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THE INFLUENCE OF CERTAIN DRUGS ON PHYSICAL STRENGTH AND ENDURANCE.

BY T. FREDERICK PEARSE, M.D., F.R.C.S.

There are certain drugs which have a great reputation for increasing physical endurance. These are chiefly coca, caffeine, and kola nut, and there are certain other chemical compounds of analogous composition which are derived from muscular tissue and have been found experimentally to have a similar effect. These are chiefly creatin and hypoxanthin. The chemical relation of all these substances is very interesting. Strange to say, some are themselves the products of muscular waste. It will be noticed also that creatin and hypoxanthin occur in beef tea, which is so well known as a general restorative and as a nervous stimulant, and there is ample experimental proof that it assists muscular power. The chemical relationship of the alkaloids found in tea, coffee, kola, and coca to the products of muscle-tissue metamorphosis suggests that these products are either replaced in the muscular tissue by these drugs, or that the products act on the nervous system either as a food or as a stimulant, and are merely supplemented in their action by the drugs. It is a very interesting question whether these alkaloids act locally on the muscle substance or upon the central nervous system.

As we know that tea, coffee, cocoa, and beef tea sustain and strengthen the nervous energies when they have been exhausted by other than prolonged muscular action, the inference is that these substances, as well as the analogous products of muscular tissue, act also directly as food or stimulant to the nervous centres. I have tested and found by experiment the powers of caffeine in increasing the respirations, and in strengthening as well as increasing the rapidity of the heart's action.

The following statements have been made by different writers as to the value of these substances.

Coca.—"Enables a greater amount of fatigue to be borne with less nourishment, and it lessens the difficulty of respiration in ascending mountain sides."—*Markham's Peruvian Bark.*

"The leaves are chewed to appease hunger and support strength in the absence of food, and used generally for the stimulant and narcotic effects of tobacco and alcohol."—*Practitioner.*

"It is of use to steady the nerves of excitable persons—to a sportsman in shooting, for example; to give endurance. It is used by travellers in Bolivia and Peru, to counteract the effect of rarefied air on mountains."—*Lancet.*

"In small doses it is said to lessen fatigue and enable the Indians in Peru to make long marches, and a similar result has been obtained in trials upon soldiers in Germany."—*Lauder Brunton.*

Experimentally, coca appears to act in small doses as a stimulant to the nervous system, affecting first of all the cerebral hemispheres, next the medulla, and lastly the spinal cord. It lessens the feeling of fatigue, but the only mental effect seems to be an exhilaration of spirits. Like caffeine, it increases the rapidity of the heart-beat and raises the blood pressure.

Caffeine.—Experimentally, caffeine has been found, in small doses, to quicken the respiration and also the pulse. It seems to affect the accelerating centre directly, as its action is equally well defined after the nerves have been divided. Besides increasing the rapidity of the heart's action it seems also to strengthen it, and it raises the blood pressure. Caffeine also seems to lessen tissue change and waste. In addition, caffeine appears to have some power in paralysing the conducting power of the sensory parts of the spinal cord, and it may be in this way that it relieves the sense of fatigue. At the same time, however, it is found to increase generally the functional activity of the spinal cord.

"The peculiar wakefulness, the increased mental activity, and the often nervous restlessness which are induced by strong coffee are familiar to almost everyone. By doses of two or three grains of caffeine a very similar state of the body is induced. The increase of brain power which has been noticed by various observers, as well after caffeine as after coffee, tea, guarana, and all the allied crude drugs, is undoubtedly real, and must be due to a direct stimulant action on the cerebrum. It appears to me that the cerebral stimulation of caffeine differs from that of opium in that it affects the reasoning faculties at least as profoundly as it does the imagination. Coffee prepares for active work both mental and physical—opium rather for the reveries and dreams of the poets. The enormous use made by mankind of substances containing caffeine indicates that in some way it is directly of service in the wear and tear of life."—*H. C. Wood.*

Kola (Sterculia acuminata).—A native of Tropical Africa. The nuts from this tree are used to support the strength, allay the appetite, assuage thirst, and assist the digestion. They have also a reputation for increasing the capacity to bear prolonged fatigue.

The kola nuts contain a large percentage of the same chemical principle, theine, as is contained in tea and coffee. They also contain an aromatic volatile oil to which some of their properties must be attributed.

The seeds have been employed as a remedy for drunkenness, and they are said to abate the drink crave.

By virtue of the alkaloids, caffeine and theobromine, contained in kola, it must act as a cardiac tonic, improving both the force and rhythm of the heart.

The kola nut is slightly bitter and astringent, and its reputed value in digestive disturbances and diarrhœa may be based on these properties.

Phosphates.—Of all inorganic compounds these seem perhaps of the greatest importance in animal tissues. They are found in considerable quantity in the human body wherever active cell growth is going on. They must be ranked among the most valuable and necessary foods. Their acknowledged value in disorders of the nutritive system of children, and also in convalescence from acute as well as wasting diseases, in all of which rapid growth and tissue development is taking place, is good ground for the practical inference that they are intimately concerned in nutrition generally, and especially in the recuperation of parts worn out by disease. The recovery from prolonged and severe exertion also may very probably be assisted by them. The compounds of the meta-, pyro-, and hypo-phosphates in which the element phosphorus is loosely combined, seem much more efficacious than the ordinary salt.

According to Ashburton Thompson, repeated doses of phosphates improve the appetite, increase the rate of the circulation, sharpen the mental faculties, increase the muscular power, and give a sensation of well-being.

Creatin and Hypoxanthin.—These substances are said in small doses to have the power of increasing muscular work, and to cause the muscle to recover rapidly after exertion. Creatin particularly is said to have this power to a great extent. Glycogen is also classed with these substances, and is said to have great power of increasing muscular capability.

In practice, however, we all recognise a difference in the action of the popular mixtures—tea, coffee, cocoa, etc. In many persons tea will stimulate, and in a few it exercises a marked action on the kidneys and bladder. Coffee, again, will keep some people awake, while tea does not have the same effect with them. With some individuals it acts as a mild aperient. Coca does not seem to have any decided action on the digestive organs or kidneys.

We find, therefore, that the reputation for sustaining the strength, appeasing hunger, and temporarily increasing the physical powers which coca, kola, coffee, and tea have in the respective parts of the world in which they are indigenous is borne out by experiment. Moreover, there seems a probability that physiological science will shortly be able to provide a satisfactory explanation of the practical value of these substances. —*Knowledge.*

HINTS TO WOODWORKERS.

There is no doubt but the proprietors of many wood-working establishments make a mistake in overestimating the value of the machinery composing their plant, says the *Timberman.* In taking an account of stock at the close of the year, a fictitious value is often given to the machinery in their mill. The original cost of the various machines, together with the cost of keeping them in repair is generally put down among the assets which enter into their balance sheets. After a few years they find that, notwithstanding they are using the same stock and employing the same class of labor, yet their neighbor in the same line of business is able to undersell them in the same market. The reason is very obvious; while they are spending large sums of money every year in keeping up their old machines, they loose sight of one important fact, that although some of the machines may be kept in first-class order, in fact, practically as good as they were when first purchased, yet at their best they have depreciated in value from the fact that they are not capable of turning out the same quantity and quality of work as some of the new and later improved machines which have come into the market and should have superseded them.

Their neighbor, who is able to put the same class of work into the market at a less price, has pursued a different policy. As soon as he finds that a machine is becoming old and is superseded by one that will do more and better work in the same time, he loses no time in useless repairs upon the old machine, but replaces it at once with the new one, and by this means his plant never becomes old. It is unreasonable to suppose in this age of improvement and competition in every branch of business, that the machinery purchased today with all its improvements will in every case be able to meet the requirements five or ten years hence. Taking the planing machine for example, the best machines that were in the market ten or twelve years ago were thought to be as near perfect as possible, but compare the amount of work turned out by them as well as the price obtained for planing, with the amount of work turned out by the planer of the present time, and the present price of planing, and it will be evident to any one that the old planers at the present prices would not turn out work enough to pay expenses.

What is true of planing mills is also true of sawmills, sash and poor factories and every other branch of wood-working where machinery is used. The article of furniture is a striking illustration of this fact. It does not require a very old person to remember the time when nearly all of the furniture was made by hand, and to furnish a house in a respectable manner required a small fortune. Then the village cabinet-maker, who in most cases was the undertaker also, was one of the most important personages in the town. The young couple when married must apply to him for the necessary furniture to commence housekeeping, and when baby was born, the cabinet-maker must furnish him a crib, and when death closed the earthly career of one of their number, he was called upon for a casket and to assist in committing his body to the bosom of mother earth. So it would appear in those days that no one in the village could be married, born, or die without his assistance.

But now all is changed. The furniture manufacturer or dealer makes this his speciality, and the cheap and elegant furniture that is now within the reach of persons of very limited means, is the result of improved and special machinery that was unknown at that time. Furniture manufacturers are fully aware of this fact, and, as a rule, avail themselves of the latest and most improved machinery for that purpose. In visiting the several factories, not only for the manufacture of furniture but every other class of wood-working, it would seem that perfection was nearly or quite arrived at in the construction of the various machines in use, but there is no doubt but ten years hence in visiting these same factories other and more improved machines, that are not now thought of, will be met with that will facilitate the work and still have a tendency to further reduce the cost of production.

A first-class plant then should never be allowed to become old, but should be supplied with new and improved machines from time to time, as fast as the old ones begin to depreciate in quantity and quality of work. In this way only can the manufacturer expect to maintain his place in the front ranks of his business.

APPARATUS FOR SOLDERING AND MELTING.

BY GEO. M. HOPKINS.

No laboratory is complete without an efficient blowpipe and some means for operating it; and while it is, as a rule, advisable to purchase apparatus of this class rather than make it, a few hints on the construction of a bellows, a blowpipe, and a small furnace may not be out of place. The bellows and furnace are of the kind devised by Mr. Fletcher, and made by the Buffalo Dental Mfg. Co. The blowpipe differs in some respects from those furnished by the above-named house.

In the construction of the bellows the following materials are required: Two hardwood boards 10 x 11 inches and ⅞ inch thick; one circular board 1 inch thick and 9 inches in diameter; one piece of heavy sheepskin 30 inches long, 7 inches wide at the middle, and tapering to 2 inches at the ends; two disks of elastic rubber, each 11 inches in diameter and $\frac{1}{32}$ inch thick; one small scoop net; 3 inches of ⅜ brass tubing; 3 small hinges; a spiral bed spring, and two iron straps.

The 10 x 11 inch boards are rounded at the ends, as shown in Figs. 1 and 2, and their square ends are connected together by the hinges as shown in Fig. 4. A hole is made in the lower board near the hinged end and covered by the valve shown in Fig. 3. The valve consists of a soft piece of leather, having attached to it two woolen blocks, one of which is fastened to the board in position to hold the other in the position of use. These blocks are beveled so as to give the valve sufficient lift and at the same time limit its upward motion. The circular board has a groove turned in its edge, and in a hole formed in its edge is inserted the brass tube. A hole is bored into the top of the circular board, which communicates with the inner end of the brass tube, and a series of holes are made in the circular board, which also pass through the upper board of the bellows. Over these holes is placed a strip of soft, close-grained leather, which is secured by nailing at the ends. This leather strip forms the upper valve.

The bed spring is secured to the upper and lower boards, and the bellows is ready to receive its covering. The spring, the hinges, and the valves should be secured with great care, as they are inaccessible when the leather covering and the rubber disks are in place. The boards are closed together, reducing the space between them to about 5½ inches. They are held in this position in any convenient way until the cover is attached. The leather covering is glued, and tacked at frequent intervals. The leather is carried around the corner and over the hinged ends of the boards. An additional piece of leather is glued over the hinged end, and a narrow strip of leather is glued to the edges of the boards to cover the tacks and the edges of the leather covering. The job will be somewhat neater if the edges of the boards are rabbeted to receive the edge of the covering and the tacks.

The rubber disks are stretched over the circular board and secured by a strong cord tied over the rubber and in the groove in the edge of the board. The net is afterward secured in place in the same way. The net should be so loose as to allow the rubber, when inflated, to assume a hemispherical form, as shown in Fig. 5. A cleat is attached by screws to the hinged end of the lower board, and a straight iron strap is attached to the rounded end of the same board. The corresponding end of the upper board is provided with an offset strap, upon which the foot is placed when the bellows is used. The hole closed by the lower valve is covered by a piece of fine wire gauze tacked to the under surface of the lower board to prevent the entrance of lint and dust.

The blowpipe, which is connected with the brass tube of the bellows by means of a rubber pipe, is shown in section in the upper part of Fig. 6. It consists of two pipes attached to each other and adapted to receive the rubber pipe connections at one end. At the opposite end they are arranged concentrically, the aperture of the smaller pipe—which receives the air—being reduced 0·05 of an inch. The outer and larger pipe, which receives the gas, is provided with a sliding nozzle, by means of which the flow of gas can be easily controlled. The internal diameter of the smaller end of the nozzle is one-quarter inch. These dimensions are correct only for a blowpipe for small and medium work, *i.e.*, for brazing or soldering the average work done in the making of physical instruments; for melting two or three ounces of gold, silver, brass, and other metals, and for forging and tempering tools and small articles of steel, and for glass blowing on a small scale.

The gas is taken from an ordinary fixture by means of a rubber tube, the supply being regulated entirely by the movable nozzle of the blowpipe. The force of the blast varies with the manner in which the bellows is operated.

One of the best supports for articles to be brazed or soldered is a brick of pumice stone. It heats quickly, is very refractory, it admits of securing the work by tacks or nails driven into it. It has the further advantage of being incombustible. The work to be brazed or soldered must be well fitted, *i.e.*, there must be a good contact between the abutting or overlapping edges, and the contact surfaces must be well painted with a cream formed by grinding borax with a few drops of water on a slate (Fig. 7). When necessary, the work may be held together by an iron binding wire. The solder is coated with the borax cream before it is applied to the joint. For most work silver solder is preferred, as it is very strong, being both ductile and malleable.

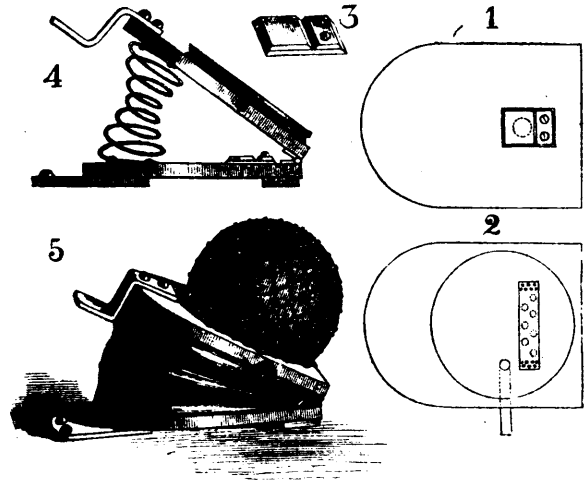
The work is heated gradually until the water of crystallization is driven from the borax, then the work is heated all over until the solder is on the point of melting, when a concentrated flame is applied to the joint until the solder flows. Care should be taken to use the reducing flame rather than the oxidizing flame. Should it be found difficult to confine the heat to the work, pieces of pumice stone may be placed around the part containing the joint, as shown in Fig. 6.

A large number of small articles may be easily and quickly soldered by placing them on a bed formed of small lumps of pumice stone and proceeding from one article to another in succession.

For supporting small work, having a number of joints and requiring much fastening, the slabs of asbestos are very desirable. For very small work to be done with the mouth blowpipe, the prepared blocks of willow charcoal are used.

After soldering the borax may be removed by boiling the article in sulphuric acid.

The small gas furnace shown in Fig. 8 may be used in connection with the blowpipe and bellows, already described, by arranging the blowpipe on a stand and placing the furnace upon the pumice stone brick or a fire brick. The blowpipe is adjusted to deliver a blast to the opening of the furnace. The crucible in which the metal is melted rests upon an elevation at the centre of the furnace, as shown in the sectional view in Fig. 8. The crucible contains besides the metal a small quantity of borax for a flux. A roaring flame is required, and the blowpipe must be carefully adjusted with reference to the opening of the furnace to secure the best results. With this furnace and blowpipe two ounces of metal can be melted in ten minutes. Its capacity, however, is greater than that.



FIGS. 1 TO 5.—BLOWPIPE BELLOWS.

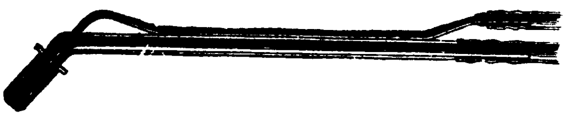
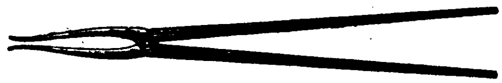


FIG. 7.—GRINDING BORAX.

FIG. 9.—INGOT MOULD.



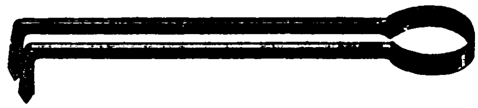


FIG. 10.—CRUCIBLE TONGS.

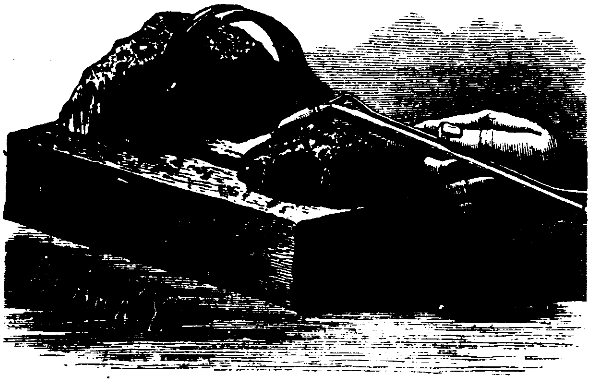


FIG. 6.—BRAZING.

After the metal is rendered sufficiently fluid it may be poured into an oiled ingot mould, shown in Fig. 9, thus giving it a form adapted to rolling or hammering, or it may be poured into a sand mould, giving it any desired form. The crucible is handled by means of the tongs shown in Fig. 10.

The body of the Fletcher furnace is formed of clay treated in a peculiar way to render it very light and porous. It is 4¼ inches in external diameter and 4¼ inches high. Its internal diameter at the top is 2¾ inches, at the bottom 2¼ inches. The hole at the side is ¾ inch in diameter. The cover, which is 1½ inches thick and of the same diameter as the body, is concaved on its under surface and provided with a ⅝ inch central aperture. The cover and the body are encircled by sheet iron.

