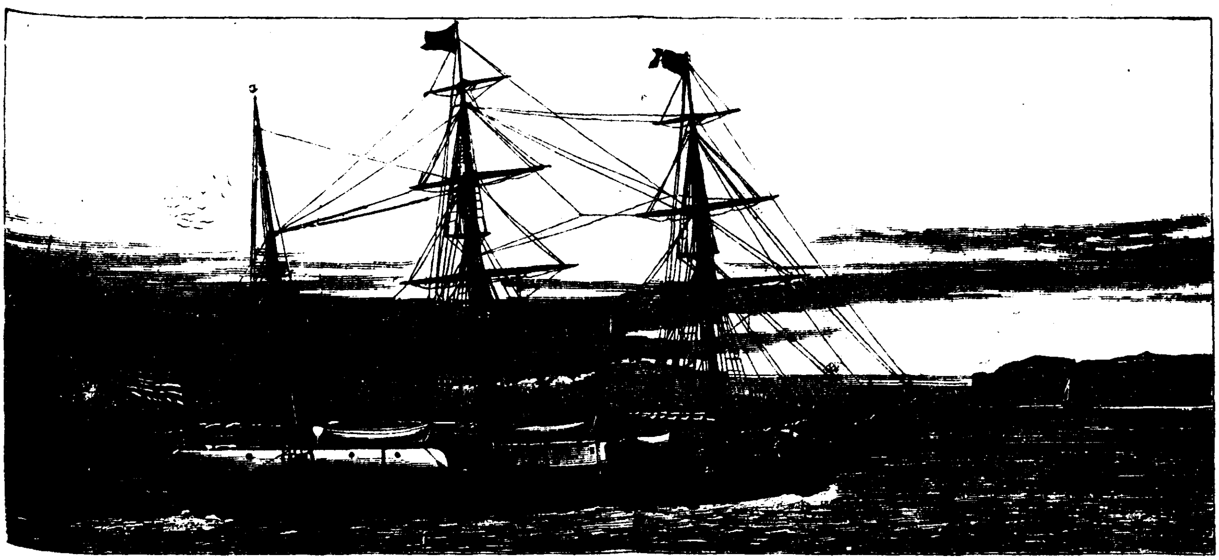
AMERICAN OYSTERS.

Can any one who has tasted American oysters say if the following is true? I cut it from the *Scientific American*, which is an out-and-out believer in everything American;—"It is a well-known fact that the edible oyster (*Ostrea edulis*) attains its full growth and proper flavor only in the waters of the American coast; and that its representative in Great Britain, owing perhaps to some trouble in its 'environments,' has dwindled down to a minute coppery-flavored bivalve, which affords to the evolutionist a melancholy example of 'reversion,' and to the American gastronome an object of aversion. It is no wonder, then, that when one of our American oysters is seen for the first time by an inhabitant of the British Isles, it should call forth expressions of great surprise."

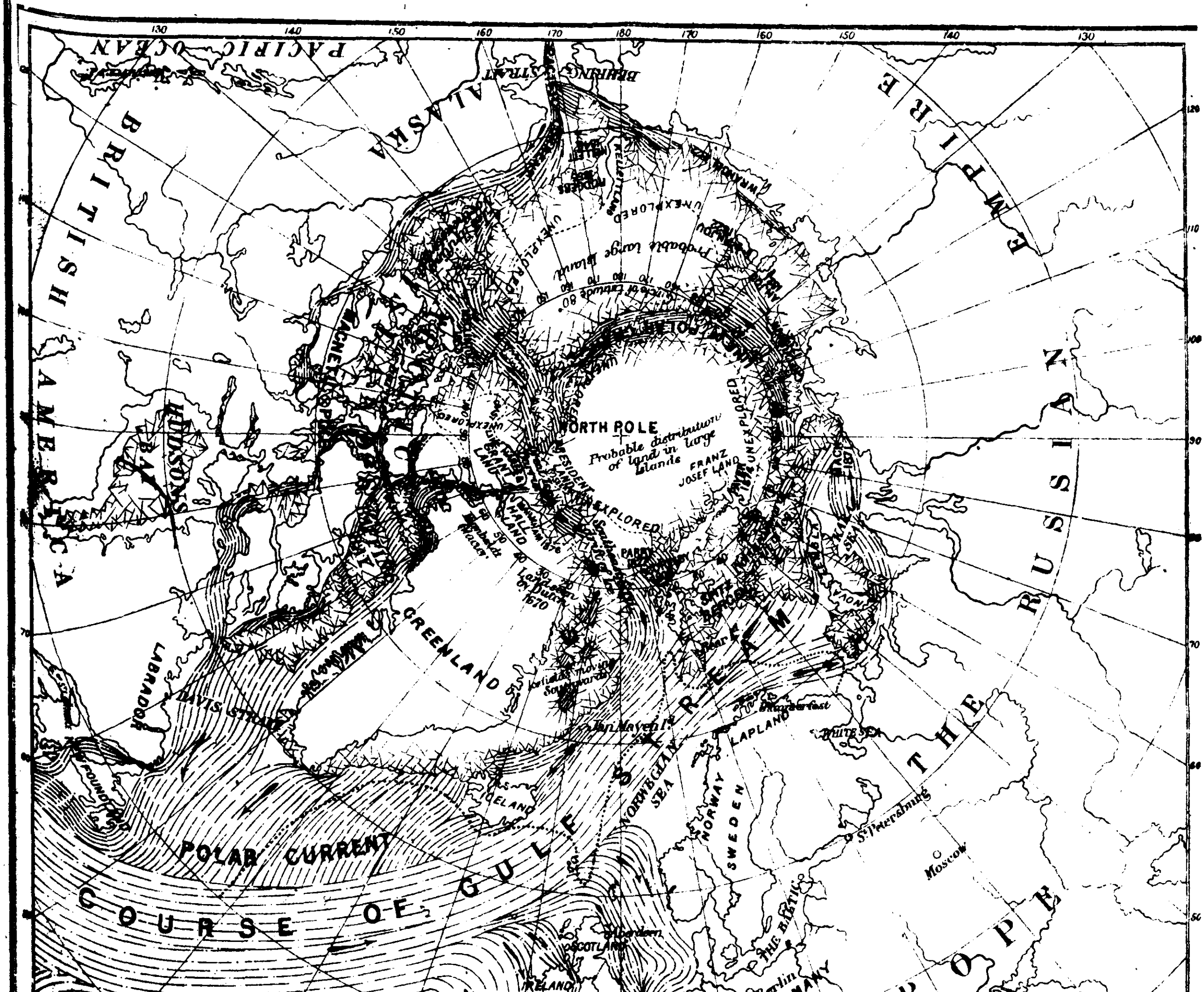
The "native" a "minute coppery-flavored bivalve!" Good gracious, has this gentleman ever tasted a real "native," which costs, nowadays, 3d. in the City, while his wonderful "blue points" can be had 14 for a shilling, done up in a bag? According to Lieutenant Broca, the Chesapeake oyster is sometimes 15 in. long and 3½ in. wide, large enough, goodness knows. But he also says that he has eaten oysters from the most celebrated localities, and always found them somewhat insipid in taste, "a marked characteristic of the species" (American). As a matter of fact, the oyster from Virginia is found in the fossil state in the neighbourhood of Bordeaux, so that American oysters have not yet been developed. Blue points may be better in the States than they are here, but I can't imagine any one preferring them to "natives." I believe American oysters are excellent when cooked, but as the real epicure eats them, they cannot compare with our natives or the bivalves of Arachon. Will any of your readers resident in the States tell us if either of the three American species, Virginiana, Borealis, or Canadensis, is equal in flavor to our native or even our common oyster, which some years ago was sold at about two a penny? The "canned oysters" sent here are, in my experience, tough morsels, fit only for the stew-pan, and a good deal of it they require. I have not ventured on "blue points," though I like the Anglo-Portugo; but if they are so much superior to our "minute coppery-flavored bivalves," it's really a wonder they sell them at a third the price.—HEMATOPUS.

PEAT MADE INTO CEMENT.

One of the most novel manufactures proposed abroad is that of Mr. J. C. Russell, of London, who makes cement of peat. The peat as cut from the bog is first dried by any suitable means, and broken up or pulped with nearly its own weight of gas tar. The peat or tan, as the case may be, is put into a kettle, and may, if desired, be well mixed with a sufficient quantity of cocoanut fibre or oakum, or cotton waste, or small twigs, or leather, or bulrushes, or grasses, or any of these together, or any material of a fibrous nature to give the product sufficient tenacity. The mixture is then mixed with either a combination of gas tar, pitch, Stockholm tar, Trinidad pitch, naphtha, benzole, spirit of turpentine, quicklime, hydraulic lime, chalk, pezzuolan, well washed or sifted sharp sand, flint glass in fine powder, any aluminous, calcareous, or silicious minerals or mixtures— Portland or hydraulic cement, iron filings or borings, slag, or scoria. The whole mass is well stirred, and heated by means of super-heated steam or otherwise until the materials which are capable of being softened or melted by a low heat that will not destroy the peat or tan, are melted or softened enough to enable the different materials used to become thoroughly mixed together, and the whole mass is finally raised to a temperature of at least 400° Fahrenheit. When used for paving purposes the material is removed from the receptacle in its heated state, and spread over the prepared surface or foundation of the road or other place, and consolidated by means of hot beaters or pressures until it is thoroughly set and even. In making drain pipes, the material in a hot state is transferred to suitable molds or to a drain pipe-making machine, and the pipes are made in the usual way of making earthenware-pipes or otherwise.



THE "JEANETTE," LATE "PANDORA," THE YACHT NOW BEING FITTED OUT FOR POLAR EXPLORATION BY MR. JAMES GORDON BENNETT



MAP OF THE POLAR REGIONS, SHOWING THE MOST NORTHERLY POINTS WHICH PREVIOUS ARCTIC EXPLORERS HAVE ATTAINED IN THEIR ATTEMPTS TO REACH THE NORTH POLE

THE AMERICAN ARCTIC EXPEDITION.

WHO INVENTED THE MICROPHONE?

During the past week we have received several American papers containing articles, reports, and letters referring to the disputed claim to the invention of the microphone. Some of these bear the stamp of the Edison Laboratory, Menlo Park, from which we assume that we may accept as authentic the statements reported to have been made by Mr. Edison. In one paper, the New York *Sun*, of June 9, we find an account of an interview which a reporter of that journal had with Mr. Edison, to whom he showed the accounts in the London papers of Mr. Preece's lecture on the microphone. After a perusal of these accounts Mr. Edison is represented to have said: "I declare that is the coolest, cleanest steal that I ever knew. This man talks of this thing as though it were entirely new, and as though he believed it was the invention of Hughes, when he has the most positive evidence that the thing is mine." In reply to a question whether Mr. Edison had shown Mr. Preece the microphone, the former is represented to have said: "Of course I did, because the microphone is contained in the telephone; it is nothing but a finely-adjusted telephone. To say that the microphone is a superior invention to the telephone is absurd, because it is only a part of the telephone. There would be no use in adjusting a telephone to such a delicate pitch, because the jar of a building, the hum and roar of the city would keep up a continual buzz." Mr. Edison, in short, claims that the principle of the whole thing is based on his undisputed discovery that certain substances, called "semi-conductors," such as carbon, several oxides and sulphides, vary their resistance to the passage of the electrical current when subjected to pressure, and in July, 1877, he "filed a patent" for an instrument which is, when properly adjusted for transmitting the sound of the voice, a telephone, but when delicately adjusted, which can be done by turning a screw, a microphone. Mr. Edison states that Mr. Preece was shown over 200 different combinations of one material and another with carbon, and also the effect of pressure on the passage of the current. The reporter of the *Sun* gives an extract from a letter addressed to Mr. Edison by Mr. Preece, in which the latter says: "Hughes' doings border very closely upon yours, and it is quite difficult to distinguish between what you have done." Under the circumstances Mr. Edison thinks it quite impossible to point out the difference, for he contends that the whole principle of the discovery was published by him a year ago, and six months ago he obtained a British patent for what Prof. Hughes "pretends to have discovered." Mr. Edison is represented as saying that "if you take the shilling piece and this nail business that he talks about, it will give sound. By means of the carbon we reproduce the original sound........ The discovery that I have made and patented consists in finding some material that would transmit waves of electric current which should be proportionate to the sound waves. That was my discovery." In the Washington *Star* of April 26, 1878, we have a report of the proceedings at the National Academy of Sciences, in which we find the following epitome of Prof. Barker's speech when introducing Edison's telephone:—"The peculiar point about Mr. Edison's invention is a little plate of carbon in the instrument, on which its efficiency depends. Carbon is susceptible to a difference in conductivity by a change in pressure. Mr. Edison has succeeded in discovering a kind so suitable for his purpose that pressure of the most extreme delicacy, even the slightest breath, may be detected. He is the discoverer of the principle on which his telephone operates, and not simply an inventor." The last sentence should help to settle the question in dispute; but while we have thought it right to give Mr. Edison's version, we must not omit the following sentence which occurs in Prof. Hughes' paper, and which has been reproduced in the reprints of it published in America:—"Edison and others," says Prof. Hughes, "have produced variations in the strength of a constant current by causing the diaphragm to press directly upon some elastic conductor, such as carbon, spongy platinum, &c., the varying pressure upon these materials varying the resistance of the circuit, and consequently the strength of current flowing." If Prof. Hughes has not gone further than Edison, it seems strange that he should have taken the trouble to mention what the latter had accomplished. However, both sides have now been heard, and we leave the facts to speak for themselves.—*English Mechanic.*

NOTE.—Since this article was published, Mr. Edison has been awarded the prize at the Paris Exposition.

WATERPROOF GLUE.—Fine shreds of Indiarubber dissolved in warm copal varnish make a waterproof cement for wood and leather.

A HANDY FRET-SAW MACHINE.

(See page 309.)

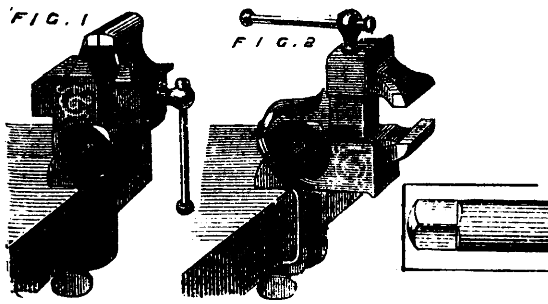
I inclose a photograph of a fret-saw machine I have made, and which I find a very useful addition to my workshop. It can be fixed either upon the lathe bed and driven from a pulley upon the crank shaft, or it may be fixed upon a bench and driven from any source of power. I drive it about three hundred strokes per minute, and can cut baywood 1¼ in. thick without difficulty. In sawing fret-work I cut through several thicknesses at once, which is not only a saving of time, but in delicate work lessens the liability of breakage. I can also cut brass ⅛ in. thick. I use any kind of saw suitable for the work I am engaged upon, from the finest German to a strong coarse one. The machine is so simple that an explanation is hardly requisite. The only part that may require any explanation is the following:—From a stud A, on slide B, is an india-rubber band C, passing around a knob D, cast on cap E; this band acts as a spring, and is of sufficient strength to draw up the slide B, &c.; by so doing all "blacklach" or shake of crank pin F, and stud H, are got rid of, so that when the saw is at work there is little or no rattle. The saw being well strained, and the frame moving in a straight line, makes the cut clean and square through the wood, which is not the case in many of the small machines I have seen, which are little better than toys, as they will not cut wood more than ¼ in. or ⅜ in. thick, and even then the path of the saw is rather uncertain. I may add in conclusion that all the sliding parts were planed in my planing machine.—*English Mechanic.*

EXAMINATION FOR TRICHINA.