It is not difficult to make a furnace which will compare favorably with the original article. Any tin or sheet iron can of the right size may be used as a casing for the furnace, provided it be seamed or riveted together. A quart wine bottle having a raised bottom serves as a pattern for the interior of the furnace. The upper portion of the raised bottom is filled in with plaster of Paris or cement to give the crucible support a level top. The material used in the formation of the furnace is clay of the quality used in the manufacture of fire bricks, or even common bricks, moistened and mixed with granulated fire brick. The material known as "stove fix," used in repairing the lining of stoves, answers very well when mixed with granulated fire brick or pumice stone.

The can is filled to the depth of an inch with the material. The chambered bottom of the wine bottle is oiled and filled with the material and placed in the can as shown in Fig. 11. A ¾ inch wooden plug is inserted in a hole in the side of the can, to be afterward withdrawn to form the blast aperture. The can is then filled with the clay mixture, which is tamped in lightly. The material should not be too wet, and it is well to oil the bottle to facilitate its removal. When the filling operation is complete, the bottle is loosened and withdrawn. The cover is formed by filling a suitable band with the clay mixture. The furnace is allowed to dry for a day or so. The first time the furnace is heated, the temperature should be increased very gradually.—*Scientific American.*

PHOTOGRAPHING PATTERNS.

Sterling Elliott sends to the *American Machinist* the following plan for keeping track of patterns:

Spread a white paper on the floor, lay patterns on it in proper order, place on each pattern a small square of white paper on which is painted a black plain figure beginning with one, two, three, etc.; these may be cut from an old calendar, or painted purposely. Directly over the patterns suspend by any suitable means a photographic camera, and you have it. From the negative thus obtained, make two blue prints; send one to the foundry, and the old problem of marking patterns is not only solved, but lost patterns are much more easily found; for a pattern, unlike an actress, resembles its photograph every time.

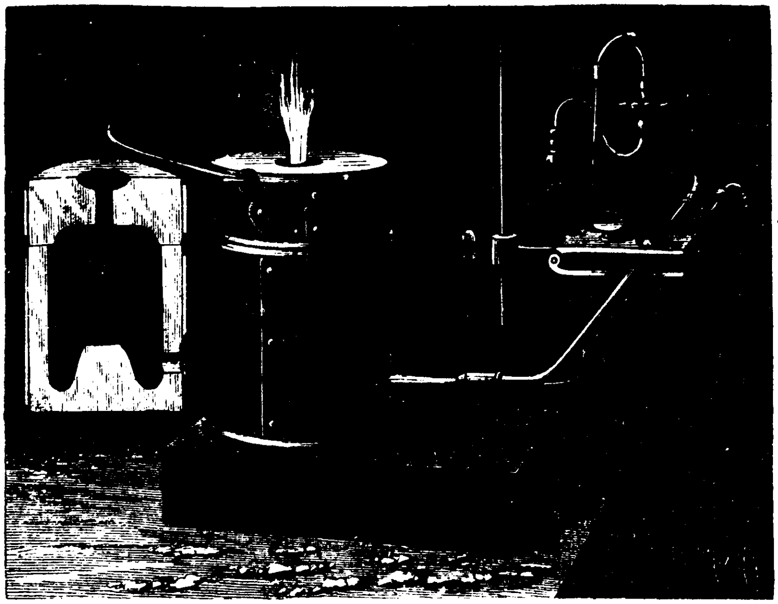


FIG. 8.—BLOWPIPE FURNACE.

FIG. 11.—MAKING A BLOWPIPE FURNACE.

DO MACHINES HURT A TRADE?

BY THEODORE L. DE VINNE.

There seems to be an uneasy feeling among compositors about type-setting machines. It is true that only three of the many recently invented are at practical work, but all of them give a promise of usefulness, if not in all fields, at least in some field of composition. It is certain that the machines have come to stay. Compositors fear that they will reduce the price of labour, and will indirectly drive them out of business.

Much of this disquietude is unnecessary. That type-setting machines may or will reduce the cost of the work on reprints and cheap books and papers is probable. That it will ever drive any large body of good workmen out of business is absurd. The machines will surely make more work for workmen. So far from decreasing the standard of workmanship, they will elevate it. This conclusion is warranted by a review of the changes in the trade made by inventions in another department—that of presswork.

Fifty years ago the advantages of machinery in presswork were recognized in this country, but they were not fairly tried. Stereotype, composition rollers, cylinder presses, and Adams presses had then been invented, but were little used. The New York *Sun* and New York *Herald* were trying to print growing editions of their then petty sheets on hand presses. Harper & Bros. and other book printers in New York were doing their presswork on hand presses. Books were cheap and editions were small; pressmen were abundant and wages were low. Journeymen piece compositors were paid an average of twenty-four cents per thousand ems, and earned seven dollars a week with difficulty. Weekly wages for time compositors were nine dollars, but this sum was earned only by the more active and expert. The average wages of piece compositors, and occasional time hands was not over seven dollars a week. Hand pressman, paid almost entirely by the piece, had to do an amount of hard labour to earn nine dollars a week, which the modern power pressmen would regard as excessive and unreasonable.

Although work was hard and wages small, there was even then a dislike to machinery—a dislike which seems to have been imported from abroad. Johnson, an eminent printer of London, had already denounced the printing machine, then in use in London, as the destroyer of the living of pressmen, and called upon Parliament to impose a tax on machine presswork, so that machines could not work for a lower price than hand presses. In 1830, and even as late as 1848, the journeymen printers of Paris destroyed printing machines in the Royal Printing Office of that city as well as in other offices, because they said that these machines were taking the bread out of their mouths. Stereotyping, invented by Ged in the last century, had been delayed more than fifty years by the opposition of hand pressmen, who secretly battered plates in the supposed interest of compositors. Master printers were afraid to use the new process. Composition rollers were opposed by pressmen, because they enabled a boy to do the work of the extra man, who wielded the old-fashioned inking balls. The first inking machine attachment was found more objectionable, because it enabled the master printer to dispense with this roller boy or this extra man who had been regarded as necessary to the working of the hand press. Every invention or process that increased production was regarded by working men as an evil agency.

In this country there has never been any active hostility to new machinery in the printing business. There have been no mobs or strikes against inventions, but workmen look on all new devices with suspicion and unfriendliness. They do not see that the invention which temporarily throws one man out of work ultimately makes work for two or more men.

What would have been the state of the trade if we had no stereotype or electrotype, no composition rollers, and no printing machines? The daily newspaper, as we now have it, would be an impossibility. An edition of two thousand or twenty-five hundred copies of a small sheet would be the highest performance of the hand press, and what severe work this paltry performance would impose on the wretched hand pressman who had to print this edition in a hurry! The illustrated magazine of large edition and low price, filled with fine wood cuts, could not exist at all in days of hand presses. One could go on and show how hand presses would curtail the production not only of the popular but of the artistic forms of typography.

Processes and machines that were once dreaded are now used by every printer, and they are welcomed as much by the journeymen as the master. No one will pretend that they have reduced the number of workmen. Where there was one printer fifty years ago, there are at least twenty printers now. Instead of driving hand pressmen out of the trade, the printing machines have really brought more pressmen in it, and have enabled an employer to pay them better wages. The machines have not even driven good hand pressmen out. In all our large cities the expert hand pressman is in active demand. He does but one-half the labour of his predecessor, yet he is paid twice as much and has steadier work. For some forms of printing the hand press is more economical than any machine, and if there were more men who could use them skilfully, they would be more generally employed. They are not used because it is difficult for an employer to get a boy to learn this branch of presswork. He objects, because the work is hard. Not even for double or treble the old pay will a pressman in 1889 undertake to do on a hand press the work done by all pressmen in 1840.

The journeyman book compositor of New York, who works by the piece, now earns an advance of seventy-five per cent on the rates of fifty years ago. The time hands get twice as much. Expert machine pressmen in the larger New York book offices are paid $20 and $22 a week—an advance of more than one hundred per cent. If they are specially skilful or active, they are cheerfully paid a good deal more. They have steady employment and comparatively easy work. It should be noted that the highest wages are always paid in those offices that have the most and best machinery. Low wages are the rule almost without exception in all offices that have little or no machinery. Instead of throwing men out of work, machinery has made a demand for more work. Instead of lowering the price of labour, machinery has raised it.

It will be noticed that the prices of composition have not increased as much as those of presswork. The compositor's advance is seventy-five per cent or less; the pressman's is one hundred per cent or more. The reason is plain. Composition has not as yet received any appreciable benefit from type-setting machinery. Nearly all of our composition is done by hand, as it was done fifty years ago, but the piece compositor who works in an office that has many printing machines earns more than he does in an office that has few machines. Indirectly he obtains advantages from machinery, which he personally does not manage.

As a rule, the average piece compositor is a better educated man than the average pressman. Under equal conditions he should and would earn higher wages, but his superior intelligence and education do not increase his production. This production is limited by the slowness of his hands, which is now as it was fifty years ago. If the compositor was employed on a type-setting machine, he would get some of the benefits of the increased production. With more machines there would necessarily be more composition; there would be more compositors, and they would be better paid.

One reason why the modern pressman is better paid than the old pressman is because he is a better workman. The machine is more complex than the hand press, and it compels the pressman to exercise more forethought and intelligence. He has to keep it in order and to get a fixed quantity of work from it within a limited time. To accomplish this he does not have the hard stretching of the muscles that was called for by the hand press, but he does have to do twice as much work with his brains. It is this work of the brains more than that of the hands that earns him higher wages, but it is the machine that spurs him on to this increased mental activity.

As a rule, the mechanics who most bitterly decry machines are those who have been found incompetent to handle them. The men who refuse to learn the theory or the practice of new processes—who are content to do work as it was done when they were boys—who "don't want to be bothered" by the study of new problems in handicraft—who evade or shirk responsibilities—are the very men that employers don't want to employ upon their machines. That they may and probably will suffer for their persistent refusal to adapt themselves to changed conditions is much to be regretted; but are they blameless? Is it the fault of the master, or the machine, or the workman himself?

It is probable that many employers will at first try to get composition done on machines with the cheapest labour. Many of them will employ poor workmen, inexpert boys and girls. They will sophisticate themselves with the notion that a cheaply paid helper will soon be taught to do as much as an expert workman. This is the error that was made when power presses were first introduced. There were employers who reasoned—"It is the machine and not the man that does the work. The machine is the first consideration and the man the second, a cheap man can be made to do as much work as a high priced man." This fallacy is no longer believed. Every master printer who does good presswork, or even tries to do a large amount of presswork in a given time, regardless of quality, knows that an expert workman at high wages is always more economical than the cheap workman. He takes better care of the machine, he gets more work out of it. The same conclusion will be reached after a long trial of type-setting machines. The expert man who thoroughly understands his business will always be in demand. He never need to fear the competition of boys, or girls, or amateurs.

It is really amusing to reflect on the cheerful short-sighted stupidity of the earnest trade union men, who so violently opposed all improvements in typography. Really meaning to benefit the trade, they were actually doing their best to destroy it. If they had carried their point, if they had suppressed all labour-saving devices, if they had kept the trade in the same narrow rut it was in fifty years ago—what would be the present condition of most of the men who are now earning fair wages in pleasant situations in our trade? It is plain that if these improvements had been prevented, they would not be in the trade at all. There would be no place for them. The limited amount of work that could be done on hand presses would have kept them out. They would have been obliged to find employment in other fields. Most of them would have to do hard manual labour, or accept inferior situations in which they could with difficulty earn nine dollars a week. In view of the enormous blunder then made by sincere men, a thinking compositor may now well question the wisdom of the policy that oppresses type-setting machines.—*National Publisher and Printer.*

MODERN IMPROVEMENTS IN ELECTRO-PLATING.

The public interest in electrical matters is so largely taken up with electric lighting—to the dazzling triumphs of which the streets of our cities, and numberless public and private edifices, bear eloquent testimony—that the substantial progress made within recent years in another equally important branch of electrical science has attracted comparatively little notice, save within the circle of those directly interested therein. Special reference is intended in this connection to the pronounced advances that have been made of late years in the application of electricity to chemistry, metallurgy and galvano-plating.

Galvano-plating, or the art of producing, electrically, metallic deposits upon metallic, or metallized surfaces, either for the purpose of protecting the said surfaces against the action of the atmosphere or corrosive agents, or for the purpose of duplicating them, has indeed been so greatly benefitted by the recent advances in electric discovery and invention, that it may fairly be said to have entered upon a new era. The great impulse imparted to this beautiful and scientific industry has been derived from the development and improvement of the dynamo-electric machine, with the aid of which mechanical energy obtained from the steam engine, or any other source, is converted with comparatively little loss, directly into its equivalent in the form of electric current. Heretofore the electro plater was confined, as to the source of his current, to the voltaic battery, which, depending as it does for its efficiency upon chemical changes taking place in the constituent elements of the cell, required on the part of the operator frequent attention in replenishing or renewing the acids and salts employed therein, to maintain the needful current strength. The voltaic battery, in brief, at its best, is a troublesome and more or less unreliable source of current. With the introduction of the dynamo-electric machine for electro-plating, the troubles and annoyances incident to the obtaining of current at once disappeared. The electro-plater has now placed at his service, with comparatively small expenditure of power, a source of electricity upon which he can depend for a current of any desired strength, and which he can maintain with practically perfect constancy for hours at a time, by the simple act of throwing on a belt. It is not to be wondered at, therefore, that as soon as the efficiency of the steam-driven plating machines had been demonstrated, the electro platers and electro-typers everywhere, for work of any magnitude, hastened to discard their battery jars and to adopt the machine; and to-day the dynamo has practically superseded the battery wherever the quantity of work to be done is sufficient to warrant its adoption.

The results that have flowed from this substitution have been highly important. It has brought about the great extension of all branches of the art of electro-plating; and in respect of one of these branches—at present the most widely extended of all—nickel-plating, it may be credited with having created it. Furthermore, by greatly cheapening the cost of a multitude of useful and artistic objects, it has placed within the

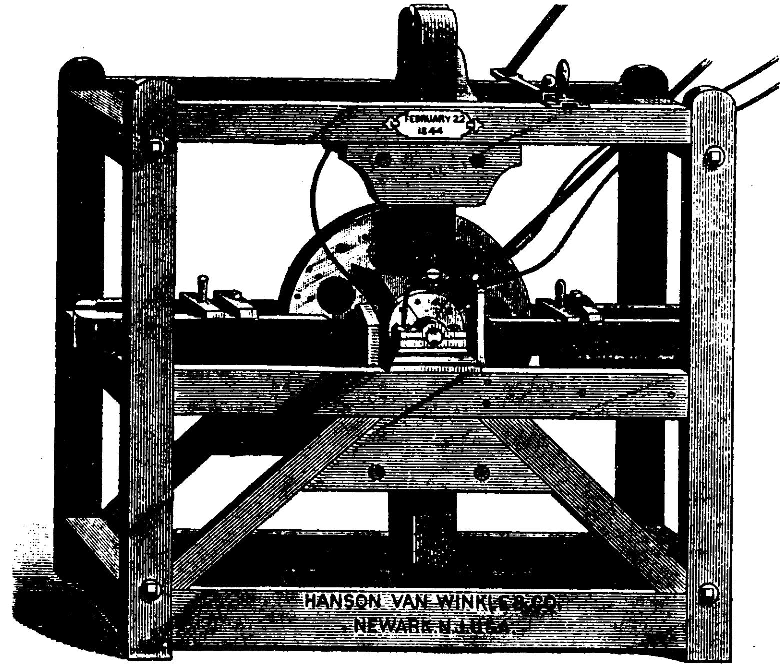


FIG. 1.—THE FIRST ELECTRO-PLATING MACHINE, BUILT BY WOOLRYCH IN 1844.

reach of people of limited means the possession of the most beautiful and artistic wares, which are not to be distinguished, in elegance of design or appearance, from the most costly articles of the precious metals. The credit of having brought about the general introduction of dynamo machines for electro-plating, is due to Hanson, Van Winkle & Co. (formerly Condit, Hanson and Van Winkle), of Newark, N.J., who are known as extensive manufacturers and dealers in electro-platers' supplies. When Edward Weston devised his now well-known plating machine, these gentlemen, appreciating its great importance to the electro-plating fraternity, at once embarked in its manufacture, and the enormous sale which it speedily commanded, demonstrated the accuracy of their judgment. This innovation was made, perhaps, less than fifteen years ago, but since that time a great number of machines for the purpose have been devised, exhibiting, naturally, a substantial improvement in efficiency over the pioneer devices.

Through the politeness of Hanson, Van Winkle & Co., we are enabled to present a picture of the earliest machine devised and operated for depositing metals. This machine, which is shown in Fig. 1, produced a continuous current from permanent steel magnets, being the first practical application of Faraday's splendid discovery of electrical induction. It was operated by Prime & Son, at their large silverware works at Birmingham, England, and the original machine constructed by Woolrych in 1844, the first machine that ever deposited silver on the practical scale, is still preserved at their works in its original position, as an interesting historic relic. In contrast with this machine, we exhibit, on the same scale, the improved "Little Wonder" plating machine (Fig. 2) of Hanson, Van Winkle & Co., representing the latest improvements in this class of machines, and, to emphasize the contrast, it may be interesting to note the following facts: The Woolrych machine stands 5 feet high by 5 feet long and 2½ feet wide.

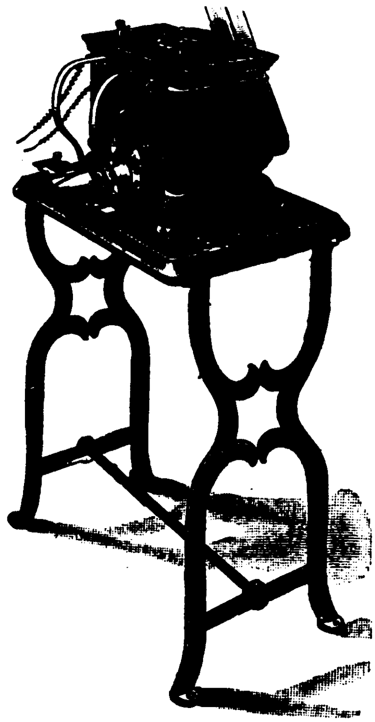


FIG. 2.—"LITTLE WONDER" PLATING MACHINE.

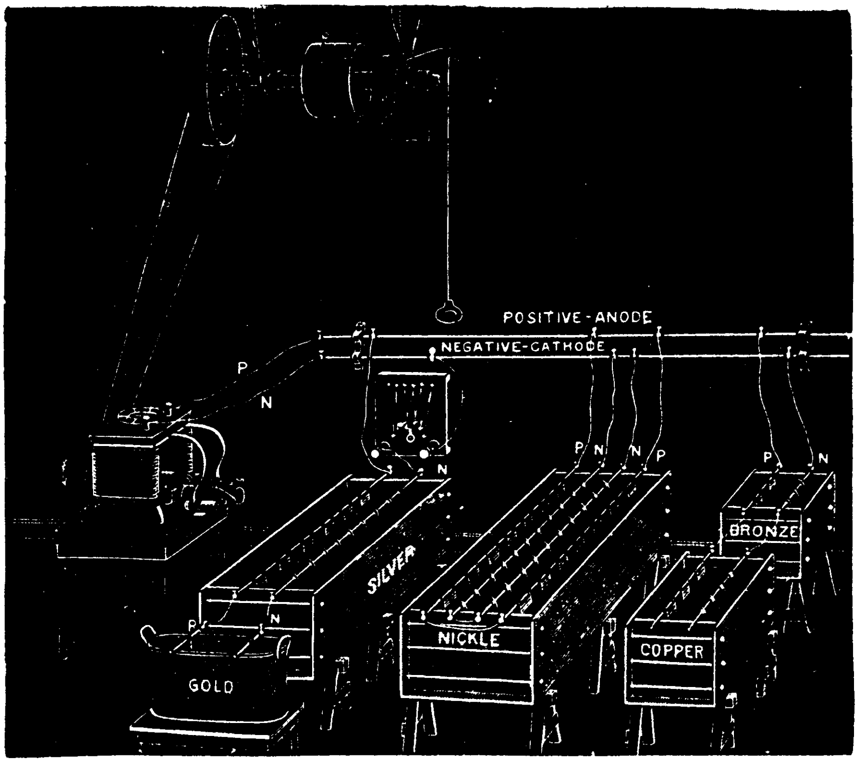


FIG. 3.—INTERIOR OF AN ELECTRO-PLATING ROOM.

The "Little Wonder" is a pigmy compared with the other in size; but though it requires only one-tenth the power to drive it that the Woolrych machine required, it will deposit ten times the amount of metal in a given time. The "Little Wonder" is very simple in construction, though highly efficient, and may be employed successfully in all forms of plating—nickel, silver, gold, copper, brass, bronze, etc. The diagram (Fig. 3) gives an excellent idea of a modern electroplating plant, exhibiting the mode of generating current with the machine, and the mode of distributing the current and connecting the various baths for silvering, nickeling, coppering, etc. The introduction of the machines has greatly simplified the labours of the electro-platers. The art has been so greatly simplified by their adoption, that many manufacturing establishments have introduced an electro-plating plant as a useful adjunct to their operations.—*Manufacturer and Builder.*

MAGNETIC VISCOSITY.

BY THOMAS T. P. BRUCE WARREN.

When experimenting on the magnetic permeability of oils and other liquids, I found that if a magnetic substance, like soft iron, be covered by different liquids, not only was its susceptibility modified by the permeability of the intervening medium, but distinct evidence was obtained in every case of a molecular stress being produced in the medium, and which indicated itself by a decided tendency of a balanced magnet to stick, as it were, when it was allowed to remain a short time over the soft iron.

The explanation seems to be that the maximum effect of a magnet on soft iron depends on the rapidity with which the medium accommodates itself to the constrained condition necessary for the soft iron to take its greatest degree of magnetization.

As time is an element of importance in attaining a full maximum magnetization from any magnet of a certain intensity, it is not unreasonable to suppose that when a *non*-magnetic medium has been so constrained by the lines of force passing through it, the molecular stress, which is also favorable to an increased magnetization of the soft iron, will retain the magnet with a slight but decided extra force. I propose to call this extra force, which is due to molecular stress, *viscosity*.

Viscosity is more probably a function of permeability. We have the magnet acting across the medium to the soft iron, and conversely the soft iron reacting through the same medium to the magnet, until the molecular arrangement of the medium accommodates itself to a maximum.

If a galvanometer needle, suspended in the usual way, be forcibly deflected by a current, it is found that the needle regains its fiducial position very slowly. This has been attributed to a crushing effect on the fibres. This effect has been called viscosity. I do not think it is entirely due to mechanical causes. The term as used in this communication is applied to a very similar phenomenon.

The experimental arrangement was as follows: A balanced horseshoe magnet was suspended from one of the arms of a balance. Immediately under the magnet was placed a shallow specimen glass (salver) with the usual flat glass cover. The cover prevented the magnet being wetted with the liquid, and allowed the attraction to be balanced through a uniform depth of liquid. The soft iron rested on the bottom of the glass.

When the magnet was allowed to rest on the cover for a short time, it required an increased weight placed in the other pan to pull the magnet off than when the magnet was momentarily in the same position, or only for so long as to restore equilibrium in the balance.

I propose giving some experimental results on a future occasion, and to point out its importance as an adjunct to analytical research.—*Chem. News.*

THE AIR WE BREATHE.

Nothing in the entire material world is to-day so little known to positive science as the air that surrounds us. It is fairly well known that 80 parts in 100 are of a gas called nitrogen, and 20 parts are of oxygen, but why its constitution is that of an elastic gaseous mixture, and not a chemical compound of these same gases, we can find no solution. The same gases form nitrous oxide and nitrous acid, with intensely active qualities, capable of condensation as liquids and of explosive expansion as gases again. The neutral element, nitrogen, which in the air is not condensable; which is an asphyxiating body if breathed into the lungs, and a non-supporter of combustion, is, at the same time, if chemically combined with this same oxygen, the most powerful of alteratives if not of destructives.

Are we sure that four-fifths of the vast aerial volume that surrounds the earth is so absolutely neutral as has been admitted or assumed? Is there no change of its volume or constitution possible, analogous to the changes by which oxygen unites with many other elements under the processes of oxygenation, acidification or combustion? Nitrogen is not obtained from the air by any process of separation, or combination with another element, as oxygen is separated. It is obtained only from pre-existing natural compounds, the nitrates of potash, or soda chiefly. The animal organizations to which nitrogen is a necessary element, do not assimilate it by absorption from the atmosphere; they must be fed with nitrogenous food, and must derive their requirement from pre-existing combinations of nitrogen. To breathe it in the common air, is to offer the oxygen of the air only to the assimilating power of the vital forces; the nitrogen, which is an absolute necessity to sustain the animal system, can only be obtained through the action of the digestive organs, fed with animal or vegetable nitrates or nitrogenous compounds.

As the air readily yields its oxygen, its ammonia, its compounds of carbon with oxygen, and all other volatile constituents than nitrogen itself, is it not reasonable to examine the constitution of this refractory and immovable 80 per cent of the aerial volumes, to see whether it has no capacity as yet undisclosed and no element as yet undefined?

As at present defined, the air is primarily important as a vehicle or sustaining body to distribute and supply other compounds, as oxygen and hydrogen in the form of water, and the many other gaseous or liquid compounds of subordinate gases. Much of the solid matter of the earth has had, and may again have, a gaseous form, but all these were impurities of the air, and were necessarily eliminated in order to prepare it as a medium for sustaining animal and vegetable life. Nitrogenous and ammoniacal gases are rather impurities than otherwise, and the nitrogen is in no case derived from or returned to the nitrogen of the atmosphere. In short, atmospheric nitrogen is not the nitrogen of animalized bodies or of native mineral nitrates, and it is never a gas of sensible properties or of capacity for assimilation or chemical combination.

We cannot burn the oxygen and hydrogen out of the air and leave isolated nitrogen. Theoretically, we produce certain "products of combustion," being compounds of carbon with oxygen, but not any form of nitrogenous residuals. We cannot find any nitrogen after the fire, although we may have a local atmosphere of asphyxiating carbonic acid or carbonic oxide.

In applying a powerful blast of cold air to a body of incandescent fuel, we furnish much more oxygen than the fuel unites with as carbonaceous combustion, and the outwardly delivered products of such combustion are much less in volume than the inwardly delivered quantities of air and gas, or of air alone. There is always much condensation, also much excess of heat over the theoretical equivalent derived from the carbon consumed. It is possible to light the fire of an air-blast with a very small relative volume of carbonaceous gas, and to burn the combined volumes with the flame and without residuals or products, such as are derived from carbonaceous combustion. There is no carbonic acid or carbonic oxide gas produced when pure hydrocarbon gas is burned with 70 to 100 parts of dry air, nor is there any nitrogenous or other residual, nor any solid carbonaceous fuel required, although the heat attained reaches 3,500°.

It cannot be unknown to metallurgists, whose works require the highest degree of heat, that the most perfect melting heat is that of the air-blast upon incandescent carbon, and as free from actual carbonaceous combustion as possible, the presence of the incandescent surface and the action of a powerful blast being the principal conditions. It cannot be a wholly new principle to assume that the heat is chiefly derived from a burning air-blast.

The common air, with its admitted proportions of oxygen and passive or neutral nitrogen, is in reality a compound of oxygen and *pyrogen*, the gaseous form of heat itself, and which is evolved as heat and converted into sensible heat of the greatest intensity by the blast of air delivered upon a surface of incandescent carbon.—*Lorin Blodget.*

THE RELATION OF THE ARCHITECT TO THE BUILDER.

The following is an extract from a paper written by O. P. Hatfield, architect, and read by John McArthur, architect, before the third annual conference of the National Association of Builders at Philadelphia, February 13th, 1889:—

The relation of the architect to the builder is a subject generally well understood. The architect determines the form of a building and decides upon the materials of which it is to be constructed. The builder should furnish those materials and erect the building. The architect gives directions as to the details of the construction, and the builder executes them fully to the architect's design. There is a divided responsibility—the architect is responsible for the *law* of the building, so to speak, and the builder for the proper execution of that law. They should work together, shoulder to shoulder, and the building grow up under their hands, perhaps a noble and enduring monument, a new creation it may be, testifying to their skill and the honourable integrity of their work.

The understanding of all is very plain; one building after another is erected; they go up on every hand, and the architect and the builder come to be looked upon as indispensable in their vocations, and altogether very useful persons in their way. To be sure, as the architect's labours imply a little more acting exercise of his brains, and the builder's a little more close handling of heavy material; the business of one is called a profession, and that of the other a trade; but both are regarded as equally honourable, and alike deserving to reap the rewards of honest industry. A worthy ambition impels both the architect and the builder to excel in their respective spheres of action, and the fortunate result is that the community profits by their emulation. Neighbourhoods are beautified and enlightened and cities made more stately and refined.

As everyone who has had anything to do with building contracts knows, no drawing or specification can absolutely embody all the details of the work called for, and the constant explanatory instructions of the originator of the design are therefore not only necessary, but they are desired and sought for by the contractor, and gratefully accepted. Not only is this the case with the contractor, but his men fall into line also, and regard the architect as the highest in authority about the building, governing their action accordingly, and taking his word as law in the smaller as well as in the greater details of the construction. They recognise the necessity of having some one chief who comprehends the whole plan of the work, and who can therefore reconcile the incongruities of the different branches of handiwork and bring order out of what seems to them a structural chaos. How many times do we hear workmen, when consulting with the architect, say—"Well, I will do just as you say." And their triumphal reply to all captious questions is—"The architect said so."

In spite of the closest calculations of the builder, as to the quantity and the quality of the work, when he first makes his estimate of the probable cost, there is a wide margin of undefined detail that must be regarded in determining the exact sum to be named in his proposal. And it is true, also, that a close acquaintance with the methods of the architect is more or less necessary in determining the plus or minus quantities which enter into the calculation of this uncertain margin. The great disparity in the amounts of the estimates depends, to a certain extent, upon this feature of the calculation, and in this way suggests one of the several relations of the architect to the builder.

Although the architect really is, in his superintendence of a building, the agent of the owner, being in his employ and looking to him for compensation for his labours, yet he should not forget that he is also an expert and umpire, who is expected to maintain, always, a judicial frame of mind and dispense even-handed justice in all his decisions as between the owner and the contractor. He is supposed to be familiar with the best methods of executing the several divisions of work that enter into the construction of a building, and with the characteristics of the best qualities of materials as well as with those of the inferior qualities, and therefore capable of giving an unbiased opinion as to their merits, which, in most cases, the owner is not. The latter, therefore, relies upon the judgment, knowledge, and experience of his architect to give a fair, honest, and just decision upon all questions that may arise as affecting his interest or those of the builder during the progress of the work. The architect should be a man of character; his integrity should be beyond question, his judgment must be good, and his store of acquired knowledge in the line of his profession full and ample. The just mean of favour toward the two parties to the contract will then be observed by him, and the work will be brought to a close to the satisfaction of everyone. The owner will possess a solid, substantial building, and the builder, in addition to his cash profits, will have received a wider indorsement of his good reputation.

No fair competition in building estimates can be obtained where the standing of the bidders are not on a level. No man whose custom is to do honest work and to furnish the best materials desires to estimate in competition with those whose purpose is to supply neither the one nor the other. The conditions are not parallel, and it is only labour lost to attempt to bring down a proposal for good work to the level or below that of one which has been calculated for work of a much lower grade. Therefore, in issuing invitations for proposals, regard should be had to the position and good character of the builders, in order that no wrong may be done to those whose intention is always to act in good faith and to maintain their usual high standard of work. This relation of the architect to the builder is one of great delicacy, and calls for a well-guarded circumspection on his part that well-earned privileges may not be sacrificed. Great care is here demanded in selecting contractors for the work.

A certain amount of unavoidable delays inevitably arise in the erection of all important buildings, and of some that are not so important. These hindrances to the progress of the work are caused most frequently from a want of the prompt delivery of material, and not seldom from the non-reception of the necessary working-drawings from the architect. The latter, therefore, should maintain a perfect system in the working of his office, so enforced as to cause the least delay possible in the production and distribution of such drawings, furnishing the drawings required for the work in the order in which it will be required at the building. Many of these classes of drawings have to be prepared at one and the same time, as the dimensions figured upon one class have to be transferred to another, and only a watchful care can insure their delivery in time for the proper preparation of the work to which they refer. It is only just that the builder should be provided with the necessary working-drawings in good time, and so as not to delay the execution of all his work in its necessary sequence. This desired end may be greatly facilitated by the close attention and determined application of the architect in his administration of the forces of his office. Many drawings can well be postponed, while others more urgently required can be prepared in their stead.

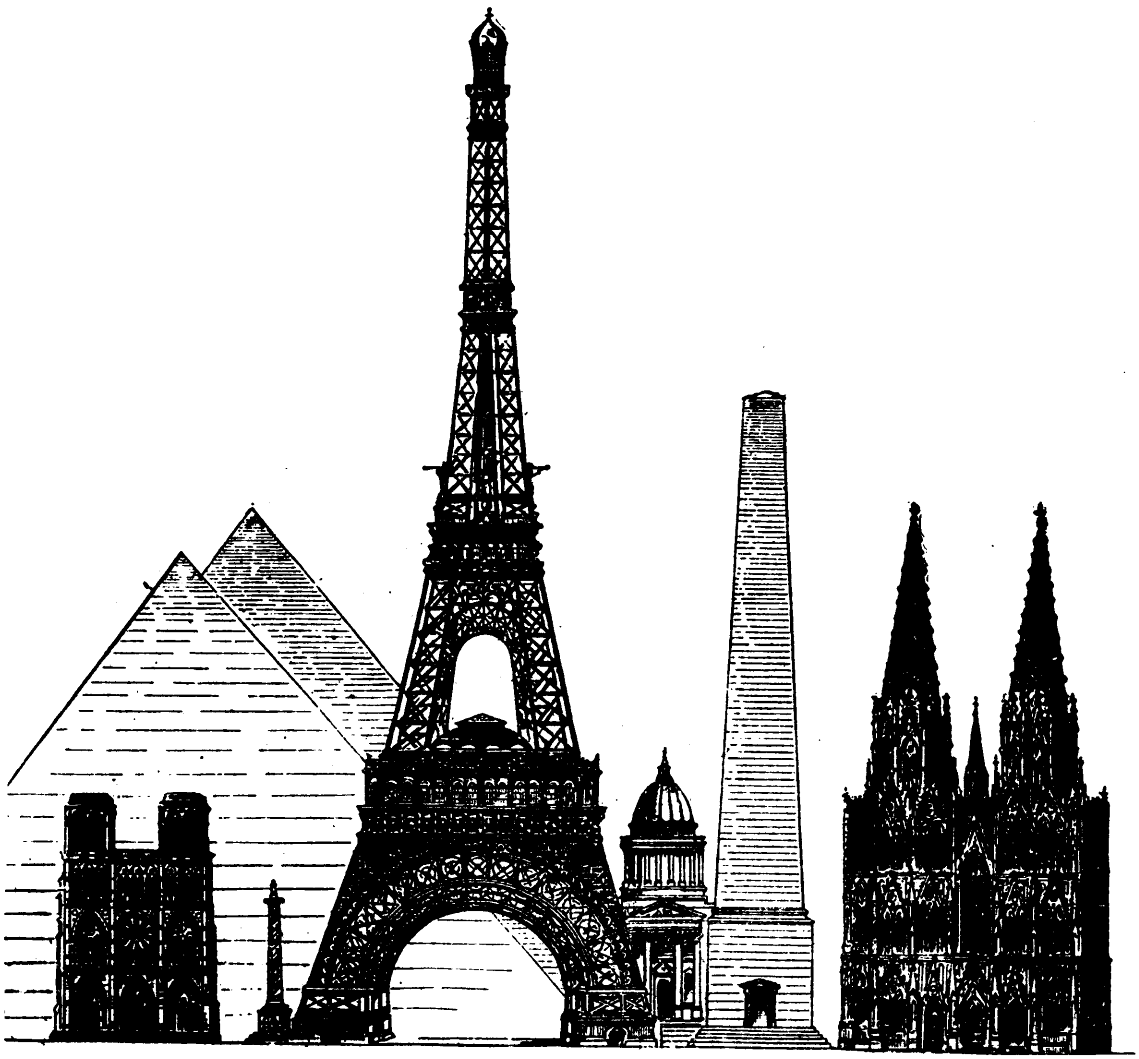
In preparing the specifications, also, the architect should have regard to the convenience and necessities of the builder. The description of the different classes of work should be so made as to include and concentrate under the several headings all the articles and details of work belonging to the various divisions respectively.

By a close observance of their several duties and obligations, on the part both of the builder and the architect, their relation one to the other may be made to be pleasant, as well as profitable, and a feeling of genuine, mutual respect be engendered, that will serve to greatly soften the asperities of their somewhat rugged, but parallel paths. It is to be hoped that every architect and every builder, be he of low or high degree, may feel called upon to contribute his portion of the goodwill and high endeavour necessary to secure this very desirable result.—*Builders' Reporter and Engineering Times.*

LAYING FLOORS.