We are not aware that the dread trichina has yet been found alive in the States, though no one can tell how soon it may appear. Notes of the best ways to recognize it may be of value to our amateur microscopists. For a first examination under a microscope, use a one-inch objective. Place a fine piece of the muscle in question on a glass slide in a drop of serum, or aqueous humour, or a 1% solution of common salt. Teaze out the fibres and separate them from one another by means of fine needles set in sticks for handles; keep the eye all the while on the work, and watch for the dim outlines of the worm. Perhaps the cyst will appear first; it may be that your manipulations will have torn the cyst and let the worm out. A little dilute hydrochloric acid added when the cyst is once discovered will decalcify it and render the parasite visible through its translucent walls. When the tissue is well displayed by the above means, a thin glass cover should be placed over it; the focusing will be better and the parts more distinct. Judicious pressure on the cover glass may often be made to bring the trichina into view by thinning and displacing the parts under it. It is often an aid to use some staining fluid; Beale's carmine, or the hæmatoxylon fluid. I have had often placed a drop of this fluid at the edge of the cover glass, watching the fiend while it made its way by capillary attraction among the fibres of the tissue, and have seen the outlines of the parasite come out clearly and distinctly when nothing could be seen before.

The examination by thin sections may be practiced with advantage. If the muscle be carefully dried, very beautiful sections may be made with a sharp razor dipped in dilute alcohol. These may be easily handled with a camel's hair pencil. The thinnest should be placed upon a slide under a cover glass, and may be examined directly in staining fluid or in the salt solution. Excellent sections may be cut from frozen tissue or from tissue soaked for a few weeks in strong alcohol, or in a 10% solution of bichromate of potash.

CUTTING RAILS.—It is a very difficult thing to cut red or nearly white hot rails so that they are of the same length when cold, as, if cut at different temperatures, they will vary in length on cooling. The following ingenious mode of obtaining a standard temperature has been adopted in some German and Russian rail mills: The glowing rails are looked at through a dark glass; when they are cooled to a certain temperature they can no longer be perceived. Using a dark blue or orange-yellow glass, *e. g.*, the rails may still be at a red glow, when the light radiated from them disappears in the dark glass. It may be considered that the light from two rails observed from the same dark glass disappears at the same temperature, and thus one is guided in cutting the rails while in this similar state, each rail after rolling being allowed to cool till it can no longer be seen at a given distance through the dark glass; thus they can be all cut of the same length.



AN ADJUSTABLE VICE.

The accompanying engraving shows a useful vice designed by Mr. W. Stevens, of East Brookfield, Massachusetts. It will be seen that the vice is so hung on an angular swivel that the jaws may be placed at any angle of inclination between the vertical and the horizontal, and be made fast in the required position by the screw-bolt shown. The illustration represents a small vice, suitable for attaching temporarily to a bench or table; the larger sizes turn on a cylindrical bearing projecting into the lower plate, the binding-bolt being turned by a wrench beneath the bench. It will be seen that the position can be altered in a very few seconds, and it is the only vice I am acquainted with which can be shifted from the vertical to the horizontal.

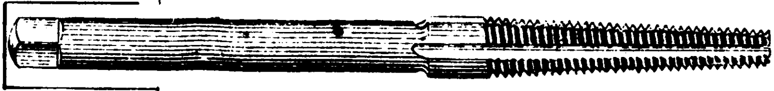
IMPROVED BEVEL.

Carpenters and builders will be interested in a new instrument which we illustrate herewith, and which is intended for use in determining the length of rafters and the bevels of their ends, when the width of the building and the desired pitch of said rafters are known. The device may also be used for getting the length and the bevels of the ends of braces, and for other similar purposes. A represents a bar, upon the edge of which is formed a scale of division marks, numbered to represent the length of the rafter or brace, and which should be made upon a scale of an inch to the foot to make it correspond with the division marks of an ordinary square. The bar A is slotted longitudinally to receive the clamping screws B which are screwed into straight bars C, placed upon the lower side of said bar A, as shown. In using the instrument the bar A is laid diagonally across the arms of an ordinary square, and is adjusted upon the long arm of the square at a point representing the half width of the building, and upon the short arm at a point representing the desired pitch of the rafters. The bars C are then adjusted against the edges of the arms of the square, and are clamped in place by the screws B. The instrument is now set to give the length of the rafters and the bevels of their ends. The instrument may be used without a square, by having lines drawn upon the under side of the bar A, to represent the different positions of the bar C, for different lengths and pitches of rafters.

Fig. 1

ANOTHER "FIVE DOLLAR" IDEA.—REAMING.

For reaming out the holes in boiler, bridge and other plate-work, a screw reamer of the form shown in the annexed figure is worth a dozen of the ordinary half-round sort. It does the work quicker and better, is not liable to be broken in use, and may, by the use of Stow's flexible shaft, be run by power.



FRUITS IN DISEASES.

A writer in the *Herald of Health* makes a strong statement regarding the use of ripe fruits in diseases. We cannot say it is not true, and yet we should apply the "fruit cure" with some precautions. He says:—"There is scarcely a disease to which the human family is heir, but the sufferings therefrom would be greatly relieved by the use of the very fruits which are now so strictly forbidden. Further, many of these diseases would be conducted to a safe termination under the free use of fruits, because of the acids they contain. When our troops were fighting the Seminoles in Florida, many sick with diarrhœa and dysentery cured those diseases by stealing from the hospitals into the fields and eating fruits, blackberries especially. Since our very pleasant and profitable excursion of last month, I have sent several children, suffering with cholera infantum and with dysentery, to the peach orchard, with most gratifying results—and where they could not be carried to the orchards to pick and eat the fruit fresh from the trees, I have had the little sufferers fed with sound fruit with equally good results. In typhoid fever, in the treatment of which such extraordinary care is enjoined as regards diet, fruits are not only highly grateful to the patient, but even work very favourable results. A physician who had been sick some weeks with typhoid fever, says his diarrhœa was cured by peaches. He says:—'I first ate the first half of a large peach, and feeling no ill effects, I ate the other half, then one or two more, and the next day as many as I desired.' He adds:—'My bowels got better at once, and my recovery was rapid.' Since our last meeting, a typhoid fever patient, who had been about three weeks sick, and though imploring, was allowed no diet but beef tea or milk punch, came under my care for a few days. I immediately ordered the free use of peaches and grapes, and the diarrhœa at once ceased, and at the end of five days, when I relinquished the care of her, she was convalescent. My impression is, the disease runs a shorter and more favourable course under the free use of fruits than under the usual method of treatment, and I think the use of stimulants rarely required when fruits are freely used. In the treatment of scarlet fever and diptheria, our summer fruits and many of the vegetables are most useful, and to the best may be added some, or, in fact, any foreign fruits. There is scarcely a disease accompanied with fever, but grapes and bananas may be freely given to the patient. In the treatment of dysentery, I would greatly prefer ripe, sound fruits, peaches especially, to any medicine that can be suggested."