There are many methods of laying floors, but the average builder is content with the old-fashioned plan. He does not take into consideration the manifest advantages of sound boarding and pugging, the expense of which is trifling compared with the advantages it secures. The coarse stuff or chopped-straw mortar used is cheap enough, the principal labour being the fillets nailed to the joists and the rough boarding which rest upon them to receive the pugging. The advantages of using silicate cotton as a non-conductor of heat and sound, great as they are, have not as yet been considered important enough to induce builders to employ it. It is the cost that hinders them. Architects are to blame for not specifying the material whenever they have an opportunity. In houses built in rows where the walls adjoin and the joists are all but continuous, the absolute value of non-conducting material is very obvious. What is required in houses built in rows is a layer of slag-wool between the flooring and the party-wall on each side, so that the transmission of sound or vibration may be checked or deadened. The joists of every floor ought to rest on sheets of this material. As houses are built now the floors of adjoining rooms generally are in contact with the wall, and there is no air space between ; often the joists run across and rest on the party-walls—a very objectionable form of construction, as then the sound can easily travel through the joists. It would be better to allow the joists to rest on the girders of iron supported on the side walls.

The jointing of floors is another matter which at present does not appear to trouble the profession ; the plain butt side joint is preferred because it is the cheapest ; the rebated and filleted joint, or the ploughed and tongued joint, are quite exceptional, and are used only in the very best houses. There are many inexpensive and useful joints that would avoid the defects of shrinkage of boards. The boards can be rebated, by which one overlaps the other, and if the boards shrink, there is not an undesirable open joint which gets filled up with decaying matter. Another plan is to rebate the bottom edge of each board, and to insert therein a slip of wood. This is the rebated and filleted joint. The fillet stops the aperture, though it leaves the upper part of the joint open. The grooved and tongued joint, where a tongue fits into a corresponding groove in the adjoining edge, is another well-known joint. The rebated, grooved, and tongued method is a more perfect but costly plan. A good and effective joint is made by making a narrow groove along the edge of each board and inserting hoop-iron, technically known as a "ploughed and tongued" joint. Other joints to conceal the nailing, in which a kind of rebate is formed, and one edge of board is screwed to the joist, are well-known. The advantages are, that dust and dirt cannot pass through the floor, and a cleaner and more sanitary floor is the result.—*Building News.*



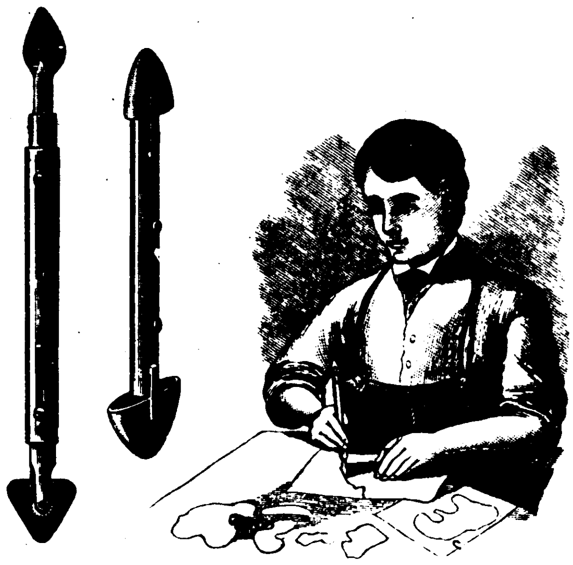
THE EIFFEL TOWER.

THE EIFFEL TOWER.

One of the most notable objects of this year's exposition in Paris will certainly be the Eiffel tower, named for the constructor Eiffel, and finished March 31. The reader knows that this immense bolt and iron structure, which is 984 feet high, is by far the highest building in the world. In the accompanying illustration we show the Eiffel tower in connection with some of the highest structures of the world, all being drawn on the same scale. Only by such a comparison as is made possible by this cut can one realize the size of this new wonder of the world.

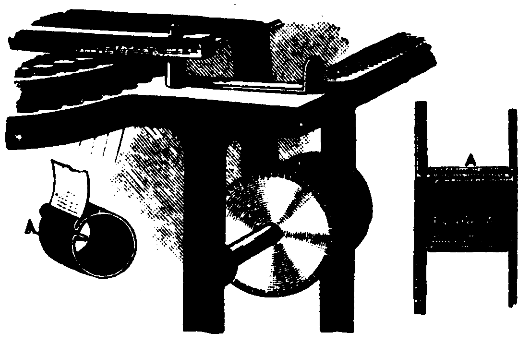
The highest structures of ancient times are the pyramids of old Egypt, the highest and best preserved of which are the pyramid of Cheops, near Ghizeh (450 high), and that of Chephren (448 feet high). Both of these are less than half as high as the Eiffel tower. Heretofore the highest building in Europe was the Cologne cathedral (about 522 feet high), and the highest in America the Washington monument (about 555 feet high). Both are greatly surpassed in height by the Eiffel tower.

To give the reader an idea of the comparative heights of the Eiffel tower and the buildings nearest it, we have shown in the picture a few of the highest structures in Paris, viz., Notre Dame (223 feet high), the dome of the Pantheon (272 feet high), and the Column Vendome (144 feet high.)—*Illustrirte Zeitung.*



DUS' KNIFE FOR PRINTERS' USE.

A knife especially designed for the use of pressmen in cutting out "overlays" or "underlays" in making a form ready, is shown in the accompanying illustration. The handle is a piece of tubing with longitudinal slots for sliding studs, by means of which the blades in either end are moved in or out. One of the blades is sharpened on its opposite edges in form much to resemble an ordinary ink eraser, while the other blade holder has pivoted therein a blade sharpened on three sides and edges, whereby the blade may be turned and adjusted to cut at any desired point and from any of its edges. This blade is retained in position when adjusted by a spring pawl made to engage with a ratchet fast on the blade or its pivot. The rotatable blade is designed to do the general work of the pressman in making forms ready, while the other blade may be used exclusively for cutting sharp angles or corners. Movable caps are provided for covering the ends of the knife, so that it may be carried in the pocket, these caps having spring catches for engagement with the slotted portions of the handle. —*Scientific American.*



RAY'S INKING RIBBON SPOOL FOR TYPE-WRITERS.

The illustration herewith represents an inking ribbon spool for type writing machines, by means of which the ribbons can be quickly and easily adjusted, and ribbons of various colours can be readily interchanged with but a single set of ribbon spools fitted to the machine. This invention has been patented by Mr. Harvey Ray, of Mobile, Ala. One side of the spool has peripheral teeth to engage mechanism of the type writer as the machine is operated, and on this toothed side is fixed a hub, slotted to receive an inwardly bent tongue of the inking ribbon bobbin, as shown at A in the small figure and in the sectional view. This bobbin consists of a plate of metal bent around from its tongue to fit loosely upon the fixed hub, and at the other end is bent upon itself to form a clamp into which the end of the inking ribbon is fastened. The other side part of the spool has a hub which fits snugly inside of the other fixed hub, and against the end of the bobbin, the side plates thus forming walls between which the inking ribbon is held truly edgewise. By removing the movable side portion, the bobbin with the ribbon wound on it may be readily slipped from the fixed hub, and replaced by another bobbin carrying a fresh ribbon, or one of a different colour, without soiling the fingers.—*Scientific American.*

A POCKET TYPE-WRITER.

A type-writer which is almost certain to attract a great deal of attention is shortly to be offered to the public. The instruments of this character now in the market are costly and of considerable size and weight—at least a person could scarcely think of carrying one about with him regularly. The one under notice, invented by A. E. Wynn, of Ilkey, England, is not only inexpensive, but is so small that it may be carried in the waistcoat pocket. The retail price will be under 10s. ; it measures three and one-half inches by three inches, and weighs about four ounces. Though so small, it is not a mere toy. The inventor claims for it that it will turn out better work and be found more useful than larger and more expensive machines. With reference to its construction, all that can be seen when superficially examined is a disk about the size of the face of a gentleman's watch, in which the type is fixed, and one or two small rollers. It will print a line from an inch to a yard long, and paper of any size or thickness can be used. Anyone can use it, though, as in the case of other instruments, practice is required to enable the operator to write quickly. Another advantage is that by means of duplicate types the writer can be used for different languages. Patents have been obtained for most of the countries in Europe, as well as for America, Canada and Australia. *London Ironmonger.*

INDIAN CRUCIBLE STEEL—MINIATURE STEEL WORKS.

The industry is still carried on to some extent. The works are conducted in some location favorable for obtaining charcoal. In the village here referred to the business affords employment for about 16 families of smiths, and is altogether in the hands of a Mussulman named Mahomed Routhen, who holds a monopoly of the right to collect charcoal for the purpose in the jungles of the estate, for which he pays 1,000 rupees per annum. Beyond the convenience of its situation as regards jungles and the existence of a tolerably fine red earth in the vicinity, the site possesses no special advantages. The modus operandi is described as follows :

"The process employed is very simple. Small quantities of iron are enclosed in a small earthen crucible with a few pieces of the wood of the avaram plant and two or three green leaves. A top is luted on, and when dry the whole is exposed to the heat of a small charcoal furnace till the iron is melted, a fact which the operator ascertains by picking up the crucibles in a long pincer and shaking them. The vessels are allowed to cool and then broken open, when a knob of steel is found at the bottom. Two sizes of ingots are made, weighing about 8 ounces and 10⅜ ounces respectively. The crucibles are made of a mixture of red earth and charcoal made of paddy husks kneaded together. They are shaped on a wooden plug about five inches long and two inches in diameter for the smaller size of ingot, and slightly larger for the other size, having a conical end which forms the bottom of the cavity in which the steel collects while fluid. The lid is of the same material and put on wet. It appears hardly to contract at all in drying, and a fairly air-tight vessel is consequently produced. The clay is not nearly refractory enough for the heat it is exposed to, as the crucibles are completely vitrified and spoiled at the end of a single operation.

"The iron used is brought from the Namakal Taluk of Salem, and appears to be a rough description of wrought iron. For the smaller size of ingot it is cut into pieces weighing as nearly as possibly ten ounces (a small piece is added to make up the weight, if necessary), and this quantity is placed in each crucible with ⅜-ounce weight of pieces of the dry wood of the avaram plant. Two or three green leaves (the kind is a matter of no consequence) are placed on top and the charge closed up with a lump of clay carefully plastered all around. Great care is taken in putting in the correct proportions of iron and avaram wood, and the operators assert that, if less is used, the iron is not melted, and if more, it will not stand being worked afterward. The green leaves probably serve in some way toward retarding the drying of the lid and preventing it from cracking. The furnace consists of an inverted cone of earthwork about two feet in diameter, and the same in depth, the apex opening into an ash-pit below. At one side, and protected from the heat by a mud wall, is a small shed in which two bellows-men sit and work a pair of skin bellows most vigorously. The air is admitted into the furnace through a hole near the bottom. In preparing a furnace, some straw is first placed at the bottom below the air-hole, and charcoal is then thrown in to a suitable hight. On this, 25 of these conical crucibles are placed with the point downward, and when all are in position they appear to form a sort of circle and to be independent of the layer of charcoal below. More charcoal is placed above, and the furnace is then lighted through the air-hole. Fresh fuel is thrown on above from time to time, and one or two of the crucibles are occasionally lifted with long-handled pincers to allow the burning charcoal to fall through and replenish the supply below. The straw remains untouched by the fire throughout the process. The crucibles are given a sharp shake on these occasions, which is said to assist the process, and, toward its conclusion, allows of the operator's ascertaining whether the iron is melted or not.

"As the mouth of the furnace is open, the waste of fuel is enormous, and I do not believe that one-fourth of the charcoal used exercises any effect on crucibles. In the absence of good fine clay this fault seems irremediable, as there is no sufficiently refractory metal available from which a separate opening for the supply of charcoal to the furnace below could be constructed. After about an hour or an hour and a half, the feel of a crucible when lifted shows its contents to be liquid. The process is then considered to be completed, and the crucibles allowed to cool, after which they are broken open, and a knob of steel is found at the bottom of each. The ingots are reheated and hammered into oblong pieces, in which shape they are sold. All the crucibles do not remain absolutely airtight during the process, the lids becoming cracked without affecting the result. I had the contents of one of these poured out through a crack, and was surprised to find the steel in a state of extreme fluidity, a thing which the heat produced hardly led me to expect."

The estimated cost of making 200 pounds of steel is about 31 rupees, and the value realized for the production about 36 rupees, the manufacturer netting a profit of 5 rupees, or about 16 per cent. The annual out-turn of the manufacturers in the village is about 14 tons.

The silver rupee is worth about 50 cents of English money ; the gold rupee about $7.—*East Indian Engineer.*

PRINTING BY ELECTRICITY.

The proprietors of the *Star of the East*, the evening edition of the *East Anglian Daily Times*, published at Ipswich, deserve credit for their enterprise in adopting electricity for working their printing machinery. The first experiment was made on Saturday last, when the dynamo usually employed to light the building was used as a motor, and current was transmitted by means of a half-inch cable from a set of accumulators at the works of Messrs. Laurence, Paris and Scott. This was, we believe, the first attempt to print by electricity in this country. The advantages of electric motive power in the printing offices of Fleet Street and the surrounding neighbourhood, where every square foot of space is important, must be obvious to our readers, and when the central lighting stations are all in full swing, we quite expect to find the companies devoting attention to the distribution of motive power.

ON ARTIFICIAL ORGANIC DYESTUFFS AND THEIR USE.

In *calico printing* the dyestuff solutions are mixed with a thickening (starch paste, gum tragacanth) and if necessary a mordant, and applied to the fibre by means of printing blocks or rollers. Then usually follows steaming, whereby the dyestuff and mordant are caused to penetrate the fibre and combine with it. When albumen colors are employed, the albumen, which at the beginning is soluble, coagulates by the steaming process and in this state holds the dyestuff fixed upon the fibre.

Leather dyeing is on the whole based upon the employment of the same dyestuffs which are used for dyeing animal fibres, such as the eosines, fuchsines, methyl violet, malachite green, acid green, quinoline yellow, ponceaux, nigrosine; but also dyestuffs which are specially used in cotton dyeing, such as phosphine and methylene blue. It must be observed, however, that the colors obtained upon leather do not always match those which are produced with the same dyestuffs upon fibrous material. Prior to dyeing the leather must be very carefully cleaned. The dyeing operation consists either in immersion in a dyestuff solution or in the application of the baths by means of brushes. In the latter case aqueous as well as alcoholic or lake solutions are used.

The dyeing of feathers and hair is effected by first cleaning the feathers or hair, before dyeing, or bleaching if necessary, by lukewarm soda water (1:120). For dyeing, all neutral dyestuffs suitable for wool dyeing are employed in the same manner as for this fibre.

The dyeing of horn, bone, ivory, and ivory nuts is ordinarily effected, after cleaning, by laying them down in the suitable dyestuff solutions, or painting with them.

Straw is dyed in the same manner; before dyeing, however, it must be cleaned by laying it down in ammonia or soda solution. Usually it is previously bleached by sulphurous acid.

Wood, grasses, flowers, moss, etc., are stained by laying the objects to be colored down in the solutions, or painting them over, or pressing the coloring liquid into them. The most used colors are fuchsine, methyl violet, malachite green, and aniline blue.

The staining of paper with the artificial organic dyestuffs constitutes an extensive industry on account of the handsome and bright colors obtained and of the simplicity of the dyeing methods, of which two are distinguished, viz., staining in the sheet, when the paper is either immersed in the dyestuff solution or painted over with the same (or with colored lakes), and coloring in the pulp, when the dyestuff is already added to the paper stuff while in the rag engine. Paper can, besides, be printed with colors like tissues, as in the manufacture of wall paper.

For coloring soaps only dyestuffs are used which are soluble in alkaline liquids and are not altered thereby.

Colored varnishes or so called brilliant lacquers are produced with aniline dyestuffs soluble in alcohol, such as fuchsine, methyl violet, azo and nitro dyestuffs soluble in alcohol, etc.

For colored inks many artificial organic dyestuffs are excellent to use on account of their great tinctorial value, and because the aqueous solutions do not become mouldy. For 3 pts. dyestuff generally 5 pts. gum arabic and 150 pts. water are used, and for copying inks some glycerine is added. Methyl violet is preferably used for violet (mauve) ink, eosine for red, and malachite green for green ink. For making marking ink (stamping) 3 pts. dyestuff are mixed with 144 pts. alcohol 50 per cent and 33 pts. glycerine.

Ink sticks were first, in 1878, produced by E. Jacobson, from aniline dyestuffs, graphite, and kaolin. These materials are mixed in four different proportions, according to the degree of hardness desired; the more kaolin and the less dyestuff and graphite, the harder the stick. The finely ground materials are carefully mixed, made into a paste with water, pressed through a perforated plate so as to form sticks, and dried.—*Textile Colorist.*

POINTS ABOUT ADVERTISING.

Newspaper men in soliciting advertising are often met with the statement—"I do not need to advertise just now; I am unable to fill my orders; when business begins to slacken up I shall perhaps avail myself of your columns." It is the old story of the leaky roof which did not need repairing when the weather was fair, and could not be repaired while it rained. The wisest business men and the most successful ones are those who keep their names prominently before the public when trade is good as well as when it is poor. The time to boom a town is when everybody is interested in it. When the interest fails, one might as well try to sweep back the receding waves of the ocean, as to withstand the stampede of waning confidence. When trade is driving, is the time to make one's business so well known that when the dull season comes there will still be customers to keep the manufacturer busy. Said a business man "I must advertise if I would get good results from any men on the road. Before I advertised, my travellers entering an office would be told 'we are not acquainted with your house,' and in many cases found that they could not secure an order which perchance would be given to a competitor before their eyes. As soon as I began to advertise I had a different experience. My men found that it was equivalent to a letter of introduction from a mutual friend. 'Oh yes, we have noticed your advertisement and we feel acquainted with your house.' In this influence alone our advertising pays." This is no unusual experience. Men will deal with those whom they know, or of whom they have heard so much that they feel acquainted. A constant and continual advertisement in a reputable journal which is constantly seen, is like the dripping water which is wearing away the flinty rock, slowly it may be but surely. Circulars are thrown in the waste basket. Catalogues may find lodgment on a shelf, but the frequent arrival of a reputable journal is a constant and sure reminder which sooner or later must bear fruit. It is the non-advertiser who complains of hard times. When everybody is rushed, it is no trick to secure custom, it is when his neighbours are idle, that the man who has wisely kept his name and goods before the public, finds himself so well known that he gets his full share of what patronage is to be had. The time to make hay is while the sun shines. Repair the roof while the weather is favourable, and there will be no leak when the storm comes.—*Dixie.*

WATERPROOF PAPER.—A paper that resists the action of both fire and water, it is said, has been recently invented in Germany. The manufacture is accomplished by mixing 25 parts of asbestos fibre with from 2 to 30 parts of aluminum sulphate. This mixture is moistened with chloride of zinc, and thoroughly washed with water. It is then treated with solutions of one part of resin soap in 8 or 10 parts of a solution of pure aluminum sulphate, after which it is manufactured into paper, as is done from ordinary pulp.

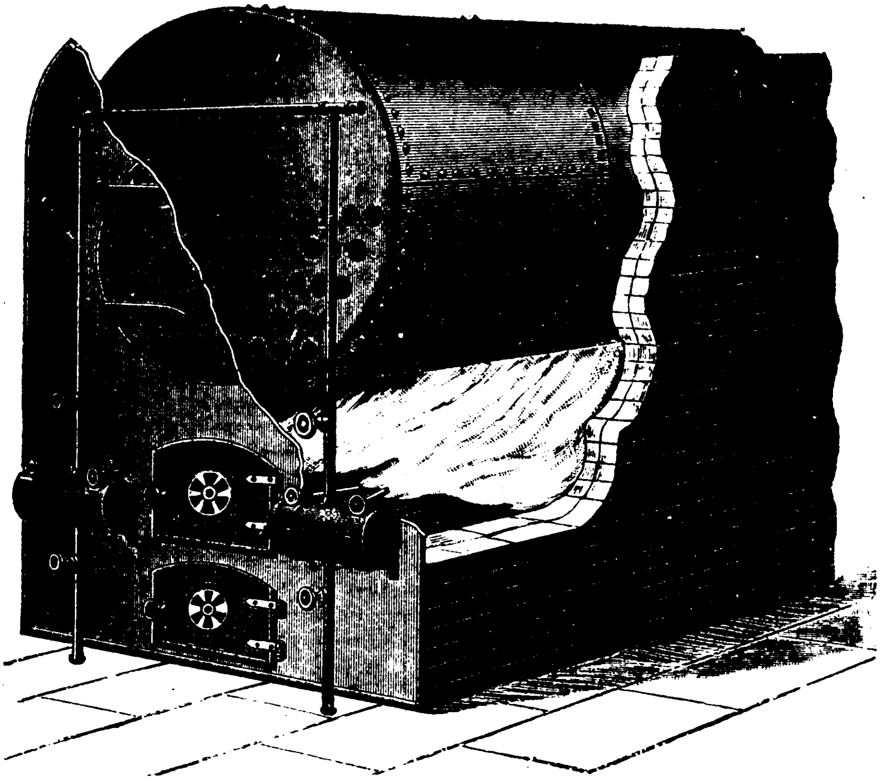


FIG. I.—BURNING CRUDE OIL UNDER A BOILER RETURN FLUE PATTERN.

CRUDE PETROLEUM FOR MANUFACTURING PURPOSES.

We illustrate herewith some of the many uses made of crude petroleum as fuel by the processes of the Ærated Fuel Company, of Springfield, Mass.

Fig. 1 shows the application of this system under a boiler, return flue pattern. Among the many advantages claimed by this system over coal are : Uniform heat, constant pressure of steam, no ashes, clinkers, soot or smoke, and consequently clean flues, one man attending from ten to fifteen 100 H. P. boilers burning this fuel easier and with less trouble than with one boiler burning coal.

Fig. 2 shows this system as applied to a forge suitable to a large variety of general work. One cylinder containing six burners is placed on one side, leaving one end open to receive the work. If desirable, both ends may be left open, especially when it is desired to heat long pieces of iron or steel in the centre. By putting an adjustable or movable brick partition in the centre, as many burners as are not wanted can be shut out, thus reducing the area of the fire box and using one or two burners, as required. At the repair shops of the Boston and Albany Railroad Company, at Springfield, Mass., where this system is generally employed, the superintendent states he regards the system as far superior to coal in every respect, particularly for work requiring a high degree of heat at short notice.

Fig. 3 illustrates the interior and end view of the burner cylinder and shows the proper position of float valve when cap is on end of cylinder.

The object of the float is to prevent the flowing of oil into the cylinder and rising above the mean level as established by the governing device in each cylinder. The float falls of its own weight, so as to open the valve and allow the oil to rise again to the mean level. The sectional cuts show that if, from any cause, the float should sink, it will also close the valve, thus preventing any possibility of flooding the furnace or overflow in tanks.

Referring to Fig. 3, it will be seen there is an air space maintained on an air pressure of from 10 to 25 lb. per square inch, according to the class of work being done. Although the nozzle of the burner is small, from 1-20 to 1-8 inch, and only a small quantity of air used, yet it must be under an equal pressure, that the oil may be finely atomized before igniting.

The Ærated Fuel Company have many forges, muffles, ovens, and similar fires, using over 1,500 burners, in successful operation, in which the fuel is crude Lima oil, burned by being atomized with a governed air pressure, very similar in quality to natural gas and free from danger. Its advantages are, no increased rates of insurance, for the best insurance companies approve of the system as shown in Fig. 2 ; no odor ; no chimney connection needed ; no sulphur or other impurities, as is the case with coal ; perfect combustion and regulation ; and cheaper than any fuel, not excepting natural gas, unless the consumer owns his own wells.

One pound of oil will do the work of from 3 to 6 lb. of the best hard coal in forges, and do it better, and there is less liability of overheating or burning stock.

The system can be adapted to nearly any forge now in use, but as it is necessary to use from 10 to 25 lb. air pressure per square inch, a compressor of some kind is necessary, as no fan

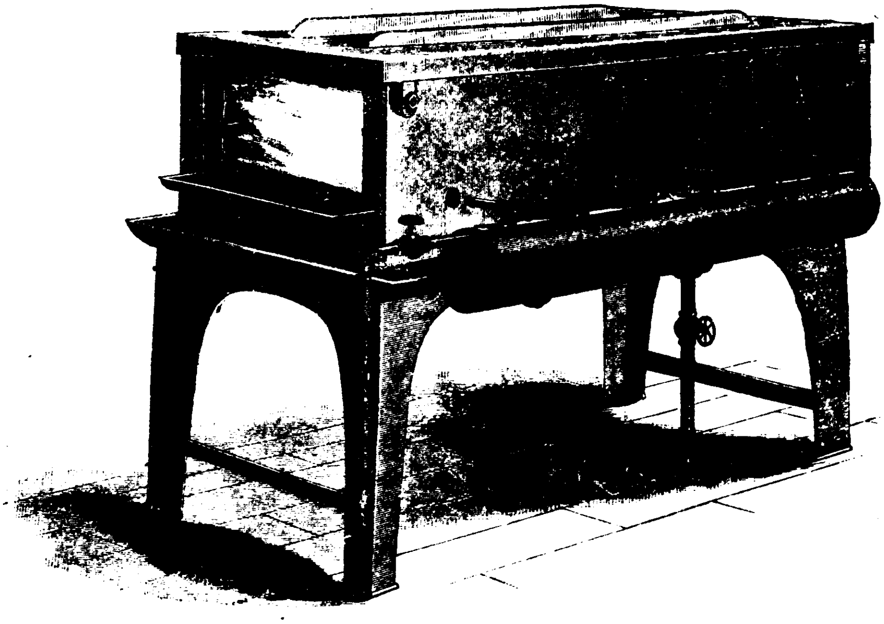


FIG. 2.—BURNING CRUDE OIL UNDER A FORGE FOR GENERAL WORK.

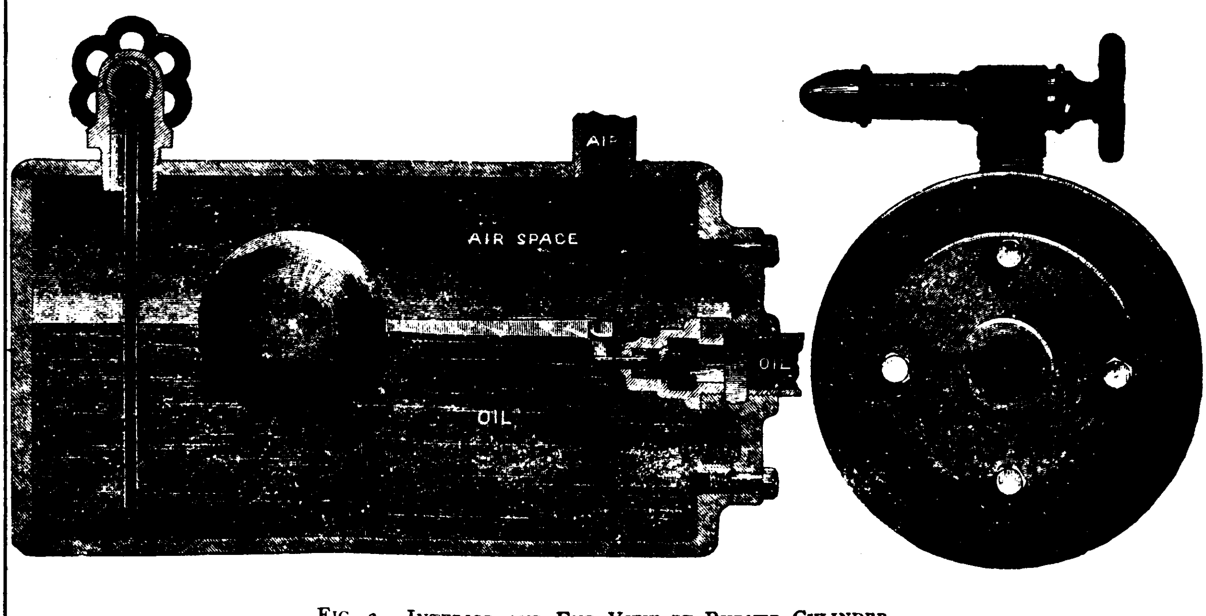


FIG. 3.—INTERIOR AND END VIEW OF BURNER CYLINDER.

blower will maintain this pressure. The oil ceases to flow through the burner when the air pressure is removed, consequently fire is impossible, and only one valve is necessary to control both oil and air. This process is already used for japanning, annealing, hardening, drop forging, shovel welding, heating blanks for bolts, riveting furnaces for boiler and bridge work, hoe, fork, and rake work, cutlery works, mowing, reaping, harvesting, binding, and hay pressing machinery, scale work, railroad repair and locomotive works, glass and copper works, etc.— *Scientific American.*

ADULTERATION OF SHERRY IN SPAIN.

There are two kinds of wine merchants who ought not to be confounded ; these are the wine-growers and speculators in wine on the spot, who are in reality those who form the market prices ; the others are the "extractors," and these are the shippers to foreign markets ; they make their purchases from the former, and prepare and blend their wines in a great variety of styles for the particular demand of the market each kind is intended for. For instance, there are markets which require a very pale sherry, and a gold or brown sherry would not sell at any price, whilst at others it happens the contrary and a very pale wine would not find buyers. There are many other specialties, such as more or less dry, more or less body, sweetness, taste, etc., in fact, each adapted for a different market; but these wines cannot be considered to form the market value of this place, and for said reason it is necessary to take the prices from the first-stated merchants. That is what the shippers do, or pretend to do, when they present their invoices, which represent the original cost of the wine and the corresponding expenses of preparation from the date of the purchase, which appears reasonable.

This is observed in the majority of shipments for New York, where the largest quantity consumed is of very low grade. It has been considered generally that low sherries cannot be fit for shipment until the third year, and so it would be if left entirely to nature; but such wines in the hands of intelligent persons in the matter, by repeated fining and raking off, reinforcing well with alcohol, and other operations adopted by wine merchants, have, in fact, of late been shipped within the second year. A great part of the wine shipped is not above twelve months, and this is the sweet or checked wine, of which a good portion enters into the combination of low sherries.

The sweet wine is made thus: During the vintage, and after the grape is pressed, they put 25 gallons of alcohol or spirits of about 66 per cent overproof to a butt, and the rest is completely filled with the must or juice of the grape, and bung made fast. The spirits stop the fermentation of the wine, which then becomes perfectly sweet. This wine can be got ready for shipment within twelve months or less, but, as I have already stated, it is only used as an auxiliary for the preparation of wines.

In general the low-priced sherries are blended or composed of four or more different sorts, viz., alcohol or spirits, sweet wine, which I have described above, colored wine, cheap new wines of different kinds, and sometimes of a few gallons of older wines to help the whole to an older appearance. Fine sherries, on the contrary, are kept in their natural state of very pale and dry for six or seven years and sometimes longer, and these wines, which, from their first growth, are costly and become still more so by the length of time required, are very frequently disapproved by such as find other sorts of wine more to their taste, and worth, perhaps, the tenth part of the above stated varieties.

Another way, and the best way, to "forward" wines is by the use of "soleras," or, as I should say, mother-wines. The said soleras are a number of butts of old wines more or less good, but always old; these butts of wine to be made use of are generally half full, the other half being filled with a new wine which, in the course of a very short time, gets so forwarded that it becomes an "old" wine under that treatment. A quantity is then taken from each butt to be made use of in the preparation of wines, and that quantity taken off is again replaced with new wine to let it grow again in the same manner. The same way of carrying on the business is hardly to be found in any other country, or even in any other part of Spain.—*Report of U. S. Acting Vice-Consul* Ant. J. Bensusan *at Cadiz.*

A photographic exhibition is now in progress at the Crystal Palace, London, in which, according to the London papers, a preponderance of the actual or comparative novelties consists of American inventions on sale by English firms.

AMERICAN WOOD ENGRAVING.

BY R. E. M. SUVERKROP.

English and Scotch manufacturers of machinery are beginning to find out that (notwithstanding their proverbial prejudice to many things American) their catalogues can best be illustrated on this side of the Atlantic, and many firms are now not only getting the engraving done in this country, but also the printing.

Printers and engravers across the water are slow to adopt new methods, thinking that "good enough" will do. "What was good enough for our fathers and grandfathers is quite good enough for us," they say. But it is not the man who does the work alone that must be pleased—it is the person for whom the work is done. They are too shortsighted to see this, and rather than move out of the rut they have been taught in, and try and improve their work by the adoption of machines and other modern appliances, they allow the work to slip from their hands to take a journey of 3,000 miles and back.

An English wood engraver as a rule is a mere machine, copying or cutting literally what is drawn for him on the block by a draughtsman, the American method of engraving from a photo. direct on the wood being almost unknown to them. No photograph of a piece of machinery, however well lighted, would look well as an engraving if copied literally. Lights must be taken out, solid blocks put in, and the whole must actually be redrawn, as far as the shading is concerned, with the graver. Therein lies the skill of the American engraver. Although the photo. is flat and devoid of correct light and shade, the final print from the finished cut will be bright, clear cut, and sharp, with a sparkle and snap to it that is not excelled even by work cut from the most finished drawing on wood.

One has only to compare the cuts in foreign machine catalogues with those of our own to see how far they are behind us in the matter of engraving machinery. Examine the shading of the one, and the lines will be found uneven and broken, devoid of contrast and that fineness and even quality so peculiar to work of the other, which is invariably ruled by machine. The ruling machine is a most delicate piece of mechanism, capable of making lines so fine that they cannot be counted without the aid of a strong magnifying glass, making straight, circular, wave, and perspective lines with absolute precision, that could not possibly be cut by hand. Improvements in the art of photography of late years have done much to assist the engraver in his work. Fifteen years ago engravers had to cut through a thick film of albumen on the surface of the wood, put there to prevent the nitrate of silver from sinking into the block. This film or coating would chip and peel off, making the lines ragged and uneven, causing no end of trouble to the electrotyper and printer.

It was due to the genius of Mr. J. M. Blake, of New Haven, to overcome this difficulty by an invention of his own. Mr. Blake made a positive on glass by the old collodion process. This film he floated off the glass silver side down, on the block, afterward dissolving off the collodion with alcohol and ether, leaving a fine, clear print on the wood that offered no resistance to the point of the graver. Since this valuable discovery engravers have been little troubled with bad photos. on wood.

Every engraver should have a camera and know how to use it, as few professional photographers can make negatives suited to the requirements of the engraver, and it is also a great aid to be able to draw. One who can draw well rarely makes a mistake in his cutting and can easily cut from a photo., while on the other hand if unable to draw he must rely on a draughtsman to retouch his photo. on the block or engrave from drawings altogether. It is impossible to draw a line with a pen as clean and sharp as it can be cut. This fact has in a great measure prevented wood engraving, especially of machinery, from being superseded by the various photo-mechanical and chemical methods of reproducing, for it is a misnomer to call them engraving. Every line must be drawn and be absolutely black, and all the spaces between the lines must be pure white in order that a perfect negative may be obtained. This drawing alone often takes more time than to engrave the same on wood, and when finished must go through many intricate processes before the final plate is ready for the printer.

Photo-reproduction of course has its uses, but will never supersede wood engraving for machinery. This no one knows better than the printer. Imitation is the sincerest form of flattery. The Germans have to a great extent abandoned the old laborious method of cross hatching and putting in useless, meaningless lines. Many of their illustrated periodicals have taken up the American style in the landscape, figure, and portrait work, but they and their brethren on the little isle to the north have still much to learn from us in the way of mechanical work, and it will take much study and many a long day of constant application ere they can begin to equal us in this line.—*Practical Mechanic.*

TO IMITATE FURNITURE WOOD.

After the colour has been applied to the panel, take a large dusting brush of the kind used by painters, and working the reverse way of your colour, lightly pass over the surface with the tips or ends so as to blend together, as it were, the light and the dark.

Quickness of manipulation is essential to obtain the desired effect while the colour is wet, for it dries or sets very quickly. Use judgment in passing over the work, so as to vary the beating, by turning your hand, according to the various directions the veins have taken when first laid on.

Next, take a piece of wash-leather damped and folded, to form a round elongated edge, and proceed to wipe out all the light parts lying between the heavy colour. Then with another piece of leather, fastened on to the end of a stick and brought to a point like a pencil, proceed to cut out all the finer lines.

If you find that your colour sets while working, you must dab it on the surface—not rub it, else you will probably rub off all the colour. As soon as the panel is dry you can, by means of a flat fitch, proceed to put in all veins (or worms, as they are sometimes called) which cross the grain, by using a little burnt umber diluted with beer to the necessary tint.

If you want the work to have dark shades on its surface, then you must work in a little Vandyke brown. These dark shades and veins can be formed with a camel's hair or sable pencil, and blended together with the badger.

Passing on next to mahogany, we shall see by examining a piece of Honduras wood that it is much easier to imitate mahogany than oak.

When the ground colour is thoroughly dry, smooth and level the surface so that the brush marks shall be hardly discernible.

Attention to this point will materially contribute to secure a good imitation. After this, proceed as before to remove with a damp wash-leather all grease and dust.

You will be able to judge whether the surface be free from grease or not, since no moisture will be absorbed by such spots, but they will appear dry and shining. If necessary, you may use soap and water. Some grainers will even rub the surface over with whiting and water, which has a good effect. Having prepared some Vandyke brown, ground and mixed in beer, proceed to thinly spread it over the work, and while the colour is quite wet freely dab a piece of sponge over it to gain the effect of light and dark shades, at the same time drawing the sponge a little.