Beds and Windows.—It is often said, though I do not say it, that no one makes good tea who does not intend to drink, but it does seem that few care to put beds in proper positions who do not mean to sleep in them. I travel a great deal and sleep in a great variety of beds, both in inns and in private houses. In the latter the beds are nearly always so placed that the sleeper can turn his face from the light, and lie undisturbed until it is time to get up. In inns, three times out of four, I at least find the beds fixed with the foot towards the window, so that sleep is apt to be broken by early daylight, long before we are accustomed to arise. When, as is usual, the window is at one side or end of the room, there are four ways in which the bed can be placed, but only one with its foot towards the light, and yet, queerly enough, the wrong way is chosen three times out of four in inns, not once out of four in private houses. Can any other reason be suggested than that those who set the beds in inns do not mean to sleep in them, while those who do have no choice?"

IS THE MOON INHABITED?

The writer of these remarks has repeatedly had the above question put to him: in return he would put the following: What evidence have we of the habitability of the moon? Some writers have indulged in the speculation that, with the large telescopes now in existence, armies of soldiers, troops of elephants and such like may be detected on the march, and others have surmised that buildings might be seen and the styles of architecture ascertained. The ideas such extraordinary statements may induce in the minds of the uneducated render it desirable to examine a little into the probability of obtaining such results. The diameter of the moon is 2,163 miles; but, as it never remains at the same distance from the earth, being sometimes nearer and sometimes further, it never presents the same apparent diameter as seen in the sky. When nearest the earth it is seen under the largest angle, or 33′ 33·20″; but when furthest from the earth it is seen under the smallest angle, or 29′ 23·65″. Now it follows from the relation between the real and apparent diameters of the moon, at its means distance from the earth, that a second of arc, written thus (1″), is the angle under which a mile and a little more than the tenth of a mile, written thus, 1·139, is seen at the centre of the moon's disk; again, as a second is pretty well the smallest distance that can be clearly discerned, it follows that a building on the moon to be clearly seen—we may say to be seen at all—must be about a square mile in extent, and then it would be seen only as a spot, light or dark according as the materials of which it was built reflected a larger or smaller quantity of light.

There are some very level plains on the surface of the moon, surrounded by mountains. One such plain has been very carefully examined; it is about 60 miles in diameter. The mountain wall rises to a height of 3,000 feet on the south, 3,200 on the west and north, and 3,800 on the east. On the wall are four lofty pinnacles of rock, three on the west and one on the east. The highest, which is on the east, rises to the height of 7,418 feet above the level interior; the next highest is on the west; its altitude is 7,258 feet; the two lower rocks are respectively 6,396 and 5,128 feet above the interior.

Let us place ourselves, in imagination, within the confines of this mountain cinctured plain and view from its centre its girdling rocks at a distance of 30 miles; they would appear from this point under a vertical angle of very little more than one degree, and the highest rock on the east would subtend an angle of less than three. It is believed that no other portion of the moon has undergone so close a scrutiny as this. For three years has its surface or floor been examined, during sunshine upon it, with telescopes able to bring small objects into view, and the results carefully discussed, from which it appears that nowhere on this plain has anything at all approaching the nature of a building or a collection of buildings been detected. At various intervals, as many as 36 small white spots have been seen during the three years, but never the whole together. Ten of these spots have been ascertained to consist of volcanic cones the bases having an average diameter of about one mile; the base of the largest, near the centre of the plain, certainly does not exceed two miles. With the exception of these natural productions nothing sufficiently elevated above the surface to cast a shadow at sunrise or sunset exists on this plain; there are, indeed, some remarkable variations of brightness upon it; for example, about the middle of the day, when the sun is highest, it appears very dark, almost black, but there is nothing to induce the opinion that a patch of a different tint exists anywhere on this plain, such as might be supposed to arise from a collection of buildings covering a space of four or five miles in extent. From such facts as these, the results of close and unremitting observation into which conjecture is not permitted to enter, we are forced to the conclusion that the evidence we possess of the habitability of the moon is very scanty. Indeed, it does not even furnish a clue by which we might institute a series of observations likely to lead to a positive result.

It must, however, be remembered that the walled plain, Plato, to which the foregoing remarks refer, is but a very small part of the moon's surface, and it would be manifestly unsafe to draw any conclusions on the above question from the examination of so small a part, carefully as that part has been examined. While there may be great difficulty in detecting any evidence of artificial construction, it is beginning to be ascertained that there is not so much difficulty as formerly in detecting instances of physical change. The discovery in May, 1877, by Dr. Klein, of a dark spot north-west of Hyginus, where nothing of the kind had been seen before, combined with the celebrated case of Linné, will go far to show that changes of a physical character and of sufficient magnitude to be seen from the earth are now in operation, and will doubtless open up a line of research by which we may learn something of the nature of the forces at work within the moon, and form more accurate notions of our satellite than those to which we have been treated of late years, such as a "burnt up cinder," "a dead world," or one reduced to its last stage of existence. So far as we are able to judge of the mundane processes going on around us, there is a perpetual cycle of recurring physical events by which decay is replaced by renovation. We have on our own globe instances of very ancient formations, and others of a most recent date: the same alternation of ancient and recent tracts is found on the moon, and it would not be difficult from careful observation to assign the epochs of some of the most striking series of changes. Indeed a chronological arrangement of the large grey plains, of the craters in their neighborhoods previously existing and of those opened upon their surfaces, has been attempted upon a large scale, but it is evident that the study of the more minute objects is likely to be attended with results upon which a more correct system of lunar topography can be raised, which, in its turn, will conduct the student to a satisfactory system of selenology.—*English Mechanic.*

A PREVENTIVE OF SUICIDE.

We lately had a paragraph from distinguished Eastern students of insanity to the fact that suicide was not necessarily the result of insanity. Dr. G. A. Shurtleff, the able Superintendent of the Insane Asylum, at Stockton, in a paper on Suicide, read before the San Joaquin County Medical Society, bears the following testimony to the influence of religion as a preventive of suicide:

"There is nothing which, in contemplation of the final hour, so solemnly and profoundly affects man, or so surely influences his acts, as an unquestioned and steadfast belief in what concerns his condition beyond this brief, mortal life. This is religion, and if born and trained in its faith, it becomes an organized element of his mind, an acquired instinct, which is more likely to direct his thoughts and acts in these matters than aught which depends solely on the logic of human evidence and knowledge. Through this faith a belief in things unseen and not of this world, which lie beyond the reach of science, of human reason and of natural evidence, is established. The weapons which would assail it are human and of the earth, and do not extend to the mysteries of another world, which are seen only by the eye of faith. This professed belief itself must be insincere and a false pretense if it fail to exercise, in the sane mind, control over the conduct of him who avows it.

"I can say positively, from my own extensive observation, that the precepts of the Christian religion, especially as taught in their long-established forms, exert a strong influence even in the disordered as well as the rational mind in deterring from suicide those who put a sincere and absolute trust in its faith. I have often heard expressed, under suicidal thoughts and temptations, the irresistible conviction of the tried and chaste Imogen:

> 'Against self-slaughter
> There is a prohibition so divine
> That cravens my weak hand.'"