With your "softener" proceed next to blend the edges of the dark into the light shades, so that the eye may not perceive any broken lines or edges, and towards the finish use the softener (or badger) in the direction of the grain, or rather in the direction in which the dark veins of the mahogany are intended to run.

When the work is dry, get a tint of Vandyke brown ready, and with a tool filled with a little colour form the lightest of the dark veins or shades, using a drier brush to obtain the effect of a kind of over grain.

The veins ought to run in the direction of the light above and below it.

A little practice will soon familiarise you with the process.

To gain a nice rolled mottle, as it were, a light dab of colour must be given just under the lightest portion, so as to render it solid and opaque.

Next blend all well together, which can be done in the first instance, by means of the dusting brush before-mentioned, while the badger may be employed for the finishing touches. —*Builders' Reporter and Engineering Times.*

WATERPROOF WHITEWASH.

A German paper publishes a formula for a wash which can be applied to lime walls and afterwards become waterproof so as to bear washing. Resenschek, of Munich, mixes together the powder from three parts silicious rock (quartz), three parts broken marble and sandstone, also two parts of burned porcelain clay, with two parts freshly slaked lime, still warm. In this way a wash is made which forms a silicate if often wetted, and becomes, after a time, almost like stone. The four constituents mixed together give the ground colour, to which any pigment that can be used with lime is added. It is applied quite thickly to the wall, or other surface, let dry one day, and the next day frequently covered with water, which makes it waterproof. This wash can be cleansed with water without losing any of its colour; on the contrary, each time it gets harder, so that it can even be brushed, while its porosity makes its look soft. The wash or calcimime can be used for ordinary purposes, as well as for the finest painting. A so-called fresco surface can be prepared with it in the dry way.

A recipe for whitewash suitable for outbuildings on a farm; something that will not wash or rub off, and not injure trees, and can be tinted: For one barrel of colour wash use half a bushel white lime, three pecks hydraulic cement, 10 lbs. umber, 10 lbs. ochre, 1 lb. Venetian red, ¼ lb. lampblack. Slake the lime, cut the lampblack with vinegar, and mix well together, then add the cement and fill the barrel with water. Let it stand 12 hours before using, and stir frequently while putting on. This wash is not a clear white, but a light stone colour, which may be more or less changed by the other colours. This covers well, hardens without scaling, and will not wash off.

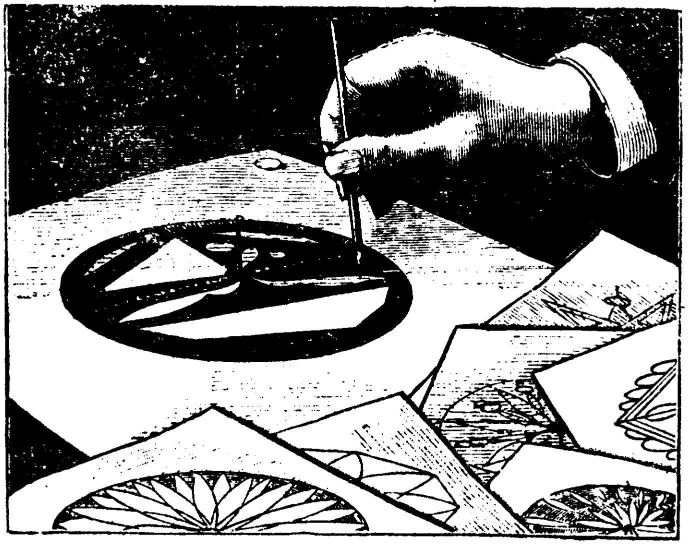


FIG. I.—THE POLYGRAPH, SHOWING HOW IT IS USED.

THE POLYGRAPH.

This ingenious scientific implement, as its name will indicate, permits of the production of a great variety of geometrical figures, simple and complex, with great accuracy and dispatch, and in so simple a manner that with little practice a child will be able to produce the most elaborate and intricate designs, which without it would be quite impossible of accomplishment, save with the aid of great skill and long practice.

The instrument consists of a circular disk of sheet brass or other metal, 4⅝ inches in diameter, from which portions, in the form of straight lines, curves, etc., have been stamped out, leaving various open spaces, as shown by Fig. 1. This simple device combines within itself the qualities of straight and curved rules, dividers, protractor and scale, and other auxiliary draughting implements, and permits the user to produce, rapidly and accurately, results which hitherto could only be realised by the employment of complicated instruments. A few specimens of the great variety of designs that the instrument is capable of producing are shown in Fig. 2.

In addition to its use for recreation and the instruction of children, for which it is admirably adapted, it is obviously capable of being employed practically by designers, decorators, draughtsmen, architects and artisans.

In using the polygrapy, it is laid upon the paper intended to receive the drawing, and pivoted at the centre by means of a pin passing through a hole provided for the purpose. A hard, sharp-pointed pencil is recommended for making the lines, and it is obviously necessary, if the results are to be accurate, that the exact distances required in each sweep of the pencil shall be laid off.

The manner of producing various regular figures will readily be understood from the following: A triangle is produced by laying off the distance marked three, three times, moving the instrument each time so that the ends of the lines so produced shall join exactly. In a similar manner, a square will be made by drawing the line four, four times; a pentagon, by drawing the line five, five times; and so on, so that polygons having three, four, five, six, eight, ten and twelve sides may readily and correctly be drawn.

A series of holes, perforated at distances of $\frac{1}{16}$ of an inch apart, as seen in Fig. 1, permits of the drawing of as many circles, each $\frac{1}{16}$ of an inch apart. For drawing larger circles, the instrument may be pivoted at the periphery, by which circles of 9 inches diameter may be drawn.

By means of the various curves, the lozenge-shaped opening, and the small circles pierced in the disk, a variety of the most fanciful and intricate drawings may be executed, limited only by the skill and ingenuity of the operator. The scale of degrees is provided on the periphery of the disk, which will commend the instrument to all who heve occasion to use a protractor. With its aid any angle, from 0° to 360°, may be laid off.

Besides the foregoing uses, there are many others which the polygraph is capable of serving in the hands of an ingenious operator.—*Manufacturer and Builder*.

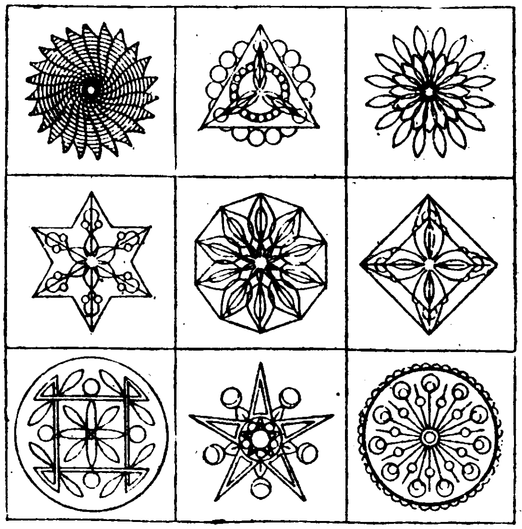


FIG. 2.—SPECIMENS OF DESIGNS PRODUCED WITH THE POLYGRAPH (REDUCED.)

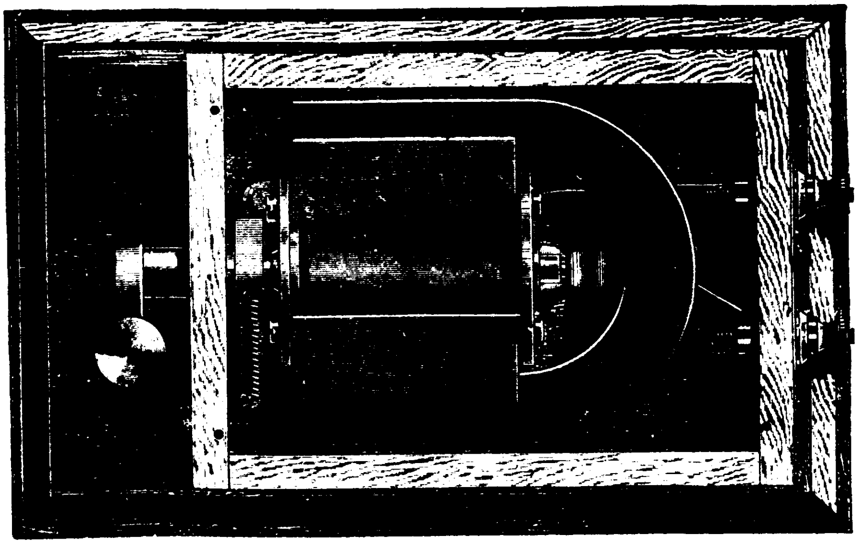


Fig. 1.

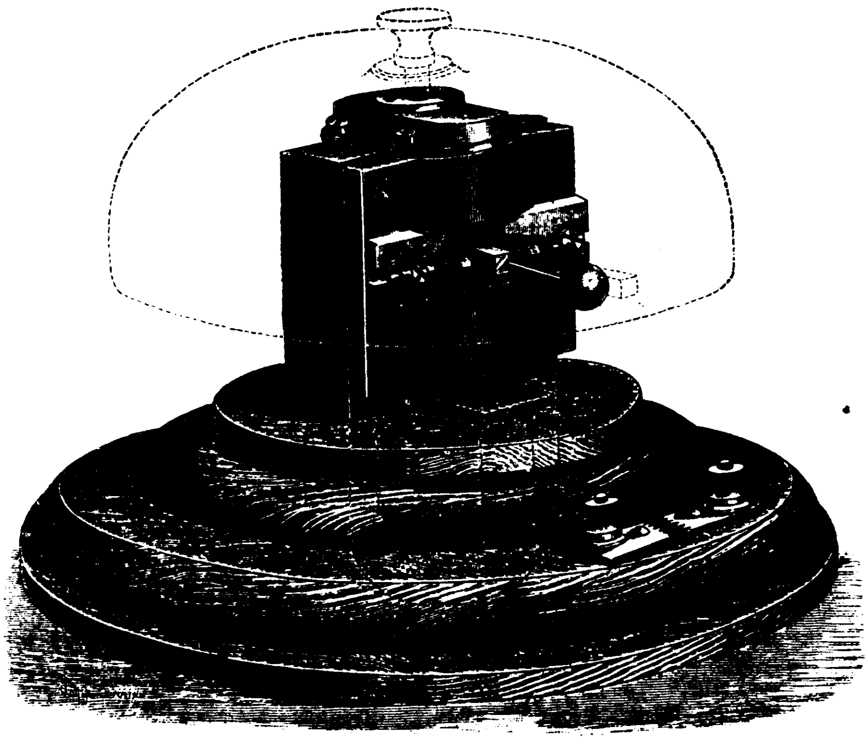


Fig. 2.

THE COX-WALKER SWINTON PATENT MAGNETO-ELECTRIC SIGNALS.

These magneto-electric generators and bells, devised by Mr. E. Cox-Walker and Mr. A. A. Campbell Swinton, have been introduced to meet the demand for a simple and efficient form of electric signal bell, which shall not require attention of any kind to keep it in working order.

The great disadvantage in connection with ordinary electric signal bells lies in the fact that the battery which up to the present time has always been required to operate them is very troublesome to maintain in effective order, and is apt to fail unexpectedly, thereby causing much annoyance. Moreover, apart from this, batteries are necessarily always consuming, and are, therefore, continually incurring expenditure for replenishment. After some months' working they must be recharged, and in a year or two are worn out, and must be renewed entirely. These operations require skilled labour, often difficult to obtain, and thus lead to considerable expense.

To avoid these difficulties electricians have endeavoured to make use of the well-known principles of the magneto-electric machine, which generates electric currents from the mechanical force required to move a coil of wire in the vicinity of a permanent magnet, without any need for a battery at all ; and appliances arranged on this plan have been employed for telegraphic and telephonic purposes.

The Cox-Walker Swinton signal bells operate on similar principles, but are of an entirely novel design which renders arge-sized magneto signal bells practicable.

The magneto generator, fig. 1, which takes the place of the transmitting key or plunger and the battery used with ordinary electric bells, is of extreme simplicity. It consists of a compound horseshoe permanent steel magnet fitted with soft iron pole pieces, between which is pivoted an armature composed of a soft iron core in the shape of a shuttle wound longitudinally with insulated copper wire. In connection with this armature is the operating mechanism by means of which the armature is easily rotated backwards and forwards through a small arc ; this motion generating electric currents in the armature wire by electro-magnetic induction, and thus actuating the bell at the other end of the line.

For single stroke bells, such as shown in fig. 2, the operating mechanism consists of a key similar to the usual tapper or push, which is attached to the armature spindle and causes the latter to rotate against a retractive spring under the pressure of the finger. For operating tremulous bells, on the other hand, a small fish-tail-shaped handle is used, which, when taken between the finger and thumb and shaken rapidly to and fro, causes the distant bell to ring continuously.

The mechanism of the bell is similar to that of the generator, with the exception that, instead of the key or handle, the pivoted armature is furnished with a hammer that strikes the gong.—*Electrical Review.*

BLACKSMITHING.

Blacksmiths and iron-workers should be very proud of their calling. Gold has been called the most precious of metals, and so admitted, but as between gold and iron, the world could better dispense with the yellow metal than with iron. Of course we could exist without either, but to be without iron would carry us back centuries and paralyze thousands upon thousands of industries, and take away nearly all the great inventions of modern civilization. This can readily be comprehended when once attention is called to the fact.

The antiquity of iron is an unsettled question, but we have mention of it in the earliest records, and from all times the workers in iron have been held in high esteem, and ofttimes considered chief among the many. The Greeks had their Vulcan and the Hebrews their Tubal Cain. Even in the wilds of Africa, Dr. Livingstone discovered workers in iron, and the novel method they had of working it was surprising. The modern forge is an improvement over the bellows, but the latter, of course, should not be mentioned in the same breath with the rude contrivance of the Africans—an earthen forge, covered with two blow-pipes, acting without any tuyeres, but attached to two upright boxes or valves. In these valves the operator places pistons, which he works up and down alternately with either hand, and thus forces a continuous blast. It is rude but ingenious, and works reasonably well. How would you like to turn a hundred shoes by such a forge ? A stone near by answers the purpose of an anvil. In early time the glory of the iron-worker lay in the fact that he was the maker of swords, spears and other implements of war. War was the principal occupation of people then ; might was right, and woe to the captives.

Now the scene is changed. The world is peaceful. Agriculture, commerce and the mechanical arts furnish the chief sources of livelihood, and in all these the iron-worker lends a helping hand. The farmers' implements are made by the iron-worker, his horses are shod (occasionally) by the iron-worker, the wheels of commerce are accelerated by his efforts. Without him, it would be the slow ox team of yore, while he almost, if not actually, personifies machinery. Verily, the legend attributing to the iron-worker the seat at the right of King Solomon, at the dedication of the great temple, is but further proof of that wise monarch's wonderful wisdom.—*Manufacturer and Builder.*

WALL PLASTERING.

Among all the improvements in building methods and materials, it is strange that so important a factor in the construction of a building as wall plastering should have stood still so many years. For some years past, however, the common mortar in ordinary use has not been standing still, but has, on the contrary, been growing worse and worse each year. One reason for poor mortar is carelessness in making up and seasoning, but the chief cause is the use of lime made from limestone, which is very hot, and even with the greatest care refuses to slake evenly. This heating quality causes the disagreeable effect known as "pitting out." The tiny lumps of lime in the plaster which refused to slake before being applied to the wall, swell as they come in contact with the air, burst and fall off, so that many a job of plastering, which seemed at the time of finishing to be a first-class piece of work, has looked after a few weeks as though it had been afflicted with the small-pox. Lime made from shells is much cooler, and therefore better for the manufacture of plaster than that made from limestone ; but in a limestone country the latter is of course cheaper, and is therefore more generally used. The recent valuable inventions in wall plaster mark a new era in the history of building, and bid fair to revolutionise that branch of the business. The ancients were thoroughly acquainted with the secret of manufacturing a perfect and durable mortar, specimens having been found in these modern days which have stood the test of ages and still retain the firm and enduring qualities of the hardest stone. "There is nothing new under the sun," and perhaps the recent inventions are but the recovery of a lost art.

Saccharine matter is said to have entered largely into the composition of ancient plaster, and is also more or less used at the present day for special occasions ; whether it enters into the new plasters or not we cannot say, but think it quite probable that it is one of the ingredients.

Sawdust is now much used in mortar, where it forms an excellent substitute for sand. In some localities it is impossible to obtain good, clear, sharp sand suitable for use in the composition of mortar, but sawdust is always to be had in almost unlimited quantities. The latter has the advantage of being lighter, and renders the mortar not only easier for the laborer to carry, but, being only half the weight of that mixed with sand, is much better for ceiling, as it is less apt to fall off. Mortar made of quicklime and sawdust in place of sand, and mixed with a proper proportion of cement, makes an excellent mortar for brick or stonework. Sawdust enters largely into the patent plasters.

By the use of these new inventions in plaster, rapid building is greatly facilitated, as there is no waiting for mortar to season ;

the composition, being all prepared, has only to be mixed with water, when it is ready for use. There is also no delay in waiting for the plastering to dry, as it dries immediately, and soon becomes as hard as stone. The plaster can therefore be directly followed by the inside finishers.

Previous to the introduction of the new varieties of plaster came improvement in the styles of lathing, and there are now many excellent kinds of metal lathing upon the market, each laying claim to some special advantage over all others.

With the new styles of plaster and metal lathing, and by encasing floor beams and posts in fireproof cement, and filling all interstices between walls and floors with "mineral wool," it is possible to-day to make even a frame house practically fireproof, particularly if, in addition to other precautions, the roof be of slate or metal, preferably the latter, as slate is apt to crack and break if subjected to intense heat.—*Builder and Wood-Worker* (New York.)

ROLL ADJUSTMENT FOR GRINDING.