THE DRAINAGE OF CITIES.—A strong argument in favor of good drainage in cities has been furnished by the experience of St. Louis. The number of deaths in 1860 was nearly 6,000, and the average mortality for the succeeding four years was 5,600. The city then had a population of 150,000. In 1870 the deaths numbered 6,670, and although there was a considerably increased mortality in 1872 and 1873, the average number of deaths for the last four years has been but 6,400, with a steady decrease. Yet the last census gave St. Louis a population of 310,000, and it is now estimated at not less than 450,000. As a fact, the mortality last year was less than the average during the period between 1860 and 1870. At the date first named, St. Louis had practically no sewers, and no rapid extension of the system was attempted until 1865. Since then such improvements have been made in this direction that the city now has 180 miles of sewers. As no other great changes have been witnessed in a sanitary point of view, it is concluded that the decreased number of deaths must be attributed to the development of the sewer system.

THE Paris *Jardin d'Acclimatation* has just secured 14 giraffes, 7 elephants, 10 lions, 2 young hippopotami, 70 dog-faced baboons, and a number of antelopes, panthers, birds, etc. These animals were captured on the banks of the White Nile.

DIRECTIONS FOR THE USE OF BELTS.

The putting on of belts should be done by a person acquainted with the use of belting, and too much judgment cannot be exercised in this respect, as the wear of the belt depends considerably on the manner in which it is put on; therefore the following suggestions, if practiced, will be of much service to persons in this capacity. The butts to be joined together should be cut perfectly square with the belt, in order that one side of the band may not be drawn tighter than the other. For the joining of belts, good lace-leather, if properly used, being soft and pliable, will always give satisfaction. Where belts run vertically, they should always be drawn moderately tight, or the weight of the belt will not allow it to adhere closely to the lower pulley, but in all other cases the belt should be slack. In many instances the tearing out of lace holes is unjustly attributed to poor belting, when, in reality, the fault lies in having a belt too short, and trying to force it together by lacing, and the more the leather has been stretched while being manufactured, the more liable it is to be complained of. All leather belting should occasionally be greased with the following mixture, or it may become dry and will not adhere to the pulleys: 1 gallon of neat's foot or tanner's oil, 1 gallon of tallow, 12 ounces of resin; dissolve by heating and mix well together. During the winter season an extra quantity of oil should be added to the mixture. To obtain the greatest amount of power from belts the pulleys should be covered with leather; this will allow the belts to be run very slack, and give 25 per cent. more wear. More power can be obtained from using the grain side of a belt to the pulley than from the flesh side, as the belt adheres more closely to the pulley; but there is this about it—the belt will not last half so long, for when the grain, which is very thin, is worn off, the substance of the belt is gone, and it then quickly gives out; so that I would advise the more saving plan of obtaining power by driving with wider belts, and covering the pulleys with leather. Where belts are in very damp places, or exposed to the weather, I would recommend the use of rubber belting; but for ordinary use it will not give the satisfaction which is so generally obtained from using oak leather belting, as it cannot be run on cone pulleys through forks or at half cross, and with fair usage would be worn out while a leather belt was regularly performing the work allotted to it; for when the edge becomes worn, the belt soon gives out.—*Van Riper.*

Skeleton Leaves.—At a recent meeting of the Scientific Committee of the Royal Horticultural Society, Mrs. Cussons, of Southport, exhibited some skeleton leaves, with the following note: "For the dissection of leaves I find the process of maceration too long and tedious, to say nothing of the uncertainty as to the results; I have therefore adopted the use of alkali in saturated solution, the specimens to be introduced while the liquid is heated to boiling point. The time of immersion to be regulated by the character of the various leaves, and the nature of the epidermis to be removed. When the specimen is freed from epidermis and cellular tissue, it must be subjected to the action of chlorine to destroy the colouring matter. The introduction of peroxide of hydrogen serves not only to render the lace-like specimens purer in colour, but preserves it also. In destroying the colouring matter in ferns this also is invaluable; added to the chlorine it gives a solidity to the bleached fronds, and appears to equalize the action of the chlorine. For skeletonising capsules the slow process of maceration by steeping in rain-water is alone available—a moderate heat may be applied to hasten the process, but alkali is useless. The only known flower which can be dissected is the Hydrangea japonica. The fibrous nature of the petals renders it easy to skeletonise in the perfect truss in which it grows. Skeletonised leaves and capsules appear to gain in the process a toughness and durability not possessed by them in their natural state."

Sir W. Armstrong's jointed gun has passed through the series of firing tests, and has been adopted for service. The gun unscrews into three parts, and is thus easily transported on the backs of mules. When the pieces are screwed together it forms a powerful long range gun, perfectly gas-tight at the joints.

There is no doubt about the success of the Paris Exposition. Up to July 5th the receipts were $753,384, or $3240 more than they were up to July 5th, 1867, though in that year the Exposition opened a month earlier.

A target which indicates instantaneously to the marksman himself the exact result of his shot, has been invented by M. Mantel-Rieter, of Winterthur. He is content at present to use numbered circles, but the system can be easily adapted to any division of the target. The mechanism (which is still kept secret) is placed behind an ordinary target; the shock of the ball produces a mechanical contact, and closes an electric circuit, so that an index at once rises from a table at the side of the marksman. This table is divided, like the target, into numbered concentric circles. Four holes are pierced in each of the zones, in the direction of two diameters at right angles, inclined 45° to the horizon; the small circle in the centre has only one hole. When a ball strikes the target a number is presented automatically on the table, in the hole corresponding to the quarter of the zone touched. At the same time there rises on the right side of the table a small card, bearing the same number, which may be delivered to the marksman. By a simple mechanism the numbers are pushed in again, and the target is ready to indicate a fresh shot. The inventor is constructing a second apparatus, in which the table will indicate not only the numbered zones, but will give a complete image of the target, so that the marksman may judge more certainly as to the point he has struck. All the balls which reach the target are retained in it.

Human Temperature in the Tropics.—We learn from the *Medical Times and Gazette* that Surgeon Major Johnston has made an extensive series of observations in India, on the subject of the normal temperature of the body in the tropics, and has found that, contrary to the general opinion, it is rather lower than the average temperature in the north. In one series of observations he found the mean axillary temperature to be 97.63°, and in another, 97.74°.

An improved form of Gatling gun was tried recently at a range of 1,000 yards, the canvas target being torn to shreds, whilst many of the bullets passed through the two-inch oak planks at the back. At 800 and 600 yards the bullets struck with marvellous precision, and, according to Sergt. Mayer, who was in the marker's retreat, it would have been impossible for a sparrow to have traversed the line of fire in safety.

The *Medical and Surgical Reporter*, in concluding a criticism of the question of spontaneous generation of the lowest forms of life, asserts that the present state of the controversy proves that there are agencies at work in the evolution of organic forms of which we are as yet ignorant, and that it is altogether premature to swear by the dictum of either party. We must wait and study.

A novel application of the electric light is proposed by Mr. Edison. His plan is to make a diminutive light apparatus, and inclose it in a glass globe of such size as to be easily swallowed! He will connect it with a suitable battery, and he expects to be able to witness the process of digestion, and to see with more or less distinctness the operations of the internal organs.

Nature, on behalf of the scientific circles of England, expresses dissatisfaction at the tardiness with which government scientific work is done, at the dilatoriness with which the results are published, and the exorbitant prices charged for such *Pub. Docs.*

The attempt of the English Government officers to raise the lost *Eurydice* has been unsuccessful. *Iron* charges the failure to the incompetency of the officers in charge, and objects to the employment of "fighting officers as wreckers."

Belgium was far behind Holland when the two countries separated. Now, thanks largely to an excellent patent law for the encouragement of inventions, her commerce leads that of Holland by $50,000,000 per year.

In a sun kitchen at the Paris show, Professor Mouchot, of Tours, has roasted quails in twenty minutes, and in forty-five boiled water. The cooking is done with an apparatus having a strong reflector.

THE AMERICAN ARCTIC EXPEDITION.

(See page 313.)

Mr. James Gordon Bennett, the energetic proprietor of the New York *Herald*, having, by a liberal expenditure of capital and the indomitable perseverance of Mr. H. M. Stanley, succeeded in opening out the hitherto unexplored portion of the African continent, has now turned his attention from tropical to Arctic exploration, and is organizing an expedition, entirely at his own cost, which is to make yet another attempt to reach the North Pole. For this purpose he has purchased the well known Arctic yacht *Pandora*, which, under the command of Capt. Allen Young, has already achieved important work in the North Polar regions. The *Pandora*, which has been rechristened the *Jeannette* by Mr. Bennett, is a screw steamer of some 250 tons burden, and is fitted with engines of 80 horse power. She is specially built for Arctic service, and, in addition to a hull of more than ordinary strength, is sheathed from eight feet above her keel to two feet above her water line with a coating of American elm some three inches thick, so that her resistance to the nipping of the ice may be rendered as great as possible. The rudder can be dismounted and replaced in case of accident, and she is fitted with a perfect magazine of appliances and instruments for Arctic exploration, such as sledges, ice-saws, tents, ice anchors, etc. ; while she carries about 164 tons of coal, her daily consumption, when steaming four knots an hour, being reckoned at three and a half tons. The hull, for greater safety, is divided into three water-tight compartments, and, since the 1st of April, has been under the hands of the shipwrights, and has been thoroughly and completely repaired, any injured woodwork being removed and replaced by new. In the stern, also, a comfortable cabin has been formed for the officers. On June 18, as we have said above, Mr. Bennett rechristened the vessel the *Jeannette*, and she has now sailed for San Francisco, where her fitting out is to be completed in time to start on her journey next January, when she will attempt to attain the North Pole by way of Behring Straits. At the same time Mr. Bennett will despatch another yacht, the *Dauntless*, which will also try to reach the Pole by way of Spitzbergen.

The map of the North Polar region needs little explanation, as it shows the most northerly points which as yet have been reached by the various explorers. The first really authentic Polar expedition was undertaken by Sebastian Cabot, in 1497, with three vessels ; and he was succeeded in 1596 by Barents, who discovered Spitzbergen. Hudson and other Englishmen followed up his researches for the next ten years ; and, in 1616, Baffin discovered the bay which bears his name, and the now well known Straits of Smith's Sound. In 1740, a Danish navigator in the Russian service, Behring, passed through the straits which separate Asia from the United States. These discoveries, which were mainly made while searching for the North-West Passage, by which the Atlantic and Pacific were supposed to be united, early proved of great value to Arctic navigators, as they opened the three chief roads towards the North Pole, namely, those of Smith's Sound, of Spitzbergen, and of Behring Straits. By the first named several noteworthy attempts have been made to reach the North Pole, beginning with that of John Davis in 1585, when the latitude of Upernavik was attained, down to later days, when Ross and Parry made their well known expedition in the *Alexander* and the *Isabella*. In 1852 Inglefield attained the latitude of 78° 28′ ; and in the following year the American explorer, Dr. Kane, in the *Advance*, reached the latitude of 78° 45′, and, being forced to pass a second winter in the ice, he sent out a sledge expedition under Lieutenant Morton, who reached 81° 20′, from which point an open sea was described. In 1860 another American, Dr. Hayes, who had served as a surgeon under Kane, sailed in a little vessel of some 133 tons, the *United States*, and reached 81° 35′ by means of sledges ; but found Kane's "open sea" covered with ice. In 1871 Captain Hall left New York in the *Polaris*, and reached the highest altitude as yet attained by a vessel, namely, 82° 16′ ; and next we come to the Nares-Markham expedition in 1875, when Captain Markham, in a sledge journey, reached the highest altitude yet recorded—83° 26′.

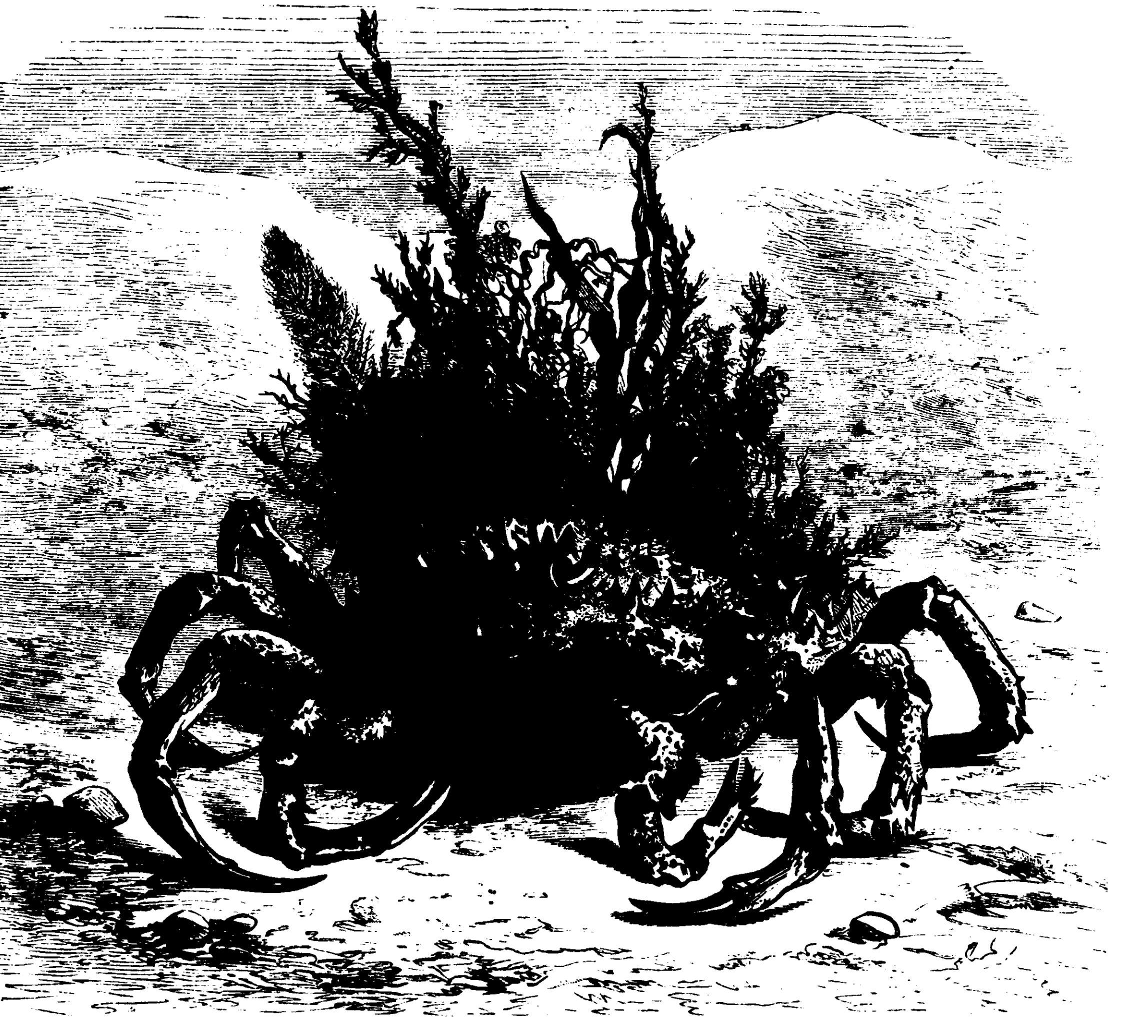
The Spitzbergen route will be ever famous by the Franklin-Parry expedition of 1827, when the altitude of 82° 45′ was attained, this being the first occasion on which sledges were used by Arctic explorers. In 1868 Dr. Petermann sent Koldewey northwards, when he attained to 81° 5′ ; and in 1869 Hegeman and Koldewey, in the *Germania* and *Hansa*, reached, in the former vessel, 75° 30′. In 1872 Wilczek fitted out the *Tegethoff*, and intrusted an expedition to the two Austrian explorers, Weyprecht and Payer, who, by means of sledges, reached 82° 5′ (the *Tegethoff* only attained 79° 54′), and discovered Franz-Josef Land. The Behring Straits have been principally explored by Russian expeditions, including those of Anjou and of Wrangell in 1821 ; but, in 1849, Kellett discovered "Kellett Land" and "Herald Island," since which time no expedition has attempted this route, which is now to be explored by the *Jeannette*. As may be seen by the map, the current in the straits sets northward, towards the Pole, while in Smith's Sound it flows in a southerly direction. Thus, a vessel entering Behring Straits would be assisted on its way by the course of the current, while all vessels going by the Baffin's Bay route lose half their time in combating the stream. The Arctic winds which mainly prevail blow from the northwest, and they cause the floating masses to drive toward the east, and thus open channels on the shores of the Arctic peninsula. A way, therefore, is expected to exist along the coast of Kellett Land, by means of which it is hoped that the *Jeannette* will attain her object. The fact that extremely thin and fragile ice exists in this direction, and that an open sea has been seen by Anjou, Wrangell, and Kellett, tends to corroborate the theory of the advantages to be attained by the choice of this route.