As now built, all roller mills, no matter how widely they may differ in design in other respects, says the *Milling Engineer*, have one feature in common, viz.: A stop adjustment to prevent the rolls coming too close together and to hold them at the proper distance apart to suit the required degree of fineness of the material being ground, and a spring adjustment to hold the movable roll up to its work, yet capable of yielding in case of the passage of nails, screws or other foreign bodies that by accident get into the material being ground. It is the practice of some millers to regulate the fineness of the grinding by adjusting the pressure of the springs, instead of the fixed or stop adjustment. This is all wrong. The distance between the rolls, which governs the fineness of the grinding, should be fixed by the stop adjustment. If the springs depended upon for this regulation, it can be easily understood that any irregularity in the feed will produce irregularity in the grinding. With belted roller mills, and nearly all roller mills are now of this class, there is another evil which arises from the use of the springs to regulate the fineness of the grinding. If the rolls be set as closely together as possible, without coming into actual contact, if the material is not sufficiently fine, the miller is naturally tempted to remedy the trouble by increasing the pressure on the springs, which makes matters worse, instead of better, because by increasing the friction between the rolls themselves, it lessens the differential between the rolls, owing to the increased slippage of the belts on the slow roll pulleys. If the rolls be set at the right distance apart by the stop adjustment, and the pressure of the springs be made no more than is required to hold the movable roll up to its work, the only friction between the roll surfaces is that incident to the work of reducing the material, and the friction or holding power of the belts on the pulleys is sufficient to more than overcome it, thus maintaining the differential. On break rolls and sizing rolls it is especially important that the grinding adjustment be made by the stop, and not by the springs, otherwise it is impossible to tell just what the rolls are doing. As the distance between the rolls for fine grinding is very small, and may be more than balanced by lost motion in the journals and spring in the adjusting devices, it is essential to good work, not only that the adjustments be very rigid and unyielding, but that the journals be very nicely fitted. Weak adjusting mechanism and poorly fitted journals will prevent good work in any machine, no matter what merit it may have otherwise in its design and construction.

SEASONING HARDWOODS.

Specifications for Seasoning by the Water Process.

BY J. W. SNAPP.

For seasoning and curing hardwoods, first, the water used should be clear and free from sediment and other impurities; freestone water is best. Dig out a vat in the earth of suitable length to take in the longest of the wood to be seasoned easily without crowding, and not more than 4 ft. deep. It may be extended in width to give it the desired capacity for taking in large or small quantities of wood. It should be lined with boards inside, bottom and sides, to prevent mud and grit from getting to the lumber. It should be located convenient to the supply of water. Stack the wood in the vat with thin sticks between it, making each stack about 4 ft. broad, and leaving one foot of space between it and the side of the vat, and about the same space between it and the next stack. Weight and stack down with clean stone to keep it from floating. If there is sufficient fall in the water supply to run it into the vat and then allow fall enough below the vat to draw the water off again (which would usually be the case where water power is used to manufacture the material), then it is easy to supply the vat with water or draw it off at will. But where this is not the case and the power used is steam, provide a steam jet pump with suitable piping and hose for jetting the water into the vat or drawing it out again when the wood is ready to be taken out. It is not necessary to renew the water for the same lot of wood, but the water should always be renewed when a fresh lot of lumber is put in. While the lumber stays in the water, care should be taken to keep every part of it entirely covered with water.

The length of time it should stay in the water depends upon the dimensions of the wood. The best test is to take out a piece and saw it in two, and if the colour of the wood is uniform all through the stick it is ready to take up. When it is taken from the vat it should be set on end until the water all drains off before stacking, which will only require a few hours. It should then be stacked on sticks, straight and nice, allowing plenty of room for the air to pass through it, and should be stacked under shelter, and where the sunshine cannot get to it. The above specifications will give a general idea of what is necessary in water seasoning woods, but of course may be varied in plan and detail to suit the location and convenience of the manufacturer, who, of course, must exercise his own judgment as to the best plan to manage the water and construct vats for his own particular location. The cause of much wood showing checks after saturation with linseed oil is on account of not being thoroughly seasoned before the oil is applied.—*Tradesman.*

BERLIN WOOL A PREVENTIVE OF SORE THROAT.

According to Mr. H. V. Knaggs, (*Archives of Pediatrics*), a few threads of Berlin wool placed round the neck and worn continuously are an efficient preventive against these uncommoding complaints, which many persons are so prone to catch on exposure to cold. From ten to twenty threads are enough for the purpose. They should only be removed for making ablutions, and should be left off gradually by discarding daily one thread at a time. The remedy probably acts by keeping up a belt of skin action, thus acting mildle and continuously as a slight counter-irritant.—*Exchange.*

MAKING CARBON RODS AND PLATES.

BY GEO. M. HOPKINS.

Carbon rods and plates of the finest quality can be made economically only by the use of expensive machinery and apparatus, such as pulverizing mills, hydraulic presses, and retorts or ovens; but the amateur, without a great deal of trouble, and with very little expense, can make carbon plates and rods which will answer a good purpose. The materials required are coke, wheat flour, molasses or syrup, and water. The tools consist of a few moulds, a trowel or its equivalent for forcing the carbon mixture into flat moulds, tubes to be used as moulds for carbon rods, and ramrods for condensing the material in the tubes and forcing it out, and an iron mortar or some other device for reducing the coke to powder.

Clean pieces of coke should be selected for this purpose, and such as contain no volatile matters are preferred. The coke is pulverized and passed through a fine sieve. It is then thoroughly mixed with from one-sixth to one-eighth its bulk of wheat flour, both being in a dry state. The mixture is moistened with water (or water with a small percentage of molasses added) sufficient to render it thoroughly damp throughout, but not wet. It should now be allowed to stand for two or three hours in a closed vessel to prevent the evaporation of the water. At the end of this time the mixture may be pressed into moulds of any desired form, then removed from the moulds and dried, slowly at first, afterward rapidly, in an ordinary oven at a high temperature. When the plates or rods thus formed are thoroughly dried, they are packed in an iron box, or, if they are small, in a crucible, and completely surrounded by coke dust to exclude air and to prevent the combustion of the plates or rods during the carbonizing process. The box or crucible must be closed by a non-combustible cover and placed in a furnace or range fire in such a way as to cause it to be heated gradually to a red heat. After the box becomes heated to the required degree, it is maintained at that temperature for an hour or so, after which it is removed from the fire and allowed to cool before being opened. The rods or plates are then boiled for a half hour in thin syrup or in molasses diluted with a little water. They are again baked in an ordinary oven and afterward carbonized in the manner already described. This latter process of boiling in syrup and recarbonizing is repeated until the required density is secured.

As some gases are given off during carbonization, it is necessary to leave the box or crucible unsealed to allow these gases to escape.

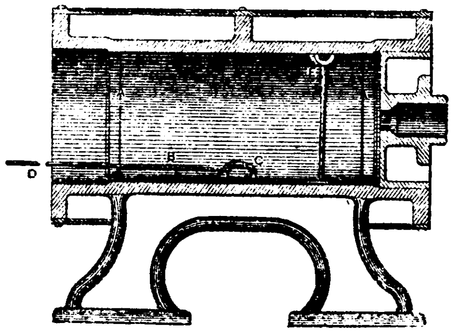


FIG. 1.

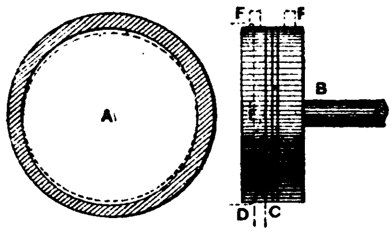
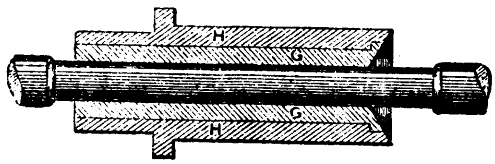


FIG. 2.

FIG. 4.



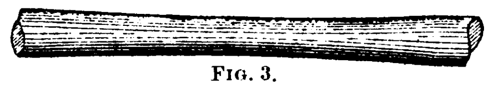


FIG. 3.

Fig. 1 shows an inexpensive form of mould for flat carbon plates. It consists of two right-angled pieces of wood of the thickness of the carbon plate to be made, and a thick plate of sheet iron. The iron should be oiled or smeared with grease before the mould is filled. The carbon and flour mixture is pressed into the mould smoothly, the wooden pieces are removed, and the carbon is left on the iron plate to dry. When dry, it is easily separated from the plate and may be handled without danger of breaking.

Cylindrical carbon rods may be formed in a wooden mould, as shown in the background of Fig. 1, and dried in a grooved iron plate adapted to receive them, or a brass tube may be used as a mould, as shown in Figs. 2 and 3. To facilitate the filling of the tube, a funnel may be formed on or attached to one end. The tube may be filled with carbon entirely from the top, or it may be partly filled by forcing its lower end several times down into the carbon mixture, finishing the filling at the top. The lower end of the tube is placed on the iron plate and the contents are rammed from time to time during the filling operation. When the tube is filled, it is discharged in the manner illustrated by Fig. 3, *i.e.*, by pulling it over a fixed rod while its dischaage end delivers the carbon cylinders to the iron plate on which they are to be dried and baked preparatory to carbonization. The plate in this case should be oiled to prevent the adhesion of the rods. The rod by which the contents of the tube are ejected should be on a level with the top of the iron plate. Fig. 4 shows in section an iron box containing plates and rods packed ready for carbonization.—*Scientific American.*

COMBINATION ENLARGEMENTS.

Supposing it is decided to introduce say a group of figures taken instantaneously on a quarter plate negative into an enlargement from a 5 x 4, or larger size, landscape negative, the work may be successfully carried out by a method based on that introduced many years ago by Mr. T. Edge for double printing.

In the first place, the figures negative must be dealt with, the figures being carefully stopped out by neatly painting round them for about the eighth of an inch with black varnish. The remainder of the negative is then covered with opaque paper, so that if it were printed from in this state, the figures only would appear on a purely white background. This done, the landscape negative must now be taken in hand, and have small pieces of gum paper fixed on its two sides, and on the top and bottom, to indicate the amount of subject it is desirable to include in the finished picture. This negative is now put into the enlarging lantern, and the image projected on to a piece of very stout cardboard the size the picture is to be—let us say 18 x 15 inches. The cardboard should be adjusted and fixed in the following manner: Two small French nails are driven into the board of the easel for it to rest upon, while a third one is driven at the right hand side to serve as a guide, against which it is placed. A couple of drawing pins at the top will hold it securely in position. Now it is manifest that the cardboard can be removed and replaced in exactly the same position as often as may be required; so, of course, could any other rigid substance the same size.

The image is next arranged to size and focused, a bold pencil mark being made exactly where each of the four strips of gum paper are shown. The object of this will be seen hereafter. The image being in focus, the place at which the figures should be introduced is determined upon. They are then roughly sketched on the cardboard the size required. The landscape negative is now removed from the lantern, and the figure one inserted in its place, the size and position of the figures being made to coincide with the pencil sketch when the image is sharply focused.

A piece of bromide paper, 18 x 15 inches, is next attached to a piece of glass the same size, by means of a few touches of India rubber solution on the back. The lens is now capped and the cardboard removed from the easel and the bromide paper fixed in its place, care being taken that the side of the glass is placed in contact with the register nail. The exposure is then made, and the lens capped with a piece of yellow glass, which, while protecting the image from further action, allows it to be distinctly seen. Of course, if the picture were developed at this stage it would have the figures only with a plain white background. We have now to protect the already exposed portion while the exposure is made for the landscape. This we do by painting it over, while *in situ*, with an opaque pigment—Indian ink for example. This is simply done by tracing over the image as projected through the yellow screen.

The bromide paper and its glass are now removed and placed in the dark, and the cardboard again placed in position. The figure negative is next taken from the lantern, the landscape one introduced, and the size of the image adjusted to its original proportions, known by the gum papers on the negative coinciding with the pencil marks on the cardboard. The lens is then capped and the sensitive paper again made to take the place of the card, the precaution being taken that the side of the plate is pressed close to the guide nail. The second exposure is then made. All that now remains is to wash off the color with water, assisted by a pledget of cotton wool, develop, and fix the picture in the ordinary manner. And, if the work be neatly executed, the juncture of the two negatives will not be perceptible.

In our first two or three essays the Indian ink was removed completely by the cotton wool, but in some subsequent ones, when using a second sample of paper, a slight stain was left on the surface, but this did not interfere with the development, and in the clearing, fixing, and washing, it disappeared entirely.

There are other methods by which the first exposed image can be protected while the second is impressed. Here is one. After the figure image is focused, take a small piece of bromide paper and expose it and then develop. This picture need not be fixed, only washed and dried. The figures are then cut out neatly by a pair of scissors or a sharp-pointed knife, and used as a shield instead of the pigment. It may be attached to the paper with a touch or two of India rubber solution. The India rubber can be easily removed, when the paper is separated, by gently rubbing with a clean finger.

When a number of enlargements of the same subject are required, this plan of masking will be found more convenient than the painting, as the same figure shield will serve any number of times. The reason why rubber solution is used as a cement is that it causes no expansion in the paper, and is easily removed without injury to the gelatine surface.—*Br. Journal of Photography.*

SUBSTANCES LIABLE TO SPONTANEOUS COMBUSTION.

Cotton-seed oil will take fire even when mixed with 25 per cent of petroleum oil, but 10 per cent of mineral oil mixed with 10 per cent of animal or vegetable oil will go far to prevent combustion.

Olive oil is combustible, and, mixed with rags, hay, or sawdust, will produce spontaneous combustion.

Coal dust, flour dust, starch, flour (especially rye flour) are all explosive when mixed with certain proportions of air.

New starch is highly explosive in its comminuted state, also sawdust in a very fine state, when confined in a close chute and water directed on it. Sawdust should never be used in oil shops or warehouses to collect drippings or leakages from casks.

Dry vegetable or animal oil inevitably takes fire when saturating cotton waste to 180° F. Spontaneous combustion occurs most quickly when the cotton is soaked with its own weight of oil. The addition of 40 per cent of mineral oil (density 0·890) of great viscosity, and emitting no inflammable vapors, even in contact with an ignited body, at any point below 338° F., is sufficient to prevent spontaneous combustion, and the addition of 20 per cent of the same mineral oil doubles time necessary to produce spontaneous combustion.

Patent driers from leakage into sawdust, etc., oily waste of any kind, or waste cloths of silk or cotton, saturated with oil, varnish, turpentine. Greasy rags from butter, and greasy ham bags. Bituminous coal in large heaps, refuse heaps of pit coal, hastened by wet, and especially when pyrites are present in the coal; the larger the heaps, the more liable.

Lampblack, when slightly oily and damp, with linseed oil especially. Timber dried by steam pipes, or hot water or hot air heating apparatus, owing to fine iron dust being thrown off; in close wood casings or boxings round the pipes, from the mere expansion and contraction of the pipes.—*American Miller.*

RULES TO MEASURE BOILERS.

At the solicitation of several correspondents we append the rules for determining the heating surface of steam boilers, which by dividing the amount of heating surface allowable per horse power will give the boiler horse power.

Tubular Boilers: Multiply $\frac{2}{3}$ the circumference of the shell in inches by the length in inches. Multiply the combined circumference of all the tubes in inches by their length in inches. To the sum of these products add $\frac{2}{3}$ of the area of both tube sheets, from this sum substract the combined area of all the tubes, divide the remainder by 144, the result will be the heating surface of the boiler, this quotient divided by 15 the number of square feet to a horse power in tubular boilers, will give the nominal horse power.

Flue Boilers: Multiply $\frac{2}{3}$ circumference of shell in inches by the length in inches. Multiply the combined circumference of the flues in inches by their length in inches. Divide the sum of the products by 144, the result will be the heating surface in square feet divide this by 12 for the nominal horse power.

Cylinder Boilers: Multiply $\frac{2}{3}$ the circumference in inches by the length in inches, and divide by 144, the result is the heating surface this divided by 10 will give the nominal horse power.

Vertical Boilers: Multiply the circumference of the fire-box by its height above the grate, all in inches, multiply the combined circumference of all the tubes in inches by their length in inches, add to these two sums the area of the lower tube sheet, less the combined area of all the tubes, divide the whole sum by 144, the result is the heating surface in square feet—*Mechanical and Milling News.*

THE DANGER OF STOVES.

Great sensation has been caused by a declaration made by Dr. Lancereaux at the Academy of Medicine, to the effect that the use of stoves for the heating of rooms is attended with the most disastrous results, either by acute or chronic poisoning of the blood, ending fatally, or causing deterioration of the health as manifested in a variety of ways. Dr. Lancereaux has recently had several cases brought under his observation of intoxication by the oxide of carbon set free by slow combustion in these stoves, which generally have not a sufficient draught, and hence the accumulation of the poisonous gas in the rooms. This danger is not confined to the room in which the stove is heated, but may extend to the neighbouring rooms, either on the same floor or above or below it. It is sufficient to have a fissure in the chimneys to permit the oxide of carbon to pass from one chimney to another, and thus cause intoxication of the neighbours. It has been proved that, even when the apartment in which the stove is heated is well ventilated, the atmosphere of the room always contains a sufficient quantity of the oxide of carbon to exercise a disastrous elective influence on the red globules of the blood. These remarks have been fully corroborated by Dr. Brouardel, who insisted on the danger arising from intoxication by oxide of carbon, even in the open air. Every winter the dead bodies of workmen are brought to the Morgue who had been lying about limekilns, from which escape large quantities of the oxide of carbon with which these men had been poisoned. M. Gautier, the eminent chemist, stated that the smallest quantities of the oxide of carbon contained in the air might prove dangerous. The blood has a special affinity for the oxide of carbon and the reduction of oxyhæmoglobin, which is distinctly seen with the spectroscope. With 1-10,000th of the oxide of carbon there is destruction of the eighth of the total quantity of the blood. He cited several cases of grave accidents due to the oxide of carbon produced by the foot-warmers that are filled with lighted charcoal dust and placed in cabs, etc. There have been this year alone five or six cases of poisoning caused by these appliances.—*Lancet.*

CURE OF INEBRIATES.

From the *Quarterly Journal of Inebriety*, published at Hartford, Conn., under the auspices of the American Association for the Study and Cure of Inebriates, we make the following extracts from a recent lecture by Dr. Elliott, at Toronto:

Four conditions must be observed. The first condition of cure and reformation is abstinence. The patient is being poisoned, and the poisoning must be stopped. Were it an arsenic instead of an alcohol, no one would dispute this. So long as the drinking of intoxicants is indulged in, so long will the bodily, mental, and moral mischief be intensified and made permanent. Abstinence must be absolute, and on no plea of fashion, of physic, or of religion ought the smallest quantity of an intoxicant be put to the lips of the alcoholic slave. Alcohol is a material chemical narcotic poison, and a mere sip has, even in the most solemn circumstances, been known to relight in the fiercest intensity the drink crave which for a long period of years had been dormant and unfelt. The second condition of cure is to ascertain the predisposing and exciting causes of inebriety, and to endeavor to remove these causes, which may lie in some remote or deep-seated physical ailment. The third condition of cure is to restore the physical and mental tone. This can be done by appropriate medical treatment, by fresh air and exercise, by nourishing and digestible food given to reconstruct healthy bodily tissue and brain cell, aided by intellectual, educational, and religious influences. Nowhere can these conditions of cure be so effectually carried out as in an asylum where the unfortunate victim of drink is placed in quarantine, treated with suitable remedies until the alcohol is removed from his system, then surrounded by Christian and elevating influences, fed with a nourishing and suitable diet, and supplied with skilful medical treatment. His brain and nervous system will then be gradually restored to its normal condition, and, after a period of from six to twelve months in most cases, he will be so far recovered as to be able to return to his usual avocation and successfully resist his craving for drink. The fourth condition of cure is employment. Idleness is the foster mother of drunkenness, industry the bulwark of temperance. Let the mind of the penitent inebriate be kept occupied by attention to regular work, and the task of reformation will be shorn of half its difficulty.