BRAIN WORK AND BRAIN ABUSE.

When we hear that a man has killed himself by excessive brain work we feel that we should like to have the witnesses in court in order that we might rigidly cross-examine them. What sort of work was it ? Was it brain work pure, or was it mixed up with anxiety, worry, and excitement ? What were the man's habits ? Did he indulge overmuch in what are called stimulants ? Did he deprive himself of a just allotment of sleep ? If all these questions could be asked and answered we suspect it would be found that the man who is supposed to have died of excessive mental energy died rather of want of fresh air and exercise, of too much fire-water in some form or another, of horrible financial embarrassment, of late hours, and of excitement other than those pure work breeds in the human brain. A distinction is sometimes drawn between imaginative work and intellectual work proper ; and the former is said to be the more wearing and the more dangerous. But we suspect there is a fallacy lurking here. Imaginative work, being more exhilarating and producing a greater sense of joy, is no doubt more exciting, but then it necessarily lasts for a shorter time. "Violent delights have violent ends" is as true of imagination as of love. The imagination periodically stops of itself and cannot be made to go on save by those stimulants which, as we have said, help to kill. A man of imagination never shortened his days by allowing his imagination to exercise itself spontaneously ; but it is quite conceivable that more than one has done so by artificially calling on it. The imagination should not be so treated. It is too holy a gift and too delicate an instrument to be thus casually instigated to exertion not self-generated. No doubt, at bottom, it is a question of use and abuse, as it is of other forms and capacities of energy. Life is almost certainly not shortened, perhaps a trifle lengthened, and is unquestionably much improved in value, by intellectual vigour ; but we fear the people who never think, though their fronto-parietal sutures may ossify early, will continue, as heretofore, to cumber the earth for a greater number of years than they deserve.

THE BEST BAITS FOR INSECT TRAPS.—M. E. C. Carriere has lately been trying a number of experiments on the best baits for insect traps, and gives an account of them in the *Revue Horticole*. The results effectually disprove the truth of the old saying "that we may catch more flies with a spoonful of honey than with a gallon of vinegar." A number of glass fly-traps filled with different liquids, sweet and sour, were placed under some fruit trees which were subject to the attacks of flies and other insects. The traps were baited with honey, weak wine and water, vinegar and water, pure beer, pure wine, crushed pears and water, and other liquids ; and the victims were counted, after the traps had been exposed for three weeks, with the following results : The trap containing beer and water stood at the head, and contained 850 flies and other insects ; pure beer stood next, with 631 ; the crushed pears, weak wine, and pure wine coming next, pure honey being at the bottom of the poll, with only 17 sufferers. No doubt the odor of the beer and water, which was in a strong state of fermentation, had a great deal to do with attracting the insects.

TO ATTACH TIN TO METALLIC SUBSTANCES.—Mucilage tragacanth, 10 ozs. ; honey of roses, 10 ozs ; flour, 1 oz. Mix.



THE SPIDER CRAB.—(One half natural size.)

To those who have sailed along our coast to enjoy the sport of "blue fishing," and have whiled away a few spare moments in the contemplation of the va ious forms of marine life, the object represented in our plate will not prove unfamiliar; and were the animal divested of its ornamentation of sea weeds it would prove no less familiar to those who frequently stroll along the beaches of Coney or Staten Island, or of the Atlantic coast generally, where the empty shell of the dead animal is rather a common object.

This unpromising looking creature is a species of long-legged crab, familiarly (and rather aptly, too) called the "sea-spider" or "spider crab," and is of an aspect scarcely less disagreeable than that of the terrestrial spider. In fact the crab, which, like the latter, belongs to the great branch of the animal kingdom, the *Articulates*, occupies a position among crustaceans equivalent to that held by the spider among other articulata. In their youngest stages crabs undergo a true metamorphosis no less striking than that of insects. The young of the crustacea are so wonderfully mimicked by the degraded forms of the young of spiders "that the two forms would seem at a casual glance hardly to belong to different genera, and the two great groups seem to run into each other here, so that their limits are scarcely distinguishable, and we only know that one is a young spider, and the other a young crustacean, by tracing their life history further on." The young in this larval condition were long ago described under the name of *zoea*, and it is still called the zoëa stage. After casting the skins several times and increasing in size, the young crabs assume the "megalops" stage. Finally, at one casting of the skin the swimming legs disappear, and the little crab comes forth something like the adult form. Most of the species undergo similar changes.

The spider crab (*libinia canaliculata*) of our Atlantic coast has a somewhat pear-shaped body, and exceedingly long legs, often spreading more than a foot across. Its back is covered with spines and tubercles. The eyes, like those of many of the crustaceans, are borne at the extremity of movable pedicles, and thus they may be turned in every direction without moving the whole body at the same time. Such a provision as this is not necessary in insects, owing to the mobility of the head of these animals; but it is absolutely indispensable in the case of crabs, where the head and thorax being consolidated into one mass, the extent of vision commanded by sessile eyes would have been extremely limited, and inadequate to the security of creatures exposed to such innumerable enemies.

The long legs of this animal remind us somewhat of those of the spider; the two anterior members are armed with slender, feeble claws only, for the animal is neither rapacious nor combative like other crabs. It will be readily seen that its defence can only be a passive one, and it is for this reason (that is, for purposes of concealment) that its shell is usually so luxuriantly adorned. In fact, the spider crab is almost always hidden among stones and seaweeds at the bottom, while other crabs frequent the shore and are continually in search of prey.

We have often fished up these creatures from the ocean and found them covered with mud, barnacles, seaweeds, and other substances which tend to conceal them from their enemies. In some foreign aquaria, where the habits of these crabs have been noted, they have been seen to seize seaweeds and polyps and place them upon their back, having first spread upon them a viscid saliva secreted by their mouth, in order to make them adhere. Seaweeds thus placed seem to grow as luxuriantly afterwards as if they had not been transplanted. Some foreign species, on the contrary, have been observed (in aquaria at least) to be entirely destitute of this artificial covering, and have been seen for hours at a time carefully cleaning themselves with their long claws, and performing the operation with all the grace of a cat. They make use of their delicate claws, which appear so awkward, to carry food to their mouths, and are able, with such imperfect hands, to pick up the minutest morsels.

The habits of this animal were well known to the ancients, and by them this crustacean was made the emblem of wisdom. Its image was suspended to the neck of Diana of Ephesus, as of a being endowed with reason. It figured also on the money of Ephesus as well as on that of several others of the shores of Asia. The ancients also regarded the crab as sensible to the charms of music, an opinion not confirmed by modern experience, and probably an extension of the idea that attributed such a gift to the terrestrial spider.

The spider crab represented in our Figure, is a common species of the Atlantic Ocean.

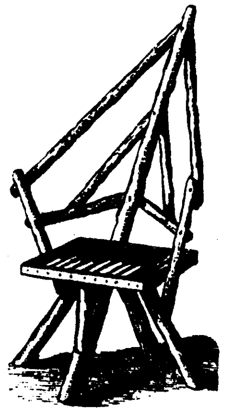
HOW TO FILE AND SET A HAND-SAW.

When a saw is in bad order, the teeth are irregular in length and pitch. This occurs through improper filing, and results in the saw working hard. The reason is that a saw irregularly filed, or set, cuts only with the longest teeth and those that have the most set. To remedy these defects, it should be pointed and filed until the teeth are all of even length, and are pitched so that the front of each tooth is at right angles with the back of the saw. The saw is fastened into a clamp, which consists of a pair of jaws fixed upon a stand, and moved by screws. The ends of the teeth are brought to a level by running a flat file lengthwise of the blade. The best form to give the edge is a slight curve from end to end of the saw, making the middle slightly rounding *outwards*, never hollow. The handle of the saw when in the clamp should be to the left, and not be changed during the filing. The part held in the clamp should be filed completely before being moved, if the jaws are not long enough to hold the whole. On a ripsaw, the teeth will be filed square on a cross-cut, they are beveled upon alternate sides. Both sides should be filed without moving the saw, which may be done by changing the position and manner of holding the file. A beginner should provide a handle at least a foot long for his file; this will enable him to hold it steadily, which is very necessary for good work. The proper size for a file is 3½ inches long for a saw having eight teeth to the inch. A saw is set before it is filed. The set given for easy cutting should be such as to make the cut as wide as twice the thickness of the blade. Several good sets are sold at the tool shops which are self-regulating, and make even work. If only a few of the teeth are short, they need not be pointed, but may be touched with a few strokes at each filing, until the rest are worn down to them. If one has no clamp, a strip of hard wood may be laid upon each side of the saw, and the whole held tightly in a vice. In filing, the strokes should be made *from* the operator, and not towards him. The file should be grasped firmly in the right hand, while the tip is held lightly between the finger and thumb of the other. A safe rule is to work slowly, and to test the teeth as the work progresses with a try square. As long as the faces are kept at right angles with the blade of the saw, the backs must come out right.
—*American Agriculturist.*

CUSHMAN'S CENTREING CHUCK.

One of Cushman's latest inventions is in the shape of an improved centreing chuck, which has just been introduced by Messrs. Churchill, of Wilson street, Finsbury. It is simply a four-jawed scroll chuck, with a steel centre, and can be fastened to a bench, or used in an upright position. It will centre round, square, or octagon bars from ¼in. to 1½in. diameter, and is claimed to do it more quickly and satisfactorily than anything else yet produced for the purpose. The jaws advance or recede equally, when the body of the chuck is turned round by means of the handles, the threads taking into corresponding threads in the jaws, which are thus forced in or out according to the direction of motion of the handles. It has a screw working in a groove, which facilitates the cleansing of the chuck.—*English Mechanic.*

THERE are 79,000 miles of telegraph wire in the United States and 6850 offices, or 1 mile of line to every 36 square miles of area. England has 75,000 miles of line and 5600 offices, or 1 mile of line to every 1½ miles of area.



RUSTIC CHAIR.

Many of our country mechanics might profitably employ their leisure hours in these hard times, by making rustic furniture. During winter they have the material—spruce and cedar branches—always close to hand. Rustic work sells quite readily in Montreal and other large cities. It is most durable if made of cedar, but any wood will answer. The main piece is a pole say 4½ feet long, 4½ to 4 inches in diameter at the base, and an inch less at the top. This stands inclined 25° to 30° for a perpendicular. Three other short pieces nailed upon it, supply the necessary legs or supports. The other round sticks are added as shown. The seat has four side-pieces, filled in with the parallel pieces which are nailed to the front and rear border piece. The side pieces come forward far enough to supply arm rests. The whole is made of round, undressed limbs, or small saplings, nailed together. A hatchet to cut the sticks, with hammer and nails to fasten them together, are all the tools needed. Any smart boy can put together a trial chair, on a rainy day, and afterwards make up as many as he chooses from any wood.

TOMATO CATSUP.—There is a wonderful difference among the various articles called Tomato Catsup, from the rich sauce, so thick it will hardly pour, to the thin, watery stuff that would not keep but for the vinegar and salt it contains. Every family should make its own, not only as a matter of economy, but of safety. *If one must buy,* avoid the bright red attractive looking compounds, as they are artificially coloured. The cheap stuff sold in restaurants is made from the peelings and other refuse of the canning factories. Good catsup can only be made when the fruit is in perfection; towards the end of the season, when the nights get cool, and growth is slow, the fruit is watery, and will not yield the rich pulp of the best fruit. Select ripe tomatoes, cutting away any green portions, cut in pieces, stew until thoroughly done, and rub through a sieve fine enough to retain the seeds. Evaporate what passes the sieve to the desired thickness; for this, no rules by quantity can be given, as a bushel of some tomatoes will yield twice as much pulp as others. The evaporation should go on over a slow fire, being careful not to scorch it. When thick enough to pour from a cruet, without inconvenience, add salt and spices. Here the recipes give the greatest possible variety. Be sure and use salt enough; a chopped onion, or clove of garlic, tied in a cloth and cooked in the pulp, to give *just a suspicion* of the flavor, is liked by many; Allspice, Black Pepper, Cayenne and Mustard, are the principal spices, and are used according to the taste of the consumers. One recipe directs for a half bushel of tomatoes; Cloves, two teaspoonsful, Cinnamon, Allspice, and Black Pepper, two tablespoonsful each; these are not to be ground, but bruised, placed in a little bag and boiled in the pulp while it is being evaporated; when the pulp is thick enough, remove the bag and add mustard, ground, two tablespoonsful; Cayenne Pepper, two teaspoonsful; good vinegar, two quarts, and salt to the taste. Another recipe uses all ground spices, viz.: For the pulp from ½ bushel of fruit: Allspice and Cloves, ¾ oz. each; Mustard, 1½ oz. Black Pepper, 3 oz.; Mace, ½ oz.; Cayenne, ¼ oz.; Salt, 6 oz. or sufficient, and Vinegar, 2 qts. Add the spices, boil a minute or two, cool, and bottle.

THE bending of hard wood, especially beech, is effected at present by means of hot water or steam—a process somewhat costly as regards fuel, and taking a long time. A patent has recently been taken out in Germany by MM. Bahse and Haendel for making sieve-hoops and like objects by a dry process, more cheaply and in shorter time, from cut wood. Two rollers are used, one above the other, and having less velocity, so that it acts by holding back, while the lower extends the wood fibres. When the board, thus bent, leaves the rollers, it is fastened in the mouth of the sieve. The upper roller is fluted, the under one smooth. If two smooth rollers were used a very much greater pressure would be necessary.