TURPENTINE BATHS FOR RHEUMATIC PAINS.

Make a concentrated emulsion of black soap, 200 grammes, add thereto 100 or 120 grammes of turpentine, and shake the whole vigorously until a beautiful creamy emulsion is obtained. For a bath take half of this mixture, which possesses an agreeable pine odor. At the end of five minutes there is a diminution of the pains, and a favorable warmth throughout the whole body. After remaining in the bath a quarter of an hour, the patient should get into bed, when a prickling sensation, not disagreeable, however, is felt over the entire body, then, after a nap, he awakens, with a marked diminution in the rheumatic pains.—*Prat. Med.*

WHY SIXTY SECONDS MAKE A MINUTE.

Why is our hour divided into 60 minutes, each minute into 60 seconds, etc.? Simply and solely because in Babylon there existed, by the side of the decimal system of notation, another system, the sexagesimal, which counted by sixties. Why that number should have been chosen is clear enough, and it speaks well for the practical sense of those ancient Babylonian merchants. There is no number which has so many divisors as 60. The Babylonians divided the sun's daily journey into 24 parasangs, or 720 stadia. Each parasang or hour was subdivided into 60 minutes. A parasang is about a German mile, and Babylonian astronomers compared the progress made by the sun during one hour at the time of the equinox to the progress made by a good walker during the same time, both accomplishing one parasang. The whole course of the sun during the 24 equinoctial hours was fixed at 24 parasangs, or 720 stadia, or 360 degrees. This system was handed on to the Greeks, and Hipparchus, the great Greek philosopher, who lived about 150 B.C., introduced the Babylonian hour into Europe.

Ptolemy, who wrote about 140 A.D., and whose name still lives in that of the Ptolemaic system of astronomy, gave still wider currency to the Babylonian way of reckoning time. It was carried along on the quiet stream of traditional knowledge through the Middle Ages, and, strange to say, it sailed down safely over the Niagara of the French revolution. For the French, when revolutionizing weights, measures, coins, and dates, and subjecting all to the decimal system of reckoning, were induced by some unexplained motive to respect our clocks and watches, and allowed our dials to remain sexagesimal, that is, Babylonian, each hour consisting of 60 minutes. Here you see again the wonderful coherence of the world, and how what we call knowledge is the result of an unbroken tradition of a teaching descending from father to son. Not more than about 100 arms would reach from us to the builders of the palaces of Babylon, and enable us to shake hands with the founders of the oldest pyramids and to thank them for what they have done for us.—*Max Muller.*

TILE-MAKING.

The clay for tile-making requires to be of a tougher description than that used for bricks; and, as it will readily be understood, owing to the much greater thinness of tiles, requires a much more careful course of preparation. It is generally dug in the autumn, and allowed to remain all through the winter months in shallow pits, to fall and mellow, and is sometimes kept for a twelvemonth before it is used; it has to be carefully picked over to remove the stones, and it is generally tempered before use in small lumps by women or children, or it is passed twice, and sometimes three times, through a pug-mill. Having been further prepared by cutting it into numerous thin slices with a wire cutter called a sling—which process assists in removing the small stones, and is similar to the wedging or slapping of the terra-cotta clay—the clay is ready for the moulder. The lumps or pieces are roughly prepared by a boy in thin slices, about large enough to fill the mould, which is nothing more than a wood frame, a little over half an inch in thickness. Tiles are invariably made in sanded moulds, as slop-moulding cannot be employed. In Staffordshire coal-dust, and in Shropshire powdered burnt clay is used to facilitate the object leaving the mould. The clay having been filled into the mould, the surface is levelled, in some places with a wire cutter, in others with a round roller, like a cook's rolling-pin. The tile is then removed to dry, and when partially dry it is beaten with a thwacker, or placed upon a horse, to give it what is termed a set. The set is a slight curve, which is necessary in order to enable the tiles to bed evenly one upon the other when used for roofing. When thoroughly dry, the tiles are stacked in kilns, and burnt as bricks are burnt. It is a very common practice to burn bricks and tiles together, the bricks being at the bottom of the kiln and the tiles at the top. The tiles are built up on edge, as close as they will lie, in layers or "bolts," which cross one another at right angles. When they are burnt alone they do not require so much firing as bricks, in consequence of their small thickness.—From *Cassell's Technical Educator* for April.

A DROP FROM THE CLOUDS AT BOMBAY.

The first descent from a balloon in India after the manner of Professor Baldwin took place at Bombay on January 27th. The aeronaut was a young Englishman, Mr. Percival Spencer, who had created much excitement among the natives by the announcement that he would make an ascent in his balloon, the "Empress of India," and when attaining an altitude of 2,000 feet would leap into space and return to Mother Earth by means of a parachute. Accordingly an enormous crowd of some 190,000 persons assembled to witness the feat, and the aspect of the motley throng is stated to have been marvelously quaint and picturesque, the gayly decked Orientals in all colors of the rainbow, and in a great many which the rainbow knows nothing about, walking, driving, riding, crowding, along the dusty thoroughfares, surmounting hills, trees, and gates, and climbing on to walls and sheds and house roofs—in fact, upon any place whence a glimpse of the proceedings could be obtained. Mr. Spencer ascended from the grounds of Government House, Parel. At the words "Let go," the balloon at once shot up like a rocket amid deafening cheers. When an altitude of 1,760 feet had been reached, Mr. Spencer took the hoop of the parachute in his hand, and flung himself from the balloon. After descending with lightning-like speed for 150 feet the parachute expanded to its full extent, and then gracefully floated down the remainder of the distance, landing the aeronaut safely in the roadway a short distance from the grounds. On his return to the starting place, Mr. Spencer was most enthusiastically welcomed, and everybody crowded round him to give him a hearty shake of the hand. Mr. Spencer's parachute was 25 feet in diameter, was covered with tough raw flexible silk, and weighed about 28 pounds. It was attached to the balloon by a thin line, the breaking strain of which was 80 pounds. Mr. Spencer's weight is almost double this figure, so that the line broke immediately he threw himself from the balloon.—*The Graphic.*

THICK MORTAR IN BRICKWORK.

G. D. Dempsey, in the *Architect*, London, says: One important rule has to be observed in order to produce good brickwork, viz., that the mortar should be as thick as it may be, or as nearly approaching the solid form as is consistent with the degree of plasticity essential for its proper distribution and penetration into the joints, while the bricks should be thoroughly wetted on the surface. By these means the adhesion between them is rendered the more perfect, and the subsequent amount of shrinking and settlement is reduced to a minimum.

CUT NAILS vs. WIRE NAILS.

The following is a statement showing the result of several tests made to determine the comparative holding power of steel cut nails and steel wire nails :—

In round figures we may say that—

1 lb. of	20d.	cut nails	equals	1½	lbs.	wire nails.
1 "	10d.	"	"	2	"	"
1 "	8d.	"	"	2	"	"
1 "	6d.	"	"	1½	"	"
1 "	4d.	"	"	2	"	"

Or to put it in another way, if cut nails selling at $2 card, wire nails should be sold at $1.12 card, to give the same value to the purchaser. Instead of this, however, the wire nails are selling about 50 per cent. higher than cut nails.

We publish the above in order to note in connection with it the facts as shown by a series of experiments at the Government Arsenal, Watertown, Mass. The tests were made to determine the comparative resistence of nails in the same wood.

The wire nail makes a very bad showing, as will be seen below :—

AVERAGE ADHESIVE RESISTANCE PER SQUARE INCH OF SURFACE IN WOOD.

	Pound.
White Pine.	
Cut nail	976
Wire nail	139
Difference in favor of cut nails	837
Yellow Pine.	
Cut nail	1,016
Wire nail	264
Difference in favor of cut nails	752
White Oak.	
Cut nail	2,003
Wire nail	780
Difference in favor of cut nails	1,223

The report states further :—"The best results are attained when the fibres are gradually compressed, as done by tapering forms, and not when the total amount of wood is abruptly displaced as done by the points of wire nails."

This is an entirely disinterested report made under the Government direction for their own purpose and as an exhibit of the comparative value of cut and wire nails.

"He who runs may read."—*Builder and Woodworker.*

HOME-MADE PERFUMES.

There has been some discussion between two contributors of the *Druggists' Circular* regarding the practicability of druggists making their own perfumes at a profit. One says it cannot be done, the other says it can, and adds :—"There is still something to be done in bottled perfumes, and when the make-them-yourself idea is applied also to those, it will give even better results" than the mere manufacture of the articles. "The druggist of average intelligence is already practically a perfumer, and the compounding of certain perfumes presents no difficulties greater than are met with in a new prescription. Moreover, in making such compounds the druggist will not only find a delightful occupation, but one which will yield him a handsome pecuniary return."

The following are some of the formulæ which this writer recommends, the cost of production in no case exceeding 6d per ounce :—

White Rose.

Rose spirit	4	ounces.
Violet essence	2	"
Jasmine essence	1	ounce.
Patchouly extract	½	"

Essence Bouquet.

Rose spirit	4	ounces.
Ambergris tincture	1	ounce.
Orris	2	ounces.
Bergamot oil	¼	ounce.
Lemon oil	⅛	"

New Mown Hay.

Tonka tincture	4	ounces
Musk "	1	ounce.
Benzoin "	1	"
Rose spirit	1	"
" geranium oil	40	m.
Bergamot oil	40	"
Alcohol (S. V. R.)	1	ounce.

West End.

Rose spirit	6	ounces.
Verbena extract	1	ounce.
Benzoin tincture	2	ounces.
Civet "	1	ounce.
Musk "	2	ounces.
Sandal oil	20	m.

Verbena.

Lemon grass oil	⅜	ounce.
Lemon oil	½	"
Alcohol (S. V. R.)	1	pint.

Heliotrope.

Vanilla tincture	8	ounces.
Rose essence	4	"
Orange flower essence	2	"
Ambergris tincture	2	"
Civet "	½	ounce.
Bitter almond oil	10	m.
Alcohol (S. V. R.)	1	ounce.

CURIOSITES OF THE PHONOGRAPH.

Subscribers, to whom are rented machines, can have left at their door every morning the waxy tablets known as phonograms, which can be wrapped about a cylinder and used in the phonograph.

On these tablets will be impressed from the clear voice of a good talker a condensation of the best news of the day, which the subscribers can have talked back at them as they sit at their breakfast tables.

In Japan the wages of carpenters are from 30 to 45 cents a day; wood carvers, 35 to 53 cents; paper hangers, 23 to 45 cents; stone cutters, 45 to 53 cents; blacksmiths, 23 to 38 cents; gardeners, 19 to 38 cents; day laborers, 15 to 23 cents. The workingman pays 40 cents per month rent for a house of one room, $2 25 per month for food and $3.75 per year for clothes. This schedule of wages and living will hardly prove complacent reading to the average American workingman.

VANADIUM INK.

Since Berzelius' statement (1835) about the preparation of a superior black ink by adding a little vanadate of ammonium to a decoction of galls, this process has been quoted in all technological hand-books, being evidently one of those which had not been practically tested. Carl Appelbaum recently reported that there is a mistake about this process, nothing in the shape of ink being thereby obtainable.

But an ink which may be useful in certain cases can be prepared as follows :

Dissolve 10 parts of tannic acid in 100 parts of water, and 0.4 part of vanadate of ammonium in 10 parts of water. Mix the two solutions, and shake moderately.

This ink flows with a deep-black color from the pen, without spreading or striking through the paper, although it contains no gum. It has a pleasant gloss, cannot be copied, dries quickly, and, even if the writing is laid in water for 24 hours, does not change its black color. It is very useful for writing addresses of letters, postal cards, etc., when used fresh. Dilute acids do not alter it, but solutions of chlorinated potassa (or soda) bleach it completely. After a few weeks the tint of the ink begins to change, writing executed with it becomes lighter and somewhat yellowish, and in about three months the change is completed, when it has a foxy yellow tint. The writing is still plainly legible, however, and cannot be removed either by water or acids.—*Dingl. Polyt. J.*, 271, 423.

POLISHING WOOD WITH CHARCOAL.—The method of polishing wood with charcoal, now much employed by French cabinet-makers, is thus described in a Paris technical journal :— All the world now knows of those articles of furniture of a beautiful dead black colour, with sharp, clear cut edges, and a smooth surface, the wood of which seems to have the density of ebony. Viewing them side by side with furniture rendered black by paint and varnish, the difference is so sensible that the considerable margin of price separating the two kinds explains itself. The operations are much longer and more minute in this mode of charcoal polishing, which respects every detail in carving, while paint and varnish would clog up the holes and widen the ridges. In the first process they employ only carefully selected woods, of a close and compact grain, then cover them with a coat of camphor dissolved in water, and almost immediately afterward with another coat, composed chiefly of sulphate of iron and nutgall. The two compositions, in blending, penetrate the wood, and give it an indelible tinge, and at the same time, render it impervious to the attacks of insects. When these two coats are dry, they rub the surface of the wood at first with a very hard brush of conch grass (chien dent), and then with charcoal of substances as light and friable as possible, because if a single hard grain remained in the charcoal, this alone would scratch the surface, which they wish on the contrary to render perfectly smooth. The flat parts are rubbed with natural stick charcoal ; the indented portions and crevices with charcoal powder. Alternately with the charcoal, the workman also rubs his piece of furniture with flannel soaked in linseed oil and the essence of turpentine. These pouncings repeated several times, cause the charcoal powder and the oil to penetrate into the wood, giving the article of furniture a beautiful colour, also a perfect polish which has none of the flaws of ordinary varnish.

Cast iron columns with flat ends uniformly bear about three times as much as those of the same dimensions with rounded ends.

APHASIA AND APRAXIA.

In an extremely interesting paper read before the New York Academy of Medicine, Dr. M. Allen Starr enters fully into the varieties of aphasia and apraxia, and gives valuable practical directions for the examination of persons presenting these symptoms.

To examine an aphasic thoroughly it is necessary to test :

1st. The power to recall the spoken or written name of objects seen, heard, handled, tasted, or smelt.

2nd. The power to understand speech and musical tunes.

3rd. The power to understand printed or written words.

4th. The power to speak voluntarily. Does he talk clearly? Does he mispronounce words? Does he misplace words? Does he talk jargon?

5th. The power to repeat a word after another.

6th. The power to read aloud. Does he understand what he reads?

7th. The power to write voluntarily. Can he read what he has written?

8th. The power to write at dictation.

9th. The power to copy.

10th. The power to recognize the use of objects seen, heard, felt, tasted, or smelt.

By apraxia is meant the inability to recognize the use or import of an object, and it includes the conditions first described as blindness of mind and deafness of mind. The variety known as blindness of mind is that most commonly found. The first example of its successful treatment by operation is recorded by MacEwen, of Glasgow, in the *British Medical Journal* for August 11, 1888. A man who had received an injury a year previously to his applying for treatment suffered from deep melancholy and strong homicidal tendencies, which were relieved by paroxysms of pain in the head. There were no motor phenomena, but it was discovered that immediately after the accident, and for two weeks subsequently, he had suffered from psychical blindness.

Physically he could see, but what he saw conveyed no impression to his mind. An object presented itself before him, which he could not make out ; but when this object emitted sounds of the human voice, he at once recognized it to be a man. In attempting to read he saw what he considered must be letters and words, but they were unknown symbols to him ; they conveyed no impression of their meaning ; the memory of their signs was gone ; it was a sealed book to him. These phenomena gave the key to the hidden lesion in the brain. On operation the angular gyrus was exposed, and it was found that a portion of the internal table of the skull had been detached from the outer and had exercised pressure on the posterior portion of the supramarginal convolutions, while a corner of it had penetrated and lay embedded in the anterior portion of the angular gyrus. Removal of the bone resulted in complete recovery from the pain and mental symptoms.

The variety of apraxia known as deafness of mind has recently been studied by Oppenheim ("Charite Annalen, XIII., 1888"), of Berlin, who noticed that while some aphasics retain their musical faculties, others may lose the power to follow melodies, to appreciate music, or to hear or sing the tunes which they formerly knew.

To test for apraxia it is only necessary to present various objects to a person in various ways and notice whether he gives evidence of recognition. Aphasia occurs without apraxia, but apraxia cannot occur except in connection with some form of aphasia.—*Medical Record.*

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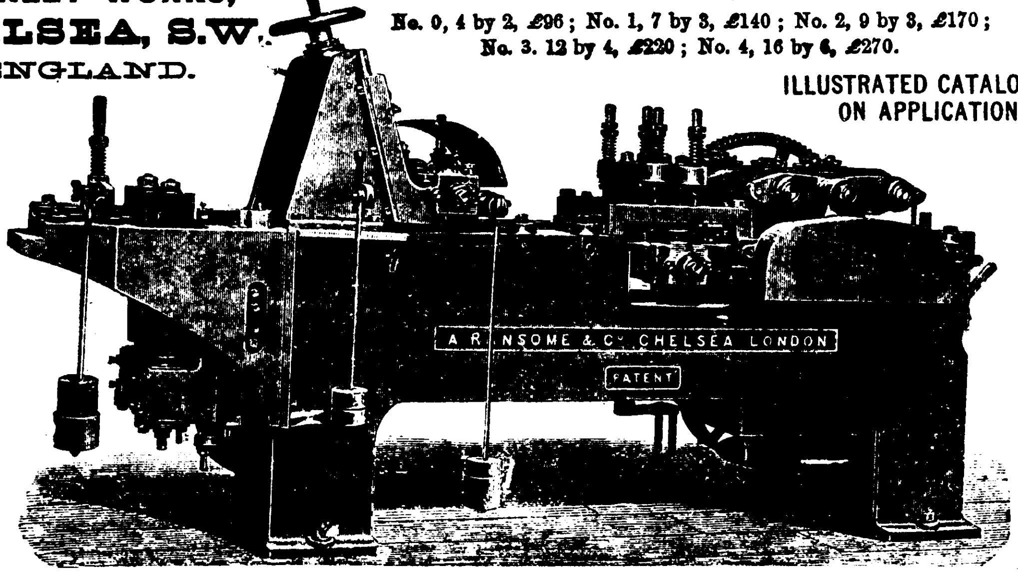

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